Eleftheria Tomadaki Peter Scott (Eds.)

Innovative Approaches for Learning and Knowledge Sharing

First European Conference
on Technology Enhanced Learning, EC-TEL 2006
Crete, Greece, October 1-4, 2006
Workshops Proceedings

Volume Editors

Eleftheria Tomadaki
Centre for New Media
Knowledge Media Institute
Open University
Milton Keynes, MK7 6AA, UK
E-mail: e.tomadaki@open.ac.uk

Peter Scott
Centre for New Media
Knowledge Media Institute
Open University
Milton Keynes, MK7 6AA, UK
E-mail: peter.scott@open.ac.uk

ISSN 1613-0073

Organization

EC-TEL 2006 was organized by the Professional Learning Cluster (PRO-LC):
http://www.professional-learning-cluster.org/

Workshops Chair	Peter Scott (Knowledge Media Institute, Milton Keynes, UK)

Preface

Innovative approaches for learning and knowledge sharing are indispensable for the rapidly evolving world of knowledge and information. One of the main objectives of the EU/IST Work Program is adopting technology enhanced learning solutions to improve the efficiency and reduce the cost of learning for individuals and organizations at any given time or location. To achieve this goal, the First European Conference on Technology-Enhanced Learning (EC-TEL) provided an exciting forum for technology-enhanced learning and its relations to knowledge management, business processes and work environments, in Europe and world-wide.

Six specialized workshops were held in conjunction with the EC-TEL 2006, which brought together researchers, technology providers and professionals from all areas related to technology-enhanced learning. The workshops were supported by the Prolearn Network of Excellence, as well as a cluster of major European research projects in the area of technology-enhanced learning, such as Up2UML, LEAD, TENcompetence and Palette.

After a rigorous review process, the program committees of the EC-TEL 2006 workshops accepted 39 papers. The selected papers are full papers and position papers, describing original research results and evaluation, solutions or on-going work, according to each workshop's format. The workshops address a variety of topics:

-Blended Learning and Small and Medium-Sized Enterprises:

This workshop explores the combination of the best elements of e-Learning and traditional learning resources, as a guidance to instructors and learners in finding the best mix of learning resources. The objective is to gather input for successful blended learning courses in small and medium-sized enterprises as well as working towards a definition for "blended learning".

-Making the Future of Technology Enhanced Professional Learning: Case Studies of Individual and Group Learning:

This workshop focuses on defining the critical capabilities needed to achieve the desired futures and includes three different themes: 'personalization', 'enhancing work performance' and 'self regulated learning, creativity and innovation'.

-Exploring the Potentials of Networked Computing Support for Face-to-face Collaborative Learning:

Face-to-face communication is significant for collaboration and learning and can be supported by collaborative technologies. The papers presented in this workshop give some insights into how learners who are in the same room can be provided with the appropriate technologies that will facilitate their collaborative learning activities.

-Professional Learning, Competence Development and Knowledge Management:

This joint workshop identifies and analyzes current technological trends to support individuals, teams and organizations to develop their competences, using online distributed knowledge resources and learning activities. Adopting a learner centric approach as well as the use of knowledge management technologies in e-Learning, the selection of papers discusses the use of social software, enabling individuals to tag content and act both as producers and consumers of content.

-*What Went Wrong with Technology Enhanced Learning:*

Conferences and workshops mostly report on success stories. However, the fields of learning, education, and training can benefit from learning from previous failures on the approach, operational problems, or the organizational context and the exchange of this (negative) knowledge. This workshop explores the reasons why certain projects did NOT achieve the originally intended outcome.

-*Technology Enhanced Learning Communities of Practice:*

This workshop investigates the multiplicity and complexity of needs of Communities of Practice during their lifecycle, exploring approaches such as multimedia information authoring and re-use, knowledge management, argumentation and negotiation, as well as the evaluation of solutions in a range of real environments.

Many thanks go to all authors who provided their contributions and to the program committees for carefully reviewing all submitted papers. We are grateful to the organizing committees for the successful preparation and realization of the workshops, involving collaborators from the following European Institutions: the National College of Ireland (Dublin, Ireland), the Experimental Institute for Software Engineering (Fraunhofer Germany), the Open University (Milton Keynes, UK), the National Center of Scientific Research 'Demokritos' (Athens, Greece), the Helsinki University of Technology (Helsinki, Finland), the University of Utrecht (Utrecht, the Netherlands), the University of Salerno (Salerno, Italy,), the German Research Center for Artificial Intelligence (Kaiserslautern, Germany), the Open University of the Netherlands (Heerlen, the Netherlands), the L3S Research Center (Hannover, Germany), the Center for Research and Technology Hellas (Thessaloniki, Greece), the Katholieke Universiteit Leuven (Leuven, Belgium), the Ariadne Foundation, the University of Patras (Patras, Greece) and the Research Academic Computer Technology Institute, (Patras, Greece).

We hope that the selection of workshop papers in this volume will inspire your research with innovative ideas. We expect that this is the beginning of a series of successful workshops, which will be adopted by future technology-enhanced conferences.

October, 2006

EleftheriaTomadaki and Peter Scott
EC-TEL 2006 Workshops

Table of Contents

Blended Learning and SMEs

EC-TEL 2006

October 1, 2006

Crete, Greece

Organizing Committee

Sabine Moebs (National College of Ireland, Ireland)
Sonja Trapp (Fraunhofer IESE, Germany)
Stephan Weibelzahl (National College of Ireland, Ireland)

Program Committee

Sinead Averill (Ireland)
Gabriela Avram (Ireland)
Hadj Batatia (France)
Astrid Beck (Germany)
Mercedes Fisher (USA)
Cecilia Hannigan (UK)
Antje Mayfarth (Germany)
Ina O'Murchu (Ireland)
Stephan Weibelzahl (Ireland)

Blended Learning: Towards the Best Mix for SMEs

Sabine Moebs[1], Sonja Trapp[2], Stephan Weibelzahl[1]

[1]National College of Ireland, Mayor Street, Dublin, Ireland
[2]Fraunhofer IESE, Fraunhofer Platz 1, Kaiserslautern, Germany

[smoebs,sweibelzahl]@ncirl.ie, sonja.trapp@iese.fhg.de

Abstract. Experience has shown that instructor-led trainings have some advantages that cannot easily be overcome by technology enhanced learning. Direct interaction with an instructor and among the group is often perceived as motivating and more personal. For small groups, in-class trainings can be more cost effective. On-line learning often requires a considerable amount of self-management and progress-monitoring from the learners. Small and medium enterprises (SMEs) are very sensitive to these issues. As customized in-house solutions that are used by global players (e.g., corporate LCMS or learning portal, content tailored to specific needs of company) are usually not feasible, SME rely on what training providers offer, i.e., instructor led training. The first part of the workshop will look at the prerequisites for Blended Learning in SMEs and insights in an e-learning provider's perspective. The second session will aim to develop guidelines and recommendations for Blended Learning in SMEs. The Invited Talk will provide the experience of an e-learning provider who mainly targets customers or learners in SMEs. Two practice reports describe the experiences with blended learning in a research project in a corporate setting and an implementation project in an institution of higher education. In synthesis, this workshop aims to assess the state-of-the-art of Blended-Learning in SMEs and to identify research gaps and opportunities. The state-of-the-art will take the form of best-practice reports, guidelines and heuristics. This will serve as important input for practitioners such as training providers and course designers. Discussion is encouraged throughout the workshop. At the same time we also anticipate that the synopsis of evidence will identify a major lack of convincing concepts and data for Blended Learning in SME that will inform and encourage further research.

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 3, 2006.

Blended Learning and SME's: the Challenge for NCI Library: USB Key as a Learning Tool

Mary Buckley, Alison Nolan, Stephanie Doyle

National College of Ireland

Introduction

The proliferation of the internet as and instructional medium has given rise to the growth of numerous types of online training. Distance learning, e-learning or blended learning are phrases exchanged frequently, as students and corporate employees log on to instructional sites at college, at the library or between staff meetings.

Although thousands of small businesses are established each year only a small number remain in operation within ten years of their inception [1]. Major contributing factors to the failure of many small firms are a lack of attention given to the development of a robust plan, goals and objectives, organising and resourcing for the new venture and the development of people assets.

Relying on instructionally solid features and simplicity in technical implementation it is no surprise that corporate managers and academic stakeholders are including synchronous education in their budget and strategic plans.

This is where NCI comes into its own. NCI is offers a series of tailor made management development programmes for both public and private sector organisations. These programmes will lead to qualifications at the level of certificate, diploma and bachelors degree. Through the In-Company Training and Education Division, National College of Ireland aims to develop and deliver a suite of programmes designed to enhance the management capability of junior to middle level managers.

A cross section of our current client list includes, Glanbia plc, Midland Health Board, C&C Group plc, VHI Healthcare, Dublin Port Company, Symantec, Dublin Bus and AXA Insurance.

The web has promoted exploration, reflection, application, discovery, and overall has encouraged learner behaviours associated with higher – order learning [2]. Blended learning, a mix of self paced (asynchronous) work and instructor led (synchronous or face to face) elements is being promoted by many in the training and executive education fields as the best way to capitalize on the strengths of elearning, while maintaining the benefits of traditional training.

E. G NCI Certificate in Managing teams –

The interaction is through personal conferences and one to one discussion with lecturer, conferences with class and lecturer and online class discussion forum.

How the Programme Works.

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 4-9, 2006.

Everything is done on-line using your PC and a connection to the Internet. You will work in a virtual classroom environment with other students from elsewhere in Ireland and/or abroad.

The Programme will be delivered on-line as follows:

Each week the lecturer delivers a formal lecture electronically to the class. As a student all you need to do is attach to NCI Online log-in using the id and password that will be assigned to you and pick up your lecture notes from there. Assessment will be done on a continuous basis. Assignments will be delivered online to you by the lecturer. You can complete these off-line and reconnect to submit them to the lecturer.

You will interact with the lecturer and with other students on-line through a number of means.

Personal conferences where one to one discussions take place between you and the lecturer.

Discussion conferences where discussions can take place between all of the class and the lecturer.

Student lounge conference where you and other students have a forum to discuss general topics with each other, like a virtual coffee room.

With blended learning as a method of teaching The library took up the gauntlet and realised this is where we needed to adopt a blended learning approach to the issue of information sourcing and literacy. Step one was the information sourcing and the concept of the Learner information key was formulated.

Because of technology limitations presented by the target user base (on- off campus/ online and in-company education , the college explored the various delivery options available to use. The main issues that arose are the issues of access, course speed, data tracking and security, maintenance issues, media elements and client preference.

In providing information sourcing and with the growth of the information society ultimately we decided on web-based delivery when possible, but it meant that we had to balance the need/ desire for a rich media solution with the reality of the low bandwidth of many of our users.

Adult learners need to be challenged, and our material needs to be interactive in order to move learners from cultural awareness, to knowledge acquisition to skill development. Although these criteria are essential to us, we also know that we must continue to solicit feedback and evaluation from our clients to better understand their requirements for intercultural training based on business needs , target populations and technical requirements.

The paper is a brief look at the practical experience of producing a ‘blended’ information source for learners at the National College of Ireland, in the academic terms 2005/6 and 2006/7. I will be looking at the experiences of the pilot programme in 2005/6, and the decision to proceed with the process in 2006/7, and to expand its distribution to all learners and staff at the College.

The decision to proceed with a different type of information device was taken initially for environmental and cost reduction in relation to printing/photocopying costs, to use a medium that was easy to produce and distribute and to encourage saving of material(s) rather than printing/copying. In order to achieve this, a USB key was chosen as the preferred method. As test groups all off campus learners(off site/distance) users were chosen as were first year students in a 3 year undergraduate degree, flexible learners (who study away from campus, but attend 1 week in 4), and postgraduate learners.

As a librarian, I am conscious that there a large number of the students attending at NCI, have difficulty in getting correct information and many of them seem to have a negative experience. At a recent conference I attended one of the speakers spoke of giving learners what they want from information sources (libraries etc.) and not what we as professionals think that we want.

The pilot programme was set up and delivered in a 6 week timeframe, with no set parameters or formal feedback. When the decision to go ahead with the process in 2006/7 academic term was taken, it was decided to:

Have formal feedback
Memory/USB key to be titled Learner Information Key or LIK
Work with NCI web interface, but also work separately
Market the product (design, packaging,information sheet, information)
Learner Information Key to be given to all NCI learners, faculty and staff
Set up efficient distribution system
Costs shared between various college departments as per previous USB key

The information contained on the key is from all department college wide, however, some departments are more proactive than others and we would hope to improve on the volume/range of information available in future years.

Contents: Brief Overview

Library Information: guides, contact details, borrowing facilities etc.
Learner Services Information: learner handbook, realising your potential,
IT Facilities and Services: acceptable usage form, I.T. guide, etc.
Off campus Information: course information, project cover sheet, programme outlines
Learner life: Examinations regulations, Learner handbook, counselling information, disability services, careers service, learning support
School of Business: Project coversheet, contact information
School of Informatics Information: Project coversheet, contact information
Faculty & Staff will also get the following information
HR Department: personnel forms policies and procedures, payroll information,
Library Information for Faculty: Video listings, case study information, staff Facts4U
(Learner Information Key has 256Mb with c. 50Mb of this with pre-loaded, permanently).

Establishing Specifics of What we Wanted:

We had some idea of what it was that we wanted. The NCI learner key for 2006/07 was to be an improvement on the 2005/06 version. However, we were not sure of exact numbers required or of the finer details, such as USB key type, the colour and position of logos, the packaging and availability of lanyards etc. Not knowing these details from the outset let to delays in obtaining a final quote and placing the order as various e-mails to the chosen supplier had to be sent in order to establish the additional cost/possibility of each new detail/as it arose e.g., change in numbers, additional logo on back of USB key and lanyard, possibility of BIWIN brand USB key not working.

Obtain Quotes from Suppliers:

Quotes from two suppliers were obtained. We requested quotes from both companies who supplied quotes last year. One firm responded immediately, the other took quite some time to prepare a quote. Additional quotes were not sought as we didn't know of other firms who could supply the goods. Price was the main factor that determined our choice of supplier.

Compilation of Data to be Preloaded (Both Content and Interface):

Each department was asked to upload all documents/information, they wanted to provide to learners on the USB key, in a shared Folder on the NCI network by a certain date.

The deadline passed and only some departments had provided the required information. After numerous e-mails and phone calls all departments eventually
3 provided the information required. However, this delayed the start of production. In addition, some files had not been converted to PDF format in advance. This delayed the process again. Some departments provided a substantial amount of information whereas others did not. This may leave some learners feeling resentful.

Efforts were also made to obtain a quote for the design of an interface to display, in an easy to read and aesthetic manor, all the information to be made available. One company was recommended to us. However, they proved most unhelpful and took some time in replying to our request. At the end of the day a member of our I.T. staff designed and built the interface. The same member of staff virus checked and loaded the data onto CD as requested by the supplier.

The delay in creating the interface also let to a delay in the start of production of the USB keys.

Breakdown of Costs:

The cost was distributed between departments within the College, based on student numbers and requirements of other departments, such as Human Resources, Information Technology and Library.

School of Business	20%
School of Informatics	10%
Library	20%
Continuing & Professional Development	20%
Human Resources	10%
Information Technology	10%
Learner Life (academic affairs)	10%

Placement of Order:

When a final quote had been agreed and all the required data compiled a purchase order number was produced and an order was placed with the supplier. The preloaded data was virus checked and loaded onto CD and couriered to the supplier as requested.

Communication:

The modes of communication for this project were meetings, phone calls and e-mail. Communications between the chosen supplier and NCI were excellent. The supplier responded very quickly to every query we made, both by e-mail and by telephone. Communication within NCI proved more difficult. Various departments were involved in the project. As mentioned above, there were difficulties obtaining the information required for preloading onto the USB key. Some departments did not respond to e-mails or return phone calls. The same problem occurred when trying to confirm the breakdown of costs relevant to each department.

Time Frame:

At each stage of the process various delays occurred. As we had a deadline (we wanted the USB keys for the 1st week of September and the supplier had indicated a time frame of six weeks from the placement of the order to the delivery of the goods) and did not start the process until the beginning of July, each delay led to our 4 timeframe becoming tighter. Although the USB keys were delivered ahead of schedule, when the order was placed (4th August) there was no time left to facilitate any potential delays.

1st contact with suppliers:	07.07.06
1st meeting with staff:	12.07.06
Order placed:	04.08.06
USB keys delivered:	31.08.06

The entire process was very time consuming as so many people were involved and communication problems were plentiful. However, the end result is a very impressive USB key for every student that should be useful to them for their entire time at NCI and afterwards.

Perhaps, in future, the entire process could commence much earlier to accommodate the various delays that are bound to occur.

Advantages of the USB Key Produced for the Students of NCI:

- Reduction in amount of printing NCI has to do.
- Learners can access information anytime and anywhere provided they have access to a computer (this also caters to our off-campus learners).
- It encourages learners to use new technologies, computers and the web. With the simple instructions provided even the most computer illiterate learner should be able to use the USB key successfully.
- Inclusive: every learner will receive a USB key irrespective of the course/year they are attending.
- Learners can access information on how best to make us of the library facilities and services therefore, furthering their learning.

The USB as a Learning Concept

The Learner key is more of an information resource than a learning concept/blended learning method. The preloaded data is mostly made up of information sheets/fact sheets and forms.

The USB also provides links to the NCI website and to on-line library resources, perhaps encouraging people who wouldn’t usually use those resources to do so.

The library information on the USB key is perhaps the closest to blended learning as it informs users how to avail of and make the most use of the library resources.

Likewise the off-campus material, it provides module outlines along with introductory material to the subject matter.

Consider users' business need and technical requirements, the course content and cultural appropriateness, and the enjoyment and ease of use of the course in order to make any learning experience meaningful and memorable for the participants.

What are the characteristics of the audience? How much time will they have access to the content? What connectivity issues do they have? What are the learning styles and education level of the employees? How motivated are the learners?

What are the characteristics of the content? How long before the information is out of date? Where is the content located? Are learning activities intended to inform people, develop skills, or build competencies?

It is essential to secure client / user participation during the development stage to address the direct needs of the stakeholders.

The key to blended learning seems to be selecting the right combination of media that will drive the highest business impact for the lowest possible cost. But how does and organization decide on the mix?

What combination of tools and media will make the biggest impact for the lowest investment?

Future Development:
Blended learning and the concept of information literacy, to be effective blended learning needs to marry the concept of virtual information and face to face interaction.

Learner profiles and the virtual library, (aspects of lifelong learning), due to the dynamic nature of learning and teaching, and the drive for lifelong learning, as information providers, we need to respond to the needs of our diverse learner profiles.

VLE's and the human dimension, it is vital at all times to keep the human dimension to the fore, when developing or delivering information using virtual learning environments.

References

1. Beaver, G.: Small Business, Entrepreneurship and Enterprise Development.Prentice Hall, Harlow (2002)
2. Thuring, M., Hannemann, J. and Haake, J.: Hypermedia and Cognition: Designing for Comprehension. Comm. of the ACM (1995) 53(8), 57-66.
3. Create Electronic Content and Surround it with Human, Interactive Content. (Berzin and Associates developed a paradigm describing the four types of corporate training. (www.bersin.com/tips_techniques/Breeze2.htm)

Towards a Good Mix in Blended Learning for Small and Medium-sized Enterprises – Outline of a Delphi Study

Sabine Moebs, Stephan Weibelzahl

National College of Ireland
Mayor Street
Dublin 1, Ireland
{smoebs, sweibelzahl}@ncirl.ie

Abstract. The mix that is suitable to target the specific learning needs and is likely to be accepted by SMEs has yet to be clarified. Recommendations for a good mix of blended learning in SMEs will be developed using a Delphi study design, implemented as a so-called e-Delphi. The sample will be SMEs from Germany and Ireland, international providers of e-learning, blended learning and lifelong learning as well as researchers in these fields. Recent experience with contacting selected participants for the Delphi study did show big differences for Germany and Ireland. First conclusions can be expected after the first round of the Delphi study has been analyzed in October 2006.

1 Learning in SMEs

SMEs are often innovative, but under high economic pressure. This economic pressure is a threat to ongoing learning activities although continuous training and learning is necessary to stay competitive. Learning in the form of e-Learning is not in high demand with SMEs although one could expect that it is highly suitable to the learning demand at short notice (Wood & Watson 2002) which is typical for SME learning.

Blended Learning can combine the positive aspects of the two learning environments, classroom-based learning and e-Learning (Bonk & Graham, 2006).

A mix of learning styles and a mix of the different dimensions of learning at the course level can increase the usage of blended learning opportunities as a suitable way to learn in SMEs and thus increase or keep up competitiveness of the companies.

A blend of classroom-based with on-line learning seems to be the most efficient approach in many settings. The aim of this study is to explore: What is a good mix in blended learning for SMEs?

This leads to the following secondary questions

- Is there a good mix for SMEs from the IT sector in blended learning?
- Does this vary depending on the industry?
- Can an optimum definition be obtained for blended learning for SMEs?
- Can recommendations be given on how to adapt blended learning to SME learners' needs?

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 10-17, 2006.

- What are the constraints in SMEs for not using blended learning?

A good mix in blended learning is characterized by satisfying particular preferences of the learner as well as meeting the learning targets.

e-Learning is "learning that is delivered, enabled or mediated by electronic technology for the explicit purpose of training in organizations. It does not include stand-alone technology such as the use of CD-ROMs". The use of e-Learning depends strongly on the size of the company. Small and medium-sized enterprises use it considerably less than large companies (CIPD, 2006). A number of obstacles to e-learning have been identified in the SMEs organizational structure, the total lack of training culture within the companies and the attitude of individual managers. This leads to a lack of effective analysis of the competence needs and hampers contacting sources of competence (McCullough 2005; European Commission 2003).

E-learning is often perceived as ineffective and lacking in structure and lacking a means of learner guidance which leads to the overall impression of too high costs. The negative cost factor is further strengthened due to the payment structure of a number of e-learning systems which demand a high investment upfront. Many SMEs are not willing to take the risk of making that investment without certainty about the return on investment (Mc Cullough, 2005; Wood & Watson 2002).

Many modern e-Learning systems have very restrictive requirements. They will often run only on one specific operating system. Whereas web-browser based systems avoid this problem, they comprise of other challenges such as the need for a number of plug-ins and supplementary applications.

The diversity in applications intensifies fear of the systems, rooted in a general computer anxiety which can be addressed with including some human teaching intervention for basic tasks like using a mouse, opening a program etc. (Wood & Watson 2002).

2 Blended Learning

Blended learning describes a learning environment that either combines teaching methods, delivery methods, media formats or a mixture of all these.

In the literature the term is used to describe the integrated combination of traditional offline methods of learning with intranet web-based, extranet web-based or internet-based online approaches (Garavan & O'Donnell, 2003). To accentuate the fact that the concept is learner centered, blended learning can be described as a mix of delivery methods that have been selected and fashioned to accommodate the various learning needs of a diverse audience in a variety of subjects (Mc Sporran & King 2002).

Blended learning combines classroom-based learning with computer-mediated instruction (Graham 2006; eLearning Guild 2006), but it also describes learning that mixes various event-based activities, including face-to-face classrooms, live e-learning, and self-paced learning (Valiathan 2002).

To describe the variety of interaction Graham (2006) introduced the four dimensions of interaction in face-to-face and distributed learning environments. The four dimensions are space, time, fidelity and humanness. Space can go from live to face-to-face to mixed reality to virtual reality. The time dimension develops from live synchronous with a very short lag time to asynchronous, which has a long lag time. Fidelity reaches from a high level that is rich in senses, which means it can incorporate sound, pictures, text and even fragrances, and the other end of the dimension is using only one of the senses, e.g. text only. The humanness dimension addresses the ratio of human interaction and machine interaction.

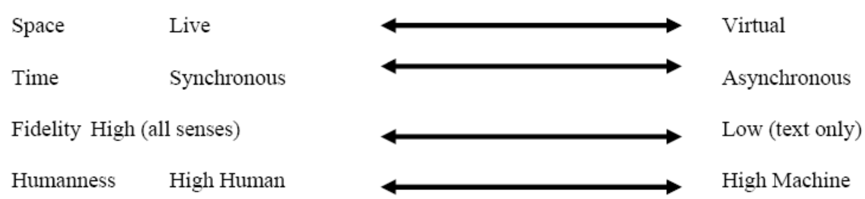

Fig. 1. Four dimensions of interaction in face-to-face and distributed learning environments (Graham 2006)

3 Frameworks in Blended Learning

Poor design of blended learning material can lead to much poorer learning results in a blended environment compared with a single method delivery. Several authors developed frameworks to react to this challenge.

Wenger and Ferguson (2006) describe how their company has come up with a framework to guide the design and deployment of their trainings and courses. It reflects the idea that most learning environments are blended already, considering that even a classroom-only course incorporates a variety of different learning modalities.

Their approach consists of three steps:

In a first step the learning ecology matrix was developed. The x-axis illustrates the focus on the delivery of instruction that varies from “content delivery focus” to “experience and practice focus” and the y-axis illustrates who controls the navigation of the learning process which varies from “guided navigation” to “learner self-navigation”.

In a second step four general learning modalities are included, studying, practicing, teaching and coaching. These modalities do not refer especially to either classroom or e-learning, but are rather applicable to both.

In a last step the matrix is completed with distinct instructional, learning and knowledge elements.

Studying	Learner Self-Navigation		Practicing
	Books, articles, guides References White Papers Asynchronous content Job aids Glossaries FAQs	Authentic tasks Role play Projects Case studies Peer discussion Discussion forums	
Content Delivery Focus			Experience and Practice Focus
	Classroom lectures Synchronous content Demonstrations Reviews/discussions Video Videoconferencing	Exercises Diagnostic labs Practice labs Mentoring/tutoring Experiments	
Teaching	Guided Navigation		Coaching

Fig. 2. Sun Learning Ecology Matrix (Wenger & Ferguson 2006)

The learning ecology matrix aims at delivering a high quality learning experience and to provide control over the learning experience for both, the learner and the instructor. It strives at combining formal and informal learning rather than positioning them as opponents. The social nature of learning has to be considered in all learning elements. The aspect of cost-effectiveness is recognized, but merely in the sense that any project aims at a combination of learning outcomes at a total minimum cost.

It is intended to be used to provide guidance for the selection of delivery methods, considering the learning needs as well as available resources. Benefits, difficulties, constraints, but also complementary methods are listed to provide the information necessary to develop the right blend. The generic framework is then applied to specific learning needs.

4 Obstacles in Blended Learning

As mentioned before SMEs use blended learning and e-learning significantly less than bigger companies. Every blend will be a trade-off from an economic perspective between cost of development, cost of delivery, time and effort and the available budget (eLearning Guild 2006). The biggest obstacles in implementing blended learning are lack of budget, choosing the right strategy and a lack of senior management buy-in. (eLearning Guild) The above mentioned methods and frameworks to design and deploy can be very helpful to find a satisfying solution.

5 Success Factors for Blended Learning

There is a variety of teaching methods, but also a variety of different learners with different preferences and needs. A well designed blend of teaching methods will provide the right learning experience for most learners. The characteristics of the audience have to be considered. This includes recognition of the amount of time they will have to access the content, which includes connectivity issues (Bersin 2003; Mc Sporran & King 2005; Saunders & Werner 2004).

The flexibility in scheduling and format is critical to success. Students have to have access to most components of a system 24 hours to make it available when they are ready to study. The flexibility in media formats provides optimum learning experiences based on personal preference. To select the right methods and formats the learning styles and the education level of employees has to be considered as well as the motivation of the learners (Bersin 2003; Serveau 2004).

Response from tutors, subject matter experts as well as technical or logistical support staff needs to be posted within 24 hours, which corresponds to a rule of thumb for effective e-communication in general. The positive effect of a timely response can be intensified by additional phone calls and face-to-face conversations and will provide a sense that there are real people behind the online environment (Serveau 2004).

Blended learning needs executive support for the introduction just as any other major change in a business environment (Bersin 2003). The decision to change to a blended solution from the system that was in use before cannot be left to individuals who are not in charge.

The content naturally will be a success factor. Apart from choosing the appropriate kind of content and making the decision whether learning activities are intended to inform people, develop skills, or build competencies, the consideration of the time before information will be out-of-date is of high importance (Bersin 2003).

6 The Delphi Study

Expert opinion on the various aspects of blended learning is required from all knowledgeable parties involved in this discussion: SMEs, providers of e-learning, blended learning and lifelong learning, experienced users of blended learning as well as researchers in these fields. The study has to involve participants from different geographical areas, different areas of expertise and aims at combining these into a common result. This is accommodated by a Delphi study. Each round of questioning is followed with the feedback on the preceding round of replies. Thus the participants are encouraged to revise their earlier answers in light of the replies of other members of the group. The evaluation of these expert opinions aims at finding a common recommendation for future learning systems for the target group, learners in SMEs. A Delphi Study is the most suitable method to accommodate all these requirements (Turoff & Linstone 2002). To already apply a first selection criteria, easy access to the internet, web-based tools are used. This demands in return to focus on establishing a credible and trustworthy communication with the participants (Anderson & Kanuka 2003).

A Delphi process using web-based and email questionnaires as well as an online discussion will provide the data. Expert opinion on the various aspects of blended learning is required from all knowledgeable parties involved in this discussion: SMEs, providers, experienced users of blended learning as well as researchers in these fields. The study will therefore involve representatives of providers, such as developers, authors, trainers involved in blended learning or e-learning, as well as representatives of small and medium-sized enterprises (SMEs) as future users of the proposed systems, researchers involved in research related to e-learning, blended learning and lifelong learning and representatives from large companies as established users of the proposed systems and as control group. To

Panelists from the four panels of experts have a leadership role in the participant's professional setting, a credible performance record and good professional reputation, such as peer recognition, market success or scholastic contribution in their field. This structure should be applied for Delphi studies which include significantly different subgroups (Kennedy 2002).

Panelists will have varied perspectives, experiences, skills and expertise; all four panels may be influential in changing the mix in blended learning or the use of the educational products. These voices from four different professional areas such as SMEs, large companies, providers and researchers will speak from different yet powerful vantage points.

Expert opinion on a wide range of topics, from the view points of four differing areas of expertise may lead to a broad consensus on issues, but in others to a divergence of opinion. The study will investigate the intersection of ideas from the four groups of experts. The investigation will result in a thorough and realistic analysis of the issues around a good mix in blended learning.

The web based open-ended questionnaire in round 1 (September '06) has an estimated time of 30 minutes to two hours; however this will depend on the individual participant. Round 2 (October '06), again a web based questionnaire, has an estimated time of one hour to 90 minutes. Round 3 (May '07), a web conference will take approximately 45 minutes to one hour. These time estimates do not include time spent reviewing and responding to comments from other panelists.

The evaluation of these expert opinions aims at finding a common recommendation for future learning systems. The study will focus on SMEs in Germany and Ireland, involving international experts and will run from August 2006 to July 2007.

7 Expected Results

We expect to find an answer to the question whether there is a specific mix or blend suitable for learners in small and medium-sized enterprises and whether there are any differences for learners from different industries or from different functions within the same company. If there are strong commonalities it will be interesting to see what they tell us. We expect to gain some information on ways to transfer existing concepts to SMEs and to identify research gaps and opportunities. In summary we will identify concepts and data for Blended Learning in SME that will inform and encourage further research.

References

1. Anderson, T. & Kanuka, H. (2003). *E-Research Methods, Strategies, and Issues* Allyn and Bacon Boston

2. Attwell, G., Dirckinck-Holmfeld, L., Fabian, P., Karpati, A., Littig, P. (2003). *E-Learning in Europe – Results and Recommendations* Retrieved January 12, 2006 from http://bibb2.skygate.de/info3/upload/impuls_10.pdf

3. Beer, I., Hamburg, P., Paul, H. (2006). *E-Learning in kleinen und mittleren Unternehmen*, IAT report. Retrieved March 27, 2006 from www.iatge.de/iat-report/2006/report2006-01.pdf

4. Bersin, J. (2003). *What works in blended learning* Retrieved April 12, 2006 from http://www.learningcircuits.org/2003/jul2003/bersin.htm

5. Bonk, C.J. & Graham, C. R. (2006). *The Handbook of Blended Learning* San Francisco Pfeiffer

6. CIPD (2006) *Learning and Development Annual Report* Retrieved May 2, 2006 from www.cipd.ie

7. European Commission (2003) *Observatory of European SMEs Competence Development in SMEs* Retrieved March 27, 2006 from http://europa.eu.int/comm/enterprise/library/lib-entrepreneurship/series_observatory.htm

8. Garavan, T.N. & Carbery, R. (2003). *Who Learns At Work? A Study of Learners in the Republic of Ireland* Retrieved April 14, 2006 from www.cipd.ie

9. Garavan, T.N. & O'Donnell, D. (2003). *eLearning in Irish Organizations?* Retrieved April 14, 2006 from www.cipd.ie

10. Graham, C.R. Blended learning systems: definition, current trends and future directions. In Bonk, C.J. & Graham, C. R. (2006). *The Handbook of Blended Learning* San Francisco Pfeiffer

11. Kennedy, A. K. (2002). *The Academy in 2005-2015: A Web-based Delphi Study* Retrieved July 14, 2006 from www.ubcdelphi.net

12. McCullough, C (2005). *Obstacles To Small Business Usage Of ELearning In Europe* Retrieved April 20 from http://www.webpronews.com/ebusiness/smallbusiness/wpn-2-20050802ObstaclesToSmallBusinessUsageOfeLearningInEurope.html

13. McSporran, M. & King, C. (2005) *Blended Is Better: Choosing Educational Delivery Methods* Retrieved March 20, 2006 from hyperdisc.unitec.ac.nz/research/KingMcsporranEdmedia2005.pdf

14. Saunders, P. & Werner, K. (2004) *Finding the right blend for effective learning*. Retrieved March 15 2006 from http://www.wmich.edu/teachlearn/new/blended.htm#move

15. Serveau, K. (2004). Examining an Online Corporate Study Group. In G. Richards (Ed.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2004* (pp. 940-945). Chesapeake, VA: AACE.

16. eLearning Guild (2003). *The Blended Learning Best Practices Survey* Retrieved April 05 2006 from http://www.elearningguild.com/

17. Turoff, M. & Linstone, H.A. (2002). *The Delphi Method – Techniques and Applications* Retrieved March 29, 2006 from http://www.is.njit.edu/pubs/delphibook/

18. Valiathan, P. (2002). *Blended Learning Models* Retrieved April 12, 2006 from http://www.learningcircuits.org/2002/aug2002/valiathan.html

19. Wenger, M.S. & Ferguson, C. (2006). A learning ecology model for blended learning from Sun Microsystems. In Bonk, C.J. & Graham, C. R.. *The Handbook of Blended Learning* San Francisco Pfeiffer

20. Wood, D. & Watson, J. (2002). Factors Limiting the Proliferation of E-learning within Small to Medium Sized Enterprises. In G. Richards (Ed.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2002* (pp. 1049-1055). Chesapeake, VA: AACE.

Who Needs "Blended Learning"? Some Thoughts on a Political Concept.

Ray Mary Rosdale

akademie.de asp
GmbH & Co. Betriebs- & Service KG
Erkelenzdamm 59-61
D-10999 Berlin
rosdale@akademie.de

Abstract. The paper covers the topic from an e-learning provider's perspective on the basis of practical experience and discussions with corporate and SME partners. In this paper the author argues that blended learning is superfluous as a pedagogical concept. Its true context is company politics and the conflict between different factions involved in human resource development. Blended learning is a political term describing a non-explicit compromise between those responsible for the costs involved in the implementation of a particular type of e-learning and those interested in a ROI for the costs incurred and control over the learners activities.

1 How do People Learn?

People learn in a lot of different ways: by example, by trial and error, by listening, by reading, by writing, by talking, by experimenting. People learn visually, through their bodies, with their senses, while dreaming, driving and while on the job – in almost any thinkable combination. The longer you look at the concept of learning, the longer the list of possible learning methods, learning media and learning spaces gets. Nobody I have met or have heard about learns in only one way with only one method or only one type of media. (This does not mean that they may not feel more comfortable and accustomed to one or the other learning method, media or space.) As far I know learning has never been accomplished otherwise. I do not think that one needs to read a lot of academic material to come to this conclusion. But after spending some time reading well documented work on the subject, I find it hard to come to any other conclusion.

People are indiscriminate, as far as learning is concerned. They use almost anything they can get their hands on to figure out how to solve their problems or meet their learning needs – and they combine different methods constantly. If this is true, then all learning is "blended". Seen in this light, the concept "blended learning" is superfluous.

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing, EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 18-20, 2006.

2 Learning or Teaching?

"Blended learning" is not really about learning, it is about teaching or instruction. One of the main dichotomies conjured up in the discussion is that between "e-learning" on the on hand and "classroom" or "traditional learning" or "face to face learning" on the other hand. That seems plausible. But when you take a harder closer look at each of the terms mentioned, they are so ambiguous that it is hard to find the dividing line.

E-learning for example is often viewed as "technology driven" or "self-paced learning" and is contrasted with classroom based, communicative, teacher driven learning. This is only true for a particular e-learning scenario and is not at all specific to e-learning. E-learning obviously does depend on technology, but it is not necessarily self-paced. E-learning (teaching and learning) can be done for example over the internet with an instructor commenting and motivating individuals or a group. This group can discuss things among themselves and/or with their teacher/instructor. They may use internet and other technologies, e.g. discussion forums, chats, voice over ip, e-mail, and the plain old telephone, just to mention some possibilities. There is nothing inherently self-paced about e-learning. And to be frank, having people placed in a classroom does not mean anything communicative is happening. Maybe they are doing self-paced work while sitting together. And sitting in a classroom with a teacher in it does not necessarily mean that the instructional scenario is teacher driven.

If indeed "blended teaching" is the combination of different *teaching/instructional* methods, media and spaces then that only makes sense if the terms one juggles delineate relevant points of reference. I do not think the points most often mentioned do this. And to be frank I do not really see the value of the effort. Good (and bad) teachers combine methods and media. Depending on their scope they use textbooks, newspapers, individual talks, group discussions, motivate self-paced work and many more. Good teachers lecture, converse, comment, coax and cry. A good teacher blends anything she can get her hands on to keep the learning process moving. From this point of view, "blended teaching" is not anything new or actually anything special.

3 E-Learning, ROI and Total Control

In my view the term "blended learning" or "hybrid learning" or whatever variation will soon certainly be coined only makes sense when viewed within the context of company training. Several years ago e-learning seemed to be the answer to human resource development's training problems: it promised to be flexible (time and place), re-usable (technical modules that could be combined and used again and again) and relatively inexpensive (when the costs saved for instructors, hotels and travel were considered). Please note: the e-learning scenario considered consisted of CBTs or WBTs (computer or web-based training). People were talking about technology based instruction or "training" (practice) programs without personal interaction or instructor intervention.

One of the most important arguments in inner-company discussions was that e-learning would be more "effective", i.e. more "pin-pointed" due to the fact that anything "irrelevant" was omitted. The learner (employee) could target the information needed and only review that exact particle of knowledge necessary for the skill building at hand. No time would be wasted on "browsing on the internet" for example and the company would be in complete control of the information placed at the employees' disposal. This knowledge could be tested, the "progress" of the employee could be monitored. This was considered the ultimate ROI (return on investment). I remember many of my discussions with the human resource departments in corporations bogging down at this point. The idea of online e-learning scenarios where the employees/students could browse the internet freely and discuss topics online with other students and the instructor were completely unacceptable. My discussion partners were aghast at the thought of their employees going anywhere on their own on the internet. The idea that employees from other companies might be in the same discussion forum lead to something akin to panic attacks.

Unfortunately much of the e-learning modules, programs and learning management systems developed and purchased by companies were notoriously ineffective. After some initial excitement due to the new media involved apathy set in. Nobody wanted to use the media. The human resource department had a problem: they had spent a lot of money and it was not working well. At the same time the "traditionalists" in the company were pawing the ground, waiting to prove that they had been right in being skeptical of the whole e-learning "fad". Nobody could afford to lose – a political compromise was necessary.

"Blended learning" has very little to do with academic or pedagogical concepts. It is about corporate politics and the context and economics of human resource development. In fact the concept of "blended learning" was the human resource department's answer to probing questions on the budgets spent indiscriminately on e-learning products that were ineffective and were not accepted by personnel. In order to justify these investments it was proposed that these products would be more effective and would bring a return on investment if they were combined with instructor based, "traditional" teaching scenarios. Academia seems naively to have taken these justification arguments at face value and has tried to incorporate these lines of "reasoning" in pedagogical concepts. One may argue that somewhere along the line someone has missed the boat.

The challenges of human resource development have not as yet really been met. Companies still have major problems finding the employees they need or finding ways to build the "new" skills (especially so-called soft skills) necessary for their business development. Neither e-learning, or blended learning, workplace learning or whatever can really help. The implicit dichotomy between private learning (at home and without constraint) and company learning (at the workplace and under control) must be overcome and a more holistic view of learning and its value within the business context become the basis for new educational projects.

Applying Blended Learning in an Industrial Context – an Experience Report

Silke Steinbach-Nordmann

Fraunhofer Institute Experimental Software Engineering
Fraunhofer-Platz 1
67663 Kaiserslautern
silke.steinbach-nordmann@iese.fraunhofer.de

Abstract. This paper, describes the experience made with coaching enriched blended learning in the context of industrial technology transfer projects. Based on numerous applications of our modular blended learning approach for teaching object-oriented software development with UML, an attempt has been made to improve the design, the organization and the execution of the blended learning arrangement. Therefore, we collected data on the learning environment, the learners´ behavior and preferences. The results from the questioning in an industrial setting, although far from being representative because of the small number of respondents, give some interesting insights in the needs and expectations of learners and the usage of different elements of blended learning arrangements which could serve as hypotheses for later in depth studies

Introduction

Model-driven development, using UML, has become the most dominant development paradigm, in software industry. To be correctly and efficiently applied, systematic teaching and learning are key prerequisites for benefiting from new technologies. However, the question of what is the best strategy for planning and conducting training and education activities is still open:

Experience shows that typical classroom education is not as effective and efficient as it should be. Reasons might be shortened education budgets, tight project schedules, or short development cycles. This is especially true for an industrial setting since companies, especially small and medium-sized enterprises, which often have tight development schedules and short re-lease rates, often cannot afford such trainings. Furthermore, trainers often have the problem on how to prepare compact but interesting course material, how to motivate trainees or students, or how to encourage active participation.

Therefore, e-learning approaches are becoming more and more popular due to their promise to enable learning at “any time and any place”. However, as any other technology, e-learning is not a silver-bullet. Typical e-learning problems are a lack of

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 21-27, 2006.

social communication or the problem of checking learning progress which, ironically, are strengths in classic classroom education. Furthermore, e-Learning courses require cost-intensive and effort-consuming development projects.

In general, "traditional" and e-learning have both their strengths and weaknesses [4]. An important factor in choosing a specific approach is its effectiveness (i.e., what are success factors?) [5]. Based on various observations and experiences with both "traditional" and e-Learning, we propose a blended learning approach, which mixes traditional classes and e-Learning: E-Learning is used to leverage knowledge and skills in the very beginning, followed by in-depth seminars for teaching advanced concepts as well as for performing group work, and practical exercises. Experiences with applying this strategy to teach object-oriented development with UML, has shown positive results in academia as well as in industry [1]. This leads us to the hypothesis that blended learning will improve the efficiency and effectiveness of education in general and especially in the area of software engineering.

The Blended Learning Approach

Blended Learning proposes a mixture of learning activities consisting of self-steered learning activities, cooperative and collaborative learning activities, learning activities supported by online tutors, social learning activities, and traditional classroom teaching activities [3]. According to this definition, a modular blended learning approach for software engineering education, especially for teaching object oriented software development with UML, was defined and implemented (see Figure 1 for the product levels and phases of the program).

The approach establishes four modular learning product levels. Each level integrates the respective lower level and supplements them with new activities, in the teaching process. This modularity provides a maximum of flexibility for the design of educational programs and assures an optimal appropriateness for the learners in specific programs.

Every educational program that is designed, organized, and performed according to the blended learning approach described in the previous section follows a specific phase schema (see Figure 1, right part). This phase schema transports the various contents of the product levels to the learners. In the first phase, the educational program is designed and organized, integrating a detailed analysis of the learners skills, educational needs, and learning environment. The method used to analyze these fields is the skill profiling and analysis method "QUALISEM-People" [3] assuring content and instructional strategy of the program are defined based on objective information. This aims at increasing the acceptance level and thus the effectiveness of the learning program by satisfying objectively identified training needs. In the second phase, the educational program is launched. It starts with a kick-off workshop, which aims at learners as well as tutors getting to know each other, and explaining the organization of the program to the learners. To this the online phase follows in which the learners work with a web-based training of *UML Basis or UML Personal*. The goal of the online learning phase is to reach an equal level of knowledge about the UML notation. This is a prerequisite for efficient teaching sessions in the subsequent classroom trainings, because the trainer can then concentrate on providing detailed advanced knowledge, such as object-oriented analysis, design, and programming from the product level *OO Practitioner (UML)*. In the third phase, the knowledge acquired is transferred into practice. That is, the learners perform an object-oriented software development project. The tutors, now acting as coaches, support them in their efforts following the principles of scaffolding und fading [2]. Eventually, the acquired knowledge is certified reaching the highest product and thus education level *OO Designer (UML)*.

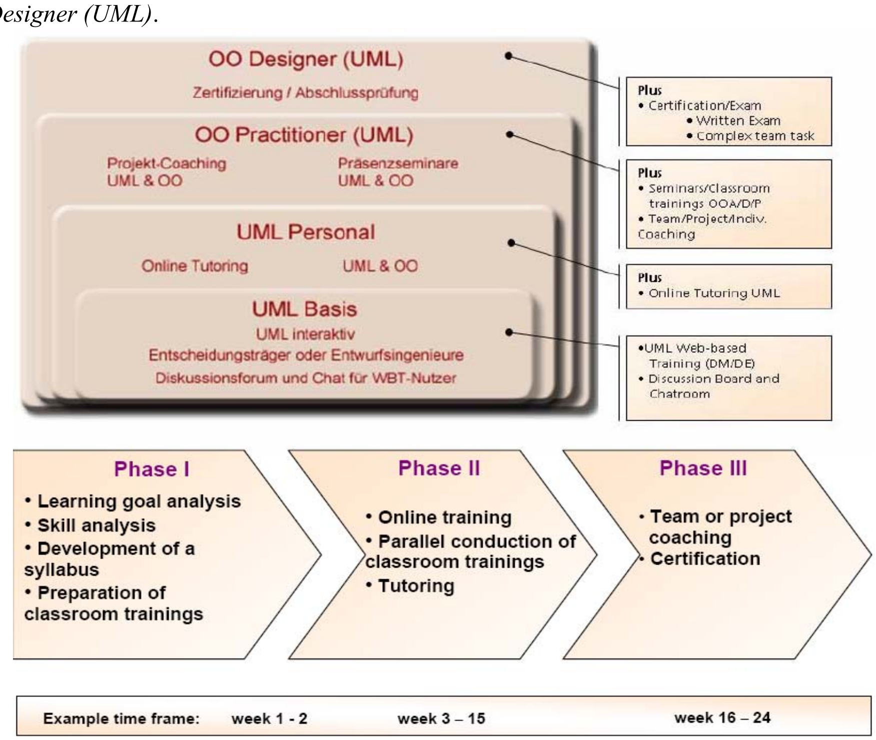

Fig.1. The product levels and phases of the blended learning program

Observations and Experiences in an Industrial Setting

The presented blended learning approach has been successfully tested both in academia and in industry [1]. With the intention to improve the blended learning arrangements and to match the industrial training programs with needs of the participants, continuously evaluation was established. Accompanying to these evaluation activities, participants were questioned about their individual learning needs, their learning behavior and their learning, preferences. The questioning was divided into a pre-questionnaire (before the Online-Learning in Phase II started) and a post-questionnaire at the end of Phase III.

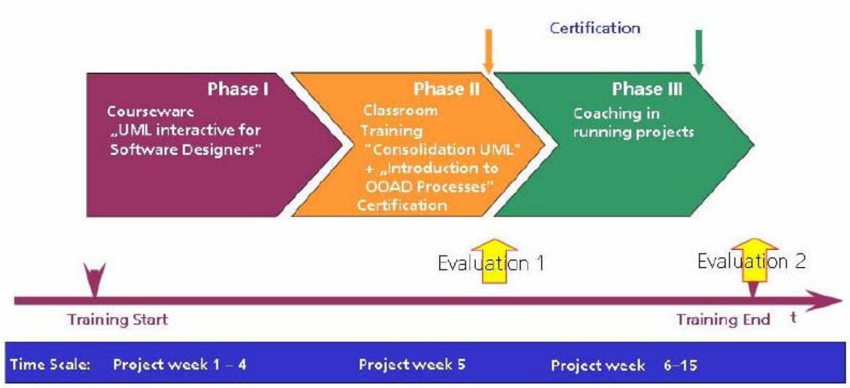

Fig. 2. Phases of the evaluated training program

The results from the questioning in an industrial setting, although far from being representative because of the small number of respondents, give some interesting insights in the needs and expectations of learners and the usage of different elements of blended learning which could serve as hypotheses for later in depth studies. One of these hypotheses states that coaching may serve very well the explored needs and preferences. The presented results were gained during a training program in a large concern (automotive branch) in Germany. A total of 42 employees (software developer, manager, persons in charge) at the age of 20-49 years attended the training program. Most of them were male (~86 percent). All participants were invited to fill out an online questionnaire at the beginning of phase I (pre) and another printout-questionnaire at the end of phase II (post). The reflux of questionnaires (23 pre/14 post) was quite satisfying, although the quantity of data and the group line-up do not allow empirical generalization.

The training program intended to provide the employees with sufficient UML knowledge for the application of an object-oriented approach.

The training program started with an online learning phase, in which the participants worked self-directed with the courseware “UML interactive for Software Designers”. This phase aimed at leveraging the knowledge and skills of the participants in applying the UML, which is a prerequisite for the classroom trainings of the second phase [8]. These classroom trainings cover topics to consolidate UML knowledge and skills of the participants and to introduce OOAD processes. To match the specific needs of the domain and the experiences of the participants, the training materials are based on realistic stuff (documentations, source code, etc.), delivered by the customer. Phase II was concluded by a certification day, where a complex, domain-specific exercise had to be solved by the participants in two-person teams. All participants were still granted access to the online course after finishing phase II. After the classroom trainings and the certification, a several weeks long project coaching phase concluded the training program. In this phase, the coach consulted the participants about how to apply UML in their day-to-day-work. The first questionnaire preceded the training program and aimed at the collection of the learning needs, their preferences and their expectations. The second questionnaire was provided to the learners at the end of the certification day. The aim of this questionnaire was to check, if their expectations were fulfilled sufficiently and if their learning behaviour was influenced by the methodical setting of the training program.

Pre-Questioning: Prerequisites and Learning Needs

- Asked about the importance of an training program on object-oriented software development with UML for their future project work, more than a third of the participants replied that it is urgent to learn more about UML Furthermore, asked for their individual goals and expectations concerning the training program, the vast majority of answers provided (80 percent) could be summarized as 'be able to apply UML in future projects actively'.
- Apart from one person, none of the participants had any experiences with any kind of eLearning resp. online training.
- The participants were asked which element of the blended learning approach they would expect most of, they referred to classroom training, coaching and the WBT in the given descending order.

Asked, which learning mode is most effective in their point of view, the participants decided in favor of more or less informal communication with their peers. Nearly at the same high level they considered classroom training involving a tutor who is also available after the training as a project coach (see Figure 3).

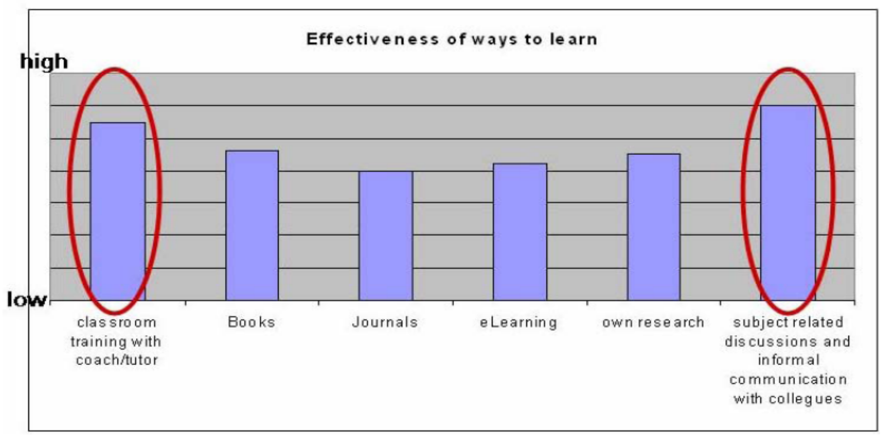

Fig. 3: Estimated effectiveness of ways to learn

Post-Questioning: Assessment of Satisfaction and Learning Behavior

- In the second questionnaire the participants regarded project coaching after classroom training the most important learning mode in the program. Therefore, providing means for communication between learners and between learners and tutors/ coaches as well as providing a tutor / coach during a specified period after the training at all should be essential parts of an training program.

- Asked, which element of the training program did support their individual learning process most effectively, the participants named classroom teaching and coaching, the illustrations of the courseware and the informal discussions with their colleagues.
- After the training, most of the participants (~ 85 percent) did not consider any of the parts dispensable. Therefore, all elements of the blended learning approach should be present in a training program.

Summary and Conclusions

With the rapid rate of innovation in object-technology, teaching/learning of that technology has become the most challenging issue. Classroom training and online-courses both have their strengths but are often cost-intensive or not specifically adapted to the needs of a specific organization. However, the synergy effects when used in combination clearly outweigh the isolated benefits of the approaches. This paper has briefly outlined a blended learning approach, in the context of teaching the UML, which promises highly effective and efficient training of software professionals in object-technology.

Recently blended learning approaches (i.e., a combination of e-learning and classroom-oriented learning) have become quite popular, since they promise to allow for learning anywhere and anytime. Thus, they make training affordable especially for small and medium size enterprises (SMEs). Although, this is a step into the right direction it still bears one major question: How can the effect of such a training be made sustainable or in other words how can it be ensured that trainees can practically apply their new knowledge in their daily work. Ironically, this problem is neither new nor specific for blended learning approaches. Thus, solutions from other areas of education might apply here as well. One such means is ‘coaching’, a technique for observing, the current functioning, assessing the strengths and weaknesses, and developing measures for addressing needed changes. Thus, in the context of technology transfer projects coaching has to be integrated into the daily work of the trainees (i.e., workflow-oriented) in order to obtain significant improvements.

From our experience in conducting blended learning programs, every educational program needs several factors to be fulfilled in order to be successful. The first and most importance issues is a full management commitment. That means that the supervisors of the personnel being trained set incentives for successfully participating in the learning program. This could be as simple as reserving an adequate amount of time for the learners to prepare for and participate in the trainings. Secondly, a “champion” whom people trust at the company and who can explain the benefits of knew knowledge for the upcoming daily work is beneficial for motivated learners. Finally, in all blended learning projects on OO & UML conducted so far, regardless of being at academic or industrial level,the upcoming certification makes people take the online and classroom trainings serious from the beginning and prepare for seminars and the certification. We currently plan empirical studies to investigate the return on investment of the suggested strategy. Moreover, we are looking for tools to support it. Both are necessary ingredients to drive the adoption of the approach in practical situations.

Acknowledgements

The WBT's described in this paper have been partly developed in the strategic research project of the Fraunhofer Gesellschaft "Fraunhofer Knowledge & Learning Network (FKN)".

References

1. Bunse, C., Grützner, I., Ochs, M., Peper, C., Steinbach-Nordmann, S.: Applying a Blended Learning Strategy for Software Engineering Education", Proceedings of the 18th Conference on Software Engineering Education and Training Ottawa, Canada (CSEE&T), 2005.
2. Collins, A., Brown, J.S., Newman, S.E.:"Cognitive apprenticeship: teaching the crafts of reading, writing and mathematics", In: L.B. Resnick (Ed.), "Knowing, learning and instruction: Essays in honor of Robert Glaser", Lawrende Erlbaum, Hillsdale, N.J., 1990, S. 453-494.
3. de Haan, D., Waterson, P., Trapp, S., Pfahl, D.: "Integrating needs assessment within next generation e-learning systems: Lessons learnt from a case study", Fraunhofer IESE, Public Report IESE-Report No. 007.03/E, Kaiserslautern, 2003.
4. Grützner, I., Bunse, C.: "Teaching Object-Oriented Design with UML - A Blended Learning Approach", Proceedings of the Sixth Workshop on Pedagogies and Tools for Learning Object-Oriented Concepts. 16th European Conference for Object-Oriented Programming (ECOOP 2002), Malaga (Spain), 2002.
5. Grützner, I., Hebestreit, C., Pfahl, D., Vollmers, C.: Erfolgsfaktoren für effektives E-Learning - Ergebnisse einer empirischen Studie. DeLFI 2004. 2. E-Learning Fachtagung Informatik - Proceedings (2004)
6. Issing, L.J. "Instruktionsdesign für Multimedia", In Issing, L.J.; Klimsa, P. (ed.) "Information und Lernen mit Multimedia". 2nd edition, Beltz Psychologie VerlagsUnion, Weinheim, 1997, pp. 194-220.
7. Kerres,M.: „Online- und Präsenzelemente in hybriden Lernarrangements kombinieren", In: A. Hohenstein, K. Wilbers (eds.), "Handbuch E-Learning", Fachverlag Deutscher Wirtschaftsdienst, Köln, 2002.
8. Mantyla, K.: Blending E-Learning. The Power is in the Mix. Alexandria: ASTD, American Society for Training & Development, 2001
9. Singh, H.: Building Effective Blended Learning Programs. Educational Technology, Volume 43, Number 6, Pages 51-54, 2003
10. Thomas, L., Waterson, P., Trapp, S.: Eight years of delivering professional education and training for software engineering at Fraunhofer IESE: An experience report. 19th Conference on Software Engineering Education and Training. CSEE&T 2006 - Proceedings (2006), 131-138.

Blended Learning Concepts – a Short Overview

Sonja Trapp

Fraunhofer Institute Experimental Software Engineering
Fraunhofer-Platz 1
67663 Kaiserslautern
sonja.trapp@iese.fraunhofer.de

Abstract. This paper presents a short overview of blended learning, showing arguments for and against these concepts. Potential blended learning scenarios are described that vary depending on the degree of instructor involvement, learner self-organisation and on-line moderation or coaching. The paper ends with an example of successful application of a blended learning concept in industry.

Definition of Blended Learning

Blended learning can be defined as the combination of multiple approaches to pedagogy or teaching, e .g. self-paced, collaborative, tutor-supported learning or traditional classroom teaching. Blended learning often refers specifically to the provision or use of resources which combine e-learning with other educational resources.

Some authors talk about "hybrid learning" [6, 7], "mixed learning" or "multi-method-learning". However, all of these concepts broadly refer to the integration (the "blending") of e-learning tools and techniques with traditional methods. Computer-based learning is no longer regarded as an alternative to traditional forms of learning/teaching. It is integrated into a learning arrangement which combines those methods that have been selected for a specific learning purpose or environment.

Blended learning is not really a new concept. Teachers have always been using 'combined resources'. Basically, blended learning is just a combination of teaching or facilitation methods, learning styles, resource formats, a range of technologies and a range of expertise.

Blended learning is actually a sort of a return to traditional learning concepts. Traditional training also relies on phases of self-directed learning. In classical classroom training, the didactical strategy is based on the

- presentation of content by a teacher / trainer
- interaction between teacher and students and among students
- follow up of content presentation and exercises (homework), to be done individually or in groups /pairs.

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 28-35, 2006.

In this respect, blended learning is also a return to teacher-centered learning scenarios, as the main responsibility over

- content structuring and didactical presentation of content
- learner support and control
- organisation of social learning

remains on the teacher's side.

Blended-Learning Concepts

Blended Learning concerns not only different methods, but also different theories of learning and applies these theories by using traditional and new media. It affects different levels:

- the **theoretical** level (combining different theories of learning, like constructivism, cognitivism, behaviorism)
- the **methodical** level (combining self-directed with instructor-led learning, individual with cooperative learning, receptive with explorative learning, etc.)
- the level of the **media** (combining face-to-face with on-line elements; using different media, like books, video, CBT, etc.)

A formal classification of learning scenarios based on the criteria of form, function and method, may help to structure different potential blended learning concepts (as described in [12]).

„**Form**“ describes the organisational form of e-learning and its integration into institutions. Organisational forms can be traditional classroom sessions or pure e-learning.

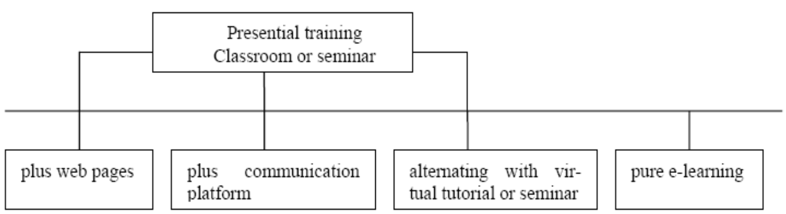

Fig. 1. Organisational forms of e-learning

„**Function**“ might be mere information, direct communication or synchronous co-operation.

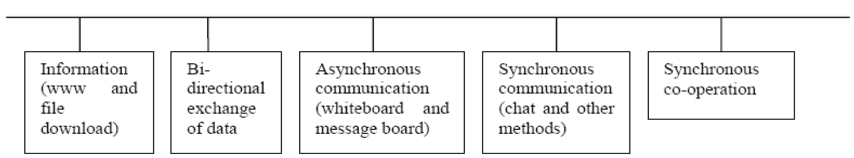

Fig. 2. Functions of learning

„**Method**“ refers to the different theories of learning and comprises instructor-led training, interactive courses or self-directed learning.

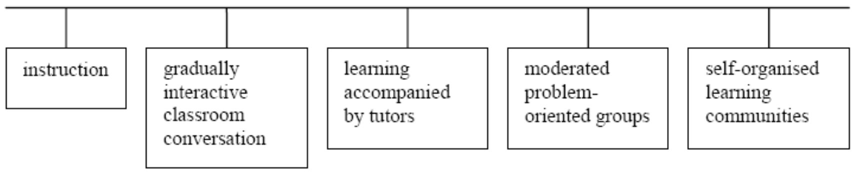

Fig. 2. Methods of learning

Combining these three levels leads to four different learning scenarios:

Table 1. Classroom training accompanied by web components (priority given to classroom training) **(Scenario I)**

	Presential component	**virtual component**
Form	Priority given to classroom training	Web components additionally used
Function	Varying	Information
Method	Varying	Instruction

Table 2. Equal importance of classroom training and web components **(Scenario II)**

	Presential component	**virtual component**
Form	Classroom training equally important	Website & platform equally important
Function	varying	Information & communication
Method	varying	Instruction, tutor support

Table 3. Integration of presential and virtual component **(Scenario III)**

	Presential component	**virtual component**
Form	Classroom training integrated	Website & Platform integrated
Function	varying	Information & co-operation
Method	varying	Moderated groups

Table 4. Virtual seminars and learning communities (no presential activities) **(Scenario IV)**

	Presential component	**virtual component**
Form	No classroom training	platform, cooperative tools
Function	Not applicable	communication & co-operation
Method	Not applicable	Groups and learning communities

Blended Learning Enriches E-Learning

Blended learning does not make the learning process easier than traditional classroom training. E-learning costs still as much effort as any other kind of learning. Every kind of self-directed learning is difficult and uncertain, because the individual learner has no opportunity to find out about his own progress. With blended learning, the comparison of individual learning progress with that of other learners is being facilitated.

Blended learning means more effective and more sustainable learning. This is especially true if the learners are accompanied by e-moderators [11] or e-tutors [8] or by project coaches.

If blended learning is only e-learning with additional classroom training, it does not make the most of technology-enhanced learning. Experienced distance learning institutes (like, e.g., the Open University www.open.ac.uk/, the Tele-Akademie www.tele-ak.de) have always been working withing on-line tutors or on-line moderators. If excellent e-moderation services are offered, there is almost no more need for classroom sessions. A face-to-face meeting would then be organized only for creating a personal/social relationship between learners and moderators/tutors and/or trainers at the beginning of the training session. But in many cases there will be no physical meeting at all. E-moderation services can offer

- motivational support (to prevent high dropout rates in distance learning)
- support with learner problems
- support with content problems
- support with technical problems
- moderated virtual learning groups
- collaborative work on the same project.

Especially with geographically distributed individual learners, e-moderation services are essential for learner satisfaction and learner success.

Is Blended Learning the Best Possible Method?

Blended learning intends to take the best of both worlds. From classical classroom training, it takes the

- teacher driven presentation and selection of relevant content
- social interaction
- the dialogue between student and teacher.

Concerning e-learning, it benefits from the advantages of self-paced learning, i.e.

- Learning anytime everywhere.
- Students can work through a specific task or problem as often as they want, until they reach their learning goal. In classroom training this would be impossible. This is why e-learning is said to be more effective and sustainable.
- The possibilty to form virtual groups for specific topics or specific levels of competence.

It is doubtful, however, whether blended learning is the ideal concept for work-based learning, for the integration of learning into work processes. Dividing the learning process into presential learning and on-line learning may result in too much teacher-centered structuring and thus prevent the learner from taking over more responsibility for her/himself. It appeals more to those learners who prefer to lean back and listen, not to the active learner required by problem-, project- or work-based learning.

Successful and effective learning is always related to the degree of implication of the learner in the learning process. With problem-oriented and explorative learning methods, learners are directly implied. However, very few web-based trainings have been built on problem orientation and exploration – they mostly reflect (hierarchical) coursebook structures with fixed scope and sequence that cannot be changed.

Moreover, studies [3, 10] have shown that people do not learn during their working hours. At least when it comes to working through on-line courses and exercises. On-line learning happens mostly at the end of working time, after work and during leisure time, and is thus not integrated at all into normal work processes.

Another interesting aspect of a recent study [3] was that on-line students largely prefer the print version of a course and spend much less time on-line than expected. Reasons for this are the preferential learning styles of the students and the fact that the print-out is more flexible and better available for mobile use. This can be interpreted as a sort of set-back for web-based training courses which do not seem to provide any added value compared to textbooks.

This leads to the conclusion that the design of web-based trainings has to be at least as good as good that of good textbooks. Browsing and scrolling through web pages instead of skimming through printed pages does not have any pedagogical added value and seems to be more cumbersome than reading a textbook.

Blended learning is definitely a good method in this period of transition, where e-learning still lacks of wide-spread acceptance. Practitioners of e-learning agree that blended learning helps learners to gradually get used to technology-enhanced learning offers, and to make them understand the advantages for their own personal progress.

Blended Learning and Change Management

There are several reasons why the introduction of e-learning in companies was often regarded as a failure in the past [5]:

- lack of internal marketing and insufficient information on e-learning offers
- lack of support from management level
- high level of self-motivation and self-learning skills required from learners
- no explicit rules for learning at the workplace
- no rules for acknowledgement of qualifications acquired by E-Learning
- lack of social exchange and direct feedback
- high initial investments and low return on the investment.

The introduction of e-learning or blended learning is a change process that has to be explicitly designed and directed. In companies with successful introduction of e-learning, changes concerning the training method were welcomed and actively supported by the managers. Habitual work processes have to be arranged in a different way if they are to be combined with learning processes. To create an atmosphere conducive to learning at the workplace is not an easy endeavour and presupposes a fundamental change in thinking. The organisational culture must reach a state in which individual knowledge and competence is integrated into daily work processes [4]. If agreements on objectives and incentives for learning are set up between managers and employees, the latter will find out for themselves when and where to learn. There is already a strong tendency of shifting training phases into people's leisure time.

Applying blended-learning concepts does not mean a radical change, as elements of traditional training are still present. This is positive because in change management it is important to find a balance between things that have to be changed and those that are worth keeping [5].

E-learning or blended learning can only be a success if it receives the same amount of attention as any other kind of training. Self-directed e-learning should be acknowledged in the same way as attending classrom training sessions. The e-learning process has to be accompanied, analysed and constantly improved.

There will be a win-win effect for both employers and employees if the concept and organisation of blended learning programmes is based on a work process perspective. Only then will operating efficiency and productivity of the company rise, and employability will be strengthened [9].

Successful application of a blended learning concept at Fraunhofer IESE

In [1] and [2] experience reports are given on blended-learning programmes performed with customers from industry and academia. Based on various observations and experiences with both “traditional” and e-learning, a blended learning approach was proposed with the following structure:

1. Kick-off meeting of all participants, their teachers, and tutors.
2. On-line learning phase to provide knowledge and skills.
3. Traditional course.
4. Final project work.

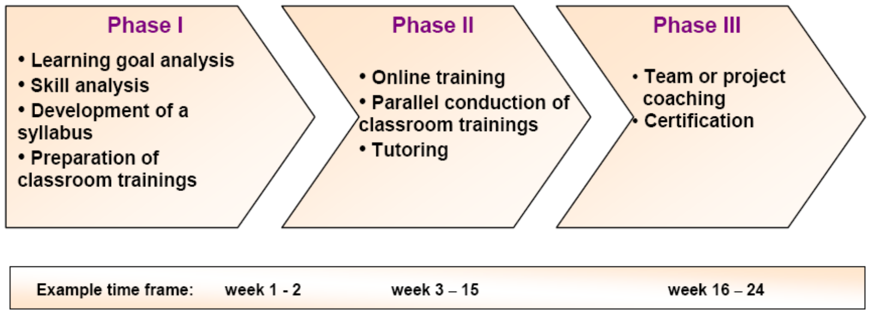

Fig. 3. Blended Learning in three phases [1]

The kick-off meeting serves as a get-together for students, tutors and trainers, with an introduction to syllabus and schedule. The on-line learning phase is supposed to leverage the knowledge and skills of the participants, which is a prerequisite for the following traditional class. The online-course comprises about 25 on-line learning hours and 10 practical exercise hours, which are normally dispensed over four weeks. It provides several navigational strategies and different entrance points in order to meet the requirements of a heterogeneous group of participants (e.g., inexperienced participants can follow a guided tour). Furthermore, participants can select one out of four modules according to their already acquired knowledge as starting point for dealing with a particular topic.

The modules are defined as parts of a virtual project where participants are part of the project team and have to support their virtual “supervisor”. The “supervisor” supports participants through expert knowledge or through self-control questions and exercises (e.g., every participant has to solve a modeling task and has to submit his solution for feedback). The results of practical exercises are then regarded as a pre-test for the following class.

The following classroom training is organized as a mix of both presentations and group work. Finally, participants are asked to perform, alone or in a small group, a specific project work as final exam. The results are evaluated by the same tutors/ trainers who have been playing the role of guides and experts [2].

Informal interviews with participants, and more general feedback from the company, indicate that blended learning is efficient in terms of changing learner behavior, especially when it is enriched with additional transfer supporting activities, such as individual coaching.

There is a great demand for examples and course material that makes use of information that can easily be integrated with routine work tasks and is not solely based on theory or from existing textbooks. In building and extending the course we have come to appreciate the need to enrich self-paced learning with specific transfer supporting actions that can be adapted to a specific domain and individualized to the learners day-to-day work. Based on our experience, such transfer-oriented efforts help the participants to apply the new knowledge more easily.

In self-paced scenarios special attention has to be paid to learner’s motivation. It is very important to provide further support in the application of the new knowledge and encourage learners to try out their knowledge in new situations (i.e., encourage them to transfer their knowledge). Furthermore, motivation is increased when the results of completing the course are acknowledged and recognized within the company by some form of certification [13].

References

1. Bunse, C., Grützner, I., Ochs, M., Peper, C., Steinbach-Nordmann, S.: Applying a Blended Learning Strategy for Software Engineering Education", Proceedings of the 18th Conference on Software Engineering Education and Training (CSEE&T), Ottawa, Canada, 2005
2. Grützner, I., Bunse, C.: "Teaching Object-Oriented Design with UML - A Blended Learning Approach", Proceedings of the Sixth Workshop on Pedagogies and Tools for Learning Object-Oriented Concepts. 16th European Conference for Object-Oriented Programming (ECOOP 2002), Malaga (Spanien), 2002
3. Grützner, I., Hebestreit, C., Pfahl, D., Vollmers, C.: Erfolgsfaktoren für effektives E-Learning - Ergebnisse einer empirischen Studie. DeLFI 2004. 2. E-Learning Fachtagung Informatik - Proceedings (2004), 295-306.
4. Hölbling, G.: Blended Learning. Anstoß für innovative Unternehmenskonzepte? QUEM-Bulletin 1/2005, p. 8-10.
5. Keller, M., Back, A.: Blended-Learning-Projekte im Unternehmen. Arbeitsberichte des Learning Center der Universität St. Gallen, 3/2004.
6. Kerres, M.: Online- und Präsenzelemente in hybriden Lernarrangements kombinieren. In: Hohenstein, A., Wilbers, K. (eds.), "Handbuch E-Learning", Fachverlag Deutscher Wirtschaftsdienst, Köln, 2002.
7. Kerres, M., de Witt, C., Stratmann, J.: E-Learning. Didaktische Konzepte für erfolgreiches Lernen, In: Schwuchow, K., Guttmann, J. (Hrsg.): Jahrbuch Personalentwicklung & Weiterbildung, Neuwied 2002.
8. Kerres, M., Nübel, I., Grabe, W.: Gestaltung der Online-Betreuung für E-Learning. In: Euler, D., Seufert, S: E-Learning in Hochschulen und Bildungszentren. Gestaltungshinweise für pädagogische Innovationen. Bern 2004.
9. Lernende Region Zollernalb: Leitfaden zur Entwicklung und Durchführung von Blended-Learning-Angeboten. August 2005.
10. Littig, P.: Klug durch E-Learning? Eine Marktstudie der DEKRA-Akademie. Bielefeld, 2002.
11. Salmon, G.: E-moderating: The Key to Teaching and Learning Online (2nd Edition). New York 2004.
12. Schulmeister, R.: Virtuelles Lehren und Lernen: Didaktische Szenarien und virtuelle Seminare. 2002. http://www.izhd.uni-hamburg.de/pdfs/VirtLernen&Lehren.pdf.
13. Thomas, L., Waterson, P., Trapp, S.: Eight years of delivering professional education and training for software engineering at Fraunhofer IESE: An experience report. 19th Conference on Software Engineering Education and Training. CSEE&T 2006 - Proceedings (2006), 131-138.

Making of the Future of Technology Enhanced Professional Learning and Self Regulated Learning

EC-TEL 2006

October 1, 2006

Crete, Greece

Organizing Committee

Vana Kamtsiou (Demokritos, Greece)
Tapio Koskinen, (HUT, Finland)
Paul Lefrere (Open University, United Kingdom)

Making the Future of Technology Enhanced Professional Learning: Case Studies of Individual and Group Learning

Workshop (2) Overview

The Prolearn Network of Excellence has facilitated a large-scale foresight work that has resulted in a set of future visions for Technology-Enhanced Professional Learning. This workshop will focus on defining the critical capabilities needed to achieve the desired futures. The workshop is organized as a Learning Café ensuring that all participants can have direct impact on how the gap will be crossed.

The workshop participants will be engaged in highly interactive, structured sessions that are formed around the 3 main themes of the workshop. For each theme, a key-note speaker will set out the current key issues and needs and give some examples of the role of today's Technology-Enhanced Learning in relation to that topic. Workshop participants then will discuss the roadmap for the selected processes, to explore ideas about FUTURE issues and needs, and the role of current and FUTURE Technology-Enhanced Learning in addressing both user needs of today and emerging needs.

The working method employed in the workshop is known as "learning discussion forum" or "Learning Café", and has been successfully been implemented in a number of events involving European experts. This group dynamics technique was initially developed by Juanita Brown and David Isaacs (MIT). The knowledge creating process, conceived by Nonaka and Takeuchi, was later adapted and added to the methodology by Leenamaija Otala.

The three main themes of the workshop:

- **PERSONALISATION:** learning for you, where, how and when you want to learn

The theme will be introduced by *Donatella Persico (Consiglio Nazionale Ricerche)*

- **ENHANCING WORK PERFORMANCE:** use TEPL to support human performance improvements and to provide links between business processes, competencies and learning processes

The theme will be introduced by *Volker Zimmermann (IMC)*

- **SELF-REGULATED LEARNING, CREATIVITY AND INNOVATION:** collaborative learning, critical reflection

The theme will be introduced *by Paul Lefrere (UK Open University) and Karl Steffens (University of Cologne)*

The table facilitators are: Lampros Stergioulas (BRUNEL University), Fanis Raptis (NCSR DEMOKRITOS), Willy Bernhard (Fernfachhochschule Schweiz)

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 38, 2006.

A Glimpse at the Future of Technology Enhanced-Professional Learning: Trends, Scenarios and Visions

Vana Kamtsiou[1], Tapio Koskinen[2], Ambjörn Naeve[3], Dimitra Pappa[1], and Lampros Stergioulas[4]

[1] Division of Applied Technologies, National Centre for Scientific Research - Demokritos, 15310 Agia Paraskevi, Attiki, Greece
{vana;dimitra}@dat.demokritos.gr
[2] Lifelong Learning Institute Dipoli, Helsinki University of Technology, P.O.B. 8000, 02015 HUT, Finland
tapio.koskinen@hut.fi
[3] Royal Institute of Technology (KTH), NADA, 10044 Stockholm, Sweden
amb@nada.kth.se
[4] Department of Information Systems and Computing, Brunel University, Kingston Lane, Uxbridge, Middlesex UB8 3PH, UK
Lampros.Stergioulas@brunel.ac.uk

The paper presents future visions of technology enhanced professional learning as expressed in a pan-European roadmapping activity. A new approach is introduced and employed to develop a roadmap for technology enhanced professional learning. Interesting findings from the first phase, which identified the future visions are presented and their analysis using conceptual mapping is proposed.

Introduction

The aim of this foresight study is to map out the desired future for technology-enhanced professional learning (TEPL) in the form of prevalent visions in the community at large. The study represents the first phase of a larger technology roadmapping activity aiming to provide a 10-year-span technology roadmap for European professional training, an initiative which has been launched within the Prolearn Network of Excellence [23].

The Prolearn Network of Excellence focuses on identifying the emerging future e-Learning scenarios and contexts, in the form of future technology-enhanced professional learning resources, and the use of these learning resources for professional training in Small/Medium Enterprises (SMEs) and larger companies. In pursuing this, the Prolearn Network of Excellence aims to also advance the state-of-the-art in the critical areas of personalized adaptive learning and interactive media, with learning resources connected to real-world settings and reusable in different contexts.

This paper first describes the specific methodology employed in order to compile a roadmap for technology-enhanced professional learning for the mid-term future (the next 10 years). It then follows on to describe in detail the work of the first phase (future visions) and discusses preliminary results. The work has brought together external experts and industry stakeholders in order to synthesize and combine knowledge.

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 39-52, 2006.

The Roadmapping Processes

The Prolearn roadmapping process aims to provide us with the information of where we are (current state) and were we want to go (vision/foresight/desired future). Once this is achieved we will be in a position to determine how we can get there (action plan). The process includes the following stages (Figure 1):

- *Vision:* tacit idea representing the desired future state
- *Expressed future state:* instantiation of the vision in a formal and systematic way
- *Gap analysis:* between the current state of the art and desired future state (critical capabilities needed to implement one or more vision statements)
- *Actions:* a portfolio of short-, mid- and long-term actions and recommendations, based on the gap analysis

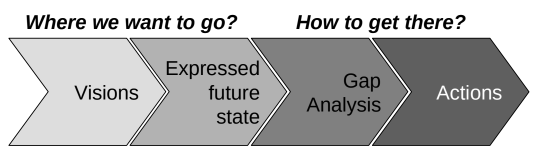

Figure 1. Roadmapping stages

In Figure 1, the first two stages comprise Phase 1 (Where do we want to go? - outputs: Vision statements and Expressed future state) and the last two stages comprise Phase 2 (How can we get there? - outputs: Critical capabilities and recommended actions).

This paper is concerned with the formulation of the future visions (Phase 1). In Phase 1, the future scenarios and the shared visions are identified and a framework is set up for the subsequent gap analysis. A variety of activities, including scenario building, international forums, surveys and workshops with experts, are used to derive and express the visions, in terms of the core concepts (vision statements, goals and influential factors). The main principle is “finding the currents that lead you where you want to go” (proactive), instead of “floating in the currents you are presently in” (reactive).

In the framework of Prolearn, roadmapping is a knowledge creating process (Figure 2) that spirals outwards from the core partners of the Prolearn Network (individuals, groups, the whole Network) via the Network’s associated partners, to the entire scientific community and industry. Therefore, it is both a learning activity and a knowledge creation process for the community building the roadmap. According to Nonaka [13-17], the key to knowledge creation lies in the following four SECI modes of knowledge conversion, which occur when tacit knowledge and explicit knowledge interact with each other:

- *Socialization* (sharing tacit knowledge): The process of sharing experiences (tacit knowledge), thereby creating new tacit knowledge.
- *Externalization* (converting tacit knowledge into explicit knowledge): The process of articulation and conversion of tacit knowledge into explicit knowledge.

- *Combination* (Systematic combining of explicit knowledge): The process of restructuring and aggregating explicit knowledge into new explicit knowledge.
- *Internalization* (Internalizing new knowledge as tacit knowledge by the organization): The process of reflecting on explicit knowledge and embodying explicit knowledge into tacit knowledge.

According to Nonaka, because tacit knowledge includes mental models and beliefs in addition to know-how, moving from tacit to the explicit is really a process of articulating one's vision of the world - i.e. what it is and what it ought to be. When individuals invent new knowledge, they are also reinventing themselves, their organization and even the world [13-17].

Similarly, knowledge creation in a roadmapping exercise is a continuous process where individuals and groups transcend their boundaries by acquiring a new context, a new view of the subject domain, and new knowledge. The employed roadmapping process model (Figure 2) is derived from the SECI process by replacing the triplet of social entities {Individual, Group, and Organization} with {Core Partners, Associate Partners, and Scientific Community & Industry} [3,9].

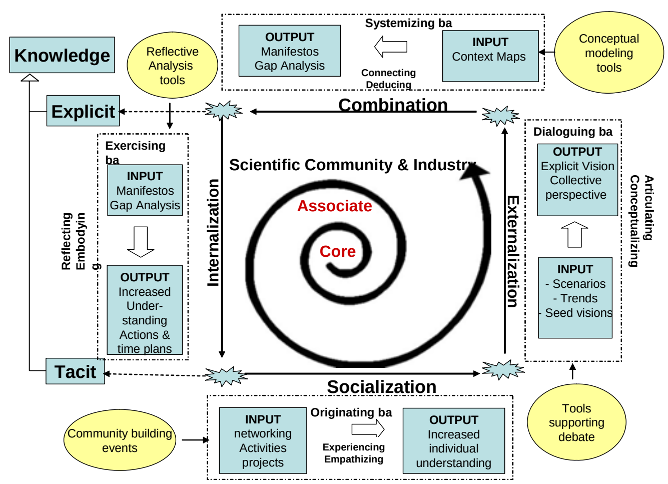

Figure 2. The Prolearn roadmapping process Framework (based on the SECI model)

During the Socialization process, networking activities and community building tools are important. Face to face meetings, various workshops, and virtual meetings have been organized to bring together the wider community of the Prolearn network (both core and associate partners spanning more than 300 organizations) on a common contextual platform and tap into their collective experience and knowledge.

During the Externalization process, awareness was raised of the key issues involved in TEPL, and the implicit concepts and ideas originated during the socialization process were expressed. Individual views and visions were expressed via scenarios produced by Prolearn partners, and by other experts and initiatives, and also through brainstorming sessions where individual visions were discussed and extended. These activities provided with a good indication of what TEPL means to different stakeholders in a variety of Professional situations. Desktop research and online surveys are also used during this phase. The aim was to create seed visions that can be used as input for starting a dialogue with external groups. The next step was to initiate a dialogue with external experts and industry stakeholders in order to synthesize and combine knowledge. In this activity, it is important to bring together people with different expertise and scientific backgrounds. A symposium with researchers, academics, industry experts and policy makers was organized where the seed visions were discussed and extended by others. Interviews with companies, forums and virtual communities are also set up in order to test, validate and update the vision statements.

During the Combination process, the outcomes of the dialogues are analyzed in order to clearly systematize concepts, identify trends and factors influencing those concepts and analyze their relationships. During this phase we use conceptual modeling tools. The different context maps are studied and the final vision statements are derived. The resulting knowledge is formulated and presented using the Conzilla browser tool. [8, 10, 11]. The resulting model is an "electronic document" in the form of a Java applet, which is available at www.conzilla.org/demo/RM.html

During internalization process, this explicit knowledge, in turn, can be reflected upon and internalized into new tacit knowledge. In the later Phase 2, the critical elements for achieving the vision statements will be identified and a gap analysis of what is available and what is missing (needed for the future) will be performed.

Prolearn roadmapping is not a linear process and more cycles of the SECI Spiral will follow. Figure 3 provides a more in depth view of the spiraling 'express future state" process which transcends individual views and experiences to form collective knowledge at a macro level (definition of desired future state – shared vision).

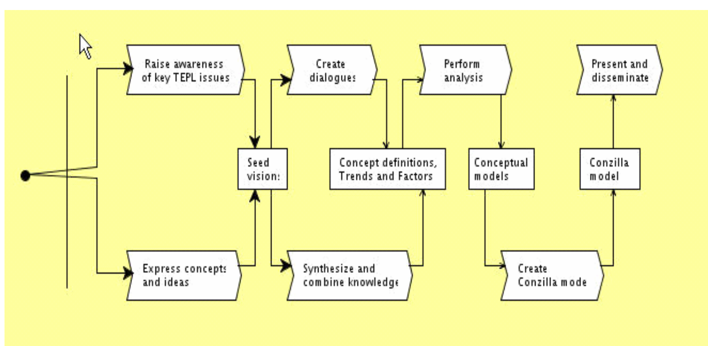

Figure 3. Express future state

Prolearn teams (Workpackages), play a central role in this knowledge creation process of building the roadmap because they provide the shared context where the team members can interact with each other and engage themselves in common projects and activities on which effective reflection depends. This provides a new individual understanding of the relevant concepts and their relationships. This new "know-how" is articulated via a constant dialogue where teams pool their information and examine it from different angles, thus integrating their diverse individual perspectives into a w collective perspective. The resulting "seed" knowledge is modeled and conceptualized and thus is easily communicated to external groups in order to synthesize information from many different sources and bring in different perspectives and contexts. In that way, an increased collective understanding is achieved where the actual concepts and their contexts are reinvented and extended by others. To this end, the micro and macro dimensions interact with each other, and changes occur at both the micro and the macro level. Thus the existing visions of the core partners of the Prolearn network (micro) influence and at the same time are influenced by the environment (macro) with which the network interacts.

Figure 4 is a quick summary of the roadmapping activities. We are working at both micro and macro levels: Micro level involves activities that are raising awareness in the relevant foresight issues in TEPL Macro level involves activities that are synthesizing and combining knowledge and expertise. In parallel we are analyzing and presenting the resulted knowledge using conceptual modeling tools and Conzilla browser.

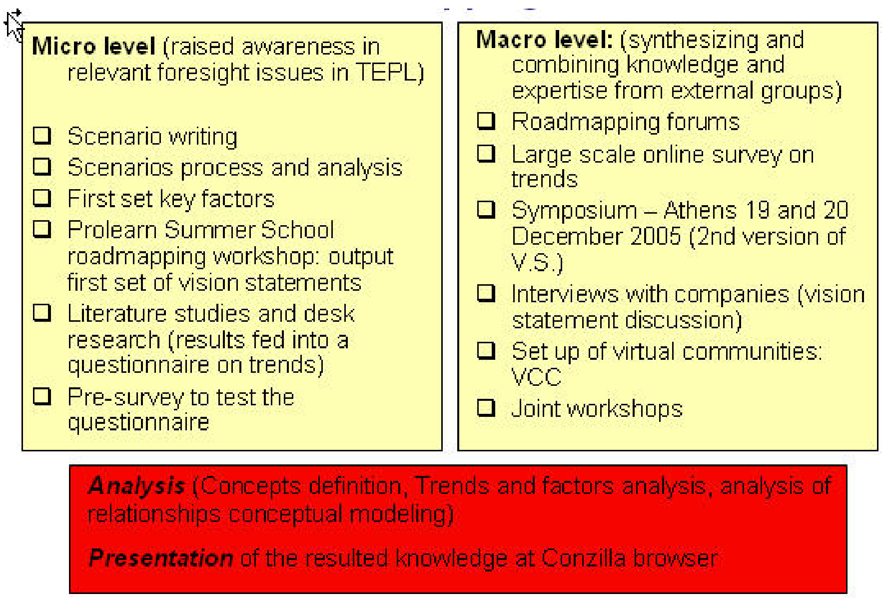

Figure 4. Prolearn roadmapping activities

Formulation of Visions

Initial findings included both the identification of major trends and the articulation of vision statements for the desired future state. A number of instruments have been employed to identify major trends and derive vision statements from stakeholders, including: Scenario analysis, brainstorming sessions, international Roadmapping forums; Interviews with companies (to generate discussion on the vision statements);

Virtual communities on the web and multi-target large scale online survey of current trends.

Scenario Analysis

In order to draw the roadmap between the current state (As-Is) and the desired future state (To-Be), detailed possible future scenarios were developed. The training solutions described in the scenarios represent realistic everyday training ten years from now in various professional situations.

Twenty five scenarios were processed and analyzed and the key drivers and factors per scenario were identified. During the scenario analysis process, we have described the primary focus of each scenario as the scenario training context, the business requirements as the driving forces behind the scenario, and the focus areas, where the focus should be if one wanted to realize the scenario. The sources for the 25 scenarios were the following: 11 scenarios have been independently developed by Prolearn core and associated partners, 7 scenarios were analyzed from the work of Norris et al. [18]; Time2Learn Thematic Network (EU) [31]: 1 scenario; ROCKET project (EU)[27]: 2 scenarios; Ariel Project (EU): 4 scenarios.

Analyzing the scenarios, we start from identifying the key business requirements which are considered to be the driving force behind the scenarios. The rationale behind these groups of drivers is primarily economic, centered on the use of TEPL in order to improve competitiveness in EU companies.

Four different sets of business requirements have been identified. Each set has a different focus. The first 3 sets are more focused on the intrinsic business requirements and are differentiated by the intended result of the training: a) TEPL supporting Continuous Improvement in Companies (micro level); b) TEPL supporting Business Process Re-engineering in Companies (medium level); c) TEPL supporting Goal Oriented Change in Companies (macro level). The 4th set is focused more on the market requirements and the emergence of knowledge exchanges and new ways of knowledge management.

TEPL Supporting Continuous Improvement in Companies (micro level)

- Competency development of the current workforce in a short period of time: (e.g. Training on demand, triggered by immediate project needs)
- Training built into the work itself (Workflow learning)
- Solve performance problems related to standard or specialized projects
- Introducing new employees to an organization/project/role
- Support collaborative work on new interdisciplinary topics

TEPL Supporting Business Process Re-engineering in Companies (medium level)

- Changes in management strategies
- Cost accounting for the cost and price of knowledge
- Value on investment drives ICT developments
- Linking training to business processes and re-conceptualize learning processes
- Internal communication problems among different company’s departments, branches or within project teams

- Managers and employees as knowledge and learning activists
- Role out of new or improve standard process and maintain it

TEPL Supporting Goal Oriented Change in Companies (macro level)

- Technology enhanced learning driven by changes in corporate strategy, goals, new products
- Introduction of new products/services to the market under stringent timelines (time-to-market)
- New forms of organization, new types of learners, such creating and leading teams across the new ecosystems of suppliers, partners and customers
- Need to align business goals and processes among newly acquired partner companies (fusion of KM, LMS and business processes)

Knowledge Exchanges

- E-Repositories and Knowledge Marker places
- Vertical silos of traditional content providers are broken up by the horizontal structures of marketplace exchanges
- Market places set relationships with aggregators of supply and aggregators of demand
- Many sources-publishers, universities, professional societies, and trade associations, and learning management system in companies - in different levels of granularity
- Marketplace pool explicit and tacit knowledge plus performances and experiences
- Added value services: content assessment and review, aggregations of knowledge recommended by experts, training assessment, use search engines, and other user support tools, personalization of learning curricular, consulting services, access to communities of practice and experts networks

The next step was to identify the main priority areas where most of the new challenges are found: the technology area and the socio-cultural area.

- **Technology Area:** Knowledge markets; Content Development, management and delivery (anytime, anywhere); Processes, models and infrastructures; "Ambient Intelligence".

- **Socio Cultural Area:** Collaboration & Communities of Practice; Informal learning, capture and exchange of tacit knowledge; New University structures (i.e. Corporate University); Universities as providers of learning services adapted to corporate needs; Associations (Professional, Trade Unions) offering access to experts and communities of practice.

Trends Affecting TEPL

From the outputs of the above mentioned instruments a raft of major trends, which are perceived to be highly influential for the future of TEPL, were identified and categorized as follows:

Market

The producers are becoming consumers and vice versa – there are indications that this distinction is now becoming irrelevant. This blending of producing and consuming, gives birth to a new type of consumers, called “prosumers” [32], who become directly involved in the creative process of products design and manufacture. “Prosumers” are part of a proactive market that develops individually tailored products (mass customization).

People

Career paths are changing - rather than being employees, more and more people are now self –employed. There is also a move from national/ethnic identities towards increasing impact of interests and motives. Also Europe faces an undeniable trend of an aging population and workforce.

Skills. In the skills base, there is a move from simpler to more complex skills and from slowly changing to faster changing.

Work patterns. There is a move towards the destandardisation of working hours and lifestyles, gradually shifting from serial (8 hours) to parallel (24/7/365) work patterns and the boundaries between living and working gradually blur.

Companies

The modern economy is becoming increasingly “digital”, as bytes replace bricks and enterprises witness a move from production of goods towards intangible assets, such as media, software, and the provision services.

Organisations become “smart” [1] and “agile”, i.e. are knowledge-driven, internetworked, dynamically adaptive to new organisational forms and practices.

Company structures move from vertical position-based hierarchies to horizontal project based interdisciplinary teams, stemming out of intra- and inter-organisational collaborations. This shift from rule directed to problem/project based work, results in flatter, leaner organizational structures with increased self regulation and less day to day direction from the top.

Business processes. There is a move from low capital costs to customer perceived values, as the customer becomes the reference point of all activities.

Employees. At the workplace there is a move from close supervision to more independence and responsibility. This implies leadership qualities. Employees are expected to form networks within and outside their organizations, master the skills of creative collaboration, respond to frequently changing priorities, and assume personal responsibility for setting their own direction. This increased autonomy is a new source of stress in the workplace.

Products and Services. There is a move from standardized forms of production and delivery to customized forms and from in-house operations to more flexible outsourced forms. Traditional companies are loosening up, moving from value chains to value nets.

Findings of the European Experts' Symposium on Future and Emerging Issues in TEPL

The objectives of this symposium [1] were to identify, record, discuss and analyze the emerging issues of technology enhanced professional learning and to pave the way for common future actions. The symposium had a unique focus on the future of technology enhanced professional learning and was a two-day-event involving 67 distinguished experts representing various sectors of the European Education and Training Community. The symposium participants were engaged in highly interactive, structured sessions that have been formed around six main themes.

The working method employed in the symposium is known as "learning discussion forum" or "Learning Café which involved expert's introductions and group discussions. The unique composition of the symposium together, with its pioneering methodology of synergy and interaction, provided and documented new ideas and concerns, which were crystallized in a series of observations, important for future planning in this field.

The dialogue resulted in the articulation of the following interesting points:

- The vision for the future Knowledge Workers focuses on three main axes: (i) promotion of innovation, creativity, proficiency and flexibility in learning and work, (ii) maximum employability of the European labor force, and (iii) equal opportunities in education and career.
- The management of human resources has to change and learning has to be integrated in the working and business processes.
- Time-to-proficiency becomes increasingly important in order for the European companies to stay competitive. Therefore, there is a need to improve the conditions for individual and organizational learning significantly and systematically in order to increase the learning speed and the ability of individual workers as well as companies to change rapidly.
- The training programmes have to be aligned with the strategic goals of the enterprise.

- A tendency of convergence between work and personal life is observed, where the lines between learning and work, work and leisure, and also formal, informal, non formal forms of learning, are becoming more and more blurred.
- The need of greater flexibility in professional development is a stress-inducing factor for the employees, as it creates intense feelings of insecurity towards work.
- Greater understanding is needed on what the knowledge worker needs are and what the skills and competencies in the new knowledge society and knowledge work should be. There is also a need to identify the underlying factors that have a major impact on knowledge worker productivity, some of them being very difficult to measure, such as values, self-image, traits and motives.
- An important change relating to the organization of jobs and company structures is emerging, which tends towards the demise of hierarchy as well as of specific titles and job descriptions, with a strong tendency towards flexible types of jobs defined by the particular "project" assignments.
- An increased imbalance of education was identified between higher ranked and lower ranked employees, as well as between small and large enterprises. In reality, "the future is already here but unequally distributed".
- The most-likely-to-succeed future type of training will be the "personalized learning", which offers to the specific person the right skills, at the right time within the specific context (work, social, technical, cognitive etc).
- There is also evidence of increasing convergence between official and unofficial training

The Athens High-Level Symposium with International Experts [2] refined the output and articulated an overarching, condensed statement of the Future Vision, emphasizing "the promotion of innovation, creativity, flexibility in learning and work, employability, and equal opportunities".

Core Vision for TEPL in 2015

The Prolearn Summer School Roadmapping Workshop [25] integrated the results from the various Prolearn foresight activities and came up with the following core vision for the future TEPL: "*To support knowledge workers with technology-enhanced learning by promoting motivation, performance, collaboration, innovation and commitment to lifelong learning."* In this context, a knowledge worker is defined as someone who doesn't just consume knowledge but who is able to create it and who reflects critically on every level of activity in the organization and contributes back.

The Six Vision Statements

The Core vision is broken into 6 individual vision statements that synthesize and explain the core vision. Each vision statement has its distinct overall perspectives and focus. They represent different and complementary views of the core vision i.e. IST view, industry views, learner view, market and societal dimensions.

- *Vision statement I:* "Everyone should be able to learn anything at anytime at anyplace." The main goal is to provide the right learning experiences at the right time for the right person. The statement is closely linked to the IST challenge. It embraces issues of digital convergence of communication networks, media, content and devices. The new capabilities offered by recent advances in mobile and internet communications can support and facilitate mobility towards a lifelong learning environment, enabling the creation, storage, management and access to knowledge everywhere and every time. The aim is to create and deliver a personalized learning experience to everyone.
- *Vision statement II (Industry Challenge):* "Learning as a means to support and enhance work performance." The main goals are to support human performance improvements and to provide links between business processes, competencies and learning processes; and use TEPL to design high quality work-based learning activities so that learning and working becomes interlocked. The statement is related to specific industry challenges, such as performance support and performance improvements at the work place.
- *Vision statement III (Industry Challenge):* "Promote innovation, creativity, and entrepreneurship at work." This vision encompasses a variety of goals such as: a) Learning supporting radical change in an organization and improving ability to change; and b) Competency development (including thinking out of the box, creativity, asking the right questions, leadership). The statement is related to industry challenges such as investment and development of the company's human capital and use of learning to support ability to change in organization
- *Vision statement IV:* "Learning as a means to increase employability." This statement focuses on the Learner's perspective, the employees' continuous professional development, and the need to increase employability. The goals in this vision include resilience, employability, getting skilled faster and personal growth. Enhanced mobility, employability and competency of the European workforce. Portability of learning achievements is one of the key-issues to be addressed.
- *Vision statement V: Market take-up.* "Professional e-learning will be a commodity market in 2015." This statement focuses on market take up of TEPL and the ability to purchase content and learning services regardless of type and country of the learner supplier in a unified transparent market. The main goals in this vision include market transparency, consumer driven market, one-stop-shopping, wider choice at all levels, and selection optimization. Development of both segments of the market: from the low end commodity market to the high end upscale, high value added segment. There are two alternative ways to achieving this vision. One is about the commodity market being based on the "canned courses" concept, while the other is based on communities of practice and collaborative creation and sharing of professional know-how.
- *Vision statement VI: Socially inclusion.* "High quality learning for all". This statement addresses social inclusion issues, such as digital divide, the gap between poor and rich etc. The goal will be to democratize knowledge provision and to support the so-called e-Inclusion and equal opportunities for all in the workplace.

As depicted in Figure 5, the PROLEARN vision statements provide a holistic picture of the desired future of TEPL in an outwards spiraling way that highlights the aspirations of all stakeholders : the individual (VS I & IV), the enterprise (VS II & III), the market (VS V) and the European society as a whole (VS VI).

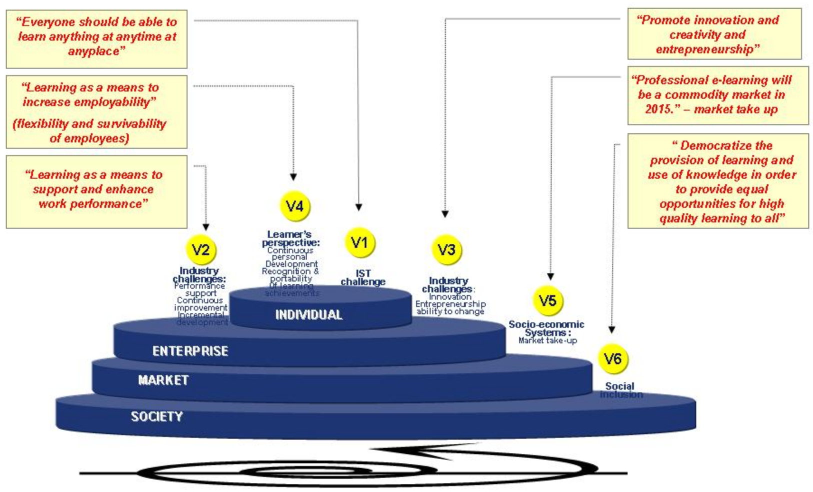

Figure 5. The six vision statements address a variety of challenges in professional learning embracing all levels of the socio-economic system.

Conclusion

Recent findings from a pan-European roadmapping exercise on the future of technology-enhanced professional training have been presented in terms of visions describing the desired future state. A new approach to roadmapping was employed, while the task of identifying the prevalent future visions involved a series of consensus building activities including scenario building and a number of community-based surveys and forums. The prevalent visions for the next 10 years seem to be centered on leveraging technology to promote (a) high performance for businesses through innovation, creativity, and flexibility, and (b) increased security for individuals in the form of employability and assuredness of equal opportunity.

References

1. Filos E., Banahan E., "Towards the Smart Organisation. An Emerging Organisa tional Paradigm and the Contribution of the European RTD Programmes", 2000

2. High-Level Symposium with International Experts on Technology Enhanced Professional Learning – Athens 19 and 20 December 2005. www.dat.demokritos.gr/pl
3. Kamtsiou, V., et. al. (2005) Roadmapping Methodology and Framework Analysis, version 2, Prolearn Deliverable 12.6, June 2005.
4. Kamtsiou, V., Stergioulas, L. K., Koskinen, T. (2005) A roadmapping framework for technology enhanced professional training, Proceedings of the 8th IFIP World Conference on Computers in Education (WCCE 2005), Cape Town, South Africa, 4-7 July 2005, pp. 157-166.
5. Kappel, Th. (2001) Perspectives on roadmaps: how organizations talk about the future. The Journal of Product Innovation Management, Vol. 18.
6. Lytras, M., Naeve, A., Pouloudi, A. (2005) A Knowledge Management Roadmap for E-Learning: The Way Ahead, International Journal of Distance Education Technologies, Vol. 3, No. 2, pp. 68-75, (Special Issue on Knowledge management Technologies for E-Learning), April-June 2005.
7. Naeve, A. (2001a) The Knowledge Manifold - an educational architecture that Supports Inquiry-Based Customizable Forms of E-learning, Proc. of the 2nd European Web-based Learning Environments Conference (WBLE 2001), pp. 200-212, Lund, Oct. 24-26, 2001 http://kmr.nada.kth.se/papers/KnowledgeManifolds/KnowledgeManifold.pdf.
8. Naeve, A. (2001b) The Concept Browser - a New Form of Knowledge Management Tool, Proc. of the 2nd European Web-Based Learning Environment conference, pp. 151-161, Lund, Sweden, October 24-26, 2001, http://kmr.nada.kth.se/papers/ConceptualBrowsing/ConceptBrowser.pdf.
9. Naeve, A., Yli-Luoma, P., Kravcik, M., Lytras, M., Simon, B., Lindegren, M., Nilsson, M., Palmér, M., Korfiatis, N., Wild, F., Wessblad, R., Kamtsiou, V., Pappa, D., Kieslinger, B. (2005). A Conceptual Modeling Approach to Studying the Learning Process - with a Special Focus on Knowledge Creation. Deliverable 5.3 of the Prolearn EU/FP6 Network of Excellence, IST 507310, June 2005
10. Naeve, A. (2005), The Human Semantic Web – Shifting from Knowledge Push to Knowledge Pull, International Journal of Semantic Web and Information Systems (IJSWIS), Vol. 1, No. 3, pp. 1-30, July- September 2005.
11. Naeve, A., Nilsson, M., Palmér, M. (2001) The Conceptual Web - our research vision, Proceedings of the first Semantic Web Working Symposium, Stanford, July 2001, www.semanticweb.org/SWWS/program/position/soi-nilsson.pdf
12. Naumanen, M. (2001) Roadmap – Kartta menestykseen. In MET-julkaisuja nro 23/2001, Finland.
13. Nonaka, I. (1994) A dynamic theory of organizational knowledge creation, Organization Science, Vol. 5, No. 1, pp. 14-37.
14. Nonaka, I., Takeuchi, H. (1995) The knowledge-creating company: How Japanese companies create the dynamics of innovation, New York: Oxford University Press.
15. Nonaka, I. and Toyama, R. (2003) The knowledge-creating theory revisited: knowledge creation as a synthesizing process, Knowledge Management Research & Practice, Vol. 1, No.1, pp. 2–10
16. Nonaka, I., Konno, N., The concept of "Ba": Building foundation for knowledge creation. California Management Review Vol 40, No.3, Spring 1998.
17. Nonaka, I., Toyama, R., Konno, N. (2000) SECI, Ba and Leadership: a Unified Model of Dynamic Knowledge Creation, Long Range Planning, Vol. 33 (2000), Elsevier Science Ltd.
18. Norris, D., Mason, J., Lefrère, P., (2003).Transforming e-knowledge, 2003.
19. Novak, J. D. (1990) Concept maps and Vee diagrams: Two metacognitive tools for science and mathematics education, Instructional Science, 19, pp. 29-52.
20. Novak, J. D. (1991) Clarity with concept maps, The science teacher 58(7), pp. 45-49.
21. Novak, J. D. The Theory Underlying Concept Maps and How to Construct them, http://cmap.coginst.uwf.edu/info/printer.html

22. Palmér, M., Naeve, A. (2005) Conzilla – a Conceptual Interface to the Semantic Web, Invited paper at the 13th International Conference on Conceptual Structures, Kassel, July 18-22, 2005. To be published in the series of Springer Lecture Notes on Computer Science.
23. Prolearn Network of Excellence, http://www.prolearn-project.org
24. Prolearn network (2004) Roadmap methodology and framework analysis, Deliverable D12.1.2, IST
25. Prolearn Summer School Roadmapping Workshop at the Prolearn Summer School, Istanbul, Turkey, 5-9 September 2005.
26. Probert, D., Radnor, M. (2003) Frontier Experiences from Industry-Academia Consortia, Research Technology Management, Vol. 46, No. 2.
27. ROCKET project (2002) The state -of-the-art of Roadmapping, Deliverable D2.2, IST-2001-38245 ROCKET project (Roadmap to communicating knowledge essential for the industrial environment).
28. Rumbaugh, J., Jacobson, I., Booch, G. (1999) The Unified Modeling Language Reference Manual, Addison Wesley Longman Inc.
29. Rehak, D. (2003), A SCORM Roadmap: SCORM's Technical Evolution, http://www.lsal.cmu.edu/lsal/expertise/papers/presentations/pf8roadmap2003/roadmap2003 1028.pdf
30. Takeuchi, H., Nonaka, I., (eds) (2004) Hitotsubashi on Knowledge Management, Wiley & Sons, 2004.
31. Time2Learn network (2004) Needs assessment for future professional training in Europe, Deliverable D2-2, IST Time2Learn Thematic Network, http://www.time2learn.org
32. Toffler A., "The third wave", New York: Bantam 1981

Exploring the Potentials of Networked-computing Support for Face-to-face Collaborative Learning

EC-TEL 2006

October 1, 2006

Crete, Greece

Organizing Committee

Wouter van Diggelen (Utrecht University, The Netherlands)
Vittorio Scarano (University of Salerno, Italy)

Program Committee

Shaaron Ainsworth (UK)
Jerry Andriessen (The Netherlands)
Michael Baker (France)
Annie Corbel (France)
Reuma de Groot (Israel)
Joerg Haake (Germany)
Beatrice Ligorio (Italy)
Paul P. Maglio (USA)
Jakita N. Owensby (USA)

Introduction: Exploring the Potentials of Networked-computing Support for Face-to-face Collaborative Learning

Wouter van Diggelen[1] and Vittorio Scarano[2]

[1]Utrecht University, Research Centre Learning in Interaction,
Heidelberglaan1, 3584 CS Utrecht, The Netherlands.
[2]ISISLab
Dipartimento di Informatica ed Applicazioni "R.M. Capocelli",
Universita` di Salerno, 84081 Baronissi (Salerno), Italy.
{w.vandiggelen@fss.uu.nl / vitsca@dia.unisa.it}

Much research into technology-enhanced learning reflects a future of online collaboration, distance learning and virtual teaching[1]. These visionary views consider networked-computing support primary as a means to bridge time and space. It is assumed that these collaborative technologies connect learners who couldn't collaborate otherwise. This partial orientation towards networked computing may limit our understanding of the potentials of such technologies for collaboration and learning. Collaborative technologies may also provide effective support for learners who meet face-to-face to collaborate, to discuss and to solve problems [2].

Scenarios studies indicate the school will remain the most important place for learning. Most learning in the nearby future still takes place on-campus, although 'blended mode learning' with a strong ICT component is widely used. ICT use has become commonplace, but it has not radically affected the nature of the teaching and learning. It gradually reshapes traditional on-campus practice [1].

1 Computer support for face-to-face learning situations

The starting-point of the workshop are the notions that *face-to-face learning situations* are an important setting for collaboration and learning *and* that collaborative technologies can support these processes effectively. We believe that one of the most important challenges for technology-enhanced learning is to provide learners who are in same room with the appropriate technologies that will facilitate their collaborative learning activities. The aim of the workshop is to set some directions of how this may be achieved.

We make a distinction between three situations of *technology-enhanced collaborative learning* (Fig. 1).

[1] For example, the fast majority of research on networked-learning environments presented on the international conference on Computer Supported Collaborative Learning (CSCL2003) focused on on-line, virtual meetings between learners [3].

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 55-58, 2006.

In the *first situation* (upper right corner of figure 1), learners interact with a standalone computer model that represents and simulates a certain problem situation. A computer model typically displays processes that change with respect to time. Learners can manipulate the model and get feedback about their intervention by running a simulation. This form of technology-enhanced learning – sometimes referred to as '*single-display groupware*' (SDG) – has received some investment in terms of research.

The *third situation* (lower right corner of figure 1) represents networked learning environments that aim to *connect learners who are dispersed in time and/or space*. The majority of research into technology-enhanced learning focuses on this type of collaboration. For many researchers, it represents the archetypal context for computer supported collaborative learning (CSCL).

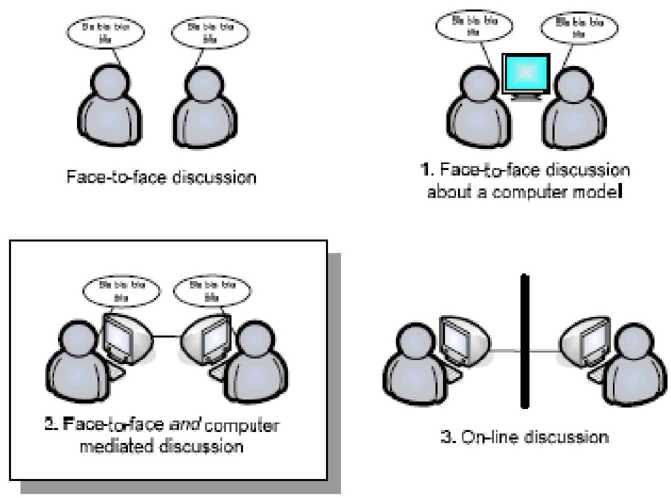

Fig. 1. Three technology-enhanced collaborative learning situations.

The participants of the workshop will focus on the second situation (lower left corner of figure 1): networked-computing support for face-to-face collaborative learning situations.

2 Workshop Theme

The theme of networked-computing support for face-to-face collaborative learning has received relatively little attention within the educational community. Still, it seems to be a promising direction for technology-enhanced learning. Collaborative technologies have the potential to create a sustainable effect on classroom practice. The main objective of the workshop is:

> to examine face-to-face collaborative learning situations and to discuss the potentials of networked-computing support for these situations.

The workshop theme will be approached from three perspectives: pedagogical, technical and the perspective of the researchers. These three perspectives are addressed in three different sections.

2.1 Pedagogical perspective

Section I focuses on the pedagogical aspects. Overdijk and van Diggelen focus on the way student groups interact with educational technology. They state that educational technology isn't a stable factor but gets its meaning in practice when students work with the technology. They refer to this process of adaptation as technology appropriation. Technology appropriation helps us to understand why and when new educational technologies work in practice.

Tateo et al. stresses the importance of Participatory Design (PD) to get a better fit between new educational technology and user's activities. PD could reveal issues that may hamper the introduction of educational by involving those who are most affected by the design, i.e. the teachers. Teteo et al. present an explorative study that they carried out among a group of Italian teachers. They conclude that pedagogical support is needed for successful implementation of educational technology in the classroom.

Lotan-Kochan et al. also focus on the teacher. They found that teachers identified several tasks that are crucial during computer supported collaborative learning. The challenge is to provide teachers with the appropriate support – technological as well as pedagogical – that enables them to carry out these tasks effectively.

2.2 Technical perspective

Section II focuses on technological aspects of computing support for face-to-face collaborative learning situations.

Malandrino and Manno present a computer-networking architecture that takes into account the specific requirements that arise from the on-campus technical situation. They present an architecture whose goal is to minimize impact on management and leverages on the LAN setting to ensure extendibility, easy deployment and a uniform work environment by hiding the client-server architecture with a dynamic discovery protocol for bootstrap.

De Chiara and Volpe discuss the development of FireFly, a modular system that allows extensibility and composability. FireFly is written using AJAX, a set of technologies for developing rich web-based application that follow the client-server paradigm. Authors' objective is to develop a client-server system that can be executed smoothly on usual desktop PC, requesting the lesser possible installation effort and achieving enough expandability to allow further extensions'.

2.3 Researchers perspective

From the articles that take a pedagogical perspective one can conclude that there is still a lot of research needed that will increase our understanding of when, how and why new educational technologies work in practice. Researchers could benefit from tools that automate the collection, transcription and analysis of face-to-face and computer-mediated actions and interactions. *Corbel, Girandot and Lund* addresses this topic in their article. They 'propose a model of designation and extraction of parts of human interaction corpora using the anchor and link concepts that allow for experimenting on the reuse of analyses of human interactions'.

References

1. Collis, B. and van der Wende, M. (2002). Models of technology and change in higher education: An international comparative survey on the current and future use of ICT in higher education. Center for Higher Education Policy Studies (CHEPS), Enschede, The Netherlands.
2. Tyran, C.K. and Shepherd, M. (2001). Collaborative technologies in the classroom: A review of the GSS research and a research framework. Information Technology and Management, 2, 395-418.
3. Wasson, B., Ludvigsen, S. and Hoppe, U. (2003), Designing for change in networked learning environments. Proceedings of the International conference on Computer Support for Collaborative Learning (CSCL 2003), Taipei, Taiwan.

*F*ire*F*ly: Lightweight AJAX System for F2F-CL

Rosario De Chiara, Marco Volpe

ISISLab - Dipartimento di Informatica ed Applicazioni
Università di Salerno,
84084, Fisciano (SA) – Italy
E-mail: dechiara@dia.unisa.it, volpemar@gmail.com

Abstract. In this paper is illustrated the development of *F*ire*F*ly, a system for the *Face to Face Collaborative Learning* (F2F-CL). *F*ire*F*ly is written using AJAX, a set of technologies that allows to create rich web-based application. The challenge is to develop a system able to be executed on usual desktop PC, requesting the lesser possible installation effort and achieving enough expandability to allow further extensions. The system is currently under development, but the prototypes and the early tests confirms that the use of AJAX technology for this kind of application is suitable and deserves further investigations.

1 Introduction

In this paper we report the results of our experiences in implementing a system for F2F-CL, *F*ire*F*ly, exploiting the set of technologies known under the name of AJAX. In our intentions the system must provide the following features:

- Easiness both in the installation and management: virtually *zero* installation effort. This is particularly critical considering that installations are usually made on tens of personal computers.
- Low-end hardware: this can be an issue in various scenarios, for instance schools.
- No Internet connection required: Internet connection is not available everywhere and even where it is available it can be subject to heavy controls and limitations.
- Need for a cross platform solution: platform independence is appreciated from the point of view of the developer, the same application for every machine, and from the point of view of the user that has not to face the problem of different *User Interfaces* (UIs).

The intersection of all these limitations excludes totally or partially some traditional solutions, for various reasons:

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 59-66, 2006.

- Java applet downloaded from a server located somewhere in the world: this solution would allow to avoid to face legacy hardware (at least for the server) allowing to provide high level services through traditional Java applet software. This kind of solution rely on a trustworthy Internet connection that is not always available. On the other hand Java applications are, of course, cross platform.
- Local Java applications: this solution is suitable for installations on machine not connected to the Internet, but can meet the limitations of computers on which the software cannot be installed. The "install nothing" policy is often enforced by system administrators as a radical solution to viruses and malware.
- Native language solution: a native language solution is not cross-platform by definition. As a pro it can deeply exploit the hardware.

Starting from all these considerations we have pondered about the use of AJAX technology would present some interesting points on its favor.

2 AJAX

The term AJAX is the contracted form for the expression *Asynchronous Javascript And XML* [13]. AJAX is a set of technologies at the hearth of which there is the capability of modern browsers (Mozilla Firefox, Microsoft Internet Explorer, Apple Safari, Opera) of managing an API (*Application Program Interface*) called `XMLHttpRequest`. This API, available within browser through Javascript, allows to transfer data to and from a web server using HTTP. This data transfer is carried out over an independent connection channel and the moved data are formatted in XML.

`XMLHttpRequest` is particularly important because it allows *asynchronous transfers* of data between the client and the server, and this permits to break the constrain of using the traditional form submission mechanism used in HTML [6]. Using `XMLHttpRequest` is just one of the elements that made up the AJAX technology, after the data are moved asynchronously between client and server the next step is to update the user interface in order to reflect the results of this data exchange. The user interface is managed through an HTML web page that is in charge for displaying data and gathering user inputs. Being the data updated asynchronously the user interface must be update in the same manner without a page reload. To obtain this, two well known ways of designing web pages are used: XHTML and CSS, in order to define the styles of the various components (text, labels, buttons etc...), and DOM(*Document Object Model*) to address the components of the page that are intended to be modified.

What is really new in AJAX is not the set of techniques but the way this techniques are used to meet a goal that is to use the browser and the network as *a platform for implementing interactive web applications*. The combined effort of `XMLHttpRequest` for exchanging data and the dynamic look and feel provided to the web pages by the use of XHTML and DOM enable the developer to create applications like GMail [5], Writely [10] and YouOS [12]: GMail is a web mail application, Writely is a cooperatively usable word processing and YouOS tries to mimic the basic behaviors of an operating system (actually a window manager).

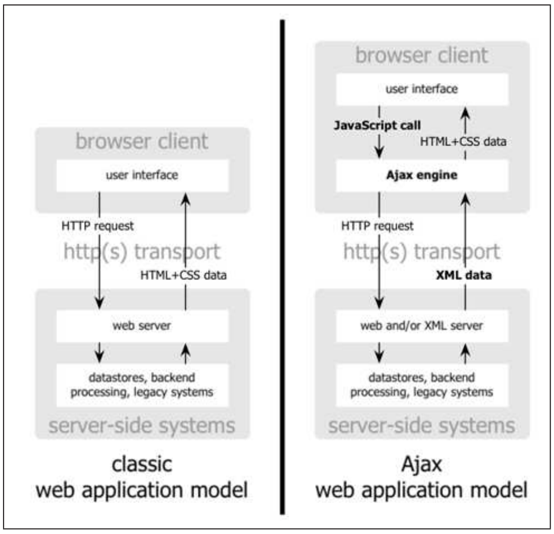

Fig. 1. Comparison between the classic web application and the AJAX web application model. (Image from [13])

In Figure 1 is compared the classic web application model and the AJAX model, on the left is shown the traditional form-driven application, while on the right there is the AJAX model in which the AJAX engine presence within the browser is emphasized. The data exchange between the client and the server is XML and this clearly request a server able to parse and create well-formed XML to send it back to the client.

3 System description

The system is implemented through a suitable configured web server that will provide the application to the clients through an HTML page. A client for *F*ire*F*ly is any modern web browser with not particular settings at all. To let an ordinary PC act as a server for some tens of clients we have focused our attention on finding a computational light web server that would not request too much computational effort.

3.1 Functionalities

The system architecture is quite simple, the software is installed together with the web server. The server part is written in PHP while the client part is Javascript, being it executed in a browser. To boot the system it is enough to execute the web server that simply will be waiting for connections. The participants can enter the system just pointing their browser to the server IP address. An authentication screen will be presented to log into the system.

The system currently provides two tools for the collaboration. One tool is a traditional unstructured chat in which contribution from users are just appended. The other tool is a threaded chat in which the contributions can be structured in a hierarchical manner.

Another task carried out by clients is the gathering of all input, this is performed by Javascript functions in execution within the browser.

Worth nothing is the fact that the system does not use any database engine, everything is stored in XML files and in order to avoid wasteful parsing of huge XML files containing more days of interactions, files are timestamped and rotated everyday in order to keep their size reasonable. These XML files could be used as input for trace analysis softwares a limitation of these traces is that they are coarse grained because of the architecture of *F*ire*F*ly.

3.2 Lightweight web servers

Clients interactions will be managed from the web server through CGI (*Common Gateway Interface*) scripts written in PHP. The ability of running CGI scripts is the sole feature a web server has to provide to host AJAX applications. We have compared three solutions, choosing among light web servers: Sambar Server [8], lighttpd [7] and ghttpd [4].

Sambar Server Sambar server is a framework that provides a wide range of different servers (DHCP, SMTP, FTP etc. . .). The purpose of Sambar is to allow with just one choice, to set up a complete set of services. Sambar is available for both Linux and Windows and is fully configurable through a web interface. A stripped down version of the server is provided for free and it is closed-source.

lighttpd lighttpd is small footprint web server. It is Open Source licensed under the revised BSD license. It is designed keeping in mind the memory and CPU occupation, no matter this it provides a complete set of feature that allows it to be compared with Apache [1]. lighttpd also support FastCGI [3] that is an extension to CGI designed to provide high performance without the limitations of server-dependent solutions. lighttpd is the server currently used for the development of Fire$F$ly.

ghttpd ghttpd is a small web server released under the GPL. It provides CGI but not FastCGI. It is available just for Linux and Unix.

Fire$F$ly is currently using lighttpd for various reasons: operating system independent solution, simple configuration, availability of FastCGI etc.... Being Fire$F$ly an AJAX application it is actually *web server independent*, because its logic is just a collection of standard HTML files and PHP sources that can be installed in whatever CGI-aware web server available.

3.3 User interface issues

The use of AJAX often raises critics about the usability level perceived by users, mainly because the UI has to be implemented using ad-hoc Javascript libraries (see [11], [9], [2]). The UIs rendered using these libraries can be non standard from a user point of view, so a particular attention must be paid in designing them. The current Fire$F$ly UI is implemented using YUI from Yahoo!, the idea is to simplify the UI and keep it as similar is possible to widespread operating systems: the users list and every tool in Fire$F$ly is rendered within a sort of windows exposing traditional controls like drag and drop on title bar and maximize/minimize icons, in the upper part there is a status bar that mimics the feature of the status bar available under most common operating systems (see Figure 2).

3.4 System life cycle

Using AJAX for implementing an highly interactive system like Fire$F$ly, means to carefully design the policy of distribution of the updates among the users. The typical user activity is to append sentences in a chat session; because of the architecture of the browser, when a user clicks the submission button for a new contribution, the text is immediately sent to the server that has to bounce it to every other client.

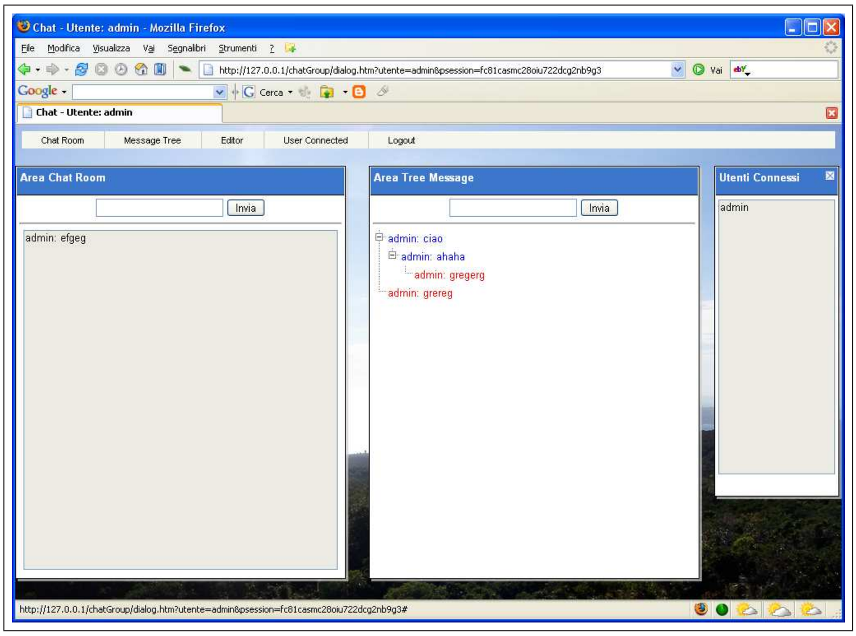

Fig. 2. A screenshot from the application.

Bouncing automatically newly available updates to the clients is not possible because the data exchange between the web server and the clients can happen just when the clients explicitly request for it. Using AJAX (and `XMLHttpRequest`) the client's browser is capable of *periodically request* updates and visualize them in the various tools. This is the key of the use of AJAX, these periodic updates cannot be avoided because of the HTTP protocol that is based on request/response mechanism [14], and the respond, that is the updates from other clients, can be sent just after a request generated by the browser. In figure 3 is shown the data exchange between the client and the server, continuous lines indicate the periodical updates, while dotted lines indicate the updates sent from client to server on every new contribution from user.

The frequency of such requests is a critical issue, too frequent requests create an heavy load on the server, while less frequent requests cause the slowdown of the interactions between users. In early testing we have used a 3 seconds interval, it is clear that this interval depends on various factors: the number of clients, the number, the size and the frequency of contributions from users. The server collects casual updates from clients

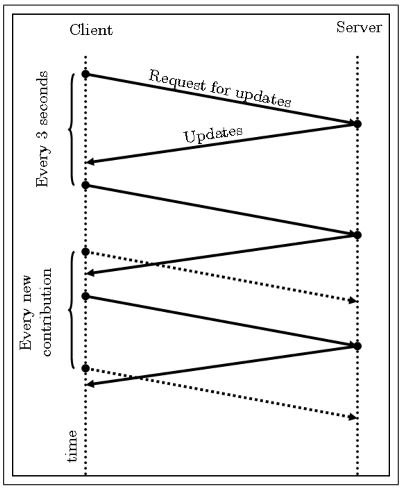

Fig. 3. Data exchange between client and server. lines between client and server indicate periodically updates, while dotted lines indicate casual updates. All the exchanged data are well-formed XML files.

and append them to the XML file that the periodical updates will request for.

4 Conclusion

The system we have designed is currently under development, our effort is in tidying up the code in order to make it modular. Our ambition is to design a modular system that would allow to developer to create tools on their own and just plug them into the system. One of the first step in this tidying up phase is to keep the XML exchange across the network the more efficient is possible, and this will request some ad-hoc measures of both generated traffic and parsing effort for both client and server.

Discussion As a summary we report here how we matched the prefixed goals reported in early sections:

- Easiness in the installation and management: *F*ire*F*ly needs just a one-step installation on the server. The installation of the web server is enough easy to be handled by common users and will not require complex settings.
- Low-end hardware: the system can be used exploiting pre-existent web server. In case no web server is available a small footprint solution can be employed.

- No Internet connection required: there is no-need for an internet connection. *F*ire*F*ly works on a LAN.
- Need for a cross platform solution: the capability of being cross-platform is achieved on both the sides, client and server, as a result of using AJAX technologies. Under various operating systems there exists plenty of web servers suitable to run *F*ire*F*ly. Whatever is the client operating system there will be a browser capable of executing the *F*ire*F*ly Javascript code.

Further undergoing developments are toward implementing new tools, like cooperative writing tool and graphical whiteboard.

References

1. Apache software fundation. http://www.apache.org/.
2. Dojo. http://dojotoolkit.org/.
3. Fastcgi. http://www.fastcgi.com/.
4. Gaztek ghttpd. http://gaztek.sourceforge.net/ghttpd/.
5. Gmail. http://www.gmail.com.
6. Html 4.01 specification: Forms. http://www.w3.org/TR/REC-html40/interact/forms.html.
7. lighttpd. http://www.lighttpd.net.
8. Sambar server. http://www.sambar.com.
9. script.aculo.us. http://script.aculo.us/.
10. Writely. http://www.writely.com.
11. Yahoo! user interface. http://developer.yahoo.com/yui/.
12. Youos. http://www.youos.com.
13. Jesse James Garrett. Ajax: A new approach to web applications. http://www.adaptivepath.com/publications/essays/archives/000385.php.
14. H. Frystyk T. Berners-Lee, R. Fielding. Hypertext transfer protocol – http/1.0. 1996. http://tools.ietf.org/html/rfc1945.

A method for capitalizing upon and synthesizing analyses of human interactions

Annie Corbel[1], Jean-Jacques Girardot[1], Kristine Lund[2]
[1]G2I / RIM, École Nationale Supérieure des Mines de St. Etienne, 42023 St. Etienne cedex 2
[2]I.C.A.R. (Interactions, Corpus, Apprentissages, Représentations), UMR 5191, CNRS, Université Lyon, École Normale Supérieure Lettres & Sciences Humaines, 15, parvis René Descartes, BP 7000 69342 Lyon Cedex, France
{Annie.Corbel, Jean-Jacques.Girardot}@emse.fr Kristine.Lund@univ-lyon2.fr

Abstract. It is often the case that analyses of human interactive activity are lost once an article is written about the results obtained. Although it is clear that corpora are gathered in order to answer particular research questions and that already collected corpora are often not adapted for answering new research questions, it is still interesting to reflect upon the capitalization and exploitation of analyses that have been carried out. For example, comparison of analyses, validation of analyses or alternatives modes of visualization could be possible. This article proposes a model of designation and extraction of parts of human interaction corpora using the *anchor* and *link* concepts that allow for experimenting on the reuse of analyses of human interactions.

Keywords: human interaction analysis, anchors, inter-coder reliability

1 Introduction

Many researchers are interested in the diverse forms of cognitive and social activities that take place when people interact together, for example, in teaching-learning situations or during cooperative problem-solving in the workplace. Computer Supported Collaborative Learning (CSCL) platforms, such as DREW[1] [1], [2] allow the researcher to collect and conserve computer-mediated interaction traces in the form of computer files. Researchers in the human sciences create other computer files when they transcribe (most often manually), the recordings of audio and video interactions. These two types of traces of human activity — issued from different sources — are the focus of analysis by researchers with particular objectives. Indeed a researcher will collect his or her data and thus define the type of trace, according to his or her research questions. As it stands today, these analyses, from which Ph.D. theses or articles are written, are not easily reusable and thus do not permit capitalizing upon analyses carried out for a given experiment or observed situation, or between different experiments or situations.

[1] Dialogical Reasoning Educational Website; see http://scale.emse.fr/

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing, EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 67-76, 2006.

In this article, we address the possibilities of exploiting the analyses of traces of human interaction, for a single situation or across situations. The hypotheses we make and constraints that we recognize are the following:

1. The traces are available in the XML format, the semantics of which is known, at least informally. This is not a strong hypothesis: many CSCL tools directly produce such formats. In other cases, if the representation and the semantics of the traces are known, it is possible to convert them to XML format without loss of information.
2. The proposed approach does not prejudge the use of a specific tool or a prescribed format; it applies to the conjoint usage of different tools and methods of gathering traces, for example through one or more CSCL tools on the one hand, and by the manual transcription of audio or video, possibly with the help of an appropriate tool like [3] or [4], on the other.

One of the needs of the researcher in human and social sciences is to explore collected interaction traces in a pertinent and efficient manner, to annotate interesting phenomena and to obtain new documents that reflect the result of his or her activity. These new documents, represented in XML, will allow the comparison of these results within and across situations. Conversion into formats more appropriate for visualizing and disseminating results should also be made possible.

2 The form of human activity traces

In the context of previous projects (CESIFS[2], SCALE[3], COSMOCE[4]), the authors carried out different experiments using the DREW platform [2]. DREW proposes different types of interaction (chat, whiteboard, argumentation grapher, text editor) and manages the creation of a trace (in XML) of the computer-mediated human activity that DREW makes possible. This trace is collected in the form of a sequence of events, each event corresponding to a single participant's intervention: a message sent in the chat, an element created in the whiteboard, an argument for or against a thesis put into the argumentation grapher, etc. In the document generated, these events are conserved in the order of their appearance, the DREW server arbitrating between events that are quasi-simultaneous.

In the context of the European project SCALE, a larger platform was developed called the Pedagogical Web Site (PWS [5] [6]). The PWS can replay in real-time a DREW session, carried out, for example, by two learners in a cooperative problem-

---

[2]The 'CESIFS' project (Conception et Etude de Sites Internet pour la Formation Scientifique) or Conception and Study of Internet Sites for Scientific Training), was supported by the French region Rhône-Alpes 1997-2000.

[3]The "SCALE" project (Internet-based intelligent tool to Support Collaborative Argumentation-based LEarning in secondary schools) was financed by the European Union "Information Societies' Technologies (IST) programme (IST-1999-10664) of the 5th framework between 2001 and 2004; http://www.euroscale.net, http://drew.emse.fr.

[4]The 'COSMOCE' project (Conception, Outils, Supports, Médias, Organisation pour la Collaboration des Entreprises) or Conception, Tools, Support, Media, Organization for the Collaboration of Companies, was supported by the French region Rhône-Alpes 2003-2006.

solving situation. It is possible to visualize the trace of their activity in html format and to perform analyses on the nature of their activity (cf. for example the Rainbow framework: [7]). Some of these experiments have also been the object of audio and video recordings, these recordings having been manually transcribed by researchers, in order to obtain documents that can be manipulated on a computer.

The traces that were gathered in the context of these projects were for the most part in XML format. However, if one takes into account the wide variety of CSCL tools and transcription conventions followed by researchers, it seems illusionary to attempt to propose a common transcription/trace format or even hope to define a kind of "pivot format" that can represent human activity, whether it is through an exceedingly complex format that expresses all the nuances and variations possible or whether it is through a simplified format that expresses a lowest common denominator. It is simpler and more reasonable to imagine that the XML trace documents are conserved, unchanged, in their original form, as the researcher chose to record them. Consequently, it becomes necessary to furnish the researcher with a tool that permits him or her to explore the collected corpus through a friendly interface. The minimal functionalities that should be supplied are:

- The visualization of corpus extracts;
- The possibility to annotate elements of the corpus;
- A search mechanism for the corpus.

Some of these functions can be provided with simple programming. Others necessitate the definition of a model of designation and extraction of parts of interaction corpora. It is this last point that we address in the method described in the following sections.

2.1 Analysis of computer-mediated human activity traces

Many researchers are interested in the *processes* that make up social and cognitive human activity in teaching-learning situations or during cooperative problem-solving in the workplace as opposed to being interested solely in a final common product that may be the goal of such situations. Thanks to the automatic chronological recording of human activity mediated by computer, researchers have the technological means since the 1990s [8] to respond to a variety of questions centered on *process*. For example:

- How do learners use the tools put at their disposal in relation to the activities they carry out? [9];

- What is the role of argumentation in the co-construction of knowledge? [10];

- How does structuring computer-mediated communication interfaces change the nature of interaction? [11];

- How do the internal factors of interaction (e.g. social talk) correlate with cooperative profiles (e.g. symmetry of roles) [12].

It is clear that each research question requires obtaining carefully chosen data that through specific analyses allow a response to be formulated. It follows that certain collected traces will not be adapted to addressing research questions for which the traces were not designed. For example, if a researcher is interested in how social talk relates to role symmetry, he or she would need to observe a task where roles can be either symmetrical or asymmetrical. On the other hand, the gathering of this same data would not help him or her in answering a question pertaining to structuring communication, if in fact learners were given the same communicative interface or indeed if they were speaking unhindered, face to face. However, if the task generated argumentation and involved complex concepts, perhaps the trace would be interesting for studying the co-construction of knowledge, even though it was not originally designed for that purpose.

Despite the constraint of research questions guiding data gathering, and that as a consequence, already gathered data is not systematically adapted to new research questions, it is nevertheless interesting to stock analyses of corpora in a database in order to further exploit and capitalize upon them.

So, what then do we mean by exploiting and capitalizing upon analyses of interaction? Firstly, researchers from different disciplines or researchers using different methodologies have been known to work on the same corpus, see for example [13]. It is interesting to reflect on how one could facilitate the comparison of these different analyses, thus confirming comparable results obtained from different methodologies [14] or generating new research questions. Secondly, when the same analysis method is performed on many interactions by different coders, inter-coder reliability should be performed [15] in order to ensure that the coders agree on how to apply the coding scheme in question and thus guarantee the results and ultimately the coding scheme's replicability. Thirdly, it should be possible to automatically generate visualizations of specific analysis results by translating the corresponding XML documents into formats readable by other software applications.

In order to understand how such issues may be treated by the method proposed in this article, we illustrate an example analysis below, beginning with the Rainbow framework, used for analyzing computer-mediated pedagogical debates [7].

2.2. Taking the Rainbow framework further

The Rainbow framework was developed as part of the European SCALE project (see above) in order to analyze the restructuring of argumentative knowledge during computer-mediated debate [7]. In the context of the method proposed for this workshop, we illustrate how analysis of interaction corpora using Rainbow can be supported and how the analysis of argumentative interactions can be taken further.

There are seven categories within the Rainbow framework (hence the name): 1) outside activity not having to do with the task at hand, 2) social relation, 3) interaction management, 4) task management, 5) opinions, 6) argumentation and 7) explore and deepen arguments. We do not have the space here to further define these categories (but see [7] for a full description); rather we use Rainbow as an example of a coding scheme that can be applied to traces of computer-mediated human activity (cf. Fig. 1) and on which our proposed method of exploitation and capitalization can be applied.

46	10:26:47	Mark	ok let's argue	4. Task management
47	10:26:48	Mike	go ahead	4. Task management
48	10:26:49	Mark	ok	3. Interaction management
49	10:26:53	Nigel	i don't like solution C	5. Attitudes, opinions, agreement
50	10:27:16	Nigel	because we won't have a good driving force	6. Provide (counter-) arguments
51	10:27:22	Mark	ah really I like it	5. Attitudes, opinions, agreement

Fig. 1 An example of the Rainbow framework applied to an extract of computer-mediated human activity translated from data from the COSMOCE project.

Fig. 1 shows how each chat intervention may be categorized according to the Rainbow framework. It becomes clear that once different researchers have coded a number of different interactions making up a single corpus, it would be interesting to automate comparison of analyses in order to perform inter-coder reliability and obtain percentage of agreement on the whole corpus. In addition, other analysis methods can be applied to the same corpus. For example, in the COSMOCE project [16], after performing analysis with Rainbow, we further analyzed Rainbow categories 6 and 7 in order to ascertain the finer relations between arguing and how arguments are discussed within collaborative conception, precisely because Rainbow was not elaborated to analyze situations where design is the task (Fig. 2 illustrates the concept with a short extract).

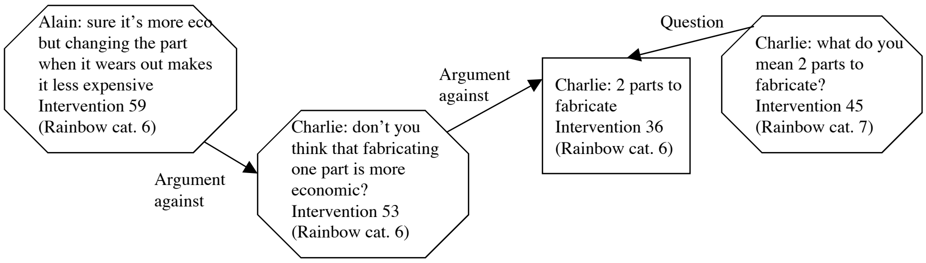

Fig. 2 illustrates a relational graph we produced that shows an example of the proposed relations between Rainbow categories 6 and 7.

In order to carry out this work, we needed to locate the chat interventions analyzed as Rainbow categories 6 and 7 in the original interaction and then propose semantic relations that existed between these interventions as a function of how we understood the designers to interpret their own discussion. We are currently developing a model of reasoning that describes argumentative activities of collaborating designers (cf. for example, [17] for a model of this type) for the situation we studied. We would like to perform these analyses on other interactions that have been analyzed by Rainbow in order to validate our model of reasoning.

The method we propose here (see the section below) is designed to support researchers in these kinds of undertakings: analysis according to a given coding schema, selection of analyses already done in order to perform further analyses, and finally comparison of analyses done by different coders or with different methodologies.

2.3 The proposed method

We begin by defining the term “primary corpus” (cf. [18] for an alternative definition) as the collection of all the documents gathered during the course of an experiment or observation. These typically consist of:

- Auditory or video documents that have been recorded during the experiment or during observation of the situation;
- Transcriptions of these recordings carried out by the researcher;
- Traces of computer-mediated interactions;
- Documents distributed to participants in the experiment/situation;
- Notes taken before, during and after the experiment/situation;
- All other documents judged to be pertinent by the researcher.

These documents are finite in number and will not evolve a posteriori, as they represent all the data gathered during and on the experiment/situation. In practice, we are interested in the documents that exist in computer format (having been originally generated in or translated into XML) for which an informal semantics can be defined.

We make the hypothesis that this primary corpus will be considered as fixed and unchangeable. All other documents created at a later date from this primary corpus will be an extract, a comment or an interpretation of the primary. Any annotations to the documents in this base will be expressed through an intermediary document (the “anchors document”) that will create references to the primary corpus. It could be the case that a study is performed on different primary corpora, these will be globally called an “observation base”.

The methodology described above allows us to constitute a corpus that contains all of the available data, without any information loss as no data is translated from one format to another. As mentioned previously, this corpus should be visualized and explored by the researcher. He or she should also be able to designate particular elements, annotate them and extract these elements or parts of them.

However, we cannot expect the human and social sciences researcher to master the different representations linked to specific software, even through the most friendly of XML editors available. We must therefore provide him or her with a tool that allows a visualization of the corpus he or she wishes to analyze.

Following an initial analysis of research practices, needs and existing tools, we propose the following tentative solution:

- The development of a generic browser, allowing for the visualization and the mark-up of the different documents that are part of the primary corpus.
- The development of an annotation tool, allowing for the linking of annotations to elements of the primary corpus.
- The development of an analysis tool allowing for the creation of links between elements of the corpus (a given chat intervention for example) and elements of the analysis method (for example, the task management category in the Rainbow method).

Documents pertinent to the analysis method (such as the enumeration of categories in Rainbow) constitute the *Analysis Base*.

Technological aspects

The use of XML [19] and the existence of related technologies allow us to list the specifications of these different tools.

Generic Browser

The use of formatting procedures for representing data contained in XML documents forms the basis of the Generic Browser. In our prototype, these procedures are written in Xquery [20], a language of interrogation and conversion, adapted to XML documents. Each particular type of XML document (for example a DREW activity trace) has an external file associated with it that describes which kinds of elements (in an XML sense) are considered as interesting by the researcher. A procedure for showing information (as defined by the researcher) is associated with such elements. It is the result of this procedure that is shown in the Generic Browser.

Mark-up Tool

The researcher in human and social sciences may at any time decide to mark up a specific element of the corpus. This mark-up process results in the creation of an *anchor*: a spatio-temporal designation of a corpus element. The anchor is an XML element that gathers diverse resources such as its type, a reference to a specific document in a primary corpus in the observation base, a geographical and/or temporal point in that document and complementary information (hour, date, author of anchor).

Each anchor is of a specific type, which describes how to interact with this anchor; this behavior is defined in in `anchor-type` XML elements, where, for example, an XQuery expression describes how to display the anchor in the Generic Browser.

The collection of anchors is conserved in an independent document. This document can also be explored with the Generic Brower, thus allowing the researcher to immediately bring up the *anchored* elements.

Link Creation

A link is a simple XML structure, made up of a group of labeled anchors. Each anchor designates an element of the observation base or an element of a primary document. The label of an anchor is an identifier that indicates the role of the anchor within the link. Each type of link is described by a `link-type` XML element that indicates the set of anchors that can be put in the link and how these anchors can be validated, and describes how the link should be displayed in the Generic Browser. Here again, XQuery is used for validating and displaying information.

Annotation Tool

The annotation tool is a simple structured text editor that allows the researcher to create an annotation document in XML. Each annotation is represented by an XML element and is designated by an anchor. Annotating a corpus consists in to creating the desired textual information and building a link between this information and the part of the corpus that is annotated

In this way, an annotation can be represented by a link that contains:

- An anchor on the comment created by the researcher
- An anchor (or more) on elements of the corpus
- An anchor on the document describing the researcher him or herself and the general objective of his or her work

(cf. Fig. 3 for an illustration of the relations between all the technological aspects described in this section).

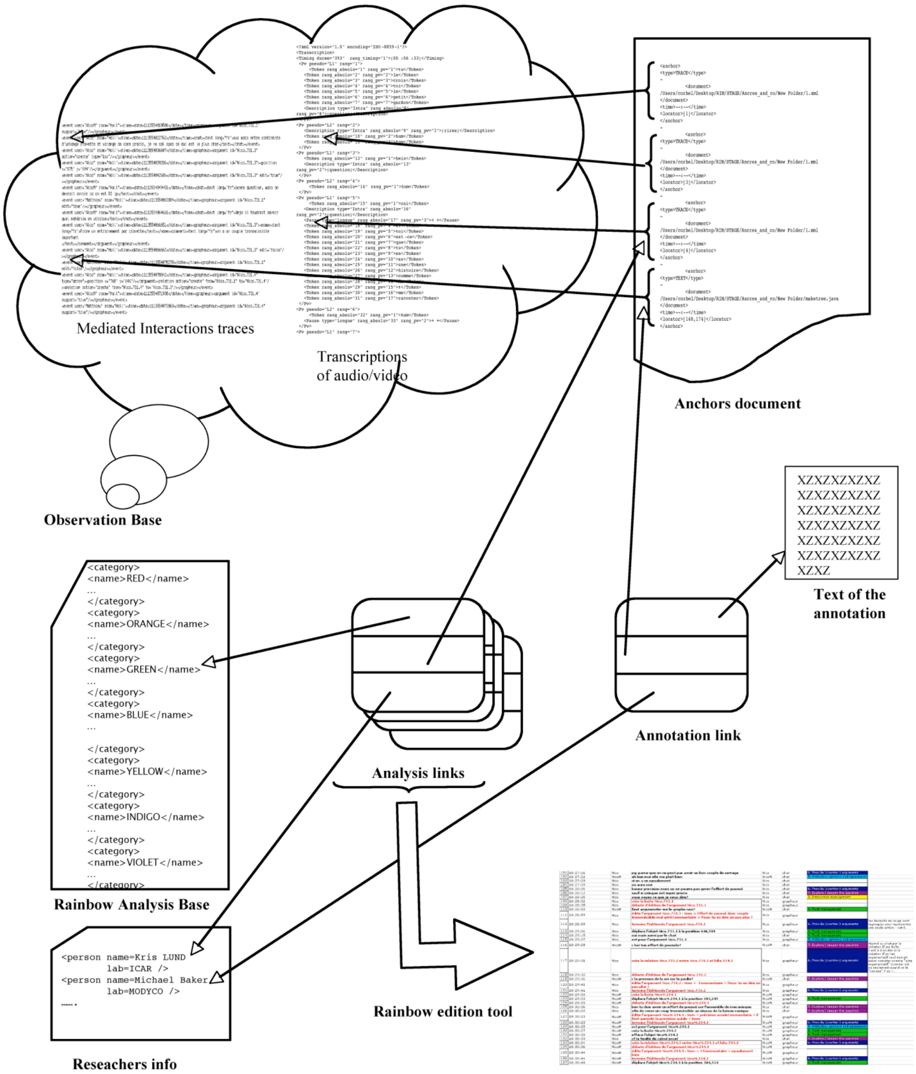

Fig. 3 illustrates the different components of the proposed method.

Analysis Tool

An analysis such as Rainbow (see the section *Analysis of computer-mediated human activity traces*) can thus be carried out with the help of the tools described above:

- The researcher can analyze the primary corpus by using the Generic Brower; he or she can create anchors on the elements deemed interesting;
- The researcher can also access an analysis base, a document in which the seven Rainbow categories are represented by anchors;
- It therefore becomes possible to place links between corpus elements and analysis categories.

The group of links thus created is in fact the analysis carried out by the researcher on the corpus. Once the analysis has been done, performing inter-coder reliability becomes straightforward. Analyses by different researchers on the same corpus can be compared and percentages of agreement calculated.

Since numerous kinds of computations and transformations can be performed on XML documents, the links resulting from an analysis can be used to provide usefull representations of this analysis; XQuery procedures can be designed to generate a representation of the result of an analysis in Word or Excel format, or create inputs for a graph drawing software such as Graphviz [21] (used in fig 2).

Computations can also be performed to provide global perspectives, like the summary of activities of individual participants, time spent in specific tasks, etc.

3. Conclusions and perspectives

A model of designation and extraction of parts of human interaction corpora was proposed. An initial prototype has been built according to the proposed model and will firstly be tested on a selection of computer-mediated human interaction traces by researchers using the Rainbow framework. Next, we will develop a second analysis base, based on a different analysis method and test its use by researchers. Our ultimate goal is to provide an observation base of primary corpora that through the definition of anchors, allows researchers to annotate, analyze, validate analyses and visualize data using a single adaptive tool with provision for future reuse of the work done.

Acknowledgments. The authors would like to thank their colleagues from the COSMOCE project, the EAIH project and the European project LEAD for the inspiration for this work.

References

1. Quignard, M. (2000). Modélisation cognitive de l'argumentation dialoguée. Etudes de dialogues d'eleves en resolution de probleme de sciences physiques. Thèse de doctorat de sciences cognitives. Grenoble : Université Joseph Fourier. [Cognitive modelling of argumentation dialogue. Studies of students in physics problem-solving].

2. A.Corbel, JJ.Girardot, P.Jaillon : DREW: "A Dialogical Reasoning Web Tool", ICTE2002, Int. Conf. on ICT's in Education. Badajoz, Espagne, 13-16 Novembre 2002.
3. CLAN: http://childes.psy.cmu.edu/clan/
4. TRANSANA: http://www.transana.org/
5. A. Corbel, P. Jaillon, H. Proton, X. Serpaggi : "A Guide for the PWS User, Scale Project". Research Report G2I-EMSE 2004-400-009, December 2004, Ecole des Mines de Saint-Etienne, 18 pages. http://www.emse.fr/g2i/publications/rapports/RR_2004-400-007.pdf
6. A.Corbel, P. Jaillon, X. Serpaggi : "PWS : An open tool to construct, use and study pedagogical sequences in collaborative argumentation training" CSCL Conference and Workshop, Budapest - Számalk 20-21 February 2004.
7. Baker, M. J., Andriessen, J., Quignard, M., Amelsvoort, M., Lund, K., Salminen, T., Litosseliti, L., Munneke, L. A framework for analyzing pedagogically oriented computer-mediated debates: Rainbow. Research Report IC-3. ICAR Laboratory, Lyon, France.
8. Jordan, B.,& Henderson, A.(1995).Interaction analysis: Foundations and practice . The Journal of the Learning Sciences, 4, 39–103.
9. Bouvery, J. (2006). Activite et Usage Synchrones en Situation de Conception Collaborative à Distance d'un Texte Procedural [Activity and Synchronous Use in the Collaborative Design of a Procedural Text at a Distance]. Master's Thesis in Cogntiive Science. University of Lyon, Lyon, France.
10. De Vries, E., Lund, K. & Baker, M.J. (2002). Computer-mediated epistemic dialogue: Explanation and argumentation as vehicles for understanding scientific notions. The Journal of the Learning Sciences, 11(1), 63—103.
11. Baker, M.J. & Lund, K. (1997). Promoting reflective interactions in a computer-supported collaborative learning environment. Journal of Computer Assisted Learning. 13, 175-193.
12. Lund, K., Rossetti, C., & Metz, Stéphanie (2006). Les facteurs internes à la coopération, influencent-ils l'activité médiatisée à distance? [Do internal factors of cooperation influence computer-mediated activity at a distance?] , M. Sidr, E. Bruillard & G.-L. Baron (Eds.) Actes des Premières Journées Communication et Apprentissage Instrumentés en Réseau JOCAIR '06, 6-7 Juillet, 2006, Université de Picardie Jules Vernes : Amiens, pp. 310-329.
13. Traverso V., Détienne, F. (forthcoming), Méthodologies d'analyse de situations coopératives de conception, Nancy : PUN.
14. Salomon, G. (1991). Transcending the Qualitative-Quantitative Debate: The Analytic and Systemic Approaches to Educational Research. *Educational Researcher*, Vol. 20, No. 6 (Aug.-Sept., 1991), 10-18.
15. B. De Wever, T. Schellens, M. Valcke, H. Van Keer, (2005) Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review. *Computers & Education* 46(1), 6–28.
16. Cassier, J. L., Lund, K., Prudhomme, G., & Pourroy, F. (2006, 28-30 juin). L'argumentation comme support à l'analyse de la dynamique des connaissances dans une situation de co-conception synchrone à distance [Argumentation as support for the analysis of knowledge dynamics in a synchronous distant design]. Poster presented at the 17e journées francophones d'Ingénierie des connaissances, Nantes, France.
17. Conklin, J., & Begeman, M.L. (1989). Gibis: A tool for all reasons. *Journal of the American Society for Information Science*, 200-213.
18. Balthasar, L. Bert, M. (2005). La Plateforme "Corpus de Languages Parlée en Interaction" CLAPI, historique, état des lieux, perspectives [The Platform "Corpus of Spoken Language in Interaction", history, state of the art and perspectives]. *Lidil : Corpus oraux et Diversité des Approches*, 31, pp. 13-33.
19. Extensible Markup Language (**XML**) : http:// www.w3.org/XML/
20. XQuery 1.0: An XML Query Language: http://www.w3.org/TR/xquery/ and http://www.w3.org/XML/Query/
21. Graphviz - Graph Visualization Software, http://www.graphviz.org/

Moderation of students’ activities in co-located computer-supported collaborative learning using *Digalo*.

Einat Lotan-Kochan[1], Raul Drachman[1], Baruch Schwarz[1] & Amnon Glassner[2]

[1] School of Education, Hebrew University of Jerusalem, Israel
[2] School of Education, Ben Gurion University, Israel

Introduction

Digalo is a graphic-based software tool for supporting collaborative argumentation and structured discussion. It has been developed in the framework of the DUNES project (IST-2001-34153, http://www.dunes.gr). Using *Digalo* consists of synchronously co-creating maps built of written notes inside different cards (represented by diverse geometrical shapes), as well as using different arrows to represent various types of connections between the cards or contributions. These ‘cards’ and ‘arrows’ represent the ontology or the ”grammar” of the discussion, which constrains but also facilitates and promotes the discourse [1,2] by guiding the learners to use specific speech acts and raising their awareness to their discursive roles, thus encouraging a certain type of discussion, such as critical dialogue.

Digalo in face-to-face settings

Although *Digalo* was designed to be integrated both in distance-learning settings and face-to-face settings, our experience in schools revealed that teachers and instructors prefer using it in face-to-face collaborative learning settings. We found that teachers use *Digalo* in three main ways:

1. for running an “opening discussion” as a first step of an inquiry process (e.g., brain storming, formulating and communicating opinions);
2. Co-constructing argumentative maps (in any stage of the learning process); and
3. for summarizing discussions (e.g. making group decisions, graphically presenting the structure of a problem/solution).

In other words, *Digalo* supports various types of face-to-face collaborative learning activities during the learning process. We also learned that it is of great importance to integrate *Digalo* activities in face-to-face collaborative learning settings, where the lesson design is as follows:
(A) face-to-face preparation activity (either teacher-led or small groups work);

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 77-79, 2006.

(B) *Digalo* activity;
(C) face-to-face summarizing activity (teacher led and/or small groups work).

This design has proved to be most effective in terms of students' learning and structuring a whole inquiry process into one lesson unit. The oral face-to-face activities in A and C were found to contribute significantly to this learning.

During the last few years our research efforts focused mainly on students' learning and use of *Digalo*[1]. However, we became more and more aware of the central role of the teacher or moderator in the implementation of the tool and its accompanying pedagogical method (argumentative-dialogue) on the one hand, and to the difficulties in facilitating students' group work in synchronous co-located *Digalo*-based discussions, on the other hand. These understandings led to a new research endeavor towards a better understanding of the teacher's role, in order to design a computational support for the moderation of *Digalo* activities. This is the focus of ARGUNAUT (IST-027728, http://argunaut.org/), a new R&D EU-funded project.

In this workshop we would like to reflect on the difficulties encountered by teachers in moderating *Digalo* activities, focusing on those related to it being a "networked-computing support for face to face [or co-located] collaborative learning situations". It is important to point out, again, that we see such difficulties as essential sources for further development and improvement of both the technological and the pedagogical aspects of *Digalo*'s implementation.

In a recent experiment, we found that teachers consider the following as key tasks (or roles) of the moderator of a *Digalo* activity:
1. Discipline and management of the activity,
2. Planning and organizing the lesson in which the *Digalo* activity is incorporated,
3. Encouraging participation,
4. Encouraging interaction and collaboration,
5. Presenting questions, asking for clarifications and explanations or playing the "Devil's Advocate" (in order to promote a dialectic argumentative dialogue),
6. Keeping the students focused on-task,
7. Emphasizing important contributions, aspects and ideas,
8. Making sure students use the ontology properly (i.e. encouraging an argumentative dialogue),
9. Providing technical support and making sure the application can be used easily in the classroom (steady infrastructure), and
10. Providing affective support and promoting students' motivation.

Obviously, these roles could refer to many face-to-face educational situations, and are not particularly unique to *Digalo*-based activities. What makes the difficulties encountered by these teachers in using *Digalo* in their instruction unique, then? We believe that the answer is in the integration of *Digalo* as a networked-computerized

[1] The results are reported in various publications of the DUNES project members (e.g. Johnson, Morgan & Simon [3]; van Diggelen, Overdijk & De Groot [1]; Glassner & Schwarz [2].

tool for learning in a co-located environment. Such a setting means running a “double-mode” activity, where written-electronic interaction and spoken-oral interaction, take place at the same time. This means a heavier cognitive-load for the teacher or moderator of the activity – who has to follow both modes of interaction between students and within groups. Apparently, it is impossible to moderate students’ activity while monitoring both modes of interaction, and at the same time trying to fulfill any of the above mentioned roles.

Our group is currently handling this challenge on two planes: on the pedagogical plane, teachers developed two partial solutions:

1. Assigning a student the role of “head of the group”. These students received instructions as to how to handle their group’s work, but mainly – how to manage the group discussion using *Digalo* (roles #3 through #8, above). In some of the activities the group leader had to lead the group to make a final shared decision or reach agreement. The group leader was also responsible of presenting his/her group work to the whole class, in the summarizing activity.
2. Another partial solution can be found in the lesson design described earlier. Using this design the teacher can both guide the students (during the preparation activity) and get a limited picture of the groups work (in the summarizing activity).

On the technological plane, we are currently co-developing two possible solutions:

1. A moderator-assisting tool (ARGUNAUT) that will collect and process the data in real time and present them to the teacher in a way that decreases the cognitive load associated with the “double mode” interaction, by facilitating the monitoring of the written-electronic channel.
2. Another discussion-support tool – "Mapit" - is currently being developed within the KP-Lab project (IST-27490 (IP), http://kp-lab.org). This will enable both channels (written and spoken) to take place simultaneously through the “electronic mode”, hence reducing the need to split attention and other cognitive resources in monitoring the group work and interaction.

We expect this workshop will contribute further to these endeavors.

References

1. Diggelen, van, W., Overdijk, M., & De Groot, R. (2005). ‘Say it Out Loud in Writing’: A Dialectical Inquiry into the Potentials and Pitfalls of Computer Supported Argumentative Discussion, paper presented at CSCL2005, May 30 - June 4, 2005, Taipei, Taiwan.
2. Glassner, A, & Schwarz, B., B. (2005). The Role of Floor Control and of Ontology in Argumentative Activities with Discussion-Based Tools. Paper presented at CSCL2005, May 30 - June 4, 2005, Taipei, Taiwan.
3. Johnson, S., Morgan, A., & Simon, S. (2004). Report on DUNES Educational Value. Deliverable 6.1, restricted formal report.

Peer-to-peer Face-to-face collaboration

Delfina Malandrino and
Ilaria Manno

ISISLab
Dipartimento di Informatica ed Applicazioni "R.M. Capocelli",
Università di Salerno, 84081 Baronissi (Salerno), Italy.
{delmal,manno}@dia.unisa.it

Abstract. In this paper, we present a *proof of concept* application of a technique that is designed explicitly for face to face collaboration software architectures. The objective is to minimize the impact on the installation and deployment of the application, that, while internally keeping a client-server architecture (in order to allow the centralize coordination and monitoring), presents to the user (both teacher and learners) as uniform work environment, integrating client and server components in one piece of software. In order to further limit the impact on the configuration, we define a *start and play* protocol, to start-up the application with no network configuration; the *start and play* protocol takes advantage from the particular conditions of the face to face context i.e. LAN setting.
The application is built on the Eclipse core (Rich Client Platform), and inherits its plug-in based architecture and its advanced tailoring features.

1 Face2face collaboration systems

Current research in Computer Supported Collaborative Learning (CSCL) has produced many studies and several classifications of the situations where the collaboration takes place. The space-time matrix (see Fig.1) is a well-known classification [4] that defines the four basic space-time situations. A lot of works have studied the *different-time* AND/OR *different-place* situations to reduce distances (both in time and space), while there are fewer studies about the *same-time* AND *same-space* situations. Of course, existing synchronous systems for remote situations can also be used in the co-located situations, but the *same-time* AND *same-space* situations is substantially different from the remote ones and the technological support should take in account this difference. Indeed, the tools to support remote collaboration try to achieve a "virtual co-location"

	Same place	Different place
Same time	Co-located collaboration	Remote synchronous collaboration
Different time	Asynchronous collaboration	Remote asynchronous collaboration

Fig. 1. Space Time Matrix

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 80-88, 2006.

enhancing remote communication by chat, e-mail, file sharing, audio and video conferencing, etc. In f2f situations, this kinds of communications channels are unnecessary because there is no distance to fill up. For these reasons, the systems to support co-located learning could and should focus on collaboration activities rather than on reducing distances, for example, they could provide reviewability and revisability [8], that are important characteristics in particular in the learning process [11].

Our team is involved as technical partner in the European project LEAD, in Sixth framework programme priority IST [5], whose goals are *to develop, implement and evaluate conceptual models, practical scenarios and associated networked-computing technologies for effective face-to-face problem-solving discussions*.

In this project we are focussing on design features and development solutions to produce a *face-to-face* (f2f) collaborative learning tool, in collaboration with others technical partner and according to the conceptual model outlined by the pedagogical partners.

In this paper, we approach the problem of designing an application for face-to-face collaboration that has minimum impact on the installation and management. We present an architecture and a small proof-of-concept prototype that was designed in order to test the effectiveness of our low-cost deployment strategy.

2 Software architectures

Most of the existing systems for CSCL have a client-server architecture. This model, in fact, simplifies data collection process and persistence management; furthermore, the client/server entities support the students/teacher roles, allowing to centralize in the server component the functionalities for the teacher, while the clients components offer the functionalities common to all the students.

The existing systems are Web-based, since the most are designed for remote situations (a survey is presented in [6]). These systems are not always suitable for a f2f didactic context, since they require to communicate with an external server (and therefore they require an Internet connection), and many schools employ restrictive firewalls and access policies. Furthermore, the teachers could not exercise fully control on the external server and is somewhat limited by its availability and configurability. On the other hand, some of the existing systems allow to install a local server, but the installation process is often too much complex for the end users, that may not have the experiences and capabilities to install and configure a Web server.

We aim to design a CSCL system explicitly applied to the f2f context, addressing the particular conditions of such context. In fact, in a co-located situation the system can use only the local area network, so it could and should do without external servers and Internet connection, in this way it can avoid many problems due to restrictive security policies, that are, often, commonplace in educational settings.

An existing cooperative system providing a LAN-based approach is MeetingWorks [7]: chauffeur and participant components are local applications and every participant links up with the chauffeur automatically, but the system[1] needs a shared directory to

[1] We have tested only the free version of the program, that has only LAN participants.

which every participant needs to gain access. Using a shared directory is a critical choice in the context of a classroom because the standard hardware and software equipment may not support many concurrent accesses (e.g. limitations on the number of simultaneous remote accesses in standard operating systems that are intended for desktop and not for servers). Therefore, the network use and configuration must be carefully designed not only to avoid problems due to security policies but to assure effectiveness and efficiency as well.

Beyond the network architecture, we are interested particularly in enhancing friendliness and deployment easiness: the system must be simple to configure, to start-up and to use, in order to encourage its usage and spreading.

In an overall view, we are designing a LAN-based system, providing a uniform work environment and a *start and play* protocol, to offer an application simple to install and to start up, in other terms, an application that exhibits a *low cost deployment*.

3 Our architecture

Several studies [9] suggest component-based architectures to address architectural requirements for collaboration systems. In particular, we are studying the Eclipse Platform [3] architecture. Eclipse is a component-based Integrated Development Environment that provides a framework (Rich Client Platform, RCP) to build general purpose applications using the Platform architecture. In the following we introduce briefly the Eclipse architecture (sec. 3.1), and then our approach to use RCP to build a face to face collaborative application (sec. 3.2).

Since the reasons (simplifying data management and matching teacher and students roles) to use the client-server model are well-grounded for the f2f system too, we do not set aside the client-server model, but we are studying how to use it in a *LAN-based* architecture, so that it can be independent of both Internet connection and external servers.

In order to simplify the system usage, we propose here an architecture with server and client components embedded in the same application, so that the system could provide a uniform work environment between teacher and students, and without requiring the management of a separate server. The idea is that the application looks *peer-to-peer* to the users even if their internal structure makes one of the peers (tipically, the teacher's one) to be the server. Of course, this architecture leverage on the growing availability of CPU cycles on low-end desktops, and on the inherent limitation on the size of the classroom, which makes acceptable the workload on a server placed on a desktop machine.

Another aspect affecting user-friendliness is the start-up phase: to simplify the start-up phase we are defining a low cost deployment approach to allows the end users to *start and play* the collaborative application, with no network configuration. We describe these design features in the section 3.3.

3.1 Eclipse architecture

Eclipse is a component-based Integrated Development Environment grounded on three key concepts: plug-ins, extension-point and lazy activation.

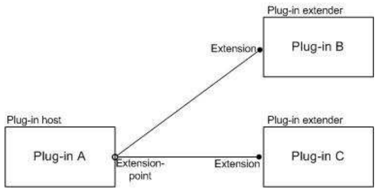

Fig. 2. The extender plug-ins B and C provide extensions to the host plug-in A.

A plug-in is the smallest independent software unit; even if a tool could be composed by more than one plug-in, the term plug-in is often used as "tool" or "component". Every plug-in declares its identity and properties in a file *manifest*[2], so these information are available without activating the plug-in.

The extension-points define the rules of plug-ins composition: an extension-point is the point exposed by a plug-in to allow extensions from other plug-ins. The plug-in that exposes the extension-point is the plug-in host, while the plug-in that provides the extension is the plug-in extender (see fig. 2).

The plug-in host declares the extension-point in its file manifest, and the plug-in extender declares the extension in its file manifest, so that the information about extension relation between the two plug-ins are available without activating them.

The lazy activation is the property that allows to activate a plug-in on demand, so that there can be a lot of plug-ins installed but only few active.

Beyond the flexibility and scalability, the Eclipse architecture assures the *extreme tailorability* [2, 9, 10], allowing customization, integration and extension.

3.2 Building on Rich Client Platform.

Rich Client Platform (RCP) is the "core" of Eclipse: it is composed by the fundamental plug-ins, mainly to manage graphic interface and plug-ins life cicle, without any specific feature of the development environment. The RCP is a framework to build general purpose applications based on the Eclipse architecture (see fig. 3). The applications built on RCP inherit the tailorability provided by the Eclipse architecture.

To build the system on the RCP framework, we have to define the components of the application. We can distinguish two types of building blocks: the Core and the collaboration tools. Each component, the Core and the tools, is a plug-in. The Core provides fundamental functions, that are, at least, user awareness (presence and activity), installed collaboration tools discovery, start-up of tools (on demand, if possible), definition of the rules for composing the building blocks in the system.

The collaboration tools can provide any kind of functionality (free chat, structured chat, graphic shared editor, mix of previous, games, etc.); they must only observe the

[2] As a matter of fact, the *manifest* is a couple of files: plugin.xml and manifest.mf, that contain respectively information about relations with other plug-ins and about the runtime. They are often referenced as a single file, first for historical reasons and then because they can be edited with a single advanced editor.

composition rules fixed by the Core. The Core depends on RCP (see fig. 4) and is the main plug-in, that is, the plug-in defining the application. The Core provides an extension-point named `tools` defining the API that any collaborative tool must implement to be integrated in the system. This extension-point (like all extension-points) may have zero or more extensions. A plug-in extender has to declare in the file manifest an extension to the extension-point `tools` and has to implement the API specified by the extension point. The Core analyzes the extensions to the extension-point at runtime, so it is possible to add a tool to the system without changing the Core.

The plug-in based architecture allows to build each tool component with its own server embedded. The idea of a server for each tool has two reasons; first, in this way the Core ignores completely the tools details (and the tools servers details), so that whatever tool will be needed, it could be added without modifying the Core, since the tool embeds its own specific server functionalities; second, having a server for each tool and thanks to the lazy activation property, in each moment only the required tool servers are running. So, the strongly component oriented architecture of Eclipse assures fully tailorability, thanks to plug-ins and extension-point concepts. Furthermore, the *lazy activation* assure scalability: each collaborative tool will be activated only when required.

The flexibility and the extendibility of RCP would allows to extend the system as the collaboration needs arise, achieving a richer system, placed at the top of the classification framework presented in [10], where at the bottom there are basic collaboration functions, while at the top there are "comfortable" collaboration functions.

3.3 Low cost deployment: uniform work environment and start and play protocol

Part of our studies concerns the problem of the start-up: we would enhance start-up transparence so that the users could start the application and could use it with no configuration (i.e. *start and play*). Furthermore, we aim to provide a uniform work environment to make semi-transparent the difference between server and clients: they are integrated in the same application so that the application server instance is not perceived

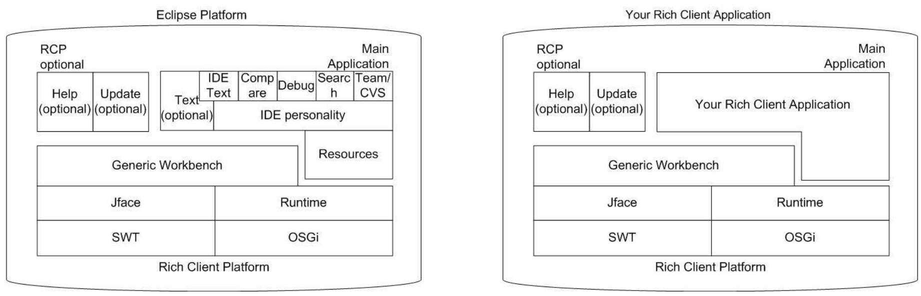

Fig. 3. *(a)* The Eclipse architecture and *(b)* a general purpose application on RCP

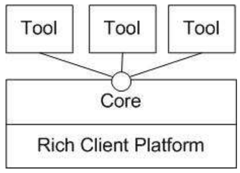

Fig. 4. The Core based on RCP can be extended by many tools.

by users as "the server" but as "a powered peer" ("powered" because it has more functionalities than standard clients). From technical point of view, this is merely a seeming difference, but from user's point of view there is no external application to install, to configure, to start up and to manage. For these reasons, each component contains both the server side and the client side, even if, in each moment, only one instance of the application over the net runs in the server mode.

To achieve a *start and play* application, we developed a UDP-based server localization protocol, using only the local network. When the application starts, it is in client mode, and the Core client sends a "server lookup" message in broadcast; if in a timeout it does not receive the server reply, it instances and runs the Core server. Every subsequent application sending the "server lookup" message will find the server (see fig.5). Furthermore, the Core manages the start-up of the tools, so when a user (see fig. 6) requires to start a tool, the core client of user 2 sends a "start tool" message (specifying the id of the tool) to the Core server. When the Core server receives the "start tool" message, it instances and runs the tool server and forwards to all users the "start tool" message; each users that receives the start message runs the tool client. Each tool client sends a "tool server lookup" in broadcast, and will receives the reply of the tool server.

Since in CSCL f2f systems it is desirable that some operations are reserved to the teacher, the servers should be hosted by the teacher. To match this requirement, we have defined a *client running mode* and a *server running mode*. The running mode can be explicitly enabled by specifying a command line parameter. The teacher application

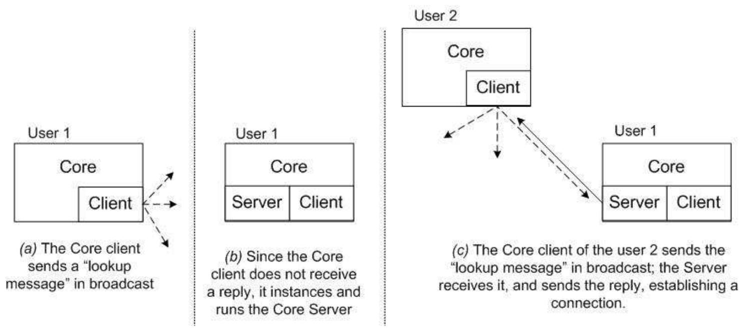

Fig. 5. The Core activation sequence.

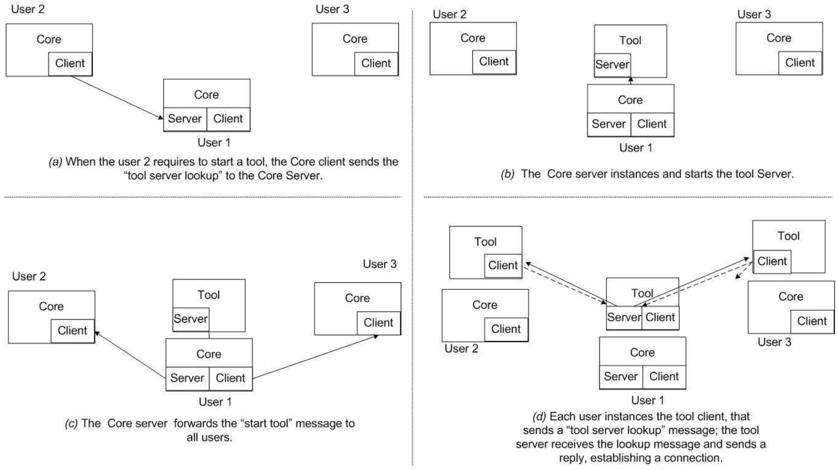

Fig. 6. The tool activation sequence.

instance runs in the server mode and directly creates and starts the Core server, skipping the lookup message broadcast; the students application instances run in the client mode and look for the server, but if do not receive reply, do not instance nor start the server. Obviously, if there is an application instance in server mode, all the other must be in client mode (or, however, they must fail if try to instance a server). This solution keeps the uniform work environment and the start and play phase, but reserves the access to the servers functionalities for the teacher. As matter of fact, we have forced (by the running modes) the protocol to achieve a powered application instance for the teacher, because the original protocol does not impose conditions about the user that hosts the server. Indeed, with the original protocol, the first user starting a component, instances and runs the server of the component (*p2p running mode*), so that servers of different components could be hosted by different users, moving the system toward dynamic architectures [1]. This solution did not seem suitable for educational settings, where it is preferable to instance and run all the servers at the teacher application, to provide servers functionalities access only to the teacher. The extreme tailorable architecture of RCP enhances the start-up transparency allowing to design the system with a set of servers: a server for the core and a server for each provided tool [3]. With the plug-in based architecture and the lazy activation it is possible to design the system so that in each moment a chosen tool can be activated and then, silently, the server of the tool is started and then the clients of the tool find it.

These features together (transparent start-up and uniform work environment) provide the end user with the perception of a peer-to-peer system, although the system is instead a client server one.

[3] In the educational setting all the server are hosted on the teacher application instance, but even so, it is preferable having a server for each component because this layout enhances extensibility (see sec. 3.2)

4 Conclusions and future work

Here we have presented our studies about the architecture of a system designed and developed explicitly for face to face collaborative learning. Our system provides a uniform work environment and allows the users to *start and play* the application. Compared with existing systems[4], our system is simpler to install, to start-up and to use, because it has neither separate server to manage (uniform work environment) nor network configuration to execute (*start and play*). Furthermore, it inherits from Eclipse advanced tailoring properties.

Since our system has to address specifically face to face collaboration, we can utilize the particular conditions of such context to achieve a more friendly application. The *start and play* protocol takes advantage of the LAN-based context, and really, it is workable only on wired-LAN, because the UDP broadcast is often disabled out of the LAN. Furthermore, the local network often offers low variance delay and this helps to prevent (but it is not the best solution, of course) race conditions in the server start-up phase. Vice versa, the high delay variance of wireless LAN may cause anomalous behaviors of the protocol, due to, for example, expiring timeouts. To use a similar protocol on wireless LAN, it must be specifically designed to address WiFi peculiarity.

In the context of face to face collaborative learning, the server functionalities should be managed by the teacher, so that all the servers (Core server and tools servers) are hosted on the same application instance (the teacher's one). Actually, the described architecture forces this behavior, but interesting studies concern the p2p running mode, that provides the opportunity of hosting the servers in a distributed way over different application instances (for example, the first user starting a tool can host the tool server), migrating the system toward dynamic architectures [1]. Even if the p2p running mode may be unsuitable for educational settings, we wish briefly describe some interesting features and problems related to the p2p running mode. The opportunity to have a distributed servers set allows to share the workload between all the users; furthermore, this allows to relax the roles strictness, matching situations more dynamic and flexible (such as a work group where different members have different roles and competences) than the educational one, where there are the well defined student and teacher roles. A problem related to the distributed servers set concerns the shutdown of a single application instance hosting one server: it should be a *controlled* shutdown, to allow the server migration toward another application instance (i.e. another application instance creates and runs the server). An even more complex problem concerns the *crash* of an application instance hosting one server, and this requires further studies, as well as the data management protocol. Obviously, the p2p running mode and the distributed servers set are based on the idea that each component embeds its own server. Maybe it is too early to make statement about the user capabilities required by a system with a distributed server set, although we expect that the distributed architecture has no consequences on the user level.

[4] i.e. existing remote systems used in a face to face context

References

1. G. Chung and P. Dewan. Towards Dynamic Collaboration Architectures. In *Proc. of CSCW'04*, pages 1–10.
2. A. Dimitracopoulou. Designing Collaborative Learning Systems: Current Trends and Future Research Agenda. In *Proc. of Computer Supported Collaborative Learning 2005: The next Ten years!*, 2005.
3. Eclipse. http://www.eclipse.org.
4. Robert Johansen. *GroupWare: Computer Support for Business Teams*. The Free Press, New York, NY, USA, 1988.
5. Lead - technology-enhanced learning and problem-solving discussions: Networked learning environments in the classroom, 6th Framework Programme Priority IST. http://lead2learning.org/.
6. J. Lonchamp. Supporting synchronous collaborative learning: a generic, multidimensional model. *International Journal of CSCL*, 1(2), to appear in June 2006.
7. MeetingWorks Software. http://www.entsol.com/html/meetingworks_software.html.
8. G.M. Olson and J.S. Olson. Distance Matters. *Human Computer Interaction*, 15(2-3):139–178, 1994.
9. H. ter Hofte R.Slagter, M.Biemans. Evolution in Use of Groupware: Facilitating Tailoring to the Extreme. In *Proc. of Seventh International Workshop on Groupware*, 2001.
10. A. Sarma, A. van der Hoek, and L.T. Cheng. A Need-Based Collaboration Classification Framework. In *Proc. on Eclipse as Vehicle for CSCW Research, Workshop at CSCW 2004*.
11. R.J Simons. Three ways to get content based and in-depth conversation in on-line learning: revisability,focussing and peer feedback, 2006. Seminario Tecnologia Cultura e Formazione.

Technology Appropriation in Face-to-Face Collaborative Learning

Maarten Overdijk and Wouter van Diggelen

Utrecht University, Research Centre Learning in Interaction,
Heidelberglaan1, 3584 CS Utrecht, The Netherlands
{m.overdijk, w.vandiggelen}@fss.uu.nl

Abstract. Studies in computer supported collaborative learning frequently under-expose the interaction between students and technology. To gain more insight in the way student groups interact with educational technology, we examine how students 'appropriate' this technology. The notion of technology appropriation implies a process of social construction in which the actions and thoughts of the user are shaped by the technology, while the meaning and effects of the technology are shaped through the users' actions. In this paper, we develop a problem analysis from theoretical findings, and work towards an initial, tentative concept of technology appropriation.

Key words: Collaborative learning, Technology appropriation, Discussion support, Face-to-face discussions.

1. Introduction

The field of computer-supported collaborative learning (CSCL) advocates the deployment of technology to promote specific interactions between learners that lead to collaboration and learning. Software tools that support discussion within student groups, for example, may facilitate a free exchange of ideas, argumentation or critical thinking within the group. These tools influence group behavior by triggering certain actions, and by shaping interactions between the students, in a way that has a positive effect on the discussion.

In addressing how collaborative learning within student groups is influenced through the use of technology, CSCL research frequently under-exposes the interaction between the students and the technology. The technology is predominantly treated as a variable with a stable influence on the thoughts and actions of the students. This influence is assumed – often implicitly – to be independent of the students' actions. There is evidence to doubt the ground of this assumption. Essentially, because the assumption reflects a deterministic view towards technology use, and conflicts with the premises of socio-constructivist theory. Questioning of this deterministic view has led to several 'emergent perspectives', which propose that the use and effects of a technology emerge on the basis of complex social interactions among users [4].

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing, EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 89-96, 2006.

To gain more insight in the way student groups interact with technology, we examine the students 'appropriation' of the technology. We claim that the use and effects of a technological tool emerge from the interaction between user and tool, based on a mutual influence between them. The notion of technology appropriation implies a process of social construction in which the actions and thoughts of the user are shaped by the technology, while the meaning and effects of the technology are shaped through the users' actions.

If we aim to understand the potential of educational technology to enhance certain processes in the collaboration between students, then we need to be informed about the dynamics of student groups interacting with technology. The notion of technology appropriation, as we will point out, has important implications within the LEAD[1] project, and also within the broader context of CSCL research.

2. The LEAD project

Problem solving discussions are common in classrooms where learners work collaboratively on a task. Groupwork, for example, requires that learners discuss in order to make progress and to succeed as a group. Learners have to share their understanding of a problem and explore different directions to solve it. They have to explicate their line of reasoning, provide arguments, and reach conclusions that are sufficiently shared to proceed with the task. While doing all this, they may have to deal with conflicts and differences in opinion. Due to the challenging character of a problem solving discussion, learners do not always succeed in making the most of it.

The objectives of the LEAD project are to develop and evaluate conceptual models, a didactical method, and accompanying network-computing support to enhance problem-solving discussions in face-to-face classroom settings. The project team posits the claim that the quality of group processes and outcomes can be enhanced through the combination of face-to-face and computer-mediated communication.

The pedagogical research of the various project partners can be positioned within one of three interrelated themes: interaction between students, interaction between students and an external artifact, and the evolving situation. The research proposed in this paper can be placed in the second theme, interaction between students and an external artifact. From the perspective of this theme, the goals of the research are: (1) to formulate a conceptual model of technology appropriation, (2) to study empirically the way in which a network-computing technology is appropriated by face-to-face groups during problem-solving discussion, and (3) to inform the technological and didactical design process in the LEAD project.

[1] The LEAD project is funded within the Sixth Framework Programme of the EC (2nd call on Technology Enhanced Learning).

2.1 Problem statement

The method and technology that are being developed in LEAD help groups to move forward in their discussion by triggering certain actions, and by shaping interactions among the group members.

The method comprises a designed sequence of activities that fit with certain pedagogical objectives. It specifies certain elements in the educational environment, like the task, instructions, and certain rules and techniques for collaboration. The method furthermore specifies the deployment of the Discussion Support System (DSS), that is, when it is deployed, why, and under which configuration. Part of the method will be reflected in the structures of the technology.

The DSS will present students with two types of tools: a text-based conferencing tool and a graphical, shared workspace tool. The tools trigger certain actions from the students, for example by making a notation system available. The notation system promotes certain communicative acts, like providing arguments or asking questions. Shaping of interactions is achieved through the use of certain techniques or rules that are reflected in the structures of the tool. For example, the tool enables students to participate simultaneously in the discussion. The process structure of the tools guide the content, pattern or timing of the communication [14].

The design of collaborative technology is based on hypothesis about how artifacts shape cognition and collaboration [19]. Similarly, the DSS is designed on basis of theory and hypothesis about how small-group problem-solving discussions between students proceed, and how they could be enhanced through technology. As we point out below, it is a goal of this research to develop and test such hypothesis.

To some extent, the tools reflect a certain intention to the user regarding their capabilities and how they should be used. Intentions about their use and effects are also explicated through the instructional design or ‘script’ that the tools are a part of when they’re presented to the student group. However, we argue that the students not necessarily use the technology in accordance with these intentions.

The effect of any didactical intervention that incorporates technology depends in part on a process of technology appropriation. Having said this, we ask the following research questions: how should we conceptualize technology appropriation; and how does technology appropriation affect the students’ discourse?

2.2 Research and development strategy

The research will follow LEADs’ research and development strategy [15]. In short, we formulate a descriptive conceptual model based on preliminary theoretical and empirical findings that were obtained through a problem analysis. We then proceed with an empirical evaluation of this model, which we subsequently adapt according to our findings. This results in a prescriptive model that may inform both the didactical and technological design process, that is, the development of the Discussion Support System and the didactical method.

In a general sense, the research may contribute to our understanding of the role of computer technology in face-to-face problem-solving discussions.

Throughout the remainder of this paper we develop a problem analysis from theoretical findings, and work towards an initial, tentative concept of technology appropriation.

3. Problem analysis

The conceptual part of our research question deals with defining what technology appropriation is, and how we should model it. Literature review brings different aspects of 'appropriation' to the fore that may be of relevance to our study. We focus on the notion as it can be found in socio-cultural theory, and with socio-constructivist perspectives on the use of technology. In our view, these two theoretical strands develop different aspects of the notion, which make up a comprehensive picture when combined. Of central importance herein is our conception of the relation between user and technology.

3.1 Appropriation of cultural tools

The notion of appropriation has been frequently used in socio-cultural learning theory. Rogoff [13] uses the term 'appropriation' to refer to "the process by which individuals transform their understanding of and responsibility for activities through their own participation". What is appropriated in this case are cultural tools, like language, procedures or 'technical tools' (e.g. a technology) that are attached to a particular practice. For Wertsch[18], 'appropriation' of a cultural tool can be distinguished from 'mastery' as a form of internalization. Whereas 'mastery' refers to "knowing how to use a mediational means with facility", 'appropriation' refers "to taking something that belongs to others and making it one's own" [18]. This should not be read as taking ownership of something, but rather as adapting it to ones own use. Both Wertsch and Rogoff refer to Bakthin in their use of the term. According to Bakthin, a speaker appropriates a word when he adapts it to his own semantic and expressive intention [1].

Human thoughts and activities undergo a transformation when they become mediated by cultural tools. The notion of mediation in the socio-cultural approach is to a large extent inspired by cultural-historical psychology [16]. Basically, tools are created and transformed during the development of an activity and carry with them a particular culture - the historical remnants from this development. The use of tools is a means for the accumulation and transmission of cultural knowledge. This developmental process influences the nature of external behavior and also of the mental functioning of individuals [2]. This emphasis urges to go beyond the here-and-now interactions of tool-users; the interaction process should be incorporated in a broader cultural and historical frame of reference. However, a 'technical tool' like a collaborative technology may also evolve 'here and now' over a short period of time.

3.2 Social shaping of technology

In a different strand of theory, the notion of appropriation has been used to explicitate a mechanism trough which technology is socially shaped [5, 9, 3].

Carroll et al. [3] define appropriation as a process in which a technology is explored, evaluated and adopted or rejected by users. According to their view, users make use of certain capabilities of a technology, and reject others, in order to satisfy their needs. They see appropriation of mobile technologies by young people as a result of the interplay between what people desire, the capabilities and implications of the technology, and the situation of use [3].

DeSanctis and Poole [5] use a different concept of appropriation. Their use of the term can be traced back to Ollman, who defines appropriation as constructive utilization [10]. According to them, 'appropriations' of a technology are immediate, visible actions that evidence deeper structuration processes. Agents appropriate rules and resources that become available as groups interact while using advanced information technology [5].

Technology appropriation can be described as a process that takes place on different levels of social organisation, that is, on the level of the individual user, a group of users, or on the level of the larger sociocultural environment. Carroll et al. [3] place appropriation on the level of the individual user. DeSanctis and Poole [5] conduct an institutional analysis, and define appropriation on the level of the organisation.

The socio-constructivist approaches to technology focus on the fact that technologies are socially shaped, and that their use and effects depend on human contingencies. This perspective suggests that a technology gets its form and meaning in-interaction. The technology-in-use is not a stable artifact with fixed characteristics that are independent from practice. In stead, students construct essential characteristics of the tool when they work with it. It follows that technology is not necessarily used in accordance with the designers' intentions. "Technological artifacts, in both their form and their meaning, are socially shaped, as opposed to being the clearly defined products of particular inventors or innovators" [7].

3.3 The relation between user and technology

In previous research we described the mutual influence and dependency between students and technology [11]. Several aspects about their relation remain unresolved.

We can make different assumptions about the relation between the students and the technology. One assumption would be to state that the behavior of the students is directed through features of the technology. Another assumption would be to state that the students need to actively explore the technology and make conscious choices in order to achieve a desired outcome.

The theory of affordances [6] fits with the first assumption. Scholars have argued in favour of the notion of 'affordance' as an analytic tool to analyse the 'effects' and 'constraints' of a technology [7, 8]. The affordance of an object refers to the possibilities for action carried by this object. The concept originates from environmental psychology, and is closely related to theories of perception. Main shortcomings of the theory are that (1) it describes explanations on the level of the individual, and says little about the group level, and (2) leaves little room for a process of mutual shaping, since the affordance is considered invariant. As Gibson states "The affordance of something does *not change* as the need of the observer changes. The observer may or may not perceive or attend to the affordance, according to his needs, but the affordance, being invariant, is always there to be perceived" [6].

The theory of 'adaptive structuration' (AST) fits with the second assumption. DeSanctis and Poole [5] describe how people utilize technology in organizations, and how their interaction with the technology influences their social practice. In AST, agents are knowledgeable, and have a conscious influence on the course of events. "New social structures emerge in group interaction as the rules and resources of the technology are appropriated in a given context and reproduced in group interaction over time" [5]. The concepts they use illustrate a construction process that transcends notions of 'internal' and 'external'. Consequently, any change or transformation that takes place cannot be solely located within a subject, the object – in this case the technology – undergoes changes also.

4 Tentative concept of technology appropriation

Technology appropriation occurs when someone puts into use a technology in a goal-directed activity while the properties of the technology, and the acts required to accomplish the goal by means of the technology, are unacquainted. When someone is presented with a new technology, he or she appropriates this tool by 'adapting' it in a goal-directed activity. That someone has to make sense of the properties of the tool, and find 'a way of doing' to perform the activity. When a group of people is presented with a tool, technology appropriation occurs on the level of the group. In this case, the group has to make sense of the technology, and adapt it in a joint activity.

Technology makes certain rules and resources available, and it provides opportunities for interaction that would be hard to achieve without the technology. However, technology appropriation does not simply refer to acquisition of knowledge about an object, or to 'learning how to' do or apply something with the technology. Appropriation of a technology simultaneously transforms user and technology. It does not only cause change in the knowledge and skill of the user, but it also causes change in the properties of the technology. Central to the concept of appropriation is a mutual shaping. The concept implies a process of social construction in which the actions and thoughts of the technology user are shaped through the use of the technology, while at the same time the meaning and effects of the technology are shaped through the users' actions.

The educational environment in which the students work encompasses more than the technology, the didactical method and the other members of the group. Elements on different levels of social organisation are of influence on the classroom practice. One could think of, for example, the routines of the practice, or norms that prevail on the level of the educational institution, which can be of influence. One could also think of the history of a student group, or the experience of the individual student. Processes that take place on each of these levels of social organisation may influence the way the technology is brought into action, and affects the students' discourse.

5 Technology appropriation and the students' discourse

The empirical part of our research question deals with how technology appropriation affects the students' discourse.

When the students lack an understanding or are confronted with a technology that seems confusing, they may engage in a process of sensemaking [17]. The use and effects of the technology emerge from the interaction between the students and the tool, as a result of interrelated individual and group processes. We make an analytical distinction between the user and the external artifact, and separate between individual and group processes. We focus on the 'here and now' of the interaction process, which may evolve over short time periods.

In previous research [11] we studied technology appropriation by examining basic actions that students performed in a graphical, shared workspace tool. This research indicates that individual students make certain choices during the process of appropriation. The study revealed that students make different choices both within and between groups. The choices they made influenced the effect of the tool, and led to differences in their discourse. In the planned continuation of this research we want to examine how the students make sense of the features of the tool, and find a way of working, as a group.

The specific focus of LEAD, the combination of face-to-face and computer mediated communication, provides some opportunities to learn more about technology appropriation. This situation enables us to investigate to what extent the students make use of (a) observations; (b) talk; (c) gestures, or (d) actions in the tool during their appropriation of the technology.

References

1. Bakthin, M. (1981). The Dialogic Imagination: Four Essays. Austin: University of Texas Press.
2. Bannon, (1997). Activity theory. Retrieved from: http://www.sv.cict.fr/cotcos/pjs/TheoreticalApproaches/Actvity/ActivitypaperBannon.htm

3. Carroll, J., Howard, S., Vetere, F., Peck, J. and Murphy, J. (2002). Just what do the youth of today want? Technology appropriation by young people. Proceedings of the 35th Hawaii International Conference on System Sciences.
4. Contractor and Seibold (1993). Contractor, N.S. and Seibold, D.R. (1993). Theoretical framework for the study of structuring processes in Group Decision Support Systems: Adaptive Structuration Theory and Self-Organizing Theory. Human Communication Research, 19(4), 528-563.
5. DeSanctis, G. and Poole, M.S. (1994). Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory. Organizational Science, 5(2), 121-147.
6. Gibson, J.J. (1979). The ecological approach to visual perception. New Jersey: Lawrence Erlbaum.
7. Hutchby, I. (2001). Technologies, Texts and Affordances. Sociology, 35 (2).
8. Kirschner, P.A. (2002). Three Worlds of CSCL: Can we Support CSCL? Heerlen: Open University of the Netherlands.
9. Mackay, H. & Gillespie, G (1992) Extending the Social Shaping of Technology Approach: Ideology and Appropriation. Social Studies of Science, 22(4).
10. Ollman, (1971). Alienation: Marx’s conception of man in capitalist society. Cambridge University Press.
11. Overdijk, M. & Van Diggelen, W. (submitted 2006). Making sense of tools and artifacts: the student-tool connection. Submitted to: International Journal of Computer-Supported Collaborative Learning.
12. Palincsar, A.S. (1998). Social Constructivist Perspectives on Teaching and Learning. Annual Review of Psychology, 49, 345-375.
13. Rogoff, B. (1995). In J. V. Wertsch, P. d. Rio, & A. Alvarez (Eds.), Sociocultural studies of mind (pp. 56-74). New York: Cambridge.
14. Tyran, C.K. & Shepherd, M. (2001). Collaborative Technology in the Classroom: A Review of the GSS Research and a Research Framework. Information Technology and Management, 2, 395-418.
15. Van Diggelen, W. & Overdijk, M. (2006). Network computing support for face-to-face collaborative learning. Proceedings of the EC-tel conference, Crete 2006.
16. Vygotsky, L. S. (1978). Mind and Society. Cambridge, MA: Harvard University Press.
17. Weick, K.E. (1995). Sensemaking in Organizations. Sage: Thousand Oaks, California.
18. Wertsch, J.V. (1998). Mind as action. Oxford University Press.
19. Woods, D.D. (1998). Designs are hypothesis about how artefacts shape cognition and collaboration. Ergonomics. 41:2, 168-173.

TEACHERS PERCEPTION OF COMPUTER SUPPORTED PROBLEM SOLVING: AN ITALIAN RESEARCH

Luca Tateo[1], Giuseppina Marsico[1], Maria Annarumma[1], Giovanna Ammaturo[1], and Antonio Iannaccone[1]

Department of Education Sciences, University of Salerno, via C. Pisacane, 2 I-84100 Salerno, Italy.
ltateo, @unisa.it

Abstract. Requirements for educational software could be based on an analysis of existing learning situations. In order to obtain useful information about teaching practices, an explorative study has been conducted with a group of Italian teachers. Collected answers highlight that pedagogical support is needed in order to design effective educational software.

1 Introduction

During the design process of educational software it is very important to take into account teachers perceptions and needs [3, 16]. A software system to support face-to-face problem solving will be designed, within the LEAD project, taking into account suggestions coming from teachers in Participatory Design perspective. In order to obtain useful information about teaching practices, an explorative study has been conducted with a group of Italian teachers. A semi-structured interview was prepared in order to gather teachers' representation of computer use in classroom and, more specifically, as support for *Collaborative Problem Solving*. Collected answers highlight that pedagogical support is needed in order to design effective software supporting *Collaborative Problem Solving* into the classroom.

This research has been carried out for EU project "LEAD Technology-enhanced learning and problem-solving discussions: Networked learning environments in the classroom", funded by the VI Framework program, priority "IST Integrating and Strengthening the European Research Area".

2 Theoretical framework

This study, focused on *Collaborative Problem Solving* (CPS), belongs to the framework of cultural psychology, in particular to the collaborative and dialogical models of learning [5, 6]. Collaboration is universally recognised as a fundamental factor for cognitive development because it allows different points of view to emerge

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 97-105, 2006.

and to be compared [14]. In such framework, CPS has been defined a complex learning process during which learners and teachers represent, analyse and try to solve different types of problematic questions. During such process collaboration and argumentation are the basis upon which new knowledge can be created [1, 2, 11, 19].
ICT tools can provide an effective support to CPS and many pieces of software have been developed, especially in educational settings, for participants interacting at a distance. In this educational paradigm [8, 18], learning mainly occurs through virtual interaction between groups of learners supported by teachers, tutors, and experts. According to [9], such educational virtual environments can be included in two main categories:

– *Action oriented systems*: environments based on the *learning by doing* principle, where learners can do actions, manipulating objects and discuss the outcomes like virtual scientific experiment software.
– *Textual production systems*: such environments are based on the collaborative production of written texts. These systems refer to the educational model that considers knowledge as built through collaboration and with the *scaffolding* of a teacher or a tutor.

Nevertheless, some studies have found that in European educational systems the most part of didactic activities are still face-to-face [7, 17]. Looking at some specific contexts, such as the South of Italy, we see many constraints to the introduction of CPS software for the everyday educational practices. For example, lack of computers into the classroom, low level of ICT expertise, and low knowledge of CPS methodology among teachers.

The Participatory Design (PD) methodology [12, 15] seems suitable to overcome at least immaterial constraints, facilitating the implementation of computer use in didactics into Italian educational context.
PD allows final user to participate to the entire process of development of technologies. In this sense, it can give the possibility to develop an environment that takes into account idiomatic and idiosyncratic communication styles of work groups. Analysis of communication technologies used in the workplaces and the analysis of users' mental models can enable designers to understand what kind of tools should be included into the software and how to display them in order to obtain the maximum advantage. Using PD, software can be designed based on teachers' needs and representations of their practices. PD in this case is useful to mediate between teachers and students knowledge mental models to build distributed systems able to give user the perception of a good affordance. Through an interface based on everyday classroom experience, the process of appropriation of new didactic support should be facilitated [13].

3 corpus, research design and categories

LEAD Italian research group collected 20 teachers' interviews from kindergarten, primary and secondary schools inquiring, among other things, what teachers know about Collaborative Problem Solving (CPS), how they use it in classroom, and how they imagine a software system that supports face-to-face CPS.

Interview was structured in the following 4 sections composed by one or more questions: professional identity, computer use, classroom activities, and school culture. For this study, only computer use and classroom activities sections have been analysed. Interviews have been audio-recorded, transcribed considering both verbal and non-verbal aspects, and later analysed using content analysis methodology [4]. First, corpus has been read and a system of categories has been created according to research objectives and textual occurrences [10]. Categories of analysis have been attributed to the text by 5 independent judges, discussing doubtful cases until reaching a 100% level of agreement. Finally, categories' frequencies have been calculated and an interpretative analysis of teachers' answer has been conducted, on the basis of content analysis results, to reach a deeper understanding of their representation of PS and software requirements.

Interviewed teachers come form different towns of South Italy (Salerno, Avellino, Bari and Barletta). They are mainly females (19 over 20); most of them teach humanities (15 over 20) and only a few teaches scientific subjects (5 over 20). This data actually mirrors the gender distribution among Italian educational context according to the Italian Ministry of Education.

Teachers' answers have been categorized with respect to the following principal themes:

- Level of ICT expertise[1]
    1. Non-users: using PC only at basic level or don't use at all;
    2. Medium-users: using PC for writing and browsing Internet;
    3. Expert-users: teachers using PC for writing and didactic.
- Definition of problem solving[2]
    1. Absent answer: teacher is unable to give a definition;
    2. Not pertinent answer: teacher gives a definition containing no reference to CPS model (e.g. "*I don't plan my school daily activities (...) I don't mind following the subject order (...) we decide together witch topic to discuss*");
    3. Generic answer: teacher gives a definition containing a single reference to CPS model (e.g. "*stimulating in the student the desire to solve a situation or a question in order to obtain an answer to the problem*");
    4. Pertinent answer: teacher gives a definition containing two or more references to CPS model (e.g. "*PS is the typical way of research questioning each situation (...) and find solution together*").
- Examples of problem solving[3]
    1. Absent answer: teacher is unable to give an example;

[1] For this category the following questions of the interview have been clusterised: "*What is the role of computer in planning and carrying out your classroom activities?*"; "*What is the role of Internet in planning and carrying out your classroom activities?*"; "*How do your students use computer in classroom activities?*"; "*What is the added value of computer in classroom activities?*".

[2] For this category the following question of the interview has been taken into account: "*Could you please give a definition of Problem Solving?*".

[3] For this category the following question of the interview has been taken into account: "*Could you please provide an example of using Problem Solving in your classroom?*".

2. Not pertinent answer: teacher gives an example containing no reference to CPS model (e.g. “*studying the child emotions, so we made a circle time*”);
3. Generic answer: teacher gives an example containing a single reference to CPS model (e.g. “*we start form a problematic situation to find the answers on each topic*”);
4. Pertinent answer: teacher gives an example containing two or more references to CPS model (e.g. “*thinking that the plant needs water for growing (…) from their answer (…) we verify it in practice*”).

– Requirements of the CPS software[4]
  1. Absent answer: teacher is unable to give a requirement;
  2. Interface/functionalities: teachers focus on the requirements concerning the software interface (i.e. with respect to users’ age) and the functionalities they think useful to support educational practices (e.g. “*perhaps with some music*”, “*helping to build diagrams*”, “*related to children’s age*”);
  3. Type of problem: teachers focus on the type of CPS the software should support and the cognitive activities involved (e.g. “*not subject related, able to manage a problematic situation”, “I imagine it like a real situation, I mean to ask the pupil a question he can understand*”).

4 Results

4.1 Level of ICT expertise

Teachers interviewed have a medium level of ICT expertise (Fig. 1) and only 15% (3 over 20) uses PC systematically at school, 60 % (12 over 20) uses it once per week and 25% (5 over 20) never uses PC in didactics.

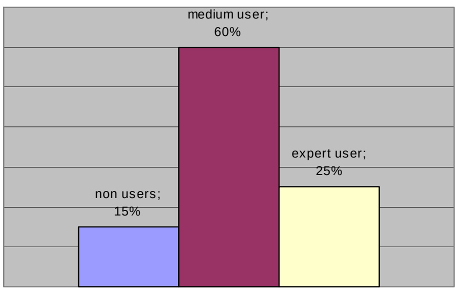

Fig 1. Teachers' expertise level

[4] For this category the following question of the interview has been taken into account: “*How do you imagine a software supporting CPS? What characteristics would you like it to have?*”. In this case categories are not exclusive so the answer could focus on more than one aspect.

The most frequent motivation to use computer use is to be updated about their work and to prepare documents (Table. 1):

Table 1. Motivation for personal computer use.

	Italian	English
Interview #16	prendo il materiale perché io lavoro molto con la civiltà, con la cultura, e il testo che abbiamo attualmente non è molto ricco, quindi attraverso internet sperimento molta roba	*I get material because I work with humanities and culture, and the textbook we use is not very rich, so I experiment many stuffs through Internet*
Interview #10	lo uso per fare la programmazione, apportare le modifiche, stampare	*I use it to prepare the subject plan, to modify it, to print it*

Only 25% of teachers declare that they use computer also to sustain activities in classroom (Table 2):

Table 2. Motivation for computer use in didactic.

	Italian	English
Interview #17	Comunque io diciamo li porto lo stesso, <u>sia</u> per la matematica, per spiegare il computer come è fatto, e <u>sia</u> anche per esempio per musica	*I often bring the pupils to the lab, for mathematics, to explain the computer, also for example music*

4.2 Definition and examples of PS

On of the aspects emerging from the analysis of the interviews is the distance between the definition of the PS that can be found in literature[5] and the definition provided by the teachers (Fig. 2). Only 10% of them is able to give a pertinent definition of PS, while 50% can define it only in generic terms. 25% gives a not pertinent definition.

A more problematic situation emerges when teachers are asked to give examples of PS in their didactic practices. Teachers seem unable to give practical examples coherent with theoretical definition, or with the definition they gave (Fig. 2). This gap is probably due to a superficial knowledge of PS or to the incapacity to recognize practices they use in classrooms as *Collaborative Problem Solving*.

[5] For this study, we didn’t refer to a particular definition of PS. The aim was to understand if the teachers could establish a relationship between theoretical knowledge and educational practices rather than verifying teachers qualification.

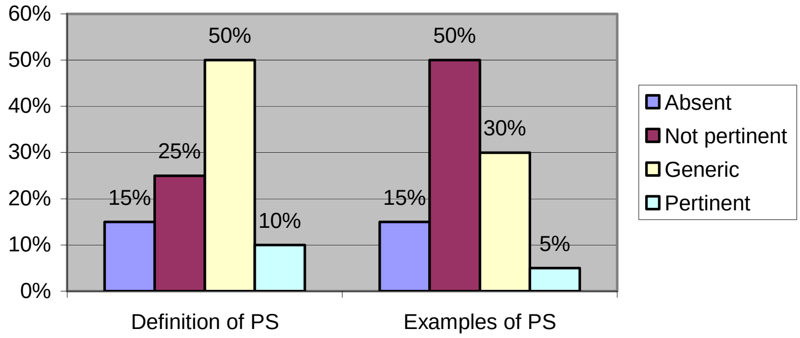

Fig. 2. Definitions of PS and examples of PS

4.3 Software requirements

The third aspect that has been investigated is requirements teachers consider relevant in a software system they would actually use in classroom. A large part of the interviewed (40%) is unable to describe any kind of features. When teachers provide an answer, it is about the interface and functionalities (Fig. 3).

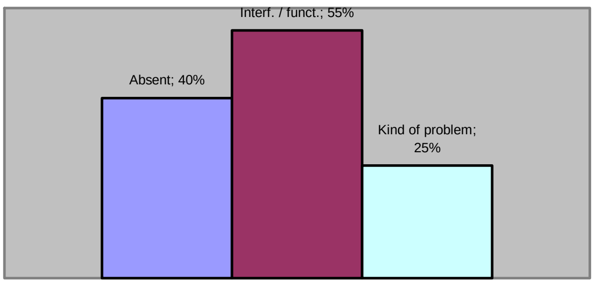

Fig. 3. Teachers' requirements for CPS software.

About interface, teachers ask for a software system that can be used autonomously by students and that is situated in children's real life (Table 3):

Table 3. Interface and functionalities requirements

	Italian	English
Interview #02	che preveda un momento in cui il bambino può utilizzarlo autonomamente ma che poi dia all'insegnante la possibilità poter concludere	*provide a moment in which the child can use it autonomously but then gives the teacher the possibility to finalise the activity*
Interview #10	i loro problemi reali, quindi mi immagino una cosa, una ripresa video e poi un'analisi successiva.	*about their real problems, so I imagine something with video clips and a successive analysis*

About type of PS, teachers imagine the software to support different problems also related to students' age (Table 4):

Table 4: Type of PS requirements

	Italian	English
Interview #12	in cui devi arrivare a una meta, risolvendo alcuni quiz.. dei giochi virtuali in cui c'è la ricostruzione di un percorso	*where you must reach a goal by solving some quiz. Some virtual games where you can reconstruct the path*
Interview #20	lo immaginerei con più soluzioni, magari lo stesso problema (…) .con gradi di difficoltà diversi	*with different solutions to the same problem (...) with different levels of difficulty*

5 Suggestions

Based on the results of these explorative interviews we can argue that:

1. teachers don't know much about CPS and they don't easily integrate it in classroom's curricular activities (e.g. "I gather the questions form children, if a pupil asks a question on his subject I find very difficult to connect it to an argument to a didactic unit that I have in my mind").
2. teachers have some requirements about a software to support Collaborative Problem Solving

Thus, design process of CPS software, at least for the Italian version, should include some kind of pedagogical support. Such support should be a short, synthetic, clear text containing theoretical, methodological, and bibliographical information.

To help teacher in designing and integrating CPS in everyday classroom activities, software should also provide a sort of template or wizard. Depending on some variables (e.g. number of students in classroom; age of students; subject of teaching), software should guide teacher through a set of phases and alternatives (e.g. problem definition; gathering information; hypotheses definition and assessment; solution of the problem). For each phase, software should present a set of possible activities (e.g. brainstorming; meta-cognitive scaffolding; laboratory activity; role play; jigsaw; etc.)

About teacher suggestion of CPS software, we may look more coherently into the *interface/functionalities* dimension that gather the most part of teacher answers. Nevertheless, it seems clear that teachers' answers don't mention any requirement concerning interactivity and group work dimensions.

We also suggest that further investigations should be carried out in different cultural contexts to provide more information useful for the design process.

References

1. Baker, M.J., Quignard, M., Lund, K. & Séjourné, A. (2003). Computer-Supported Collaborative Learning in the Space of Debate. In: B. Wasson, S. Ludvigsen and Hoppe, U. *Designing for Change in Networked Learning Environments*. Kluwer Academic: Dordrecht.
2. Baker, M.J. (2002). Argumentative interactions, discursive operations and learning to model in science. In P. Brna, M. Baker, K. Stenning & A. Tiberghien (Eds.), *The Role of Communication in Learning to Model*, pp. 303-324. Mahwah N.J.: Lawrence Erlbaum Associates.
3. Banathy, B.H. (1992). Comprehensive systems design in education: building a design culture in education. Educational Technology, 22(3) 33-35.
4. Berelson (1954) "Content Analysis" in G. Lindsey, *Handobook of Social Psychology: Theory & Method*, Vol. 1, 488-522. Cambridge, Mass: Addison-Wesley.
5. Brown, A.L., & Campione, J. (1990). Communities of learning and thinking, or a context by any other name. *Contributions to Human Development*, 21, 108-126.
6. Cole, M. (1996). *Cultural Psychology*. Cambridge: Belknap.
7. Collis and Van der Wende (2002), Models of technology and change in higher education: an international comparative survey on the current and future use of ICT in higher education
8. Dillenbourg, P. (ed) (1999). *Collaborative learning: Cognitive and Computational Approaches*. Pergamon, Amsterdam.
9. Dimitracopoulou A. (2004). Designing collaborative learning systems: current trends & future research.
10. Glaser, B.G. & Strauss, A.L. (1967) *The Discovery of Grounded Theory*. Aldine: Chicago
11. Jonassen, D.H. (2000). Toward a design theory of problem solving. *Educational Technology: Research & Development*, 48 (4), 63-85.
12. Kensing, F. & Blomberg, J. (1998). Participatory design: Issues and concerns. Computer Supported Cooperative Work, 7, 3-4, 167-185.
13. Overdijk, M. van Diggelen, W. (2006) Technology Appropriation in Face-to-Face Collaborative Learning. Paper presented at 1th European Conference on Technology Enhanced Learning (EC-TEL 2006), 1-4 october 2006, Crete (Greece).
14. Perret Clermont, A. N. (1979). *La construction de l'intelligence dans l'interaction sociale*. Berne: Lang.
15. Perriault, J (1989). *La logique de l'usage. Essai sur lesmachines à communiquer*. Editions Flammarion, Paris
16. Reigeluth, C. M. (1993). Principles of educational systems design. *International Journal of Educational Research*, 19 (2), 117-131.
17. Ruthven, K. Hennessy, S. Brindley, S (2004). Teacher representations of the successful use of computer-based tools and resources in secondary-school English, mathematics and science. *Teaching and Teacher Education*, 20 (2004) 259–275

18. Slavin, R.E. (1989). Research on cooperative learning: An international perspective. *Scandinavian Journal of Educational Research*, 33 (4), 231-243
19. Resnick, L.B. Levine J.M. & Teasley S.D. (Eds.) (1991), *Perspectives on Socially Shared Cognition*. Washington DC: American Psychological Association.

Professional Learning, Competence Development and Knowledge Management - LOKMOL and L3NCD

October 2, 2006

Crete, Greece

Organizing Committee

Martin Memmel (German Research Center for Artificial Intelligence DFKI GmbH, Germany)
Eric Ras (Fraunhofer Institute for Experimental Software Engineering, Germany)
Stephan Weibelzahl (National College of Ireland, Ireland)
Daniel Burgos (Open University, The Netherlands)
Rob Koper (Open University, The Netherlands)
Daniel Olmedilla (L3S Research Center, Germany)
Demetrios Sampson (CERTH, Greece)
Martin Wolpers (KUL, Belgium and L3S Research Center, Germany)

Program Committee

LOKMOL

Gabriela Avram (Ireland)
Andrea Back (Switzerland)
Stephan Baumann (Germany)
Ines Grützner (Germany)
Rob Koper (The Netherlands)
Stefanie Lindstaedt (Austria)
Andreas Schmidt (Germany)
David Wiley (USA)

L3NCD

Sandra Zilles (Germany)
Stefano Ceri (Italy)
Eric Duval (Belgium)
Dai Griffiths (UK)
Anna-Karina Kaimaro (Finland)
Alexander Karapidis (Germany)
Barbara Kieslinger (Austria)
Oleg Liber (UK)
Patrick McAndrew (UK)
Ambjörn Naeve (Sweden)
Wolfgang Nejdl (Germany)
Gilbert Pacquette (Canada)
Griff Richards (Canada)
Mike Spector (USA)
Colin Tattersall (The Netherlands)
Klaus Tochtermann (Austria)
David Wiley (USA)

Joint International Workshop on Professional Learning, Competence Development and Knowledge Management - LOKMOL and L3NCD

Martin Memmel[1], Eric Ras[2], Stephan Weibelzahl[3] (LOKMOL)
Daniel Burgos[4], Daniel Olmedilla[5], Martin Wolpers[6] (L3NCD)

[1] German Research Center for Artificial Intelligence DFKI GmbH,
Erwin-Schrödinger-Straße 57, 67663 Kaiserslautern, Germany
Martin.Memmel@dfki.de
[2] Fraunhofer Institute for Experimental Software Engineering
Fraunhofer-Platz 1, 67663 Kaiserslautern, Germany
Eric.Ras@iese.fraunhofer.de
[3] National College of Ireland, Mayor Street, Dublin 1, Ireland
sweibelzahl@ncirl.ie
[4] Open University of the Netherlands
Daniel.Burgos@ou.nl
[5] L3S Research Center, Expo Plaza 1, 30539 Hannover, Germany
olmedilla@L3S.de
[6] Katholike Universiteit Leuven, Celestijnenlaan 200A, 3001 Leuven, Belgium
Martin.Wolpers@cs.kuleuven.be

1 Introduction

In many organizations most working processes are very knowledge intensive and involve many people working at different locations and on different tasks. The context in which people are working is changing constantly through changing work processes, different tasks or problems to be solved, and evolving technologies which are used at work. These facts require life-long competence development. Competency development takes mostly place during informal learning at the workplace. The learning process is characterized by self-organized activities such as selecting the environment for learning (e.g., Internet), defining learning goals (e.g., related to a work problem), finding and selecting content for learning (e.g., websites or colleagues), and following a preferred learning path.

Beside a continuous formal competence development, sharing knowledge among members of the organizations and making ones knowledge explicit for others is crucial. Working and learning takes place in a network of people, tools, environments, and knowledge. These networks facilitate interaction and communication
The use of available e-Learning and Knowledge Management applications in a network setting can help to address the challenge of continuous competence development.

However, questions arise how these methodologies and technologies of the different domains fit together in order to ensure that the learned can be transferred to

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 108-114, 2006.

the workplace and to improve the performance of each individual? How can we foster interaction and provide a personalized learning experience according to the current situation and context (e.g., flexible guidance for self-directed learning, adaptive content selection and structuring)? How can we better use existing networks for competence development and how can we ensure that learning goals are based on real-world needs? How can we engage learners and actively involve them in the learning process through interaction?

The high potential for synergies between Knowledge Management (KM) and e-Learning seems obvious given the many interrelations and dependencies of these two fields. However, the relationship is not yet fully understood and harnessed. KM addresses learning mostly as part of knowledge sharing processes and focuses on specific forms of informal learning (e.g., learning in a community of practice) or on providing access to learning resources or experts. Current KM technologies focus on knowledge acquisition, storage, retrieval, and maintenance. However, regarding the deployment process, learning is considered to be a fundamental part of KM because employees must internalize (learn) shared knowledge before they can use it to perform specific tasks. On the other hand, e-Learning systems might also benefit from KM technologies. Especially the ones focusing on the support of technical and organizational components can play an important role concerning the development of professional e-Learning systems.

During the last years, so-called Web2.0 technologies, such as Wikis and Blogs, received more and more attention and they are currently used in many different domains. So far, these technologies seem to have a positive impact in terms of community building, knowledge sharing, and content creation - even if their success has not been empirically proven. First questions arise, to what degree these systems (e.g., Weblogs, Wikis, XML/RSS based content syndication and aggregation) support certain learning processes.

This workshop is made out of two different calls for papers. On the one hand, LOKMOL (Learner-Oriented Knowledge Management & KM-Oriented E-Learning), based on the insight that KM technologies need to take into account findings from social sciences such as pedagogy or psychology, to be effective in terms of learning and that learning can profit from KM technologies. In fact, there is a gap between well organized, but monolithic and inert e-Learning material such as courseware on the one hand and dynamic and flexible knowledge bases that are often not able to activate learning processes on the other hand. An integration of KM and e-Learning, especially by using Web2.0 technologies, could dramatically change today's understanding of further education towards lifelong learning fed by dynamically changing public and organizational knowledge repositories. Web2.0 technologies already incorporate the network paradigm of continuous documentation, sharing, and construction of new knowledge.

On the other hand, L3NCD (Life Long Learning Networks for Competence Development), based on the experience of the European projects TENCompentence (www.tencompetence.org) and ProLearn (www.prolearn-project.org). Researchers in the workshop are able to identify and analyse current research and technologies in certain fields in order to support individuals, teams and organisations to (further) develop their competences, using all the distributed knowledge resources, learning activities, units of learning and learning routes/programmes that are available online.

Recent developments clearly indicate a change in the way we acquire and improve our level of expertise in some field or another. Life Long Learning Networks and Competence Development are two relevant topics focusing on continuous education to support new ways to our professional development. Getting some personal competences that provide a good framework beyond the established curriculum is a crucial issue to get and consolidate any professional position. On the other hand, learning networks are an excellent way to acquire and to share knowledge in an informal communication process. The combination of both topics enables the development of tools and methodologies to improve personal competences while, possibly at the same time, contribute to the development of other learners.

The requirements of the models and technologies to support such integrated facilities differ considerably from those traditionally required from technologies that support lifelong learning, or to enable company knowledge dissemination and knowledge management needs. The lifelong competence development of each individual and the multi-institutional and episodic nature of this learning are not reflected in today's mainstream learning and knowledge technologies and their associated architectures.

As a result of these two calls for papers, LOKMOL and L3NCD bring together a common workshop providing a pool of interesting and highly related topics: Professional Learning, Competence Development and Knowledge Management.

2 Workshop Topics

Adaptivity and Personalization

Providing information tailored to an individual’s needs and preferences is a key factor for the success of professional learning. Thus, systems must take into account the current situation and context to be able to deliver an appropriate learning experience. Learner-oriented knowledge structuring and the ability to deliver “just enough” information “just in time” are key technologies to enable such an experience.

Rostanin & Schirru [7] present a method for learning goal elicitation by using information derived from an enterprise workflow management system. Adaptive presentation generation is enabled by using the learning goals to select appropriate content and a learning strategy. Ley et al. [5] use the competence performance approach to support informal learning interventions. In this approach, competencies are used to structure single learning resources according to the underlying knowledge need. Braun & Schmidt [2] give an overview about the potential of “social awareness”, claiming that technological support must become more aware of the social context of the individual in order to be able to provide adequate support.

Collaborative Work and Collaborative Learning

As working and learning often takes place in a network of people and (KM) tools, an appropriate support by these tools can also stimulate learning processes. Moreover, collaboration is facilitated by a lot of social web applications that become more and more popular.

Allert et al. [1] focus on scenarios of ontology-based collaborative learning, while Braun & Schmidt [2] investigate the influence of the social context of a user, e.g., when using an "expert finder" component. Kohlhase [3] addresses the topic of users as consumers and producers using the notion of content collaboration as example for the "Prisoner's Dilemma".

Users as content consumers and producers

Nowadays, users are often no longer acting just as consumers of content. User generated content has become more and more important in the recent years, fostered especially by the use of Web2.0 technologies like Wikis and Blogs. These developments do not only support sharing knowledge, but also an active involvement in the learning process. However, there's still a lack of deeper analysis concerning the success of these methods in different scenarios.

Kohlhase [3] analyzes social tagging as a technique being used very successful in various applications within the Web2.0 context to investigate how users can be stimulated to contribute.

Lifelong Learning Networks and virtual learning communities

Koulouris & Sotiriou [4] research on the use of Long Life Learning Networks in rural environments and show how powerful are and how many benefits the users can take out of it. In doing so, it is needed to establish members' commitment to the domain, and facilitate community development by assisting them to engage in joint activities and discussions, help each other, share information and learn from each other in a collaborative way, while pursuing their interest in their domain. This will indeed be a community of practice rather than a mere community of interest.

On the other side, Varlamis & Apostolakis [8] address that the gains from the use of a virtual learning community [9] are many for universities and students, as the students have the ability to exchange empirical knowledge while carrying out learning activities and the tutors can increase the consultation time through forums. On the other hand, when communities are in contact with companies, they receive information on new products and reading material, thus promoting professional excellence of educators.

Personal Learning Environments

Wilson et al. [10] state that VLE is clearly the dominant design in educational technology today, and is nearly ubiquitous in higher education institutions. There is a desire to bridge the worlds of formal and informal learning and to realize the goals of lifelong learning by the increasingly prevalent forms of social software and the new paradigms of the web as technology platform. The VLE is by no means dead, and those with investments in this technology will attempt to co-opt new developments into the design in order to prolong its usefulness.

3 Concluding Remarks

In this chapter we reviewed the contributions to the Joint International Workshop on Professional Learning, Competence Development and Knowledge Management. Similar to what we found in the previous LOKMOL workshop [6], these three topic areas can be brought together and even integrated in a variety of different ways. Life-Long Learning is an important task and challenge of the future, both for organizations as well as for the community as a whole. KM and e-learning technologies offer opportunities to master this challenge by contributing and facilitating to continuous competence development in trainings and at the workplace.

In particular, the workshop identified three emerging trends that look promising and that present a number of research questions:

- *User Orientation:* KM technologies provide huge potential for delivering content and information that is tailored to the individual needs of the user or learner. Rather than a one-size-fits-all approach, as frequently adopted in early e-Learning products, the learner should be put into the center of the learning process. User adaptivity and personalization in accordance with individual preferences, learning goals, needs or learning styles might improve the learners' motivation and the learning effect. Individually tailored knowledge chunks delivered in a timely manner offer learning opportunities that would not be available otherwise.
- *Collaboration:* Collaboration in a variety of formats became popular with the adoption of the social web, the so-called Web2.0. For instance, learners collaborate or cooperate in communities of practice as well as for informal or self-directed learning. Social web technologies aim to exploit the power of the social knowledge, by facilitating common efforts (e.g., wikis, blogs) or by providing information about the behavior of peers (e.g., social tagging). A number of examples demonstrate how this can be harnessed for learning. In the context of Life-Long Learning , learners must be enabled to build and maintain communities that are stable enough to provide over-lasting, trust-worthy social contacts, but that are flexible enough to cater for the ever changing learning needs.
- *Activity centered:* Both e-Learning and KM used to be very much focused on content delivery as opposed to learning activities. The recent trend towards richer, interactive content has also been recognized in this workshop. Explicit modeling of and adaptation of technologies to the learners' activities will make learning at the workplace more natural and effective.

The workshop also stressed again the fact that effective and efficient competence development can be achieved only in an interdisciplinary effort. Pedagogy, sociology, psychology, business administration and computer science can make valuable contributions to this field, but need to learn from each other. We are confident that the workshop represents a step towards this goal by outlining synergies and opportunities for research and practice.

Acknowledgements

We would like to thank all individuals and institutions who contributed to the success of the workshop: the committee of the ECTEL2006 conference for providing a perfect basis for organizing and conducting this workshop, the authors for submitting their papers and lending us their insight into recent developments in their research areas and the program committee members (see below) for their hard work reviewing the submitted papers.

LOKMOL

- Gabriela Avram, University of Limerick, Ireland
- Andrea Back, University of St. Gallen, Switzerland
- Stephan Baumann, DFKI GmbH, Kaiserslautern, Germany
- Ines Grützner, Fraunhofer IESE, Kaiserslautern, Germany
- Rob Koper, Open University of the Netherlands
- Stefanie Lindstaedt, Know-Center, Graz, Austria
- Andreas Schmidt, Forschungszentrum Informatik, Karlsruhe, Germany
- David Wiley, Utah State University,
- Sandra Zilles, DFKI GmbH, Kaiserslautern, Germany

L3NCD

- Stefano Ceri, Politecnico di Milano, Italy
- Eric Duval, Katholieke Universiteit Leuven, Belgium
- Dai Griffiths, University of Bolton, UK
- Anna-Karina Kaimaro, Helsinki University of Technology, Finland
- Alexander Karapidis, Fraunhofer IAO, Germany
- Barbara Kieslinger, Center for Social Integration, Vienna, Austria
- Oleg Liber, University of Bolton, UK
- Patrick McAndrew, Open University of the United Kingdom
- Ambjörn Naeve, Royal Institute of Technology, Stockholm, Sweden
- Wolfgang Nejdl, L3S Reseach Center, Hannover, Germany
- Gilbert Pacquette, Licef, Canada
- Griff Richards, Simon Fraser University, Canada

- Mike Spector, Florida State University, USA
- Colin Tattersall, Open University of the Netherlands
- Klaus Tochtermann, Know-Center Graz, Austria
- David Wiley, Utah State University, USA

References

1. Allert, H., Markkanen, H., Richter, C.: Rethinking the Use of Ontologies in Learning. This volume. (2006)
2. Braun, S., Schmidt, A.: Socially Aware Informal Learning Support: Potentials and Challenges of the Social Dimension. This volume. (2006)
3. Kohlhase, A.: The User as Prisoner: How the Dilemma Might Dissolve. This volume. (2006)
4. Koulouris, P., Sotiriou, S.: Building Lifelong Learning Networks of Teachers for the Development of Competence in Teaching in Small Rural Schools. This volume. (2006)
5. Ley, T., Kump, B., Lindstaedt, S. N., Albert, D., Maiden, N. A. M., Jones, S.V.: Competence and Performance in Requirements Engineering: Bringing Learning to the Workplace. This volume. (2006)
6. Ras, E., Memmel, M., Weibelzahl, S.: Integration of E-Learning and Knowledge Management - Barriers, Solutions and Future Issues. In Professional Knowledge Management (Berlin, 2005), K.-D. Althoff, A. Dengel, R. Bergmann, M. Nick, and T. Roth-Berghofer, Eds., Lecture Notes in Artificial Intelligence LNAI, Vol. 3782, Springer Verlag. (2005)
7. Rostanin, O., Schirru, R.: Identification of User's Learning Goals in Workflows. This volume. (2006)
8. Varlamis, I., Apostolakis, I.: A framework for building virtual communities for education. This volume. (2006)
9. Wenger, E.: Communities of practice: learning, meaning, and identity. Cambridge: Cambridge University Press. (1998)
10. Wilson, S., Liber, O., Johnson, M., Beauvoir, P., Sharples, P., Milligan, C.: Personal Learning Environments: Challenging the dominant design of educational systems. This volume. (2006)

Rethinking the Use of Ontologies in Learning

Heidrun Allert[1], Hannu Markkanen[2], Christoph Richter[1]

[1]University of Applied Sciences Upper Austria, Campus Hagenberg,
Hauptstr. 117, 4232 Hagenberg, Austria
{Christoph.Richter, Heidrun.Allert}@fh-hagenberg.at
[2]EVTEK University of Applied Sciences
Vanha maantie 6, 02150 Espoo, Finland
hannu.markkanen@evtek.fi

Abstract. This paper investigates the use of ontologies in processes of collaborative learning and knowledge generation. The creation and use of ontologies is analysed from an activity theoretical perspective in order to understand processes of shared conceptualization as well as the role of ontologies in processes of change and transformation. Scenarios of ontology-based collaborative learning and knowledge-creation are presented. This work is based on the cultural-historical activity theory, providing a theoretical framework (1) for understanding processes of knowledge-creation which take place when generating and using ontologies and (2) to investigate the dynamic relationship (coupling) between individual learning and the transformation of a community.

1 Introduction

A fundamental challenge for modern societies is to organize both work and learning in a way that goes beyond the reproduction and use of preexisting knowledge and contributes to the generation of innovative solutions and knowledge, such as new theories, innovative work flows, and advanced technological products. Here, knowledge generation is a common intention of learning and knowledge management. To address this challenge diverse approaches have been developed in the fields of knowledge management as well as in education. These approaches, which can be subsumed under the so called “knowledge-creation metaphor of learning” [21] conceptualize learning and knowing as a social process where people collectively improve their understanding by generating shared knowledge artefacts. As knowledge creation is directed towards the creation of shared artefacts, the development of a shared understanding about the knowledge domain becomes crucial. Therefore the collaborative creation of ontologies and conceptual models lends itself to this task quite naturally. But, while much effort has been spent on the definition of ontology languages and the automated processing of ontologies, the individual and social processes underlying the creation, use, and evolution of ontologies, as well as the potential of ontologies to foster processes of knowledge creation are not yet being studied to its full extent [11].

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 115-125, 2006.

This paper explores how to utilize ontologies to support and trigger processes of knowledge creation. Unlike in present ontology-based learning applications, we are interested in exploring learning processes where learners collectively advance their individual and shared understanding through social interaction. This work is based on the cultural-historical activity theory as a theoretical framework, capable to explain the generation and evolution of ontologies from a social as well as an individual perspective. Section 2 illustrates the usage of ontologies in education and defines the core terminology. Section 3 gives an outline on the *cultural-historical activity theory* and discusses ontologies for learning from an activity theoretical perspective. Section 4 explores ways to use ontologies in education and outlines several educational scenarios. Section 5 sets up directions for further work.

2 The Usage of Ontologies in Learning

The term *ontology* has generated substantial controversy. As one can find many definitions in the current literature, this paper provides some introductory remarks on terminology and presents how ontologies are used in learning. It explores the status of ontologies from an activity theoretical perspective. Even though they are rarely acknowledged as such, ontologies are a cognitive tool in a wide range of settings where learning takes place. Learners often actively deal with ontologies in learning processes. For example, students learn to read geographical maps. In order to read and understand the map, they have to understand the underlying ontology codified in the different shapes, colors and symbols and explained in the legend. In another setting learners use a basic ontology of argumentation as they learn to analyze an argument distinguishing between a fact, a hypotheses, a question, and a conclusion. In order to find a certain book in the library students have to become familiar with some academic ontologies on scientific disciplines. A project team developing a shared file-system to organize their documents has to agree on a shared ontology. When being asked to describe a certain business process students have to decide and to agree on the concepts relevant to describe such a process. In this work, ontologies are discussed as a concept used in computer science, deliberately excluding other denotations. We refer to the following often used definition: “An ontology is a formal explicit specification of a shared conceptualization for a domain of interest” [14]. An ontology includes a vocabulary of terms, and some specification of their meaning [16]. This includes definitions and an indication of how concepts are related, which imposes a structure on the domain and constrains the interpretations of terms. Ontologies formally define the semantics of concepts and their relations for a specific domain. Ontologies are socially shared artifacts as their generation requires a cooperative process in order to gain a consensual representation of the collective knowledge on the domain [11]. As ontologies arise as a result of cooperation within communities, they are inevitably aligned with a particular perspective on the domain of interest. This perspective defines the *underlying rationale* and *theoretical foundation* of the ontology, irrespective if it is explicitly stated or not. We refer to an ontology as a *conceptual model* and to the underlying theoretical foundation of an ontology as the *meta-model* of the ontology. Ontologies can be represented in diverse languages. While informal ontologies and conceptual models can be described by graphical modeling languages, formal ontologies and their instantiations are usually expressed in formally defined languages. In the context of the semantic web RDFS or OWL (http://w3.org/TR/owl-guide/ and /rdf-schema/) provide such ontology languages.

3 An Activity Theoretical Perspective on Ontology Development

An ontology by definition is a socially shared artefact. It provides a shared understanding of the semantics of objects and their relationships within a certain domain. As shared mediating artefact it is a prerequisite for communication and collaboration within a community. Even though each member of a community might have its own “private” ontology, these personal conceptual models evolve and are shaped in the context of social interaction. Due to the socially shared nature of ontologies, learning theories that focus on individual learning processes fall short to explain the socially shared development of ontologies. Ontologies are created at the intersection of individual learning and the collective transformation of a community. In the following, the cultural-historical activity theory serves as a theoretical framework to explain ontology development from a social as well as an individual perspective.

3.1 The Cultural-Historical Activity Theory

The following is a fragmentary synopsis of the *cultural-historical activity theory*, stressing those aspects that are relevant with regard to the role of ontologies in work and learning. For a more comprehensive introduction the reader is referred to [26], [18], [10]. The cultural-historical activity theory is originated in the works of Vygotsky [26] and extended by Leontjev [18] and Engeström [10]. The theory provides a framework for describing and analysing collaborative processes. In contrast to psychological theories of human action which focus on cognitive processes of the individual on the one hand and sociological theories describing work and activity as merely social phenomena on the other hand, the cultural-historical activity theory stresses the *dynamic interrelation of individual processes and the social context* they are embedded in. It allows explaining the dynamic relationship between individual learning and the transformation of knowledge within a community.

The essential premises of the cultural-historical activity theory can be summarized as follows. (1) Human activity is object-oriented, i.e. it is directed towards a material or ideal object that is transformed or manipulated by the activity. It is the object and not the goal that allows distinguishing different activities from one another. (2) Activities are mediated by tools and signs, which are constitutive elements of any activity system. They are mediating artefacts ranging from physical tools over less tangible artefacts like plans and spreadsheets to scientific theories and languages. Mediating artefacts capture and preserve the socially shared knowledge developed in a community [18], [24]. (3) Human activity cannot be detached form its social context as every activity draws on artefacts which are the result of cultural-historical development. The meaning of an activity is bound to its interpretation within a social context. (4) Learning is an ongoing process of mutual-dynamic adaptation of culture and the individual. By means of an activity, the individual successively opens itself to the scope of options provided by the culture. In turn, culture is created by individuals' activities [20]. Learning is directed towards the co-construction of shared mediating artefacts, e.g. the conceptualization of a shared conceptual artefact. (5) Activity theory is interested in processes and practices that differ from expectations and anticipations as well as deviate from routines and taken-for-granted assumptions [9]. Consequently, it foregrounds breakdowns, conflicts, deviations, discoordinations, disturbances, tensions, and unofficial work-arounds that tend to be explained away by other approaches. These are assumed to be signs of deeper contradictions among the elements of activity system or between interacting activity systems [15]. Activity systems are never static but evolve, e.g. when contradictions emerge between the elements within an activity system or between interacting activity systems. The elements within an activity system can not be detached and isolated from each other.

3.2 Activity Theory and Ontologies

Before we explore the role of ontologies within the context of learning, it is important to clarify the concept of ontologies from an activity theoretical perspective. The mediation of activities is not limited to physical tools but encompasses linguistic, conceptual, as well as cognitive artefacts, including theories, models and languages [24]. Therefore, it is argued that an ontology or a conceptual modeling language also constitutes an artefact capable to mediate human activity. Given the understanding of an ontology or conceptual modeling language as a shared mediating artefact (tool) that can be used to modify or transform a certain object several implications impose themselves. An ontology is by no means neutral, neither to the subject nor to the object of the activity, but is part of the activity system. The ontology used in a certain activity system has an impact on both the subject and the object. Accordingly the utility of an ontology is bound to the object and the subject of the activity and cannot be assessed independently. Secondly, an ontology like any other mediating artefact is the result of a cultural-historical development process within a certain community. As mediating artefacts are objectifications of socially shared knowledge and are build on specific premises it is likely that ontologies not only vary in their terminology but also reflect different theoretical foundations [1]. Thirdly, an ontology can become the object of an activity itself and can be modified or transformed. As ontologies provide powerful tools for organizing and assigning meaning and directly relate to the epistemological foundations held within a community, the analysis and development of ontologies is an important and sometimes drastic intervention. The domain of psychiatry provides an example for the dynamic relationship between individual learning and transformation of a community: Kraepelin's ethiology-based classification system, which is based on the underlying rationale that deceases can be classified according to its causes, has been the first systematic classification scheme in psychiatry (~1900). It forms the basis for the first standardized International Classification of Deceases (ICD). Despite continuous specification and modification inconsistencies became obvious in work practice using the ontology. As the ontology did not well support work practice of individuals, the community reconstructed the ontology and its underlying rationale and now classifies psychological deceases by specifying its syndromes. Changes in the ontology and its theoretical foundation came along with transformation of knowledge in the activity system itself.

3.3 The Role of Ontologies in Knowledge-Creation

The development and use of conceptual models in learning has been a research topic of the learning sciences for many years. While the earlier works focussed on the individual learner, the collaborative use of conceptual models has become a research field in its own later on [19]. Despite the ongoing interest in the use of conceptual models for learning, there is a lack of theoretical as well as empirical work regarding the role of ontologies in collaborative learning and knowledge creation. The following is an attempt to chart uses of ontologies for learning and to sketch respective challenges from a learning sciences point of view. Ontologies (whether explicit or not) provide a common ground for a community. Participation within any kind of community requires familiarity with its (explicitly and implicitly stated) ontologies. Accordingly knowing and applying domain specific ontologies is an integral part of vocational training, e.g. the classification of diseases for a nurse. To become familiar with an ontology does not only mean to recall the concepts and their relations correctly but also to use them as a tool when carrying out an activity. Using an ontology is a challenging tasks for a learner: There is not a single ontology as communities often create and use multiple ontologies which do not necessarily map to each other. Accordingly, the learner has to be familiar with multiple ontologies, be able to mediate between them and to know when to use which one. The competent use of an ontology requires to understand the underlying rationale on which it is built, its theoretical foundation, as well as its historical evolution. In order to grasp the provisional character of ontologies the learner must have developed a sophisticated set of epistemological beliefs himself [5].

Shared conceptual models are never static but are constantly transformed as the activity system evolves. Therefore, it is crucial to treat ontologies as the object of an activity itself. New communities have to construct their ontologies from scratch or have to change existing ontologies due to changing practices. Changing work practices often enforce transforming ontologies. The shared conceptualization of an ontology provides a genuine opportunity for learning for the individual (individual learning) as well as the community itself (knowledge generation and transformation of the community, e.g. organizational and societal learning). The shared conceptualization of an ontology has the capability to provoke cognitive conflicts and helps to unravel prevalent misunderstandings: Processes that can trigger significant learning [22].

3.4 Meta-Models as the Object of Activity

Not only an ontology but also its meta-model and underlying theoretical foundation can become an object of activity. The change of a meta-model and the corresponding underlying rationale and theoretical foundation is associated with transformation and change within an organisation and a community. Knowledge generation takes place in making conflicts and contradictions explicit. Ontologies which are based on conflicting meta-models and underlying rationales can and must not simply be mapped, merged and integrated automatically as they provide the opportunity to generate innovative knowledge as well as organizational and collective learning. This is based on a central principle of activity theory: Conflicts, tensions, and contradictions are assumed to be signs of deeper contradictions among the elements of an activity system (or between interacting activity systems) [15]. The following example demonstrates this: [7] describes the results of an analysis of the formal and informal structure of a huge petroleum organization, depicted by an organigram and a sociogram respectively. Both models are essential to define the problem, to gain insight, to understand the problem, and to propose a solution as each model provides a unique perspective onto the organization. Regarding the use of ontologies this means that learning not necessarily requires mapping and integrating ontologies, but that crucial insights become apparent when incommensurable ontologies based on different meta-models are contrasted. The analysis of meta-models opens up perspectives that go beyond those provided by using a single ontology. The work on meta-models is seen as a profoundly reflective activity tackling the theoretical foundation of a community. Change occurs when a community gives up a certain meta-model and introduces a new one. The comparison of different meta-models allows questioning the theoretical foundation. As the refinement of conceptual models can be seen as a process of successive optimization, changes in the meta-model come along with qualitative changes in the activity system itself. Both, ontologies and meta-models are a means of learning. In this sense the work on meta-models parallels the idea of double-loop learning as proposed by [2].

4 Using Ontologies to Foster Learning

This section explores ways to use ontologies in educational settings. Due to the fact that ontologies provide a socially shared conceptualization we focus on collaborative learning and knowledge creation. Scenarios are presented to exemplify collaborative practises to support ontology-based knowledge creation in education.

4.1 Existing Approaches

Besides one reference [8], a literature review on using ontologies in learning ended without any noteworthy results. Nevertheless there are at least two areas of research on the use of ontology development to foster learning. Even though they are either not explicitly focusing on ontologies (e.g. concept mapping) or do not lend themselves to learning as in the sense of collaborative construction of ontologies, they provide a valuable base to reveal methods for ontology development as a learning method.

Concept Mapping. There are many commonalities between ontology development and concept mapping in terms of learning. Concept maps are used in educational settings e.g. as a technique for teaching conceptual thinking and for externalizing learner conceptualization of a domain [6]. [4] proposes using conceptual models as advance organizers in instructional design. Concept maps can be developed by individual learners to externalize and organize thoughts, providing a means for reflection and for extending the capability to recall things. Concept mapping techniques have also been applied in evaluating students' learning. [6] proposes concept mapping to capture a student's understanding of the ontology of a domain, as well as to infer his/her misconceptions. Concept mapping is used in scenarios of collaborative learning. [12] describes a scenario where individual students have to develop concept maps for a specific domain of interest and link them to associated materials. Peers then assess these maps, modify and enhance them, and provide alternative versions. While many of the tools and methods developed for concept mapping might also be applied in the context of ontology development, there are limitations of current approaches. Based on the examples found in literature concept mapping often is performed as an isolated task, solely focusing on the explication and negotiation of concepts without being embedded within a purposeful activity. This might hinder learners to see the mediating and dynamic nature of ontologies.

Collaborative Construction of Ontologies. As the potential of constructing ontologies as a means to foster knowledge creation has hardly been recognized in education, there is a lack of respective models. Several methods to facilitate ontology construction processes have been developed in knowledge engineering [13]. Ontologies are usually designed by expert knowledge engineers, who are often not aware of the conflicting views of the specific target domain in question (medicine, process management, etc.) and the respective conceptual models held within a specific domain [3]. To overcome this problem proposals for organizing the cooperative construction of ontologies in (distributed) groups of human actors have been made. [3] proposes a three-phased ontology construction procedure consisting of a generation phase (joint brainstorming on relevant concepts), an explication phase (a joint taxonomy is worked out), and finally the integration phase (the proposals are negotiated into a shared conceptualization supported by a human mediator). [17] presents the Human-Centered Ontology Engineering Methodology (HCOME) for the development of dynamic ontologies, which are seen as a means to explicate conceptualizations that are constructed by humans during practice. The approach aims to empower knowledge workers to manage their formal conceptualization in daily tasks through a continuous process. Methods for the collaborative construction of ontologies provide valuable input to the use of ontologies in education. However, the strategies described above fall short with regard to knowledge creation and learning as they do not provide means to foster reflection on the value and role of the ontology.

4.2 Scenarios of Ontology-Based Collaborative Knowledge Creation

The following scenarios present practices to support ontology-based knowledge creation within communities. In the first and second scenario ontologies are used as tools. In the third scenario, the ontology is the object of the activity. The fourth scenario deals with the use of multiple ontologies and their respective meta-models.
Using Existing Ontologies to Carry out an Activity. To become familiar with the ontologies, classification schemas, and conceptual models used in a certain domain or

professional community is an important learning objective in many training programs. In order to train the competent use of existing ontologies learners can be assigned tasks that require the use of the ontology to carry out an activity. Students in a course on biology have to classify the plants they found on an excursion. Using an ontology not only requires to know the ontology itself, but also to understand the underlying logic. The task becomes even more challenging when there are different and competing ontologies available.

Using Ontologies to Organize or Annotate Shared Artefacts. Both in project- and problem-based learning students often have to deal with a plethora of artefacts that have to be organized, stored and retrieved during the learning process. Ontologies can be used to sort and classify artefacts relevant to the problem. Students assigned to carry out an empirical investigation conduct a literature review and organize the results according to a shared conceptual model. The need to use ontologies for this purpose grows in relation to the amount of shared documents and the duration of the project. While students might have access to existing reference ontologies, it might also be useful that the students develop an ontology on their own.

Collaborative Ontology Development as Part of an Overarching Task. In this scenario a group of students develops a shared ontology to make sense of concepts and relations relevant to their task at hand. As ontologies are not just externalizations of mental models but have to proof their utility in practice, the process of ontology creation should not be an end in itself but an integral part of a more overarching task. Developing a shared ontology requires a lot of collaborative effort in order to gain an improved comprehension of the domain and how it might be conceptualized. Learners produce networks of linked ontologies and associated resources. The process can become very complex, particularly in long-term advancement of shared knowledge artefacts, a process typical to project- or inquiry-based learning.

Collaborative Inquiry Based on Multiple Ontologies. In this scenario students use multiple ontologies in parallel to solve a problem. Each student develops his/her own conceptual model. Then the students compare their models. A group is encouraged to describe the problem from different points of view using multiple ontologies. A group of students in computer science is asked to conceptualize a problem from a technical as well as a social perspective. In contrast to the development of a shared ontology, the goal is not to merge or map the different perspectives, but to use them to shed light on a problem from different angles.

A prevailing characteristic of this learning scenario is the use of multiple ontologies in parallel. The issue of dynamic and multiple classification, hardly addressed by current conceptual modeling techniques, becomes apparent when multiple domain-ontologies are used to describe a common set of resources. According to [23] the concurrent use of multiple domain-ontologies requires an explicit distinction of contexts. In order to allow for dynamic modeling [25] recommends introducing the concept of *roles* into object-oriented modeling. This approach distinguishes *natural-types* (class-types) and *role-types*. Instances of natural-types can fill and leave a role without losing their identity. An instance of a natural-type can fill different roles in different contexts. According to [1] the *role-*

based modeling approach allows describing coherent and theoretically founded conceptual frameworks and activity systems while at the same time allows semantic interoperability by defining attributes of natural-types.

Ontologies as Meta-Cognitive Tools. The use of ontologies in learning, focusing on the concepts of a specific knowledge domain (typically the nodes in a node-arc-node diagram) often sticks to learning facts. It lacks to support the development of meta-cognitive skills, such as the competence to carry out research, comprising argumentation, inquiry, and knowledge generation. Meta-cognitive tools comprise e.g. an ontology of argumentation and an ontology of progressive inquiry. Ontologies which specify different types of knowledge are integrated in tools like Belvedere and the Future Learning Environment (FLE3), but are not explicitly stated as such. The use of an argumentation ontology is depicted in figure 1.

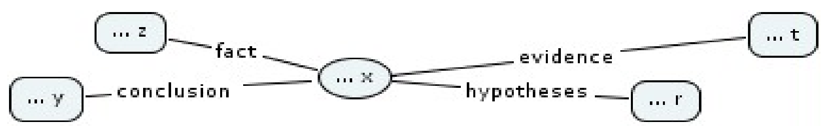

Fig. 1. An argumentation ontology which helps to develop meta-cognitive skills.

5 Discussion and Further Work

Ontology development as learning method is mentioned in [8] with a conclusion that "a good suite of tools, integrating both learning environments and ontology development tools, are required in such a learning process". The rationale for using formal languages to represent conceptual models developed by learners is that formal languages will enable many kinds of applications that are based on automatic or semi-automatic processing of the formal models. It makes sense to re-use and build on existing tools developed for ontology engineering. Present ontology-based learning applications do not embrace learning processes where learners collectively advance their individual and shared understanding through social interaction. Ontologies may have a significant role in learning when studied from an activity theoretical perspective, in which an ontology can be seen as an artefact that is capable to mediate human activity. Further work may develop methods and techniques to foster knowledge creation e.g. when ontologies can not be mapped and merged automatically, for reflecting the underlying theoretical foundation of ontologies within activity systems. Learning oriented tools include technologies to support the collaborative ontology development embedded within a purposeful activity, evaluation and evolution of ontologies.

Acknowledgments. This research was conducted within the Knowledge Practices Laboratory (KP-Lab) project co-funded by the IST programme of the EU 6. R&D

Framework programme. We thank our colleagues for numerous reflective discussions and insights shared.

References

1. Allert, H.: Modeling Coherent Social Systems for Learning. Dissertation, Universität Hannover, Hannover (2005)
2. Argyris, C., Schön, D.: Organizational Learning. Addison Wesley, Reading, MA (1978)
3. Aschoff, F.-R., Schmalhofer, F., van Elst, L.: Knowledge Mediation - A Procedure for the Cooperative Construction of Domain Ontologies. Proceedings of the ECAI 2004 Workshop on Agent-mediated Knowledge Management (2004) 29 – 38
4. Ausubel, D.P., Novak, J.D., Hanesian, H.: Educational Psychology: A Cognitive View. Holt, Rinehart and Winston, New York (1978)
5. Bromme, R.: Thinking and Knowing about Knowledge. In: Hoffmann, M.H.G., Lenhard, J., Seeger, F. (eds.): Activity and Sign. Springer, New York (2005) 191-201
6. Cimolino, L., Kay, J., Miller, A.: Concept Mapping for Eliciting Verified Personal Ontologies. International Journal of Continuing Engineering Education 14(3) (2004) 212-228
7. Cross, R., Parker, A., Borgatti, S.P.: A Bird's-Eye View - Using Social Network Analysis to Improve Knowledge Creation and Sharing. IBM Institute for Knowledge-Based Organizations (2002) [http://www-304.ibm.com/jct03001c/services/learning/solutions/pdfs/]
8. Devedzic, V.: Education and the Semantic Web. International Journal of Artificial Intelligence in Education (IJAIED) 14 (2004) 39-65
9. Engeström, Y.: Learning by Expanding: An Activity-Theoretical Approach to Developmental Research. Orienta-Konsultit Oy, Helsinki (1987)
10. Engeström, Y.: Activity Theory and Individual and Social Transformation. In: Engeström, Y., Miettinen, R., Punamäki R.-L. (eds.): Perspectives on Activity Theory. Cambridge University Press, Cambridge (1999) 19-38
11. Fensel, D.: Ontologies - Dynamic Neworks of Formally Represented Meaning. Technical report, Vrije Universiteit Amsterdam (2001) [http://sw-portal.deri.org/papers/publications/]
12. Gaines, B.R. and Shaw, M.L.G.: Supporting the Creativity Cycle through Visual Languages. AAAI Spring Symposium: AI and Creativity. Menlo Park, California (1993) 155-162
13. Gomez-Perez, A., Corcho, O., Fernandez-Lopez, M.: Ontological Engineering with Examples from the Areas of Knowledge Management, E-Commerce and the Semantic Web. Springer-Verlag, London (2004)
14. Gruber, T.R.: A Translation Approach to Portable Ontology Specifications. (1993) [http://ksl-web.stanford.edu/KSL_Abstracts/KSL-92-71.html]
15. Hakkarainen, K.: Dichotomies of the Knowledge-Practices Laboratory - Working Papers of Knowledge-Practices Laboratory. WP3 Workshop, University of Helsinki (2006)
16. Jasper R., Uschold, M.: A Framework for Understanding and Classifying Ontology Applications. KAW'99 - Twelfth Workshop on Knowledge Acquisition, Modeling, and Management. Banff, Alberta, Canada (1999)
17. Kotis, K., Vouros, G.A., Alonso, J.P.: HCOME - Tool-Supported Methodology for Collaboratively Devising Living Ontologies. SWDB'04: Second International Workshop on Semantic Web and Databases (2004)
18. Leont'ev, A.N.: Activity, Consciousness, and Personality. Prentice Hall, New Jersey (1978)
19. Mandl, H., Fischer, F.: Wissen sichtbar machen. Hogrefe, Göttingen (2000)
20. Oerter R.: Kultur, Erziehung, Sozialisation. In: Schneewind, K.A. (Hrsg.): Psychologie der Erziehung und Sozialisation. Hogrefe, Göttingen, (1994) 135-165

21. Paavola, S., Lipponen, L., Hakkarainen K.: Models of Innovative Knowledge Communities and Three Metaphors of Learning. Review of Educational Research 74(4) (2004) 557-576
22. Seel, N.: Weltwissen und mentale Modelle. Hogrefe, Göttingen (1991)
23. Sowa, J.F.: Knowledge Representation. Brooks/Cole, Pacific Grove, CA (2000)
24. Stahl, G.: Meaning and Interpretation in Collaboration. In: Wasson, B., Ludvigsen, S., Hoppe, U. (eds.): Designing for Change. Kluwer, Dordrecht (2003) 523-553
25. Steimann, F.: On the Representation of Roles in Object-Oriented and Conceptual Modelling. Data & Knowledge Engineering 35(1) (2000) 83–106
26. Vygotsky, L.S.: Mind in Society: The Development of Higher Psychological Processes. Harvard University Press, Cambridge, MA (1978)

Socially-Aware Informal Learning Support: Potentials and Challenges of the Social Dimension

Simone Braun, Andreas Schmidt

FZI Research Center for Information Technologies, Karlsruhe, GERMANY
{Simone.Braun|Andreas.Schmidt}@fzi.de

Abstract. With increasingly conceiving learning as a social activity, technological support must become more aware of the social context of the individual in order to be able to provide adequate support. But many issues related to making systems socially aware are subject to ongoing research, e.g., the description and mining social relationships, and especially privacy preservation. This paper wants to give a brief overview which possibilities social awareness can offer, and to present a research agenda for realizing these potentials.

1 Introduction

E-Learning is currently undergoing a paradigm shift, from formal, organized, and certifiable towards informal, spontaneously networked, and intangible—and many label it with the striking “2.0” tag. Learning Management Systems, courses, reusable learning objects—everything having to do with formality and content was yesterday. If content was king, then now “context is king” (as Peter Baumgartner put it in [1]): decontextualized and standardized courses are being replaced by in-context learning on demand, especially in workplace learning [2].

However, this shift towards context does not imply that systems are becoming more context-*aware* so that they can respond to contextual needs; rather they provide content *in context* and the possibility of “networking” in a “Social Web”. This Social Web offers networking of people (as successful networking platforms like openBC[1] show), of information artifacts (as novel learning theories like connectivism [3] stress) and of tools and services (“mashups” in which technologies like RSS play a prominent role). For this Social Web, which is basically a global loosely coupled platform for continuous learning, fostering the interactions of people in manifold forms is the ultimate goal.

But does this social software understand a person’s social context and how it affects the “learning by networking”? It is commonsense that it draws a distinction from whom you learn, whom you help and from whom you receive a message because it affects your willingness, your receptiveness, whether you overcome barriers etc. Leaving all this up to the user may help to build lightweight applications and may be in line with the Web 2.0 idea of man as a self-determined master of a

[1] https://www.openbc.com/

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 126-131, 2006.

globalized web, but it definitely neglects the affective dimension of information seeking [4] and inter-human communication [5] and their implications on system usability and denies the importance of guidance.

In this paper, we want to introduce the concept of socially-aware applications—understood as applications knowing about the user's social context and adapting to it. In section 2, we present potentials of this concept in the form of three sample applications. In section 3, we discuss the challenges we have to face when realizing these applications before we conclude the paper in section 4.

2 Potentials of Socially-Aware Learning Support

Social relationships do have a huge impact on human behavior, and they do so especially for learning activities. But does this mean that systems should adapt to the social relationships of its user? In this section we want to have a closer look where socially-aware system behavior is strongly needed or at least a promising perspective.

2.1 Social People Finder

Although much attention has been given to formal and semi-formal learning situations the majority of learning activities are informal, especially in workplace learning. One typical learning situation is that one employee asks another (who shall become the "informal teacher") about a problem at hand. In order to support this form of learning, knowledge management solutions usually have an "expert finder" component that tries to locate experts for specific subjects (e.g. [6]).

But do employees always want to ask experts? And doesn't it matter if we know this expert and get along well with her? We have to acknowledge that asking for help always requires admitting a weakness, exposing vulnerability. If there are tensions in the relationship, we will do anything but appear vulnerable. This means that expert finder applications have to balance the "expert status" with the quality of the social relationship towards the potential "expert" in order to provide *relevant* results. As a consequence, a colleague and good friend next door, who is somewhat competent in the area, could be a much better result than the ultimate expert, who is viewed as a rival. This type of scenario can be easily generalized to any form of people finding, e.g., looking for cooperation partners for projects where you have to balance the objective relevance with the social dimension to achieve "subjective relevance" [19].

2.2 Socially-aware Mediation of Communication

If we stick to the expert finder example from the last section, then we will discover an ongoing problem of these "expert finders": usually the expert's side (who is actually an informal teacher) is not appropriately considered. Listed experts get overloaded and distracted from their own work, which leads to annoyance. Often it is not only objective overload and bad timing, but also missing consideration of how the designated informal teacher views her relationship to the learner. For instance, there are always colleagues to whom you will answer even though you are in a hurry, while there are others you will never allow for disturbing you.

In [5] a method was presented that mediates the communication between an informal teacher and an informal learner, taking into account the context of both sides. Each communicative action is assigned a degree of efficiency based on multiple criteria (like current task and its characteristics, urgency, but also the quality of the social relationship). That way, we can reduce annoying forms of communication.

2.3 Socially-aware Opinion Sharing and Resource Ranking

As the success of social bookmarking systems shows, users are willing to rely on explicit opinions of other users, as these opinions represent a form of guidance. Especially when you are new in a certain subject area, it is extremely helpful to get links to "good" resources instead of just receiving resources matching your query. But how do you know if you want to have yourself guided by another user's opinion or assessment? And beyond: how do you know if you want to guide others, especially if they are potential competitors?

An analysis of scientific work within the project *Im Wissensnetz*[2] ("in the knowledge web") has shown that social bookmarking services like Bibsonomy[3] would be used if there was better control with whom to share your findings, e.g., they do not want to share the result of their literature study with competing institute as such, but possibly with individuals within those institutes to whom they have a relationship of trust (cf. [7] and [8] examining the social and cultural impact on knowledge sharing). This means that if systems offered a socially-aware sharing policy, this would overcome classical knowledge management barriers.

3 Challenges of Socially-Aware Learning Support

The previous section has shown that socially aware system behavior can improve the relevance of results, reduce annoying forms of social interaction, and foster collaborative behavior by overcoming trust-related barriers. But realizing such systems poses severe challenges, which shall be briefly summarized in this section.

3.1 Describing the Social Context

Before we can start exploiting the social context, we need a model with focus on qualifying relationships in an appropriate way. Representing only formal relationships like family relationships or organizational relationships is insufficient. Rather we have to consider informal relationships, which can be distinguished along multiple criteria;

---

[2] http://www.im-wissensnetz.de

[3] http://www.bibsonomy.org

among the most popular are trust [9], loyalty, expectancy of reciprocity, reliability etc (see, e.g., [10]).

An important insight for developing this ontology is that we primarily do not need to model objective relationships, but rather subjective opinions about the quality of the relationships, because usually our behavior only depends on how we regard the relationships (and not how it "is").

Approaches towards a social relationship ontology are rather scarce. Research in sociology does not concentrate on well-defined, universal definition of relationships. There are some first steps with FOAF[4] in the Semantic Web community like [11] and [12], but their level of differentiation is still too low because of their focus on objective (and often symmetric) relationships.

3.2 Acquiring the Social Context

Having a model for social relationships is quite useless if we do not have methods to fill it. Social network analysis (SNA) is currently quite popular for a wide range of application scenarios. Usually its results are visualized as graphs with weighted edges where the weight represents communication intensity, frequency or importance (e.g. [13]). The work of [18] examines searching algorithms for expertise location by the use of such social network graphs. In [15] and [16] social network analysis is used for improving information retrieval.

Because of their focus on objective relationships ("whole-networks"), the importance of these approaches to our problem is only limited. Especially, they the quality of the relationships is neglected. There, relying on so-called egocentric networks is more promising (e.g., [17]) because they are capable of representing subjective relationships.

3.3 Methodological Framework for Socially-Aware Learning Support

In section 2, we have presented commonsense arguments on how social relationships affect what is to be considered good, relevant, and appropriate. But the world is hardly ever mono-causal. So we need to find out (a) how each type of social relationship and (b) to which degree the social dimension (together with other criteria) affects subjective relevance. Empirical studies will be needed to establish a sound theoretical basis, combined with results from pedagogical research on the role of the social dimension in learning activities. First steps based on a trust-based concepts have been done e.g. in [14].

3.4 Preserving Privacy

Privacy is always an issue when dealing with personal data, but qualified social relationships belong to the most critical data items. Even in the "objective" case of

---

[4] **F**riend **o**f **a F**riend: http://www.foaf-project.org/

social network analysis visualizing existing social relationships within a group of people can have unexpected side-effects by making explicit who is the hub, who is the outsider etc. This is even truer for subjective assessments of social relationships because these subjective relationships are sometimes not symmetric, and it would be disillusioning if this asymmetry was actually revealed.

The problem with socially-aware systems is not only that they have to store this critical data—here we can think of technical solutions for data protection—but their adaptation behavior can sometimes disclose the underlying social relationships.

Let's take the case of the mediated communication where we have to take into account both perspectives on the social relationship between them: What if you never receive a certain person as a recommended communication partner although you assume a good relationship to that person and you discover that she knows about what you need? Another example is if we consider contacts of contacts for people finders: even if the system does not present explicitly how your contact assesses her contacts, the way the results are presented can reveal it to you. Therefore, the system behavior has to be carefully checked so that these sensitive data are not exposed or could not only be traced back to one's subjective view on the relationship.

4 Conclusions and Outlook

Within the movement towards context-aware systems—particularly in the domain of learning support—social awareness appears to be the next frontier of user-adaptive learning support. It is especially promising for addressing informal learning scenarios, as the presented scenarios and preliminary research results in these areas have shown. But even more than other aspects of the user context, the social context has several hard challenges associated with it, which can be traced back to the subjectiveness and the damage of exposition to existing relationships.

The Web 2.0 (and with it eLearning 2.0) has discovered the social dimension, and with the focus on social processes, the distinction knowledge management and (informal) e-learning becomes less and less important. But this is only the first part of the story. Before real-world applications, which currently confine themselves to a very shallow consideration of the social context at best, can be made *socially aware*, a lot of interdisciplinary research questions must be answered. But in the end, applications and services can become a little bit more adaptive to human peculiarities.

Acknowledgements. *This work was supported by the German Federal Ministry for Education and Research within the project "Im Wissensnetz" (http://www.im-wissensnetz.de)*

References

1. Baumgartner, P.: Context is King, Keynote at the European Distance and E-Learning Network Conference, Vienna (2006)

2. Schmidt, A.: Potentials and Challenges of Context Awareness, Proceedings of the 3rd Annual Workshop of the SIG Adaptivity and User Modeling in Interactive Systems, Saarbrücken (2005)
3. Siemens, G.: Connectivism – A Learning Theory for the Digital Age, eLearnpace, 10.12.2004, http://www.elearnspace.org/Articles/connectivism.htm (2004)
4. Kuhlthau, Carol C.: Seeking Meaning – A Process Approach to Library and Information Services, Libarieries Unlimited (2004)
5. Braun, S.; Schmidt, A.: Don't Annoy the Informal Teacher – Context-Aware Mediation of Communication for Workplace Learning, Proceedings of the 6th International Conference on Knowledge Management (I-KNOW 06) (2006)
6. Becks, A., Reichling, T., Wulf, V.: Supporting Collaborative Learning by Matching Human Actors, Proceedings of the 36th Annual Hawaii International Conference on System Sciences (2003)
7. Huysman, M., Wulf, V.: IT to Support Knowledge Sharing in Communities: Towards a Social Capital Analysis, Journal on Information Technology 21 (2006)
8. Ackerman, M., Pipek, V., Wulf, V.: Sharing Expertise: Beyond Knowledge Management, MIT Press (2003)
9. Golbeck, J., Hendler, J.: Inferring Trust Relationships in Web-Based Social Networks, ACM Transactions on Internet Technology, 7(1) (2006)
10. Mika, P., Gangemi, A.: Descriptions of Social Relationships. In: Proceedings of the 1st Workshop on Friend of a Friend, Social Networking and Semantic Web. (2004)
11. Masolo, C., Vieu, L., Bottazzi, E., Catenacci, C., Ferrario, R., Gangemi, A., Guarino, N.: Social Roles and their Descriptions. In: Proceedings of the Ninth International Conference on the Principles of Knowledge Representation and Reasoning (KR2004), Whistler, Canada, June 2-5, 2004. (2004)
12. Matsuo, Y., Hamasaki, M., Mori, J., Takeda, H., Hasida, K.: Ontological Consideration on Human Relationship Vocabulary for FOAF. In: Proceedings of the 1st Workshop on Friend of a Friend, Social Networking and Semantic Web. (2004)
13. Mika, P.: Flink: Semantic Web Technology for the Extraction and Analysis of Social Networks. Journal of Web Semantics 3(2), Elsevier (2005)
14. Heath, T., Motta, E.: Personalizing Relevance on the Semantic Web through Trusted Recommendations from a Social Network, Proceedings of the Semantic Web Personalization Workshop, ESWC (2006)
15. Kirsch, S., Gnasa, M., Cremers, A.: Beyond the Web: Retrieval in Social Information Spaces. In Proceedings of the 28th European Conference on Information Retrieval (ECIR 2006), London, Springer (2006)
16. Dubois, V., Bothorel, C.: From semantic to social: an integrated approach for content and usage analysis. In: Proceedings of the Workshop on Semantic Network Analysis (co-located in ESWC 2006), June 12, Budva, Montenegro (2006).
17. Fisher, D., Dourish, P.: Social and temporal structures in everyday collaboration. In: Proceedings of the SIGCHI conference on Human factors in computing systems table of contents, Vienna, Austria (2004)
18. Zhang, J., Ackerman, M.: Searching for expertise in social networks: a simulation of potential strategies, Proceedings of the 2005 International ACM SIGGROUP Conference on Supporting Group Work (GROUP 2005), Sanibel Island, Florida, USA (2005)
19. Tang, R. and Soloman, P. (1998). Toward an understanding of the dynamics of relevance judgment: An analysis of one person's search behavior. Information Process and Management, 34, 237-256.

The User as Prisoner: How the Dilemma Might Dissolve

Andrea Kohlhase

School of Engineering and Computer Science, International University Bremen
Dept. of Mathematics and Computer Science, University Bremen
a.kohlhase@iu-bremen.de

Abstract. Content objects are essential links between Knowledge Management and E-Learning systems. Therefore content authoring and sharing is an important, interdisciplinary topic in the resp. fields. In this paper, we want to critically elaborate on the "user as producer and consumer"-concept for content production and consumption. We address the subject by using the notion of content collaboration as example for the *"Prisoner's Dilemma"*, in which the sensible way out (from a macroperspective) is sensibly not pursued by an individual (from a microperspective). We will use this micro-perspective of a user as prisoner to analyze what the recently very successful Social Tagging processes can teach us about the user taking action as a producer and/or consumer.

1 Introduction

Knowledge Management (KM) systems as well as E-Learning systems are built on knowledge[1] blocks that contain reified knowledge, i.e. content or learning objects. As objects these knowledge chunks can e.g. be managed, shared, reused, or aggregated; as reified knowledge they can be used pedagogically as e.g. Reinmann declares them to be "the link between learning and teaching" [Rei05, 117]. In particular, software can construct or help to construct learning contexts based on them: knowledge contexts (like ontologies or intersubjective knowledge), didactical contexts (like learning paths), or subjective contexts (like personal learning environments), for examples and ideas we suggest [Koh06], [LG06], or [MHBR05, 53].

Unfortunately, KM as well as E-Learning weren't as successful as expected (with occasional exceptions). Therefore a joint venture was undertaken to harvest synergy effects. The pedagocial approach of constructivism seems to fit well for such a venture because of its highly individualized construction potential (see e.g. [Sch05]). But constructivism posits that the construction has to be done by the user herself. This

[1] In [Kor05] Kornwachs critically discusses the use of the terms 'knowledge' versus 'information' and points to their "fundamental difference"[34], in particular, he points to the "self-referential characteristics"[36] of knowledge that makes its handling via technological systems problematic. Keeping this (as well as [PRR97, 16] and [BD00, 125]) in mind, we use the term "knowledge" nevertheless.

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 132-137, 2006.

can e.g. be accomplished by self-steered learning (which is tentatively antagonistic in E-Learning environments) or by enabling a learner's adaption/accommodation processes to rebuild existing cognitive structure (Piaget) by envisioning the user as a producer of content. Fittingly, in recent years the needle's eye for KM systems turned exactly out to be the generation of content. So the "user as consumer and producer"-scheme moved in.

In Section 2 we will argue that we can comprise this scheme to a "user as a prisoner"-concept (cf. the well-known "Prisoner's Dilemma"). The dilemma consists in two competing perspectives on taking action: the micro- and the macroperspective, where the first one is disabling content collaboration. In [KK04] Kohlhase and the author discussed this phenomenon as "Authoring Problem", in an educational context in [Koh05] as "User Riddle": even though the advantages of using KM systems for content collaboration seemed tremendous, no action was taken by users to invest the additional energy and effort to produce such content. So, the real problem in the "user as consumer and producer"- concept is the micro-perspective of motivation for action and it is not clear, whether the one or/and the other is more helpful for this.

In order to get a clue though we finally turn in Section 3 to a microperspective analysis of the recently very successful Social Tagging systems like del.icio.us, flickr, or Connotea, in which the "user as prisoner"-dilemma seems to dissolve. We will conclude with the thesis that a joint venture is best done if the user starts her activities as a producer with specific expectations (like added-value services or Personal Knowledge Management) and then decides for herself when the time for consumption (like collaboration or E-Learning features) has arrived.

2 Content Generation as Prisoner's Dilemma

Conventional wisdom (aka. "hope") is that the added-value applications based on semantic annotations will create a stimulus that will entice common users to invest time and effort into content production within this exciting new technology. Unfortunately, respective communities experienced otherwise, e.g. the Semantic Web did not take off as expected even though it is still pursued because of its "believed" potential.

Starting from a detailed look at the motivations of users to produce semantic data, we argued in [KK04] that the discrepancy between a content author's excitement about the fascinating potential of semantically enriched data and her unwillingness to invest her time and energy to profit hereby is actually an author's dilemma — an example of the well-known non-zero-sum game "Prisoner's Dilemma" ([Axe84]). It is often used for analyzing short term decision-making processes in cooperation scenarios, where the actors do not have any specific expectations about future interactions or collaborations. Concretely two players are imagined in a prison scenario where they are independently confronted with cooperation offers by a public prosecutor. They can choose between two moves, either "cooperate" or "defect". The idea is that each player gains when both cooperate, but if only one of them cooperates, the other one, who defects, will gain more. If both defect both lose, but not as much as the 'cheated' cooperator whose cooperation is not returned.

For a user of semantic material, the motivation for preferring semantically rich data is simple: explicit document structure supports enhanced navigation and search, semantic markup yields context and search by content. Furthermore, the higher the degree of semantic structure, the more added-value services can feed on the material, the higher the benefit for the user. But this is only a standpoint from without, that is a macro-perspective. From within, that is a micro-perspective, there is also the motivation against taking action, as (generally) the cost of creating a document is proportional to the depth of the markup involved. However, the argument goes that — once the markup quality passes a certain threshold which supports flexible reuse of fragments — content creation costs may actually go down as they are dominated by the cost of finding suitable (already existent) knowledge elements. Thus, the author is interested in a high reuse ratio, provided that retrieval costs are not prohibitive. The benefits seem obvious for the author who has the opportunity to reuse her own content modules frequently, but the real payoff comes when she is part of a group of individuals that share content objects and knowledge structures freely.

The analogy of the "Prisoner's Dilemma" to the content author's situation is apparent: if the author decides to invest her time and effort and others contribute as well, everyone profits tremendously from this synergy of cooperation. On the other hand, if just the author works on semantic markup, then she will gain nothing in the short run, but some in the long run. Note that the microperspective is less than a subjective standpoint, it considers only the surrounding micro-cosmos, the here-and-now of a subject.

In the Prisoner's Dilemma, if the decision-makers were purely rational, they would never cooperate (without at-hand incentives) as they should make the decision which is best for them individually. Suppose the other one would defect, then it is rational to defect yourself: you won't gain much, but if you do not defect you will have all the work. Suppose the other one would cooperate, then you will gain (especially in the long run) whatever you decide, but you will gain more if you do not cooperate (as you don't have to invest your time and effort), so here too the rational choice is to defect. The problem is that if all content authors are rational, all will decide to defect, and none of them will gain anything. In particular, *if we assume content authors to be rational, then we anticipate their non-cooperation based on the individuals' micro-perspectives.*

3 Why does Social Tagging as Content Generation succeed?

What we are looking for is a way out of the "user as a prisoner"-scheme. We illustrated above that the Prisoner's Dilemma is based on two competing perspectives: the micro- and the macro-perspective.Moreover, the micro-perspective turned out to be the limiting factor for an author's content generation. Therefore, if we continue to predominantly take the macro-perspective when developing software systems, then the "user as producer and consumer"-concept is reduced to the "user as a prisoner"-scheme.

Recently though, web software comprised under the term "Social Tagging" is celebrating enormous growth rates in terms of user access and acceptance rates (despite rather simple interfaces). Here, the users tag system-specific objects like bookmarks (e.g. del.icio.us or scientifically Connotea) or images (e.g. flickr) to organize and share their resp. objects so that they become *"pivots for social navigation"* [Mor05, 137]. A closer look reveals directly that their users are not only producers of content, but also managing and learning content consumers. They take action in generating content and using other's content by the emergent "self-organizing" web-effect of *"small pieces that then loosely join themselves"* [Wei02, 82, 23]. The question is why these social tagging systems succeed in attracting considerable amounts of (informal) content authors? If we look at the "Social Tagging" phenomenon from the macro-perspective, then there is not so much to be gained. Sure, there is the possibility that someone else's bookmark might be of relevance to my personal knowledge and I would not have found it except using the social tagging software. But the finding of such a treasure seems rather haphazardly organized and therefore not to be the underlying motivation for using the software.

The idea for dissolving the "user as a prisoner"-scheme consists in a microperspective analysis of this successful software to come up with more general conclusions for the design of software for KM and E-Learning. So we can rephrase the underlying question to be "Why do people use social tagging systems or what is their motivation?". Even though all tags as a whole form a "folksonomy" [Wal04], this collaboration clearly isn't the motivation for an individual user to take action. We believe that a user's tags can be viewed from the microperspective as her personal knowledge management system that e.g. represents a personal information model (PIM, [MHBR05, 53]). At the beginning she doesn't think of her tags as public objects but as private ones. It really doesn't matter whether a user is aware that the tags are openly viewable as the experience of the Web itself constitutes global invisibility and irrelevance. This thesis is supported by many reports of bloggers, who are astonished how much publicity a blog de facto draws (for example: *"it's recently become apparent that the vast majority of blogs are written by ordinary people with much smaller audiences in mind"* [SNGS04, 1143]). However, as a personal knowledge management system the social tagging software support is definitely helpful in tackling today's overly abundant information flow — the same idea that enlivens Berner-Lee's Semantic Web vision [BLF99] from a macro-perspective. But in contrast to the Semantic Web, people are willing to invest their time and energy to assign personal, semantic metadata to resp. objects as it makes sense from their very own personal micro-perspective. The interest for other users' input comes later — whenever the individual user is ready. At that point in time we have a flowing transition from personal knowledge management to social E-Learning. Interestingly, the user decides *for herself* when she wants to change from being a producer to becoming a consumer, i.e. it is a self-steered process. This fits nicely with the observation that an individual's competence development has a time component and therefore has to be viewed as a process (see [BW05]).

In accordance with the "Prisoner's Dilemma", social tagging can teach us that taking action is much easier as producer with specific expectations for consumption — that at first are typically rather private than public — than as consumers with unspecific ones as well as producers with specific ones for production. Actually, the same is true and long known for consumers. Specific consumption expectations of consumers like interface and interaction design are still a hot research topic.

Moreover, the transparency of early personal computers (i.e. specific expectations of consumers for production) was replaced/complemented by Macintosh's iconic style or graphical user interfaces (i.e. specific expectations for consumption) relatively early on (see [Tur97, 23ff]). Now, that the consumers are consuming "well enough", the question of specific expectations of consumers for production comes into focus again.

As many users of social tagging systems have experienced in the mean time, once this dynamic spiral is in place, it enables much finer-grained semantic annotation. In general, once the first steps were taken by the user as a producer, at some point she will become a consumer and will strengthen the mentioned spiral.

4 Conclusion and Outlook

In the same way as knowledge and learning are dynamically interwoven, the according supportive technology can obtain synergies, but we as system designers cannot sensibly start with the macro-perspective and overwhelming, abstract potential, otherwise we support the "user as prisoner"-scheme. Rather we need to use the micro-perspective and provide specific expectations (like value-by-itself e.g. a personal KM system, short-term rewards e.g. occasional hits with recommender systems, and/or added-value services that do not assume collaboration e.g. visualization of complex content) for content authors to draw them into the spiral of "users as producers and consumers". The analysis presented in this paper will form the starting point for the development of a stepwise process of content generation (working title: "Stepwise Blended Learning and Knowing"). We plan to implement and evaluate this in the context of the CPoint system (implemented by the author)[2], leveraging a central aspect of the social tagging process: the transition from Personal KM up to a social, but self-steered E-Learning System.

References

[ADB+05] Klaus-Dieter Althoff, Andreas Dengel, Ralph Bergmann, Markus Nick, and Thomas Roth-Berghofer, editors. Professional Knowledge Management, number 3782 in LNCS. Springer Verlag, 2005.

[Axe84] Robert Axelrod. The Evolution of Cooperation. Basic Books, New York, 1984.

[BD00] John Seely Brown and Paul Duguid. The Social Life of Information. Harvard Business School Press, 2000.

[BLF99] Tim Berners-Lee and Mark Fischetti. Weaving the Web: The original design and ultimate destiny of the World Wide Web, by its inventor. Harper San Francisco, 1999.

[BW05] Maximiliane B¨onnighausen and Uwe Wilkesmann. E-Learning meets

[2] CPoint is an open source, semantic, invasive editor from within MS PowerPoint that attaches semantic annotation to PPT-objects and converts this micro-content into a web-capable format. More information and download site is available under http://kwarc.eecs.iu-bremen.de/projects/CPoint/install.html

Wissensmanagement: Wie Qualifikations- und Kompetenzentwicklung in Betrieben zugleich erfolgen. online at http://www.diezeitschrift.de/22005/boennighausen05_01.htm (seen at 2006-08-21, February 2005.

[KK04] Andrea Kohlhase and Michael Kohlhase. CPoint: Dissolving the Author's Dilemma. In Andrea Asperti, Grzegorz Bancerek, and Andrej Trybulec, editors, Mathematical Knowledge Management, MKM'04, number 3119 in LNAI, pages 175–189. Springer Verlag, 2004.

[Koh05] Andrea Kohlhase. Overcoming Proprietary Hurdles: CPoint as Invasive Editor. In Fred de Vries and Graham Attwell and Raymond Elferink and Alexandra T¨odt, editor, Open Source for Education in Europe: Research and Practise, pages 51–56. Open Universiteit of the Netherlands, Heerlen, 2005.

[Koh06] Michael Kohlhase. OMDoc: An Open Markup Format for Mathematical Documents. Springer Verlag, August 2006. ISBN 3-540-37897-9.

[Kor05] Klaus Kornwachs. Knowledge + Skills + "x". In Althoff et al. [ADB+05].

[LG06] Paul Libbrecht and Christian Gross. Authoring LeActiveMath Calculus Content. In William Farmer and Jo Borwein, editors, Mathematical Knowledge Management, MKM'06, LNAI, pages 251 – 265. Springer Verlag, 2006.

[MHBR05] Heiko Maus, Harald Holz, Ansgar Bernardi, and Oleg Rostantin. Leveraging Passive Paper Piles to Active Objects in Personal Knowledge Spaces. In Althoff et al. [ADB+05], pages 50–59.

[Mor05] Peter Morville. Ambient Findability. O'Reilly, 2005.

[PRR97] G. Probst, St. Raub, and Kai Romhardt. Wissen managen. Gabler Verlag, 4 (2003) edition, 1997.

[Rei05] Gabi Reinmann. Blended Learning in der Lehrerbildung. Pabst, 2005.

[Sch05] Andreas Schmidt. Bridging the Gap Between Knowledge Management and E Learning. In Althoff et al. [ADB+05], pages 203–213.

[SNGS04] Diane J. Schiano, Bonnie A. Nardi, Michelle Gumbrecht, and Luke Swartz. Blogging by the Rest of Us. In Late breaking result papers, pages 1143–1146, April 2004. ISBN 1-58113-703-6.

[Tur97] Sherry Turkle. Life on the Screen: Identity in the Age of the Internet. Touchstone, 1997.

[Wal04] Thomas Vander Wal. Folksonomy? Information Architecture Institute Members Mailing List, July 2004.

[Wei02] David Weinberger. Small Pieces Loosely Joined: a Unified Theory of the Web. Basic Books, 2002.

Building Lifelong Learning Networks of Teachers for the Development of Competence in Teaching in Small Rural Schools

Pavlos Koulouris & Sofoklis Sotiriou

R&D Department, Ellinogermaniki Agogi, Dim. Panagea Street, 15351 Pallini, Greece
{pkoulouris, sotiriou}@ea.gr

Abstract. This paper reports on ongoing research efforts and discussions about how to enable, through new technologies, the building of lifelong learning networks and the development of competences of teachers who work in small rural schools. Teachers of such schools are confronted with significant challenges, needing to develop personal competences falling beyond the established initial and in-service teacher training curricula. The notion of communities of practice (Wenger, 1998) is proposed as a conceptual tool in the endeavour to better understand the issues emerging.

1 Multigrade schools: The 'Borderers' of the Education System

In many primary schools of the Greek provinces there is not one teacher available for each of the six grades: the low number of students statutorily justifies the employment of less than six teachers –even of one or two–, who nevertheless are expected to cover the needs of a full school. These schools, known internationally as multigrade schools [1], fulfil a function of national importance, as they provide the children of remote and less accessible areas with the access to education which all children of Greece are entitled to.

1.1 Teachers in Multigrade Schools: Need for, and Obstacles to, Continuous Professional Training and Competence Development

Teachers of multigrade schools are confronted with significant challenges, as they have to teach simultaneously two or more age groups and possibly more than one curriculum subject in the same class. Teachers' initial professional training does not suffice and the need for competence development is evident – especially in the light of the fact that typically inexperienced, newly-appointed teachers are posted to remote schools for a relatively short term service. Thus the average teacher working in a small rural school needs to acquire new knowledge and skills and continually improve their expertise in teaching in the demanding context of the multigrade classroom. They need to develop personal competences falling beyond the established initial and in-service teacher training curricula, which are oriented towards conventional monograde teaching, in order to develop and maintain the ability to respond to the challenging circumstances of their professional position.

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 138-147, 2006.

However, there exist a number challenges in connection to remote rural teachers' need for competence development. On one hand, offering teachers from remote areas conventional professional development provision, such as in-service training seminars, is not easy. A teacher's round trips between their remote school and an urban training centre tend to be costly, if not virtually impracticable, given that there may not be a colleague available to replace them during their absence. On the other hand, the very concept of competence in the context of multigrade teaching may not be as straightforward as it appears. In the field of Human Resources Management competence is usually defined as a standardized requirement for an individual to properly perform a specific job, encompassing a combination of knowledge, skills and behaviour utilised to improve performance. However, whether a teacher is adequately or well qualified so as to have the ability to perform successfully in the multigrade classroom is a question with no official, standardised answer. The educational system –in Greece at least–, through its choices for the preparation of teachers-to-be, does not clearly define what good multigrade teaching is. Teachers are more or less left alone to explore and learn multigrade teaching on their own, through their solitary experiences in remote rural schools. What is worse, teachers at remote schools also suffer the consequences of a widening socioeconomic and digital divide which separates the rural from the urban areas in most parts of the world.

2 Greece: A Case Reflecting International Trends

The above described difficulties of multigrade teachers working in remote areas are not unique to Greece. Internationally, the shortage of teachers in rural and remote areas, and the weaknesses of the education systems in the provision of training and professional support to these teachers, have been well-documented in the literature [2], [3], [4], [5], [6], [7], [8]. However, these problems appear to be in sharp contrast with a growing recognition of multigrade schools as not only a necessary, but indeed a good-quality option for education systems, believed even to have some advantages over single-level classes [9], [10], [11].

2.1 The Use of ICTs

As a response to the obstacles described earlier, the use of different forms of technology-supported learning and distance education models have been advocated for the enhancement of quality and accessibility of teacher training programs in rural areas [12], [13]. Relevant attempts have followed the technological trends in the field of computer-supported learning, while the content of training delivered via the different technologies varies greatly, from conventional seminar-type lessons to classroom observations at a distance [14], [15], [16], [17], [2]. What is more, in recent years a lot of attention is paid to the role satellite telecommunications can play for the bridging of the digital divide [18], [19], and distance education is seen as a major field of application in this area, as this technology provides a delivery option facilitating access to new student populations in distance locations [20]. Significant experience has already been gained internationally, particularly in the United States and in Australia (e.g. [21], [22], as well as in other less developed countries with populations distributed over large geographical areas (e.g. [23], [24], [25].

3 Our Response to the Challenges so Far

This growing mass of international experience clearly demonstrates that emerging technologies offer promising solutions to the challenges of providing appropriate training and support to rural educators. Adopting this as a proposition in our work in the framework of a number of pioneering European and national research projects, our team has in recent years made efforts to alleviate the isolation of teachers working in remote schools through the provision of distance training, support and networking, using to the full the possibilities offered by new technologies.

The main questions we have addressed in the course of almost six years of consecutive projects, have referred to: a) the appropriate content of the relevant professional development and support activities; b) the appropriateness of the various available and emerging delivery technologies, given the remote and digitally disadvantageous location of the beneficiaries; and c) the possible extensions to conventional e-learning technologies and practices, which could help the geographically disadvantaged rural educators to learn as individuals and to learn from each other, participating in informal learning experiences within a sustainable lifelong learning network.

The whole effort started with a rather greater emphasis on teachers' competence development through training content delivered over the web (MUSE project); it gradually moved into testing more advanced technologies for broadband delivery over satellite, while continuing to further develop the content (ZEUS and RURAL WINGS projects). The 'maturity' brought about through the training experiences and the increasing involvement of remote rural teachers led to the development of a network (NEMED) and an increased interest in concepts and tools related to lifelong learning networks (NEMED, RURAL WINGS) (Fig. 1). The projects, their interconnections and outcomes are presented below in more detail.

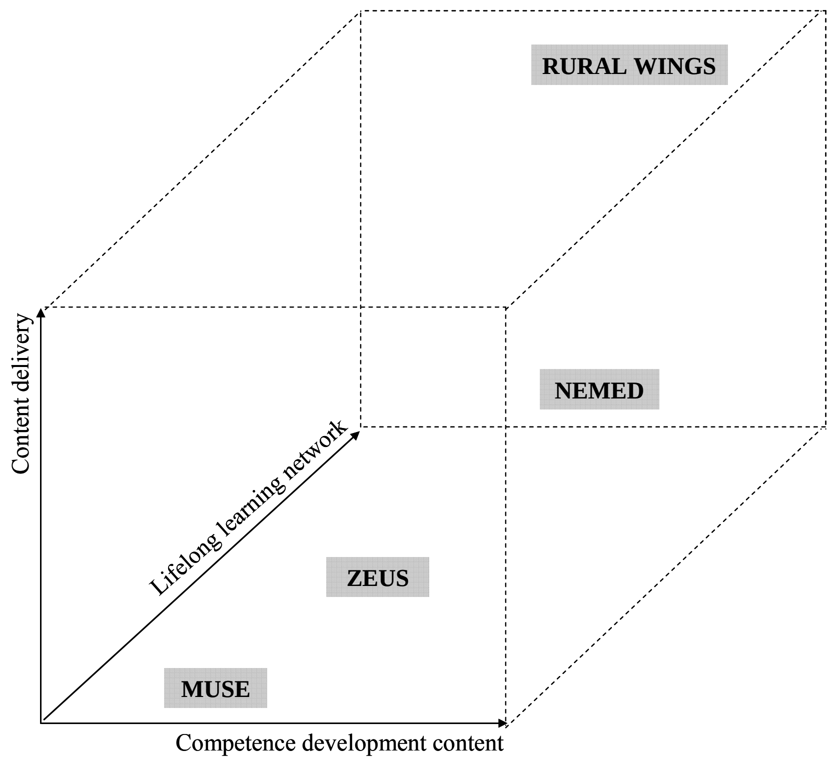

Fig. 1. Positioning of *(projects)* along three ***(axes of inquiry)***

A first milestone in our effort was the European project MUSE (MUltigrade School Education), which was supported by the Socrates Programme – Comenius 2.1 Action (2002-2004). In this project, through close international collaboration between teachers and researchers, an innovative, specialised in-service training programme was developed for teachers working in multigrade schools. The main outcome of that project was a realisation of the need of multigrade teachers in Europe for training in innovative teaching and learning approaches that are well-suited to the multigrade school environment, including the use of ICT in everyday school work, as well as the development of a relevant training programme promoting teachers' professional development in these fields. Thanks to the MUSE project, training material specifically designed for multigrade school teachers was for the first time made available to all who may be interested, via the internet.

A follow-up of the activity developed within MUSE has been the networking, at the European level, of educationists and school practitioners sharing an interest in multigrade schools, either as a field of research or as a space of educational practice that deserves attention and support. This contact and exchange is taking place within the European network NEMED (NEtwork of Multigrade Education), a trans-national network supported by the Comenius 3 Action of the Socrates Programme (2004-

2007). Through its activities in ten European countries and at pan-European level, the network is currently studying the characteristics and the needs of multigrade schools, is actively promoting the upgrading of questions relating to multigrade education in educational policy-making, is investigating and proposing ways to improve the education provided by multigrade schools, as well as offering support to multigrade school teachers and fostering the development of communication among them. What is more, there is a specific interest of the Network in developing the NEMED web portal, which should foster and enhance the functioning of NEMED as a lifelong learning network for Europe's multigrade teachers. In addition, NEMED regularly organises international workshops and conferences, aiming at the widest possible dissemination of knowledge and experiences accumulating within the network, as well as the sensitization of the world of education towards multigrade schools and their issues.

At the same time, a lot of the energy and attention of our team has been devoted to securing better channels for the delivery of rich training and support content, as well as for enhanced communication among isolated teachers, so as to drastically combat the introversion of the digitally deprived remote school. In this context the ZEUS project (2003-2005) timely recognized the crucial role of satellite telecommunications for securing broadband for geographically disadvantaged populations. This project offered to remote teachers a rich distance learning environment for participating in synchronous and asynchronous training via satellite networks. This was an initiative at the national level, supported by the General Secretariat for Research and Technology within the Concerted Programme for Electronic Learning. The training programme was attended by teachers at ten sites in the extremities of Greece, via satellite installations made by the project at their schools. The research in ZEUS focused mainly on the appropriateness of the training content (which built on the MUSE content, extending and enriching it), the development of a distance training organisation and delivery method (which is described further below), and the testing of connectivity through DVB one-way satellite links as a channel for distance training delivery to remote teachers. The outcomes of this project in terms of training content and methodology are described in detail further below. As far as the technology is concerned, the DVB satellite link, demanding the use of non-broadband terrestrial infrastructures (broadband downloading from the satellite, uploading through ISDN telephone line), caused some technical problems and relevant user dissatisfaction, which clearly indicated the way forward.

A 'child', in many respects, of the ZEUS project, and the peak of the whole effort is RURAL WINGS (2006-2009), an ambitious, large-scale international research project supported by the Directorate-General for Research of the European Commission (Thematic Priority 'Aeronautics and Space' of the 6th Framework Programme). This project takes several decisive steps ahead, not only in the field of technology, but importantly also by carefully addressing the real needs for learning of all citizens living in remote rural areas, and by fostering the development of lively learning communities in remote schools and the villages hosting them. On one hand, DVB-RCS technology is used, which allows for two-way communication between the end-user and the satellite lifting the need for any terrestrial telecom infrastructure, thus rendering broadband really available everywhere, even in the most isolated and deprived area. At the same time, the RURAL WINGS project integrates satellite telecommunications with local wireless networks, thus demonstrating the appropriateness of satellite technologies for the provision of fully integrated services and applications to the whole of the remote rural population. What is more, RURAL WINGS builds on the successful approach of the ZEUS project to develop an advanced technological environment supporting lifelong learning activities in the school, at work, as well as at home. In this way, familiarization of all citizens with the new technologies is promoted, resulting in a reduced resistance to the use of state-of-the-art opportunities for local development. Teachers working in remote rural schools –the main target group in the pilot applications in Greece– undertake a crucial role in this process. Through further support, professional development and networking, teachers of rural areas are encouraged to evolve into catalysts of change and development, not only within their schools, but more widely within their local communities.

4 The Training Programmes and the E-learning Technologies

Based on initial analyses of teacher needs, professional development schemes piloted in the above projects aim at helping multigrade school teachers to develop their professional skills along two main axes:

- Use of ICT in their work, both for teaching/learning and administrative purposes.
- Application of teaching and learning approaches which are most appropriate for the multigrade classroom.

The corresponding e-learning environments have been realised through several technologies, exploiting satellite telecommunications for broadband delivery of rich educational content, in the context of both synchronous (videoconferencing, application sharing, chatting) and asynchronous (web-based learning through structured access to a rich pool of educational content, and networking) activities. Of particular interest in the current context is the NEMED web portal. This is a networking web space serving all network actors by facilitating communication and exchange, sharing of information and conducting of research, as well as provision of professional development and support opportunities to multigrade school teachers. The portal is divided in six identically structured areas, which correspond to the six working groups of the network: ICT for multigrade schools; classroom management in multigrade schools; society, cultures, and the multigrade school; learning modes in the multigrade classroom; educational resources development for the multigrade school; policies for multigrade education.

In a working group area, users can access work relating to research, educational resources, and training materials, as well as participating themselves in ongoing work by uploading their own contributions. Users may also view and download the different Reports of this working group to the whole NEMED Network, while there is also a dedicated area to facilitate communication and exchanges within the group in the form of asynchronous forums. On the whole, the NEMED Networking Portal is meant to be a lively virtual space of structured exchange between network partners, participating teachers and schools, as well as any other users interested in multigrade education.

5 A Model for Training Delivery

It has been a firm belief of the team that, although technical specifications do play a crucial role in a distance-education scenario, the success or not of the effort mainly depends on the underlying pedagogical design [26]. In line with this, the training programmes produced aim to cater for both flexibility and guidance, both interaction with others and self-paced learning. To this end, a comprehensive model for training delivery has been developed and tested in the framework of these projects (mainly ZEUS) (Fig. 2).

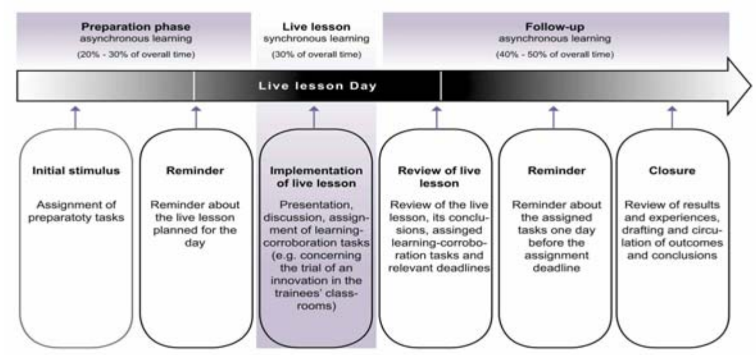

Fig. 2. The *(ZEUS model)* of training delivery

In this model, the central event for each lesson is a live videoconferencing session, using a synchronous e-learning tool, thus covering the need of isolated teachers for communication and real-time interaction with colleagues and instructors [27], stressing the importance of interaction in similar settings). On average, this synchronous e-learning portion of a lesson takes up about 30% of the overall lesson duration.

As can be seen in Fig. 2, however, both before and after the live session there is learning activity taking place independently in the working environment of the trainee. Through the use of web-based instruction techniques course participants are offered on-the-job training opportunities through tasks and materials that allow them to work at their own pace, interact with the instructor and other practitioners as needed, and receive individual feedback as they applied information to their classroom settings. For each lesson, there is introductory information on the topic covered, preparatory activities, the outcome of which are then reported by participants in the web environment and during the live session, as well as post-session consolidation and conclusion activities. The training delivery model has generally been well received by trainers and trainees.

6 Outstanding Questions: Emerging Issues of Lifelong Learning Networks and Competence Development

In all the work described above, two central concepts of this workshop, Life Long Learning Networks and Competence Development, form two major, albeit not always explicitly acknowledged, conceptual pillars.

The various efforts have led us to provide teachers working in remote small rural schools with opportunities for continuous professional development, through a number of different training initiatives, which foster the improvement of personal competences in rural teachers. In parallel, we have been experimenting with methods aiming to develop and foster a learning network of teachers, which will hopefully provide a framework for the acquisition and sharing of knowledge in an informal communication process (informal learning) lying beyond and supplementing teachers' formal professional education.

Realising the issues and challenges arising, our team has started investigating further the characteristics of tools and methodologies which can foster the improvement of personal competences in rural teachers (competence development), and encourage and facilitate a teacher's contributions to the development of the other teachers (lifelong learning network). In this context, we are currently revisiting the training delivery model mentioned above (Fig. 2) at the micro level, aiming to identify, adopt and/or adapt methods and tools which could be incorporated in this general model in order to facilitate and support informal learning through peer interaction. In other words, we are currently investigating ways of effectively combining competence development and lifelong learning networking priorities and initiatives.

At the level of technology, too, our team has come to realise the limitations of the conventional e-learning technologies and models, when the issue at stake turns into how to promote and facilitate competence development through networking with peers – a lifelong learning experience of multi-site and episodic nature. What is crucial at this stage is to identify the features and clarify the main issues connected with the technology/-ies which will be able to support rural teachers, both as individuals and as members of teams within the educational system (an 'organisation' in itself), to further develop their competences making use of the distributed knowledge and learning resources available. The NEMED portal is our current attempt in this direction, which has so far managed to develop into a repository of teaching and learning resources connected to multigrade education, jointly created and update by the teacher-members. It clearly needs to be further developed in the light of contemporary advances in social software and in fields such as knowledge organisation, collaborative authoring and learning, discovery and exchange of knowledge resources, personal profiling and ePortfolios, competence assessment and monitoring of change, etc. What is more, the newly-started RURAL WINGS project provides ample opportunity and challenge to organise the numerous learning resources and diverse learners in rural communities worldwide into meaningful, working networks fostering lifelong learning and competence development, within its own learning-enabling portal.

In the endeavour to better understand and enable our vision of lifelong learning networks of rural teachers, we have found the notion of communities of practice [28] to provide a powerful conceptual platform. According to Wenger, communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. We are then aiming in this case to enable the development of a community of practice of rural teachers, which is defined by a shared domain of interest, that of the development of multigrade teaching competences. We need to establish members' commitment to the domain, and facilitate community development by assisting them to engage in joint activities and discussions, help each other, share information and learn from each other, while pursuing their interest in their domain. This will be indeed a community of practice rather than a mere community of interest, as members of the community will be rural teaching practitioners developing a shared repertoire of resources – a shared practice: experiences, stories, tools, ways of addressing recurring problems in their small rural school, etc.

This kind of learning of course takes time and requires sustained interaction – which are some more of the things that the technologies we are envisaging have to afford. Likewise, the technologies will need to support and facilitate a variety of activities through which communities develop their practice, such as problem solving, requests for information, experience seeking, reusing of assets, coordination and synergy, discussion of developments, mapping of knowledge and identification of gaps, etc [28]. How this can be designed and realised given current technological developments remains for us an open challenge.

References

1. Little, A W. *Education for All and Multigrade Teaching: Challenges and Opportunities*. Dordrecht: Springer (2006)
2. Forbush, D E, Morgan, R L. 'Instructional Team Training: Delivering Live, Internet Courses To Teachers and Paraprofessionals in Utah, Idaho and Pennsylvania'. Rural Special Education Quarterly, Spring (2004)
3. Helge, D I, Marrs, L W. 'Personnel recruitment and retention in rural America: A growing problem'. The Pointer, (1982) 26, 2, 28-33
4. Ludlow, B L. 'Preparing special educational personnel for rural schools: Current practices and future directions'. Journal of Research in Rural Education, (1998) 14, 2, 57-57
5. Miller, J, Sidebottom, D. Teachers: Finding and keeping the best in small and rural districts. Alexandria, VA: AASA (1985).
6. Ankrah-Dove, L. 'The Deployment and Training of Teachers for Remote Rural Schools in Less-Developed Countries'. International Review of Education, (1982) 28, 1, 3-27
7. Coldevin, G, Naidu, S. 'In-Service Teacher Education at a Distance: Trends in Third World Development'. Open Learning Journal, (1989) 4, 1, 9-15.
8. Benveniste, L A, McEwan, P J. 'Constraints to Implementing Educational Innovations: The Case of Multigrade Schools'. International Review of Education, (2000) 46, 1-2, 31-48.
9. Cook, M. 'What's So Good about a Small Rural School?...Everything!'. Education in Rural Australia, (2000) 10, 2, 59-62.
10. Lloyd, L. 'Multiage Classes: What Research Tells Us about Their Suitability for Rural Schools'. Education in Rural Australia, (2002) 12, 2, 1-14

11. Boss, S. ‘Big Sky Legacy. In Montana, Small Schools Aren't a Bold New Idea. They're a Way of Life’. Northwest Education Journal, (2000) 6, 2, 34-42.
12. Squires, J. ‘Preparing personnel in rural areas’. In D Bricker & A Widerstrom (eds), Preparing personnel to work with infants mid young children and their families: A team approach. Baltimore, MD: Brookes (1996) 253-272
13. Ludlow, B L. ‘Technology and teacher education in special education: disaster or deliverance?’. Teacher Education and Special Education, (2001) 24, 2, 143-163
14. Kendal, R M. ‘Evaluating the benefits of a computer based telecommunications network: Telementoring and teletraining for educators in rural areas’. Journal of Research in Rural Education, (1992) 8, 1, 41-46
15. McDevitt, M A. ‘A virtual view: Classroom observations at a distance’. Journal of Teacher Education, (1996) 47(3), 191-195
16. Ludlow, B L, Duff, M C. ‘Webcasting: A New Technology for Training Special Educators in Rural Areas’. No Child Left Behind: The Vital Role of Rural Schools. Annual National Conference Proceedings of the American Council on Rural Special Education (ACRES) Nevada, March 7-9 (2002)
17. Falconer, K B, Lignugaris-Kraft, B. ‘A Qualitative Analysis of the Benefits and Limitations of Using Two-way Conferencing Technology to Supervise Preservice Teachers in Remote Locations’. Teacher Education and Special Education, 25, 4, (2002) 368-384.
18. European Commission. White Paper: Space: A New European Frontier For An Expanding Union: An action plan for implementing the European Space Policy. Luxembourg: Office for Official Publications of the European Communities (2003)
19. Cohendet, P. The Digital Divide in the European Enlarged Economic Scenario: An Assessment of the Socio-economic Effects. Strasbourg: University Louis Pasteur (2003)
20. Littman, M K. ‘Satellite Communications in the Telelearning Environment: Innovative Delivery Options for Distance Learning’. Journal of Online Learning, (2000) 11, 2, 5-11
21. Boverie, P, Gunawardena, C, Lowe, C, Murrell, W M G, Zittle, R H, Zittle, F. ‘Designing Satellite Instruction for Elementary Students: Importance of the Classroom Teacher.’ International Journal of Educational Telecommunications, (2000) 6, 2, 107-22.
22. Boylan, C, Wallace, A, Richmond, W. ‘Remote Student Access to Education via Satellite Delivery’. Education in Rural Australia, (2000) 10, 1, 2-12.
23. Al-Sharhan, J. ‘Education and the Satellite: Possibilities for Saudi Arabia?’. International Journal of Instructional Media, (2000) 27, 1, 51-56.
Cartheron, R (2003). Reducing the Digital Divide in Europe: Competitiveness of Satellite among Broadband Access Technologies. Paris: Vista Advisers.
24. Cohen, D. ‘Satellite-Based Computer Network Serves Students on Remote Pacific Islands’. Chronicle of Higher Education, 48, 18, (2002) A41-A42.
25. Lorenzo, G. ‘World Bank's Global Development Learning Network: Sharing Knowledge Electronically between Nations to "Fight Poverty"’. USDLA Journal, (2002) 16, 5.
26. Lim, D H ‘Perceived Differences between Classroom and Distance Education: Seeking Instructional Strategies for Learning Applications’. International Journal of Educational Technology, (2002) 3, 1
27. Shrestha, G M, Sutphin, H. ‘Relationship between Interaction and Acceptance in Satellite Video-Conferencing’. Journal of Educational Technology Systems, 28, 1, (2000) 43-58.
28. Wenger, E. Communities of practice: learning, meaning, and identity. Cambridge: Cambridge University Press (1998)

Competence and Performance in Requirements Engineering: Bringing Learning to the Workplace

Tobias Ley[1], Barbara Kump[2], Stefanie N. Lindstaedt[1], Dietrich Albert[2], Neil A. M. Maiden[3], Sara V. Jones[3]

[1] Know-Center Graz
{tley,slind}@know-center.at
[2] Cognitive Science Section, University of Graz
{kumpb,dietrich.albert}@uni-graz.at
[3] Centre for HCI Design, City University, London
{N.A.M.Maiden,S.V.Jones}@city.ac.uk

Abstract. Challenges for learning in knowledge work are being discussed. These include the challenge to better support self-directed learning while addressing the organizational goals and constraints at the same time, and providing guidance for learning. The use of competencies is introduced as a way to deal with these challenges. Specifically, the competence performance approach offers ways to better leverage organizational context and to support informal learning interventions. A case study illustrates the application of the competence performance approach for the learning domain of requirements engineering. We close with conclusions and an outlook on future work.

Learning in Knowledge Work: The APOSDLE Approach

With the term knowledge worker we refer to an employee of an organisation whose essential operational and value creating tasks consists in the production and distribution of knowledge (Machlup, 1962). Knowledge Workers are predominantly controlled by overall goals and expected results instead of defined procedures. Thus, they have significant autonomy in structuring their activities (such as timing and procedures) (Pyöriä, 2003; Davenport, 2005).

Learning in knowledge work operates in a constant tension between personal goals and organizational constraints. On the one hand, knowledge workers increasingly learn in an informal and self-directed manner (Pinchot & Pinchot, 1996). On the other hand, aligning learning to organizational goals and task requirements is an important factor. This even poses challenges for traditional personnel development instruments and trainings. How this alignment can be addressed within knowledge work, remains an open issue even more (Elkjaer, 2000).

This is also reflected in the differences between eLearning and Knowledge Management (KM) approaches. While eLearning has traditionally focused on providing guidance to learners by structuring content according to pedagogical models, KM has focused more on self-directed aspects of information search and knowledge sharing with a lack of addressing learning issues (Ras, Memmel, &

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 148-158, 2006.

Weibelzahl, 2005). While in traditional eLearning the guidance may be too strict to address challenges of knowledge intensive work, KM certainly has neglected that certain structures are needed for learning to take place.

As a result of this discussion, two challenges can be identified when addressing learning in knowledge work: (1) the tension between individual goals and organizational goals and constraints, and (2) the "problem of the amount of guidance" (Ras, Memmel, & Weibelzahl, 2005, p. 158). These challenges are currently being addressed in the APOSDLE project[7]. The goal of APOSDLE is to create a process-oriented learning environment which supports knowledge workers to work and learn at the workplace. The APOSDLE approach to workplace learning addresses the challenges by offering knowledge workers easy access to relevant knowledge artefacts and persons, and thereby giving them considerable freedom to work and learn in a self-directed manner. In order to address organizational issues as well, APOSDLE looks at the organizational context in which the knowledge worker operates (Ulbrich, Scheir, Görtz & Lindstaedt, 2006).

One of the elements of this context is made up of the competencies needed for performing the work the knowledge worker is engaged in. Specifically, our goal is to suggest ways in which a competency gap (i.e. a gap between the competencies required for a task, and competencies the knowledge worker has available) can be (semi-)automatically inferred from a comparison of a person's task performance in the past, and the tasks she is about to tackle in the future.

The purpose of this paper is to suggest a framework which formalizes the connection between knowledge intensive tasks, such as ones performed in a requirements engineering activity, and the competencies needed to perform these tasks. The framework informs an implementation methodology. This is then introduced and illustrated by means of a case study conducted in the domain of requirements engineering.

A Competence Performance Approach for Workplace Learning

The use of competencies has often been advocated as a way to deal with the challenges in workplace learning (Green, 1999; Lucia & Lepsinger, 1999; Erpenbeck & Rosenstiel, 2003). Specifically, competencies are being used to more closely relate learning to organizational requirements (such as goals or task requirements). Ley, Lindstaedt and Albert (2005) have suggested the competence performance approach as a model to formalize competencies and their connection to workplace performance for work-integrated learning.

With the competence performance approach Korossy (1997, 1999) has introduced an extension of knowledge space theory (Falmagne et al., 1990; Doignon & Falmagne, 1999). Knowledge space theory has been developed in the 1980s and 90s as an attempt to model a person's knowledge state as close as possible to observable behavior. It is predominantly concerned with the diagnosis of knowledge and has

---

[7] APOSDLE is an Integrated Project (IP) partially funded under FP6 of the European Community. For more details, see http://www.aposdle.org.

been applied in adaptive testing and tutoring scenarios and system (e.g. ALEKS Corp., 2003; Hockemeyer, Held & Albert, 1998). The fundamental idea of knowledge space theory is that a person's knowledge state in a certain domain can be understood as the set of problems this person is able to solve. Since solution dependencies exist among the problems, it is possible to present a person only a subset of all problems of a domain in order to diagnose his/her knowledge state. The collection of all possible knowledge states is called a *knowledge space*. A knowledge space is a partial order and is stable under union.

In an attempt to develop Knowledge Space Theory further, Korossy (1997) suggests that in addition to the set of problems, one should look at the set of competencies, that is knowledge, skills and abilities needed to solve the problems. This would generate information on the *reasons* for different levels of performance, and thereby help to suggest learning measures. Similar to the set of problems, competencies are also structured in a competence space which results from a surmise relation on the set of competencies.

The relationship between the two sets (problems and competencies) is formalized by an *interpretation function* which maps each problem to a subset of competence states which are elements of the competence space. This subset of competence states contains all those competence states in each of which the problem is solvable. The interpretation function induces a *representation function* which assigns to each of the competence states all problems which are solvable in that competence state. Which problems are solvable is determined by the interpretation function.

The competence performance approach has been applied in technology enhanced learning applications. For example, Hockemeyer et al. (2003) have assigned "competencies required" and "competencies taught" as metadata to a collection of learning objects. Thereby, prerequisite structures are derived for the eLearning content which allow for adaptive tutoring. New course content could easily be integrated, as metadata was only held locally.

In the current approach, we define *competencies* as personal characteristics of job holders which they bring to bear in different situations. Competencies are hypothetical constructs which determine performance in a job. The term *performance* is understood to encompass all behaviors relevant for the accomplishment of a certain task in a specific situation (Schmitt & Chan, 1998). We will differentiate competencies into more stable characteristics such as personality traits (or temperaments), motives and cognitive abilities, and more variable characteristics, such as skills and knowledge. This differentiation is in line with a large body of research into KSAOs (knowledge, skills, abilities and other characteristics) (Lucia & Lepsinger, 1999; Schmitt & Chan, 1998).

Case Study: Modeling Competencies for Requirements Engineering

This section introduces the methodology we use to model competencies within the competence performance framework. The methodology has already been applied in different settings (i.e. in the automotive industry and in a research based setting) (Ley, Albert & Lindstaedt, in press). We have recently conducted a further case study focused more directly on supporting workplace learning. We briefly introduce this case study here. It will then be used to illustrate the procedure employed for deriving competence performance structures.

The case study is currently being conducted as part of the APOSDLE project where the learning domain for a first prototype is requirements engineering (RE). The learning environment targets persons with various levels of expertise in RE who are working in a requirements engineering project. They may be domain experts with little knowledge of RE who have been made responsible for eliciting requirements for a system to be built, or RE specialists who need only little guidance to conduct RE projects. Specifically, we are using the RESCUE process (Requirements Engineering with Scenarios in User-Centered Environments, see Maiden et al. 2004).

RESCUE is an innovative process developed for the elicitation and specification of requirements for socio-technical systems. RESCUE supports a concurrent engineering process in which different modelling and analysis processes take place in parallel: Human Activity Modeling is done to provide an understanding of how people work in order to baseline possible changes to it. The aim of System Goal Modeling is to model the future system boundaries and dependencies between actors for goals to be achieved. The Goal Modeling is formalized with the i* notation. Use Case Modeling is the process of writing use cases for the future system, exploring it with stakeholders and carrying out impact analyses in order to obtain consistent and valid requirements. These sub processes are aligned at designated synchronization points. During the whole elicitation process, RESCUE provides guidance on requirements management. Furthermore the use of creativity workshops encourages requirements and design ideas to be discovered and elaborated together.

In the following sections, the methodology for modeling competence performance structures will be introduced. According to Ley & Albert (2003a), the methodology entails the following three steps: (1) derive a set of tasks (performance) for the position in question, and for the learning domain to be supported (see 3.1), determine competencies needed to successfully perform the tasks (see 3.2), and relate tasks and competencies in a task competency matrix (see 3.3). These three steps focus on the process “defining competencies” mentioned in the overall organizational competency management process presented by Ley, Albert & Lindstaedt (in press). Section 3.4 then suggest a way to use and validate the resulting structures.

Deriving a Set of Tasks

The tasks can be derived from a detailed analysis of the work to be performed in the chosen domain. It is important that tasks do well reflect the learning domain in question, and that performance in these tasks can be assessed with regard to some quality criteria which are agreed within the organization (i.e. whether a task has been performed well or poorly).

We have previously employed hierarchical task analysis to find tasks employees perform in a certain position (Ley & Albert, 2003b). In Ley & Albert (2003a), we have chosen documents produced by the workforce as a way to reflect the more dynamic nature of the tasks.

In the present case study, the set of tasks is rather easily obtained as there exists extensive documentation for the work to be performed in RESCUE. The set of tasks was derived by means of a detailed content analysis of the RESCUE process document (Maiden & Jones, 2004). We focused on the two streams *Human Activity Modeling (HAM)* and *System Goal Modeling (SGM).* As a result, a first list of tasks was obtained for these two streams and later reviewed by the authors of the RESCUE process. The final list of tasks was composed of 29 tasks in the *HAM* stream, and 18 tasks in the *SGM* stream.

Deriving Competencies Needed

When eliciting competencies needed, we rely to a large extent on techniques for eliciting knowledge from domain experts with structured interviews or questionnaires. For instance, Ley & Albert (2003a) have used the Repertory Grid technique to elicit competencies from documents which the experts had written in the past. In the present case study, a first open ended interview was held with the two RESCUE experts mentioned above. We considered the tasks obtained in the previous step and asked the experts to name competencies (knowledge and skills) needed to perform well in these tasks. The interview data obtained was then complemented with data derived from the analysis of existing documented sources from related research, such as van den Berg (1998) and National O*NET Consortium (2005). From these sources, an extensive list of competencies was obtained, cross-checked for consistency and then validated with the RESCUE experts. In total the list consisted of 33 competencies.

Table 1: Tasks in System Goal Modeling Selected for the Example

	Tasks
1_1	Build a first cut Context Model to identify system boundaries
1_2	Carry out an initial stakeholder analysis
1_3	Develop an extended Context Model
1_4	Allocate functions between actors according to boundaries
1_5	Identify intentional strategic actors
1_6	Model dependencies between strategic actors
1_7	Write different forms of dependency descriptions
1_8	Produce an integrated SR Model using dependencies in the SD model
1_9	Check the i* Model for completeness and correctness
1_10	Validate the i* SR Model against the SD model (cross-check)

To exemplify the procedure, we have selected a subset of tasks to be achieved in the sub-process of *System Goal Modeling*. Table 1 shows the lists of tasks, Table 2 shows the list of competencies selected for our example.

Table 2: Competencies in System Goal Modeling Selected for the Example

	Competencies
A	Knowledge about actors, tasks, goals and resources
B	Knowledge of different types of system stakeholders
C	Knowledge of building the Context Model
D	Knowledge about the Strategic Dependency Model (SD-Model)
E	Knowledge about the Strategic Rationale Model (SR-Model)
F	Ability to produce an i* Model
G	Judgement and decision making skills
H	Knowledge of guidelines for validating the SR Model

Constructing Competence Performance Structures

To build the interpretation function, the experts were asked to assign to each task those competencies they regarded as mandatory for successfully accomplishing the respective task. This was done by means of a *task competency matrix* (see Ley & Albert, 2003a). In the present case, the experts were asked to give their assignments independently from each other. This way, agreement can be measured as one way to evaluate the methodology and the resulting structures (see below). In continuing the example from above, Table 3 gives the results of this assignment. The crosses in the matrix indicate the minimal interpretation for each task, i.e. the set of competencies that a person has to have at the minimum to be able to perform the task well.

To obtain the whole competence space, the competence states of the minimal interpretation were closed under union and the empty set was added. Furthermore, for every competence state the representation function was built by assigning to every state the set of tasks a person would be able to accomplish in the respective state, thereby obtaining the competence performance structure.

The competence performance structure derived for the example above, can be seen in Figure 1. In this example, a person who is in the competence state {B, C, D} should perform well in the tasks {1, 2, 7} (the respective performance state). A person who is able to accomplish task 4 (*Allocate functions between actors according to boundaries*) is assumed to be able to also perform task 2 (*Carry out an initial stakeholder analysis*) because any performance state which contains task 4, also contains task 2. In other words task 2 is assumed to be a prerequisite of task 4, since the minimal interpretation of task 2 ({B}) is a subset of the minimal interpretation of task 4 ({A, B, C}).

Table 3: Task Competency Matrix and Minimal Interpretation of tasks in SGM

		Competences								Minimal Interpretation
		A	B	C	D	E	F	G	H	
Tasks	1_1		X	X						{B, C}
	1_2		X							{B}
	1_3		X	X				X		{B, C, G}
	1_4	X	X	X						{A, B, C}
	1_5	X	X	X				X		{A, B, C, G}
	1_6	X	X	X	X		X	X		{A, B, C, D, F, G}
	1_7				X					{D}
	1_8	X	X	X	X	X	X	X		{A, B, C, D, E, F, G, H}
	1_9	X			X	X	X			{A, D, E, F}
	1_10	X			X	X	X		X	{A, D, E, F, H}

The purpose of this procedure is to limit the number of competence states (and performance states) that can be expected to appear in a population as a consequence of the prerequisite relationships. As a result, several adaptive procedures can be applied that can be utilized when the structures are put to use (see next section).

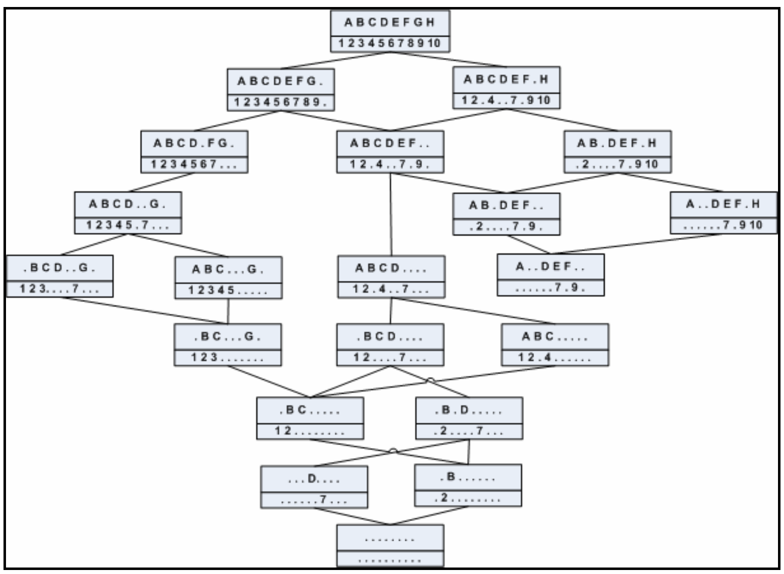

Fig. 1. Competence Space and Representation Function for the Example

Using and Validating the Structures

Given a valid structure of the domain, one can diagnose the competence state of a person by evaluating his/her performance in the tasks being performed, and thereby derive competency gap. Given certain tasks that were performed well, and others that were not performed well, it is relatively easy to find the likely competence state this person is in. If a person consistently performs well in tasks 1, 2 and 7 in the above example, but fails to perform well in task 4, this would mean that competency A (*Knowledge about actors, tasks, goals and resources*) would be a relevant learning goal. In case of such discrepancies one could provide the person with tailored learning contents.

This competency diagnosis can make use of the adaptive potential mentioned previously. From knowing that a person can perform well in certain tasks, it can be inferred with some certainty that this person also performs well in other tasks. This seems to be especially relevant for structures that encompass a large number of tasks where it is unlikely that performance information about all tasks is available for each and every employee.

Judgments of whether a certain task has been performed well or not (performance appraisal) can be obtained in a number of different ways. Standard procedures of self- and supervisor rating known from competency management and other Human Resource instruments (such as assessment centers or performance appraisal schemes) can be obtained. An important advantage when compared to many of the standard practices is that appraisal can be based on task performance which is relevant for the job that is being performed. This avoids several biases known from the appraisal of competencies (Schmitt & Chan, 1998).

The procedure of diagnosing competence states from past performance, and especially the adaptive procedures, require that the structures are valid. This is not an exclusive requirement for our approach, but in fact is essential for any appraisal system that is being put to use (see e.g. Schmitt & Chan, 1998). A special benefit offered by the competence performance approach is that it makes validating easier and offers the opportunity to integrate validation directly into the modeling or assessment process (Ley & Albert, 2004). Criteria for validating competence performance structures are discussed in Ley, Albert & Lindstaedt (in press). In the present case study, an initial comparison of the assignments done by the two experts resulted in an agreement coefficient (inter-rater reliability) of $r=0.26$ for the *HAM* stream and $r=0.53$ for the *SGM* stream.

Conclusions and Outlook

The above structures map the learning domain in terms of learning goals and the related tasks directly derived from relevant working tasks. This means that learning is specifically tailored to the requirements of working tasks and processes. We are currently also examining other elements of the user context that can be of use when providing process learning support, namely the process context and the application domain (see Ulbrich et al., 2006). We expect that by integrating competence performance structures (as well as other elements of the user context) into a user profile component, the retrieval component of the APOSDLE system will be able to better tailor the retrieval of existing resources to current available and missing competencies of the user.

In terms of structuring available content, competence performance structures provide an overall map of the learning content. Moreover, the use of competencies makes it possible to structure single learning resources according to the underlying knowledge need. We are currently researching ways to construct learning material automatically from available content that is structured by a "learning template" (de Jong, van Joolingen, Veermans, & van der Meij, 2005). The structure of the template and content of the material is dependent on the learning goals of the user (derived from the missing competencies), as well as the type of missing knowledge. For example, competency A ("Knowledge about actors, tasks, goals and resources" in Table 1) is mainly based on conceptual knowledge, whereas competency C ("Knowledge of building the Context Model") is mainly based on procedural knowledge. As a consequence, the structure of the template will be different for learning something about competency A (e.g. learning definitions, background of terms etc.) than for competency B (learning procedures using how-tos and worked out examples).

Acknowledgments

APOSDLE is partially funded under the FP6 of the European Commission within the IST Workprogramme (project number 027023). The Know-Center is funded by the Austrian Competence Center program Kplus under the auspices of the Austrian Ministry of Transport, Innovation and Technology (www.ffg.at) and by the State of Styria.

References

ALEKS Corp. (2003). ALEKS - A Better State of Knowledge. Retrieved July 20, 2006, at http://www.aleks.com

de Jong, T., van Joolingen, W.R., Veermans, K., & van der Meij, J. (2005). Authoring discovery learning environments; in search for reusable components. In M. Spector, C. Ohrazda, A. van Schaack & D. Wiley (Eds.), Innovations in instructional technology: Essays in honor of M. David Merrill (pp. 11-29). New Jersey: Lawrence Erlbaum.

Davenport, T.H. (2005). Thinking for a living. Havard Business School Press, Boston, MS.

Doignon, J., & Falmagne, J. (1999). *Knowledge Spaces*. Heidelberg: Springer.

Elkjaer, B. (2000). Learning and getting to know: the case of knowledge workers. *Human Resource Development International, 3*(3), 343-359.

Erpenbeck, J., & Rosenstiel, L. v. (Eds.) (2003). *Handbuch Kompetenzmessung*. Stuttgart: Schäffer-Poeschl.

Falmagne, J., Doignon, J., Koppen, M., Villano, M., & Johannesen, L. (1990). Introduction to Knowledge Spaces: How to Build, Test, and Search Them. *Psychological Review, 97*(2), 201-224.

Green, P. C. (1999). *Building Robust Competencies: Linking Human Resource Systems to Organizational Strategies*. San Francisco: Jossey-Bass.

Hockemeyer, C., Held, T., & Albert, D. (1998). RATH - a relational adaptive tutoring hypertext WWW--environment based on knowledge space theory. In Ch. Alvegård (Ed.), *Computer*

Aided Learning and Instruction in Science and Engineering, Proceedings of the CALISCE'98 (pp. 417-423). Göteborg: Chalmers University of Technology.
Hockemeyer, C., Conlan, O., Wade, V., & Albert, D. (2003). Applying Competence Prerequisite Structures for eLearning and Skill Management. Journal of Universal Computer Science, 9(12), 1428-1436.
Korossy, K. (1997). Extending the theory of knowledge spaces: A competence-performance approach. *Zeitschrift für Psychologie, 205*, 53-82.
Korossy, K. (1999). Modeling Knowledge as Competence and Performance. In D. Albert, & J. Lukas (Eds.), *Knowledge Spaces: Theories, Empirical Research, and Applications* (pp. 103-132). Mahwah, New Jersey: Lawrence Erlbaum Associates.
Ley, T. & Albert, D. (2003a). Identifying Employee Competencies in Dynamic Work Domains: Methodological Considerations and a Case Study. *Journal of Universal Computer Science, 9* (12), 1500-1518.
Ley, T. & Albert, D. (2003b). Kompetenzmanagement als formalisierbare Abbildung von Wissen und Handeln für das Personalwesen. *Wirtschaftspsychologie, 5* (3), 86-93.
Ley, T. & Albert, D. (2004). Quality Criteria for Competency Assignments: Examples from a Project Management Case Study. In P. Dadam & M. Reichert (Eds.), *Informatik 2004 - Informatik verbindet* (LNI, Vol. P-51, pp. 342-346). Bonn: Gesellschaft für Informatik.
Ley, T., Albert, D. & Lindstaedt, S. N. (in press). Connecting Competence and Performance in Competency Management: Modeling, Assessment, Validation and Use. In M. A. Sicilia (Ed.), *Competencies in Organizational E-Learning: Concepts and Tools (pp. 83-119)*. Hershey: Idea Group.
Ley, T., Lindstaedt, S. N., & Albert, D. (2005). Supporting Competency Development in Informal Workplace Learning. In K.-D. Althoff, A. Dengel, R. Bergmann, M. Nick, T. Roth-Berghofer (Eds.), *Professional Knowledge Management* (LNAI 3782, pp. 189-202). Berlin: Springer.
Lindstaedt, S. N., Farmer, J., & Ley, T. (2004). Betriebliche Weiterbildung. In J. Haake, G. Schwabe, & M. Wessner (Eds.), *CSCL-Kompendium - Lehr- und Handbuch zum computerunterstützten kooperativen Lernen* (pp. 423-434). München: Oldenbourg.
Lindstaedt, S. N., Ley, T., & Mayer, H. (2005). Integrating Working and Learning in APOSDLE. *Proceedings of the 11th Business Meeting of the Forum Neue Medien, November 10-11, 2005, University of Vienna, Austria.* Graz/Austria: Forum Neue Medien.
Lucia, A. D., & Lepsinger, R. (1999). *Competency Models: Pinpointing critical success factors in organizations*. San Francisco: Jossey-Bass.
Machlup, F. (1962). Function and Distribution of Knowledeg in the United Sates. Princeton University Press, Princeton, NJ.
Maiden, N.A.M., & Jones, S.V. (2004). The RESCUE Requirements Engineering Process – An Integrated User-centered Requirements Engineering Process, Version 4.1. Technical Report, Centre for HCI Design, The City University, London.
Maiden, N.A.M., Jones, S.V., Manning, S., Greenwood, J., & Renou, L. (2004). Model-Driven Requirements Engineering: Synchronising Models in an Air Traffic Management Case Study. Proceedings CaiSE'2004, Springer-Verlag LNCS 3084, 368-383.
Pinchot, G., & Pinchot, E. (1996). The Rise and Fall of Bureaucracy. In P. S. Myers (Ed.), *Knowledge Management and Organizational Design* (pp. 39-54). Newton/MA: Butterworth-Heinemann.
Pyöriä, P. (2005). The concept of knowledge work revisited. Journal of Knowledge Management 9(3), 116-127.
Ras, E., Memmel, M., & Weibelzahl, S. (2005). Integration of E-Learning and Knowledge Management – Barriers, Solutions and Future Issues. In: K.-D. Althoff, A. Dengel, R. Bergmann, M. Nick, T. Roth-Berghofer (Eds.). *Professional Knowledge Management* (LNAI 3782, pp. 155-164). Berlin: Springer.
Schmitt, N., & Chan, D. (1998). *Personnel Selection*. Thousand Oaks: Sage.

Ulbrich, A., Scheir, P., Görtz, M. & Lindstaedt, S. N. (2006). A Context-Model for Supporting Work-Integrated Learning. In Nejdl, W., & Tochtermann, K. (Eds.), *Proceedings of 1st European Conference on Technology-enhanced Learning* (LNCS, Vol. 4227). Heidelberg: Springer.

Van den Berg, P. T. (1998). Competencies for Work Domains in Business Computer Science. *European Journal of Work and Organisational Psychology, 7*(4), 517-531.

Identification of User's Learning Goals in Workflows

Oleg Rostanin[1] and Rafael Schirru[2]

[1] German Research Center for Artificial Intelligence (DFKI), Kaiserslaut
Germany oleg.rostanin@dfki.de
[2] University of Kaiserslautern, Germany schirru@dfki.uni-kl.de

Abstract. Nowadays, the main focus of business process management research is concentrated on keeping the enterprise business processes up to date and conform to the enterprise business goals. The fact that enter- prise employees need to adapt to the new process flows, efficiently make decisions in a new situation and apply recently emerged technologies is often left without attention. The authors of this work argue that the methods of goal oriented adaptive e-learning will help employees to solve the problem of being informed up-to-date and competent without taking off work. The paper presents a method for employee's learning goal elicitation during their work with the enterprise workflow management system.

1 Introduction

Once,Workflow Management Systems (WFMS) [Allen 05] were intended to support the enactment of the enterprise business processes and to guarantee the quality of process results. However, the modern world sets harder requirements to business process management [Scheer 05] because of the permanent changes in the economy trends and the hard competition in the global market. Changes in the enterprise workflows can lead to embarrassing consequences for enterprise employees. Examples of challenges for the employees can be the necessity to make decisions in a new situation or to efficiently use a newly emerged technology on a certain workflow step. As recent surveys [Ridge and Solis 03] show, an appreciable amount of time nowadays is being spent on looking for information on the internet, local desktop or in the corporate document repository. Although the methods and tools for efficient information search are being permanently developed [Safari,GDS], we advocate the approach of the lightweight proactive information delivery and business process oriented knowledge management described in [Holz et al 05]. In the TEAL (Task Embedded Adaptive Learning) project, we extend the idea of context-specific, proactive information delivery by using up-to-date e-learning technologies enabling just-in-time delivery of goal-oriented, user-tailored learning curricula, helping workflow participants to solve problems autonomously and competently (workflow embedded e-learning) [Rostanin et al 06]. The current paper presents a method for employee's learning goal elicitation during their work with the enterprise workflow management system which has been realized in the project TEAL.

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 159-164, 2006.

2 Goal Orientation in Workflow Learning

In order to achieve the effectiveness of workflow embedded learning (short time and acceptable quality), two requirements have to be met by information assistants delivering the task-specific information to their users that are integrated into a WFMS: first, the delivered information has to satisfy the user's current information need (be just-in-time); second, it is necessary that the delivered information does not overextend the user (just-enough) [Rostanin and Holz 05]. Hence, the concept of goal-oriented learning is highly relevant for enterprise workflows. Let's consider an employee that is facing a new task. The employee mentally checks if his knowledge is sufficient to perform the task. If the necessary knowledge is not present a knowledge gap is identified. From this gap the learning goal "cover the knowledge gap in the context of the given task" is identified. For complex tasks more than one learning goal might be identified.

Learning goals influence the learning process in two ways:

– They narrow the range of content which is considered necessary to be learned (what to learn).

– They guide the learning process by specifying the learning strategy (how to learn).

To illustrate the notion of learning strategies, we consider the following example: A software team has to develop a client-server system using the J2EE[1] technology. The team consists of one project manager and four programmers. Neither the project manager nor the programmers have experience in programming with J2EE, so they have to learn J2EE to accomplish their task. The project manager's learning goal is to receive knowledge about the architecture of J2EE and about the advantages of the technology so that he can design the system. An overview of the technology is suitable learning content for him. The learning goal of the programmers is to learn how to program the system with J2EE. They require more detailed and specific learning content than the project manager (including exercises and examples). Even if the same knowledge is involved in both cases, the appropriate learning contents are different according to the learning goals.

According to the above considerations, we define a learning goal as a triple $g = (c, s, m)$ where g is a learning goal, c is a concept from the learning ontology (see chapter 3), s is a learning strategy and m is the user's motivation to achieve the learning goal. Typically, the motivation is a reference to the current workflow task that has to be fulfilled after the user eliminates the knowledge gap. The problem of learning goal identification can be narrowed to finding a target concept and an appropriate strategy of learning. Once the learning goal is identified and accepted by the user, it receives the following runtime characteristics: identification date, current state (not started, started, finished) and completion date. In TEAL we call an identified learning goal a *potential learning goal*. After the potential learning goal is accepted by the user it is called a *current learning goal*.

[1] J2EE: Java 2 Platform, Enterprise Edition. URL: http://java.sun.com/javaee/

3 A Method for Learning Goal Identification (Project TEAL)

3.1 Learning Concept Ontology and LeCoOnt Tool

The basis for the retrieval of the concept to be learned is the ontology of learning concepts that depicts the outline of the learning content in the Learning Content Management System (LCMS) used for workflow embedded e-learning as an information assistant. The purpose of the learning concept ontology is to model the domain of knowledge related to the given workflow. Learning objects contained in the LCMS are bound to the corresponding learning concepts using adequate metadata. The more concepts are preserved in the ontology, the finer knowledge gap identification can be achieved.

The creation and maintenance of such ontology is a long and time consuming process. To simplify the ontology maintenance, in the project TEAL there was a tool created called LeCoOnt that allows to present the ontology graphically, conveniently navigate in the ontology, search, add and change ontology concepts[2]. On the figure 1 one can see a screen of the LeCoOnt tool showing a part of the software engineering ontology that contains concept SQL and related concepts. In addition to the graphical editor, the LeCoOnt tool provides also functionality for automatic extraction of learning concepts from the online glossaries[3] that allows to significantly reduce time needed for the initial ontology creation. Later, the ontology will be continuously refined and complemented using the graphicaleditor.

3.2 Proactive Delivery of the Potential Learning Goals in Workflow

For identifying the potential learning goals of the workflow user, there was a middleware component developed called DyLeGo (Dynamic Learning Goal). The DyLeGo component can be integrated into any WFMS that provides open API for accessing the workflow context information. The workflow context includes a variety of information about the task environment that allows identifying potential learning goals:

– Task information
- • Task name, description, task-relevant concepts and documents provide the key information about what the user is currently doing. Using task name we can identify potential learning goals of the user.
- • Reference to the instantiated task model if the current task is instance of the certain activity model it can givemore precise information on what the user is currently doing than just using a task name.
- • Project information, connection to other tasks The information about the project and other tasks (predecessor, successor etc.) of the user can help to interpret current user actions.

---

2 LeCoOnt. Learning Concept Ontology Editor. URL: http://lecoont.opendfki.de

3 Sun Java Enterprise System Glossary. URL: http://docs.sun.com/source/8166873/index.html

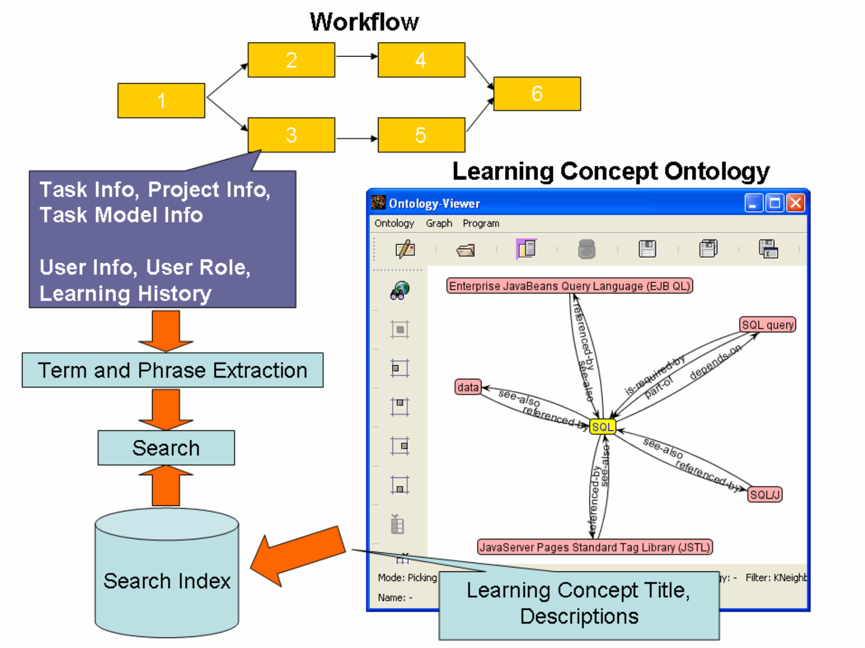

Fig. 1. Learning Goal Identification in the Workflow Context

– User information
  - User role is the base for determining learning strategy of the user (see example in 2).
  - User skills, interests, working and learning profile allow us to exclude concepts that user already knows or include concepts that are unknown for the user.

If the workflow context has changed, DyLeGo issues an automatic query containing workflow context information to the learning concept ontology and delivers a list of potential learning goals to the workflow user. The delivery is conducted proactively (push-approach) so the user does not need to start search or to specify query manually and is not interrupted in his work. To enable efficient search of potential learning goals, DyLeGo creates a text search index from the learning ontology concepts using Apache Lucene software[4] (see figure 1). The learning concept retrieval is based on extracting important keywords and subphrases from the name of the current task and its description and querying the learning concept ontology for the corresponding concepts. Found concepts are filtered using the user's learning history and his competence profile (delivered from the WFMS). The algorithm being used to determine the optimal learning strategy for the user is based on the user role in the

4 Lucene. URL: http://lucene.apache.org/

current workflow (see example in chapter 2). The database of DyLeGo contains a special table that provides information about matching between a learning concept, a user role and a recommended strategy. The contents of the table is initialized by the authors of the learning concept ontology who can make recommendations about the usefulness of the corresponding concept for every role. During the usage, the system learns which users prefer which strategy and the information about concept-role-strategy matching is being automatically updated. Other information used for specifying the learning strategy is user's skills, interests, working and learning history. In the TEAL project the following learning strategies were identified:

– **overview** Very short description giving the general impression about the subject to be learned. One can compare this with glossary description. On the basis of the overview Bob should be able to judge whether he needs to learn this subject deeper or not.

– **cursorily** If the learner decided to learn the subject but he/she does not need to get expert-level knowledge on it, the cursorily strategy should be chosen. For instance, it would be the case if Bob's manager would like to get acquainted with possibilities of the SQL language.

– **detailed** Provides expert-level knowledge on the subject. If Bob would like to optimize a complex Oracle query and has no idea about optimization, a detailed course on Oracle SQL tuning should be delivered for him.

– **repeat** Serves as reference material on the subject. If Bob finished the course on Oracle SQL tuning he might still need a succinct reminder course on Oracle optimizer hints. The above listed strategies were oriented on the learning course generator [Ullrich 05a] developed in the LeActiveMath[5] project and used in TEAL for dynamic goal-oriented course generation. In the future, the list of strategies will be extended and should cover the Bloom's learning goal taxonomy [Bloom 56].

4 Conclusion

This short paper introduces a simplified model of goal oriented learning in enterprise workflows and presents a method for user's learning goal elicitation in the workflow process. The proposed method is a lightweight approach based on the assumption that most of the concepts used in the current workflow are modeled in the learning concept ontology. It also assumes that users give names to the current tasks according to certain naming conventions (e.g., the name of the task starts with a verb etc.). In order to sophisticate the presented approach, further research and evaluation is currently being conducted.

The feasibility of the proposed method was proved during the TEAL project. In the project, the DyLeGo system was successfully integrated into a flexible workflow engine called TaskMan that was developed at DFKI[6]

---

[5] LeActiveMath. URL: http://www.leactivemath.org

[6] FRODO Taskman. URL: http://www.dfki.unikl.de/KM/content/e179/e506/index_ eng.html

5 Acknowledgements

Work is funded in part by "Stiftung Rheinland-Pfalz für Innovation" (InnoWiss, TEAL). The authors especially thank the diploma student Shenwei Song for his work in the project TEAL.

References

[Allen 05] Allen, R., Open Image Systems Inc., United Kingdom Chair, WfMC External Relations Committee Workflow: An Introduction. Url: http://www.wfmc.org/information/Workflow-An Introduction.pdf

[Atkins 03] Atkins, S., Introduction to workflow learning. White paper. 2003. Url: http://www.internettime.com/workflow/intro wfl.htm.

[Bloom 56] Bloom, B.S., Engelhart, M.D., Furst, E.J., Hill, W.H., Krathwohl, D.R.: Taxonomy of Educational Objectives, The Classification of Educational Goals, Handbook I: Cognitive Domain. New York: McKay 1956, reprinted 1969.

[GDS] Google Desktop Search. http://desktop.google.com/en/about.html

[Holz et al 05] , Holz, H., Maus, H., Bernardi, A., Rostanin, O., From Lightweight, Proactive Information Delivery to Business Process-Oriented Knowledge Managment. Journal of Universal Knowledge Management. 2, 2005, Pages 101–127.

[Ridge and Solis 03] The Ridge Group in conjunction with Solis Consulting. Information Gathering in the Electronic Age: The Hidden Cost of the Hunt, Safari, January 2003.

[Rostanin and Holz 05] Rostanin, O., Holz, H., Task-Embedded e-Learning. Url: http://137.251.109.40/dl2000/publicationdetail.php?&setchannelid=1&publicationid=912

[Rostanin et al 06] Rostanin, O., Ulrich, C., Holz, H., Song, S. Project TEAL: Add Adaptive e-Learning to your Workflows. In proceedings of IKNOW 2006, 6-8 Sept. Graz. To be published.

[Safari] Safari books online. http://safari.oreilly.com/

[Scheer05] IDSSheer.Aris Platform. http://www.idsscheer.com/sixcms/media.php/2188/PR0905-E-BR.pdf.

[Ullrich 05a] Ullrich, C., Course Generation Based on HTN Planning. In Proceedings of 13th Annual Workshop of the SIG Adaptivity and User Modeling in Interactive Systems, 2005, Pages 74-79.

A Framework for Building Virtual Communities for Education

Iraklis Varlamis, Ioannis Apostolakis

Department of Psychology, Panteion University, Athens, Greece,
varlamis@aueb.gr, apost@panteion.gr

Abstract. The aim of education is to provide the basis for life long learning and improvement. In this direction, schools and universities offer standard curricula aiming to cover the fundamental needs of their students in a few years scope. On the other side, institutes and companies offering life long education focus on improving specific skills and competencies of people in a short period of time. Obviously the aims, capabilities and availability of attendants vary significantly, since they usually have to cope with their morning work and their family duties. As a matter of fact, several issues, such as the limited duration of training programs, the loaded schedule of trainees, the inevitable absences due to other obligations, the multitude of topics to be covered, the variance of attendants' interests and needs, have to be considered in order to create a competitive training program. In order to support attendance and inform people on the topics, requirements and aims of programs we need a flexible program structure and an infrastructure that delivers information, training material, and support on demand, in a daily basis. We believe that a single institute is not always capable in coordinating such a composite effort and we capitalize on the building of a virtual community for education. Community will comprise training institutes, educators and trainees who will interact and co-operate in order to achieve maximum gain and flexibility.
Keywords: Virtual communities, education, life long learning

1 Introduction

The evolution in networks and hardware and the advances in software integration, allowed educational institutes and organizations to join forces and offer advanced courses to people. In the same time they have the infrastructure required to monitor and support students either from distance or in contact. In the same time the work performed in educational standards and course design software [13],[14] allows educators to build modular educational material and exercises and compose flexible course scenarios [10] and programs [6] that fit to every student's needs.

In the scope of life long education, people search for training opportunities in order to cover their needs at work, enhance their skills' profile and shift or push their career. On the other side training institutes strive to find space, time and people (educators) and organize them efficiently. Educators should have profound knowledge and be capable to teach multiple topics, classrooms should be available and well equipped all the time in order to support a group or a single student. The institutes must provide flexibility in the delivery of training programs which could last from a weekend to a

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 165-172, 2006.

few months. The same topics should be covered, although in a different level of detail. Finally, institutes should provide side-support, offer additional material and exercises to trainees and give them the ability to demand new programs.

For all the above reasons, we consider that a flexible framework for offering education and training is crucial for life long learning. A ***community framework*** will allow the collaboration of institutes and management of trainees and training programs and will facilitate the cooperation of educators and trainees. In this paper we present the main directives for developing a virtual learning community, which incorporates educators, trainees and institutes and offers reading and training material and packaged training solutions. We discuss the main issues concerning the design, operation and administration of this community and focus on the features and services it should offer. We present technical solutions with minimum cost and portray the merits of this approach through the prototype application of a virtual learning community for a postgraduate programme.

The next section presents the fundamental concepts of contemporary education and virtual communities and is an introduction to the framework presented in section 3. Section 4 illustrates the prototype application of this framework into a virtual community of postgraduate students and focus on implementation details. Section 5 discusses major operational and administrative issues of our prototype that apply to all virtual learning communities. Finally, section 6 summarizes the gains of the community approach for institutes, educators and students and provides useful insights for the success of a larger learning community.

2 Fundamental Concepts: Education and Communities

Life long education covers a wide range of ages and comprises all official, unofficial and informal learning methods [12]. It also refers to any learning activity through life that aims in improving knowledge, skills or dexterities. Education can be supported or not and support can be provided in vivo or from distance. The motive behind this personal improvement is either social or professional or both [1].

In **distant education**, the reading material, courses and support are offered using network technologies to distant students all over the world [5]. The supervision and guidance of students in real-time is optional, however the duration, the educational targets and the tasks to be performed are predefined.

In **open education** all learning tools and materials are available to the student. The syllabus, tasks and targets of a program can be modified at students' will. In open education, autonomous learning is favoured [9]. Moreover, students' needs and capabilities affect the structure, duration and tempo of an educational program. Open education can be delivered from distance or not, is delivered to groups or single students and allows students to interact with the programs' structure. The term 'open' has a second meaning, referring to the ability of anyone to participate in a program.

Virtual communities (or internet communities) are defined as groups of people with common interests and practices that communicate regularly and for some duration in an organized way over the Internet through a common location or mechanism. **Virtual learning communities** share many features with the pre-mentioned concepts [7]. First, all community members have a common interest: education. Second, Internet is the carrier and network technologies the supporting infrastructure. Finally, the idea of ‘open’ is tightly related to virtual communities, since anyone interested in education is a potential member for an learning community, and is likely to communicate his/her opinion to other community members.

A review of the existing solutions in education reveals the power and flexibility of communities [8]. The undeniable gain from using communities in education springs from the increase in membership. However, increased participation results in augmented administrational and operational costs and risks. Since the main aim of the community is defined, the next step is to define the community borders: the contributors and members, the roles and rules of the community. In the following, we present in more details the framework for establishing a virtual learning community.

3 A Virtual Community for Education

The success of a community is measured in the degree of its members’ participation. Since the members carry all community tasks, the definition and assignment of roles, duties and rights to members is crucial. In opposition to virtual enterprises and organizations, the definition of rights and responsibilities in a community is not strict and changes according to members’ need and participation. Active and capable members of a community are promoted or assigned new roles. Members that do not contribute are restricted, demoted and set aside by other members. Potential members of a learning community are students, people that need training, trainers and tutors, researchers seeking to exchange knowledge, universities and institutes that offer training and companies that produce educational material and software.

The building blocks of the community are ***students*** or ***trainees***. They join the community in order to attend an educational program and obtain knowledge. They request for training in side fields unrelated to their studies and receive support and guidance by other community members or experts. ***Universities*** and educational ***institutes*** are the community motors. They assemble educational modules into targeted programs and guide students and trainees to improve skills. They undertake the administration of the community and in parallel monitor and facilitate members. They study the members’ needs, design and offer courses and direct members to the appropriate knowledge. Individual ***educators*** and ***researchers*** are able to offer their expertise to the community, always under the administrators’ control. The anatomy of a learning community is depicted in figure 1 and explained in the following.

In order for the community to thrive, the harmonic cooperation of all members must be achieved. The system should consider the particular needs and targets of life long learners [3]. The community should be able to adapt content and courses to the match changes in the work environment and rapid technological expansion. A ***profile base*** where members’ skills, needs and educational targets are recorded is very useful in the design of new courses or seminars. The analysis of members’ profiles will give better educational solutions and create competitive groups of learners.

A “***knowledge base”*** [11] will contain educational material organized by topic, course scenarios, educational solutions, program evaluation reports, answers to users’ requests etc. Educational programs must comprise reusable learning objects that can be easily recomposed or transformed to fit each employee needs. The use of learning objects facilitates the monitoring of content, since it is easier for institutions to rate the quality and suitability of content uploaded by educators. Additional training material can be added by authorised members, only after evaluation.

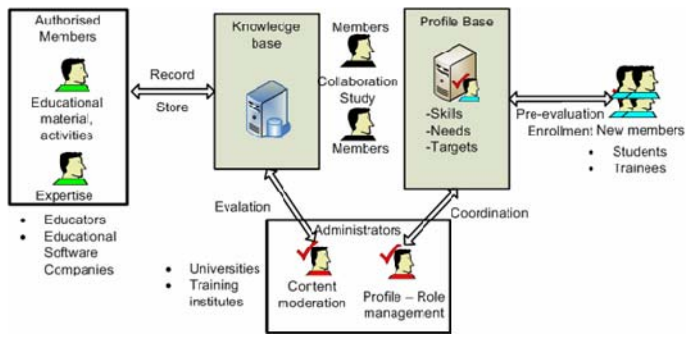

Fig. 1. A learning community

Finally, the power of the community resides in the ability of members to collaborate. It is essential in this case to build a ***collaboration environment*** and encourage members' interaction through group activities. In such activities, distant members of a virtual class are forced to communicate, to participate in synchronous activities, to split composite activities into tasks and work in subgroups etc.

4 A Prototype Virtual Community for the Education

In order to strengthen our belief on the power of virtual communities in education we established a community supporting a postgraduate program held in our university. The program, was entitled "Virtual Communities Socio-psychological Issues and Applications" was a joint effort of the university with one technical university and one research institute. Tutors from the three institutions had different theoretical background (psychologists, sociologists and computer scientists) and orientation and the same happened with the students. All courses were performed at the university place, whereas tutors could be in distant places. The community members were divided into professors and students. However, administrative and coordination tasks were held by the registrar.

In order to advertise the program we created a web site with general information. Additional information concerning every day activities of each course, news and announcements of interest to the students were hosted in a free web space server (web log) and only registered community members were allowed to update or comment. In an effort to delegate administration tasks, we created what we call the "weblog umbrella" (Figure 2). Web logs are easily updatable websites where administrators can post messages by filling a few forms and without special knowledge on web design technologies. We created separate web logs, hosted into free web servers, one for each course. The ***course tutors*** could add short notices or announcements and manage the comments or posts of the community members. The ***students*** were permitted to comment on the tutor notices thus providing them with useful feedback. Weblog ***visitors*** were able only to read announcement or comments. On the top of this set of weblogs we created an additional weblog for the whole program, in which community members were able to post messages. The program web log was accessible for the program web-page and provided links to all program courses.

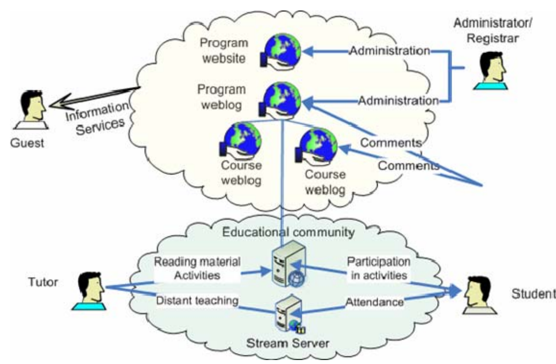

Fig. 2. The prototype learning community structure

The main educational activities of the community were supported by an open-source web application (Moodle: http://moodle.org/), which was accessible for students and tutors. In the majority of courses tutors used the community application solely for provided reading material to students. However, in several courses, students and professors employed the forum, chat and news services in order to coordinate their actions. We have completely tested the activity services provided by the application, which is on our plans for the upcoming semester.

Finally, using the technological infrastructure of the university's teleconference room we performed distant courses from one of the joint institutes. Tutors and students were interacting using real-time video over a streamed media server.

4.1 Applied Course Scenarios

In the scope of the post graduate program, we setup several educational activities for the students and employed as many of the community software facilities as possible. In a certain course we asked students to form subgroups in order to carry out the assignments. Using the "Form sub-groups" option of the software we divided students into teams that could discuss the assignment issues in private. Although, all the other students were not able to watch the private discussions, the tutor could monitor the activities and coordinate each group.

In another course, students were provided with individual weekly assignments. In order to provide additional support for the assignments, the tutor arranged an online group meeting once a week with all his students. During the online meeting the tutor answered questions, provided consults and gave directions.

Apart from the course activities, tutors used the poll services of the community in order to trigger their students' interest. The students used the same services in order to perform surveys among their classmates and visitors.

5 Administration and Operation

In this section we present a walkthrough for the design of a virtual learning community according the aforementioned framework, and based on our experience from the program.

5.1 Roles

The first step is to define the members and their roles. As explained in section 3, anyone can be a member in an open community. More specifically, ***student-members*** should provide their educational profile in detail in order to be accepted. A pre-evaluation procedure will give educators a better view on members' knowledge and skills. Universities and institutes are expected to provide the community with content, guidance and support. As a consequence, ***administrators*** are selected from these institutions and are responsible for managing members' profiles and evaluating content. Some ***tutors*** are assigned with the task of producing new educational material upon request. The same people carry out a ***moderator*** role in the community services. Additional material can be obtained from volunteers out of the community borders.

Apart from the educational subjects, members need technical support on the use of the community services. The technical staff of the institutes will initially become the community ***facilitators*** [15]. However, regular community members with technical expertise can be accredited this role. The role tasks comprise the editing of help files or user manuals, the answering of frequently asked questions and the response to members' requests for help. Facilitators will help new members, either students or tutors to get accustomed to the community services and take full advantage of them.

5.2 Services

The community must build a gateway for people or companies outside its borders that wish to cooperate with the community. ***Information*** services are the front-end of a community. A web site with informative material on the community activities, sample courses, contact information and a feedback form will allow companies or individuals to offer content and potential students to reach and join the community.

Simplicity in the use of services is another factor that increases participation. New members are attracted by an easy interface and request for more advanced services only when they become accustomed to the community. Unfamiliar members can easily become disappointed by complicated services and leave, unless they have the proper support. *Support* is another important factor for a successful community [2]. It can be established by providing informative material to members (online tutorials, manuals, frequent questions and answers etc.) and by assigning guidance roles to selected existing members (facilitators, moderators etc.). ***Communication*** services (synchronous or not, private or public) are vital to all community members: to educators for coordinating their collaborators, guiding and supporting their students, to students for discussing about assignments and requesting help on activities.

Collaboration services are very useful when they are coupled with educational activities. A group project turns autonomous learning into a collective activity and helps students to improve their analytical and collaboration skills. An activity, which flourishes in educational and knowledge sharing communities are wikis. A wiki is the collaborative coverage of a topic from the members of a community. Any member can contribute or modify the content under conditions (proper reason, provide references etc.). Other collaboration services comprise, virtual workbenches, virtual blackboard etc. The results and history of collaboration services are usually stored and used as a reference by other community members.

5.3 Operational Issues

The aim of the community is to help members improve their profile. It is essential for educators that the students profile is real and that their virtual identity is consistent. ***The validity of the educators' profile*** information is also crucial for students [4]. Since educators have a mentoring role, it is important that they definitely posses the knowledge and skills they declare. The ***validity of content*** is strongly connected to the quality of the community and should be considered wisely. The administrating institutes are responsible for the validity of both educators and content. An authorization mechanism is sufficient to guarantee the constant member identity and to protect community from unauthorized users. Administrators are responsible to continuously monitor the freshness and usage of content and in parallel test the capability and knowledge of tutors in order to proceed with updates. They should also build the students' profile and analyze the profiles evolution in order to create and suggest new training programs.

A usually neglected aspect of virtual communities relates to their expansion plan. The expansion in the structure of a community can be bi-directional: a) ***sub-groups*** can be formed inside the community, thus increasing its complexity and the need for internal management and administration, b) ***new members*** can be added, thus expanding the borders of the community. The creation of sub-groups is an additional burden for the administrators of the community. Although the existence of sub-groups generates the need for additional services and increases managerial tasks, it is essential for educators and students to work in harmony. The self-administration of sub-groups is more convenient for the administrators of the community, however limits control over the group activities.

6 Conclusions – Benefits and Future Work

The gains from the use of a virtual learning community are many for universities and students. Students have the ability to exchange empirical knowledge while carrying out learning activities. Tutors can increase the consultation time through forums, they share their knowledge and contribute to the guidance of members more easily. When communities are in contact with companies, they receive information on new products and reading material thus promoting professional excellence of educators. As a result members work smarter that harder, communicate expertise to new members and acquire maximum benefits. The benefits from the use of communities are the main motive behind the participation. The benefits for the educational institutes are mostly organizational and strategic. They cooperate, expand their borders, advertise their programs easier and with minimum cost and increase their potential students. Universities are the focal points of the community, since they provide support and guidance, and they define key knowledge areas.

It is in our next plans to increase the activities of our community and create new educational scenarios that fully exploit the community infrastructure. We have already planned several wiki activities, which we expect to activate students in a daily basis and interact with each other frequently. In the same time we intend to analyse the users' behaviour inside the community in order to detect what is attractive and what is not for the students, what possible flaws in courses result in decreased participation and finally to evaluate the usability of the provided services and interfaces.

References

1. Hake, B. J. Lifelong Learning in Late Modernity: The Challenges to Society, Organisations, and Institutions, Adult Education Quarterly, Vol. 49, No. 2, (1999). 79-90.
2. James I. Virtual communities Wish List, Encyclopedia of Virtual Communities and Technologies. Edited By: S. Dasgupta, George Washington Univ, USA, (2005). 520-525
3. Jarvis, P. Adult education and lifelong learning: Theory and practice (3rd ed.). London: Routledge Falmer. (2004).
4. Jordan K. et al. The augmented social network: Building identity and trust into the next generation internet, FirstMonday Internet Journal, vol. 8, no 8. (2003).
5. Keegan D. The incorporation of mobile learning into mainstream education and training in Isias, P., Borg, C. and Bonanno, P.(eds) Mobile Learning Lisbon: IADIS. (2005). 198-202
6. D. Olmedilla, N. Saito, B. Simon. Interoperability of Educational Systems - Editorial of Special Issue. Educational Technology & Society 9(2). (2006). 1-3
7. Palloff, R., & Pratt, K. *Building learning communities in cyberspace*. San Francisco. (1999)
8. Preece, J. Online communities: Designing usability and supporting sociability. New York: John Wiley & Sons. (2000).
9. Race, P. 500 Tips on Open and Online Learning: 2nd edition London, Routledge. (2005).
10. D. G. Sampson, P. Karampiperis, P. Zervas. Developing Web-Based Learning Scenarios Using the IMS Learning Design: The ASK-LDT Environment. WISE Workshops, (2005).
11. D. G. Sampson. ASK-eEDCOM: Enhancing Educational Portals through Capturing Collective Knowledge of Web-Based Learning Communities. ICALT. (2005) 207-209
12. Sutton, P. J. Lifelong and Continuing Education, International Encyclopedia of Adult Education and Training. UK, Pergamon. (1996). 27-32.
13. Varlamis I., Apostolakis, I. "The Present and Future of Standards for E-Learning Technologies", Interdisciplinary Journal of Knowledge and Learning Objects, Volume 2. (2006).
14. Varlamis, I., Apostolakis, I., Karatza, M. A Framework for Monitoring the Unsupervised Educational Process and Adapting the Content and Activities to Students' Needs. WISE Workshops, (2005) 124-133.
15. White N. Online group facilitation skills, Encyclopedia of Virtual Communities and Technologies. Ed.: S. Dasgupta, George Washington University, USA, (2005). 354-358.

Personal Learning Environments: Challenging the Dominant Design of Educational Systems

Scott Wilson, Prof. Oleg Liber, Mark Johnson, Phil Beauvoir, Paul Sharples & Colin Milligan, University of Bolton

Abstract. Current systems used in education follow a consistent design pattern, one that is not supportive of lifelong learning or personalization, is asymmetric in terms of user capability, and which is disconnected from the global ecology of Internet services. In this paper we propose an alternative design pattern for educational systems that emphasizes symmetric connections with a range of services both in formal and informal learning, work, and leisure, and identify strategies for implementation and experimentation.

1 Introduction

Abernathy and Utterback introduced the concept of dominant design in 1978 [1] to describe the emergence of a broadly accepted core design principle from a number of competing incompatible alternatives.

Common examples are the QWERTY keyboard, the VHS video standard and the IBM PC. The primary characteristic of a dominant design is that, once it emerges, innovative activity is directed to improving the process by which the dominant design is delivered rather than exploring alternatives.

A dominant design may persist for a considerable period of time, even though it might not represent the best technical solution (e.g. VHS v Betamax).

Within the field of education technology, the focus in recent years has been on the improvement of the technology of the virtual learning environment (VLE, also known as a Learning Management System, or LMS) with software and techniques that do not fit the general pattern of capabilities of a VLE being largely marginalized.

We have seen the emergence in recent years of substantial product improvement, of mergers and consolidation (e.g., the merger of WebCT and Blackboard), standardization and conformance regimes (e.g., IMS [2], SCORM [3]), and major investments made in open-source versions of VLEs (Moodle [4], Sakai [5]).

However, in this same time period several other innovative technologies – peer to peer systems, weblogs, wikis, and social software – have at the same time been both widely adopted and used by a varied and diverse number of people, yet until very recently been marginalized, unsupported and even in some cases banned [6] within educational institutions, despite increasing conviction amongst some education technologists (e.g., Downes (2004) [7]) that they represent something closer to the generally lauded ideals of lifelong and personalized learning.

If we accept the notion that the VLE represents a dominant design, then perhaps we can also consider the possibility that there lies within the alternatives the

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 173-182, 2006.

possibility of a new design which represents not just a refinement of the design but an entirely new design pattern which could offer a very different set of possibilities, better reflecting the needs of lifelong learners.

Current systems used in education follow a consistent pattern, one that is typically referred to as a Virtual Learning Environment (VLE, fig. 1.) within the context of UK education (and termed a Learning Management System (LMS) elsewhere).

This pattern describes a particular category of software that has reached near saturation within the UK educational system [8], from which we might justify describing the VLE pattern as the dominant design of educational systems.

2 Characteristics of the Dominant Design

2.1 Focus on Integration of Tools and Data within a Course Context

The general design of a VLE follows a consistent model of integrating a set of tools (forums, quizzes) and data (students, content) within a context of a course or module. This pattern follows the general educational organizational pattern of modularization of courses and the isolation of learning into discrete units. This design pattern is very prevalent; in some VLE products it isn't even possible to share content between course spaces within the same system.

2.2 Asymmetric Relationships

Within current learning systems there is often a very clear distinction between the capabilities of learners and of teachers. In particular, the tools to organize and create are richer for the teacher than for the learner. This asymmetry sends a conflicting message to users; on the one hand they are exhorted to be creative, participate, and to take control of their learning, and on the other they are restricted to a primarily passive role, where what contributions are possible are located first within the small slice of their overall learning represented within the VLE, and then further by the slots within the existing structure of information organization presented within the VLE.

2.3 Homogenous Experience of Context

The course-centric organizational model and the limits on learner's ability to organize the space combine to create a context which is greatly homogenous; all learners have the same experience of the system, see the same content, organized in the same fashion, with the same tools. This replicates the general pattern of education that places emphasis on the common experience of learners within a context. This contradicts the desire often expressed under the general heading of lifelong learning for an individualized experience tailored to personal needs and priorities.

2.4 Use of Open E-learning Standards

Alongside the VLE a parallel development process has taken place, creating a set of standards and specifications to assist in the integration of VLE products into management systems (e.g., the IMS Enterprise and Enterprise Services specifications), for incorporating packaged learning materials (e.g. SCORM, IMS Content Packaging), and for incorporating automated assessments (e.g. IMS QTI). These have been adopted by VLE vendors and requested by customers and industry groups, and have further stabilized the design of systems around compliance with these core platform standards.

However, other specifications, such as RSS [9], that have achieved widespread adoption outside education have not directly impacted the VLE; this is at least partially a side effect of the closed nature of the products, which discourage open sharing of content.

2.5 Access Control and Rights Management

The VLE typically restricts access to content and conversations to the cohort engaging in a unit, and through arrangements with publishers acts to safeguard licensed content from external view. This restriction acts against the drivers of lifelong and lifewide learning, which seeks to unite the experiences of learning in the workplace and home, and of cross-organizational learning. Most content within a VLE is not available to the outside world; it is also often unavailable to learners after they leave a course.

2.6 Organizational Scope

The scope of operation of a VLE is typically the organization that installs and manages the software; a service-based model is supplementing this where systems are hosted for organizations by vendors on their behalf. However, the scope of operation is still organizational in that the scope of information managed by the system is the management information of the organization. Typically a VLE makes it difficult to engage external organizations, and learners who are not registered in some fashion with the organization. Again, this is in opposition to the lifelong and lifewide learning model where there is an important role for cross-organizational learning and informal learning.

More interesting are hybrid models emerging such as the Blackboard model of creating a network of systems enabling better coordination amongst organizations using Blackboard. However, the scope of operation is still limited to organizations using the same platform, and so the problem of isolation remains.

3 Characteristics of an Alternative Design

The critical design flaws inherent in today's learning systems can be addressed through adopting a new design pattern that shifts emphasis away from the isolated experience of the modular VLE. We characterize this new pattern a Personal Learning Environment, although unlike the VLE this is primarily a pattern concerned with the practices of users in learning with diverse technologies, rather than a category of software.

The discourse of PLE began to emerge from conversations amongst a diverse group of educational technologists in early 2005, and in particular momentum began to build when Wilson published a conceptual model for a new type of system, termed at the time as the "VLE of the future" (Wilson, 2005 [10]). An updated version of the diagram is presented here to illustrate the possibilities of a PLE (See Figure 1.)

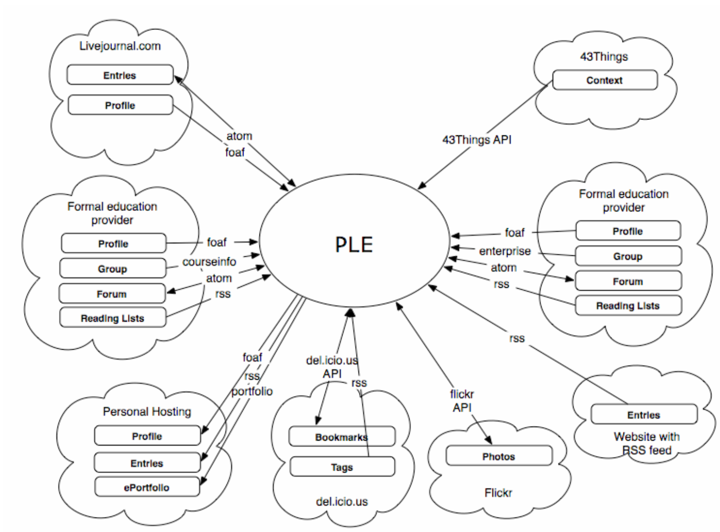

Fig. 3. Conceptual model of a personal learning environment, a development of the model by Wilson (2005)

3.1 Focus on Coordinating Connections between the User and Services

Rather than integrate tools within a single context, the system should focus instead on coordinating connections between the user and a wide range of services offered by organizations and other individuals. Rather than interacting with the tools offered within the contexts supplied by a single provider, the PLE is concerned with enabling a wide range of contexts to be coordinated to support the goals of the user. This is more consistent with a competence-oriented approach to learning, and explicitly recognizes the need to integrate experiences in a range of environments, including education, work, and leisure activity.

3.2 Symmetric Relationships

The system should be rebalanced in favor of symmetric relationships; any user should be able to both consume and publish resources using a service, and users should be able to organize their resources, manage contexts, and adopt tools to suit their needs.

3.3 Individualized Context

Given the focus and nature of the relationship with the system, it will no longer be possible to provide a homogenous experience of a context outside the scope of closed systems, as users can re-organize the information within the context as they see it in any fashion and choose the information and tools to situate within it.

3.4 Open Internet Standards and Lightweight Proprietary APIs

Because the scope of the system has expanded beyond the services offered by institutions, the range of standards and protocols used to interact with services increases, and it is no longer possible to focus solely on standards developed to suit the needs of the education sector. Instead, systems will need to interact with services offering their own proprietary APIs (for example, Google Maps [11]) and with services offering interfaces that support more general web standards (for example, IETF Atom [12]).

From the perspective of the PLE, connection is far more critical than compliance, and it is far better to offer a wide range of services, requiring support for a range of standardization from formal standards through to fully proprietary (yet publicly available) APIs, than to restrict the connections possible to users.

3.5 Open Content and Remix Culture

Unlike the VLE, the PLE is concerned with sharing resources, not protecting them, and emphasizes the use of creative commons licenses [13] enabling editing, modification, and republishing of resources. Rather than pre-packaged learning objects, the resources collected and accessed using the PLE are more typically weblog postings, reviews, comments, and other communication artifacts.

The PLE encourages users to make “playlists” of resources and to share them with others for collaborative knowledge construction, using online services such as del.icio.us [14] and connotea [15].

3.6 Personal and Global Scope

Whereas the VLE operates within an organizational scope, the PLE operates at a personal level in that it coordinates services and information that is related directly to its user and owner. However, the PLE can also be considered global in scope as the range of services it can potentially coordinate is not bounded within any particular organization. The user can connect their PLE with social networks, knowledge bases, work contexts, and learning contexts of any size to which they can obtain access.

4 Implementation Strategies

Implementing the pattern is not straightforward, as the pattern suggests several very different strategies may be feasible. For example, a single PLE application may be possible, or on the other hand, the coordinated use of a range of specialized tools may achieve a satisfactory result. However, there are some general strategies that will be useful in many cases.

4.1 Plug-in Connectors for Services

One of the characteristics of the PLE pattern is the use of a range of services within the environment. While it may be possible to connect these services in a very minimal fashion (e.g. by screen-scraping techniques, or by just linking to them), far more interesting results are possible by utilizing a range of machine-readable services.

Primarily this can be accomplished through the use of feeds to exchange metadata; however, there are also a wide range of web APIs available from services that enable a much more interactive range of services. Crucially, these support the creation of new information and not just the aggregation of existing content, one of the major requirements of the PLE pattern.

While it is perfectly possible to implement web APIs in a piecemeal, one-off fashion, it may be more effective to elaborate a general pattern of connectors for services that can be managed dynamically and share core techniques. We term this type of reusable connector a conduit, and its main characteristics are that it provides an encapsulated service usage capability, including all the format conversion and protocol management needed to support the API, can be dynamically associated with an application, and can also encapsulate any provisioning or access control information needed to access a particular service.

An example of a conduit is the service management within the Flock [16] social browser application. Flock enables connection to a range of services including social bookmarks, blogging, and notification. The set of connections is managed using a categorized set of preferences; each individual conduit contains both the protocol information and also any required credentials.

This is especially useful in development as many web APIs, even if they begin in a totally proprietary fashion, are increasingly likely to be adopted by similar services. For example, the adoption of the Blogger API by rival services.

This implementation pattern is not just a feature of Flock. Quite independently, the PLE project at the University of Bolton [17] consciously developed a conduit pattern for their prototype service-oriented personal system, Plex [18]. Plex, like Flock, has a management interface for adding new services and dialogs for entering credentials and options

1.

Online, there are also examples of this pattern in a range of web applications, such as NetVibes (which offers its conduit API to other developers to assist them in developing new conduits [19]) and SuprGlu [20].

4.2 Tags, Lists and Smart Groups

To support effective organization of information, mechanisms of flexible tagging should be combined with list creation and sharing facilities. Wherever possible the acts of tagging and listing should by default be shared with a wider community through social bookmarking services. Also, rather than supporting hierarchical folder structures, the use of flexible playlist-style groups and smart groups should be considered. Smart groups are used extensively in products such as iTunes [21] and enables organisation to structure itself based on simple user-provided rules.

5 Challenges

5.1 Lowest common Factors

A PLE combines information from a heterogeneous set of services within the purview of the user; while this can be done in a fairly isolated fashion (such as an information portal) more value can be obtained by the user when the information of services is combined to enable sorting, filtering and searching.

However, given the scope of operation of the PLE, the implication is that the structure of the information operated upon will be highly diverse. This means that, rather than relying on services to offer a very detailed set of metadata using a common profile, systems will instead need to offer greater capability for managing either heterogeneous information or operate on a very limited set of information which can be commonly assumed, such as titles, summaries, and tags.

To counter the potential reduction in capability the PLE can take advantage of collaborative filtering techniques through the use of sharing “playlists”, and the use of rating services, reviews, and comments. The PLE needs to contribute to this process by enabling the automatic sharing of ratings and comments made by the user on resources with the wider network.

---

[1] A set of screenshots from Plex and Flock comparing the configuration of service can be found online at http://www.flickr.com/photos/vanishing/sets/72157594167600345/

5.2 Soft Boundaries

While the contexts of formal education systems can be characterized as having bounded variety (e.g., a course typically has around 20-2000 members) and possessing rigid boundaries, general social systems used in informal learning can possess more diverse levels of variety (e.g., Goal groups in the online service 43Things [22] vary in size from 1 to hundreds of thousands of members) and have soft boundaries. For example, social contexts possess 'lurkers', transient members, and members with varying levels of commitment and visibility that makes establishing the actual boundary of a context more difficult.

Connecting with very large contexts using a PLE poses both a technical and a usability challenge, as it will not be possible to absorb all the information within the context into an environment to be operated upon locally, nor is it feasible to present users with flat representations of contexts when they contain thousands of resources. One solution is to accept soft boundaries as being an inherent aspect of context, and to design the PLE to provide locally meaningful context boundaries for the user. One approach to supporting this is to filter the context to reduce the amount of visible users and resources based on the declared interest of the user.

To cope with large contexts, the PLE may opt to reduce the scope of representation (for example, just provide the context name and an indication of member numbers with some search tools), and encourage interaction with the context through leaving the PLE system and engaging directly with the service.

Clearly, however, the approach used in the dominant design of presenting the entire contents of a context in a fairly flat way does not scale well to handling more diverse contexts.

5.3 Effective Coordination of Groups and Teams

While social software in general has seen widespread popularity, and general social mechanisms operating across very diverse groups has been demonstrated in these open public systems, it remains unclear what mechanisms can underpin the coordination of collective actions by groups and teams within a PLE. The PLE project at the University of Bolton has investigated some mechanisms using services for coordination, and this is being further explored within the TenCompetence project [23].

5.4 Inappropriate Reification of the Design

While we have discussed the PLE design as if it were a category of technology in the same sense as the VLE design, in fact we envisage situations where the PLE is not a single piece of software, but instead the collection of tools used by a user to meet their needs as part of their personal working and learning routine. So, the characteristics of the PLE design may be achieved using a combination of existing devices (laptops, mobile phones, portable media devices), applications (newsreaders, instant messaging clients, browsers, calendars) and services (social bookmark services, weblogs, wikis) within what may be thought of as the practice of personal learning using technology.

However, for the design to reach equivalent or superior levels of efficiency to the VLE, as well as broader applicability, requires the further development of technologies and techniques to support improved coordination. Some initial investigations include the work of projects such as TenCompetence and the Personal Learning Environments work at the University of Bolton cited previously.

5.5 Living with Existing Systems

It is one of the invariant laws of technology that any new system must co-exist with previous systems, while that in the case of education the VLE pattern should lose, eventually, its status as the dominant design, the technology will be around us for a long time to come. So how will the PLE and the VLE design co-exist? This can simply be a case of parallel lives, with the PLE becoming a dominant design in the space of informal learning and some types of competence-based learning, with the VLE remaining the key technology of formal educational systems. Alternatively, we may see a period of connection, whereby VLE products start to open their services for use within the PLE. However, we may also see a pattern of co-opting, whereby the characteristics of the PLE are incorporated into the VLE, yet along the way robbing them of some of their transformative power.

We are seeing some evidence of all three strategies. We have an emerging discourse of “elearning 2.0” [24], new tools for competence-based learning in projects such as TenCompetence, and also of existing VLEs adding features such as weblogs and Wikis.

6 Conclusions

The VLE is clearly the dominant design in educational technology today, and is nearly ubiquitous in higher education institutions. However, its hegemony is being challenged, partly from within education by the desire to bridge the worlds of formal and informal learning and to realize the goals of lifelong learning, and partly from outside education by the increasingly prevalent forms of social software and the new paradigms of the web as technology platform.

The VLE is by no means dead, and those with investments in this technology will attempt to co-opt new developments into the design in order to prolong its usefulness. It is however the view of the author that the key distinctions between the VLE and the PLE are of a more conceptual nature than one purely of features, and that ultimately alternatives such as the PLE model will develop in sophistication, making the VLE a less attractive option, particularly as we move into a world of lifelong, lifewide, informal and work-based learning.

References

1. Abernathy, W. J., Utterback, J. M. Patterns of Industrial Restructuring. Technology Review, 80 (7), (1978) 1-9.
2. IMS Global Learning Consortium, http://www.imsglobal.org
3. Advanced Distributed Learning Network, http://www.adlnet.org
4. Moodle, http://www.moodle.org
5. Sakai, http://www.sakaiproject.org
6. Parry, W., School orders students to remove blogs. In USA Today, 26/10/2005. Downloaded from: http://www.usatoday.com/tech/news/techpolicy/2005-10-26-school-bans-blogs_x.htm
7. Downes, S., Educational Blogging. Educause Review, (2004) 39 (5).
8. Farmer, J., and Tilton, J. The Use of Virtual Learning Environment Software in UK Universities 2001-2005, Industrial Media and Magic Inc Technical Briefs, http://www.immagic.com/eLibrary/GENERAL/IMM/I060616F.pdf (2006)
9. RSS (file format) http://en.wikipedia.org/wiki/RSS_(protocol)
10. Wilson, S. (2005), Future VLE – The Visual Version, http://www.cetis.ac.uk/members/scott/blogview?entry=20050125170206
11. Google Maps API, http://www.google.com/apis/maps/
12. The Atom Syndication Format, RFC4287, Internet Engineering Task Force, http://www.ietf.org/rfc/rfc4287.txt?number=4287
13. Creative Commons, http://www.creativecommons.org
14. Del.icio.us, http://del.icio.us
15. Connotea, http://www.connotea.org/
16. Flock, http://www.flock.org
17. Personal Learning Environments Reference Model Project, http://www.cetis.ac.uk/members/ple
18. Plex, http://www.reload.ac.uk/plex/
19. Netvibes mini API specification, http://eco.netvibes.com/developers/mini-api-specification
20. Suprglu, http://www.suprglu.com
21. iTunes, http://www.apple.com/itunes/
22. 43Things, http://www.43things.com
23. TenCompetence project website, http://www.tencompetence.org
24. Downes, S., E-learning 2.0, eLearn Magazine, http://www.elearnmag.org/subpage.cfm?section=articles&article=29-1 (2005)

What Went Wrong with Technology Enhanced Learning

EC-TEL 2006

October 2, 2006

Crete, Greece

Workshop Chair

Erik Duval (Katholieke Universiteit Leuven & Ariadne Foundation, Belgium)

Program Committee

Stefano Ceri (Italy)
Erik Duval (Belgium)
Wayne Hodgins (USA)
Jan Pawlowski (Germany)
Dan Rehak (USA)
Maria Rimini-Döring (Germany)
Robby Robson (USA)
Demetrios Sampson (Greece)
Frans Van Assche (Belgium)
David Wiley (USA)

CELEBRATE's Lessons

David Massart

European Schoolnet

Abstract. The CELEBRATEproject developed and successfully demonstrated a federated learning object brokerage system architecture and made available to schools over 1350 learning objects produced by both public and private sector content developers. Despite its encouraging results in terms of acceptance by the participating teachers and pupils, some of the assumptions the technical infrastructure was originally designed upon proved to be problematic, which hampered broader adoption of the proposed solution.

1 Introduction

CELEBRATE was a strategic, large-scale (_7M Information Society Technologies – IST) demonstration project that ran from June 2002 to November 2004. It developed and successfully demonstrated a federated learning object brokerage system architecture and made available to over 319 schools in six countries approximately 1350 learning objects produced by both public and private sector content developers.

Thanks to this infrastructure, the project permitted us to demonstrate that:

- Teachers are enthusiastic about Learning Objects (LOs);
- Emerging standards (for interoperability) make it easier for schools to exchange and reuse LOs;
- Given simple, user-friendly authoring tools, teachers who are experienced with information and communication technology (ICT) are capable of developing high-quality learning resources;
- Several Ministries of Education are interested in supporting national teams of teacherdevelopers and finding new mechanisms in order to quickly develop a critical mass of "open content" and are particularly interested in exchanging resources via a new educational content web portal.

Despite these encouraging results, some assumptions that the project was originally built upon proved to be problematic (and in retrospect somewhat naive). They hampered broader adoption of the developed infrastructure. This paper reviews these assumptions and attempts to explain what went wrong. A brief overview of the interoperability aspects of the project is provided in Section 2. The technical infrastructure of CELEBRATE is discussed in Section 3.

The approach used to build semantic interoperability is discussed in Section 4. Finally, digital rights management is discussed in Section 5.

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing, EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 185-191, 2006.

2 An Overview of CELEBRATE

CELEBRATE aimed at providing an easy way for teachers and pupils to get access to learning resources scattered between different e-learning systems: online educational portals, learning (content) management systems, and learning object repositories[1].

The access to resources consisted of four steps:

(1) Search the pool of existing resources;

(2) Assess their usefulness on the basis of search results;

(3) Obtain relevant resources and (re)use them transparently regardless of the technical complexity associated with the resources and the technical platforms involved, and

(4) Do all this in a way that respects the intellectual property associated with the resources involved.

This scenario was made possible by federating the participating e-learning systems around a brokerage system. This approach had the advantage of being more flexible than more centralized architectures and less complex than peer-to-peer solutions, the two architectures on which already existing networks of learning object repositories were based at that time [VAM04]. It provided a good balance between trust and autonomy. It was decentralized enough to allow content providers to manage their collections autonomously and was secure enough to ensure the trust necessary when dealing with content for sensitive groups like pupils.

The CELEBRATE brokerage system was responsible for:

- Carrying and routing messages exchanged by the federation members (technical interoperability);
- Enforcing semantic interoperability; and
- Digitally managing rights.

3 Technical Interoperability: All Or Nothing ?

Although most e-learning systems (or systems) are connected to the Internet, they can be seen as isolated islands of knowledge. Their content is ignored by search engines, which are generally not able to get access to, and to index, the resources hidden in the system repositories. One of the first problems to be solved by CELEBRATE was to break the isolation of the participating systems by putting in place an infrastructure that makes their content accessible (i.e., discoverable and exchangeable).

As already mentioned, the central part of this infrastructure was a brokerage system (or broker), with which registered systems opened sessions in order to exchange messages. In this infrastructure, no direct exchange between systems was allowed, except those explicitly authorized by the broker. Systems authenticated transactions and messages via synchronous calls to webservices. Messages such as the

[1] In addition, one of the project objectives consisted of understanding, from a pedagogical standpoint, how these new types of standards-based learning resources commonly referred to as "learning objects" are used and re-used in classrooms and what is their pedagogical impact.

queries used during a federated search were Java Messaging Service (JMS) asynchronous text messages.

E-learning systems avoided the hassle of implementing such a complicated communication scheme by using a special software library (or brokerage client) that hid the complexity of the system-broker communication behind a simplified application program interface (API). This technique led to a first communication protocol that let systems focus on the content of messages (e.g., query, result set) without having to worry about the lower-level details of message exchanges.

Despite the relative simplicity of the low-level protocol necessary to use its communication infrastructure, CELEBRATE was victim of its ambition to offer a complete solution for the discovery and exchange of learning resources. All together, a dozen messages based on approximately the same number of XML schemas were necessary to carry out activities such as federated searching [ML04], semantic interoperability [MVA03], learning resources exchange [VAM04] and digital rights management (DRM) [CS03, SC04]. For an e-learning system that wanted to join the federation, it was necessary to support all of them, even when only a subset of them was actually useful to the system under consideration. For example, the DRM protocols are not needed for systems that provide only free resources. As a consequence, it was quite a complex task to connect to the federation. The only result of this all-or-nothing integration policy (that wanted to force systems to “do things well”) was to discourage people. As a consequence no one joined the federation after the project.

4 Semantic Interoperability: Is It Affordable ?

Even when they are publicly available online, the dynamic and multimedia nature of most learning resources makes them unlocatable using text-based search engines such as Google which, in addition, return results that are difficult to assess by teachers and pupils. This problem is usually solved by creating metadata to “adequately” describe learning resources.

In CELEBRATE, "adequately" meant adapted to the context of primary and secondary schools in Europe. The problem was three-fold:

- Primary and secondary schools have specificities in terms of organization, pedagogy, and curriculum.
- Although commonalities exist, these specificities vary from one European country (or region) to another.
- In Europe, multilingualism is the rule, not the exception.

These issues were addressed by profiling the IEEE 1484.12.1 Learning Object Metadata Standard (IEEE LOM) [IEE02] as follows:

- Mandatory, recommended, and optional elements of the IEEE LOM standard data model were defined. For example, “Age Range”, which was considered as the best way to refer to the audience of a resource regardless of the school system under consideration, was made mandatory.

- New elements were added (such as element 6.4 "CELEBRATE Digital Rights" that permitted the expression of rights associated with a learning resource in a machinereadable form).
- New controlled vocabularies were created, including for "Learning Resource Type".

  Each new vocabulary was designed to take into account the specificities of primary and secondary education in Europe. In addition, each vocabulary was translated in different European languages including a neutral form that was used as an interlanguage during the search and exchange of resource descriptions.

Following the CELEBRATE approach, the conformance of the metadata used in the federation to this CELEBRATE metadata application profile [NVA03] was enforced by the brokerage system.

This worked reasonably well. Thanks to the CELEBRATE application profile, a teacher belonging to a school system was able to retrieve a resource created and described in another language (and in the context of another school system).

This being said, the a priori description of resources according to the application profile also has drawbacks. It requires specialized indexers. Its cost in time and money is proportional to the number of resources to describe, which makes expensive the indexing of large collections of resources. In addition, it potentially restricts the use of the resource. For example, the CELEBRATE evaluation demonstrated that a resource described by a publisher as a "drill and practice" learning object could actually be used in more innovative ways (e.g., for collaborative learning) by an experienced teacher, thereby rendering the "Learning Resource Type" description as somewhat inaccurate.

Moreover, as time went by, requirements evolved and it became necessary to adapt the application profile. Although the adaptation itself is a tedious process (it is necessary to collect requirements, build consensus, ensure backward compatibility, translate), the main difficulty of the task consists of finding an affordable way to convert existing metadata to the new application profile.

5 Digital Rights Management: What For ?

Content is a key factor to attract users in a federation such as the one developed by CELEBRATE. The project targeted commercial content providers and, at their request, put in place a technical infrastructure necessary to digitallymanage the rights associated with the learning resources exchanged through the federation.

The digital rights management (DRM) mechanism [SC04] was based on a subset of the Open Digital Rights Language (ODRL) [Ian02]. It permitted description of the rights associated with each resource and storing of these descriptions in the learning resource metadata.

The rights document included in the resource metadata corresponded to an offer. Once a resource requester had the offer, the next step was to initiate a negotiation with the provider and to instantiate an agreement that binds both parties; the requester and the provider. An agreement is dynamic by nature. For instance, a permission may be granted for a specific number of accesses to the resource, which requires a proper accounting of the resource use.

It was the responsibility of the brokerage system to store and enforce the agreement. Each time a resource was requested, the brokerage system checked that a valid agreement existed and that all preconditions and constraints were met before authorizing the use of the resource by returning a handle to it.

One of the lessons learned in CELEBRATE was that commercial content providers were not ready and/or did not yet have a business model for providing content through a federation. They were unable to define the rights they wanted to associate with their resources although the technical infrastructure to support these rights was in place.

CELEBRATE was a demonstration project; within the available budget, there was only the ambition to develop a critical mass of content in a limited number of curriculum subjects to have a credible validation of the approach with schools. At the end of the project, commercial content providers, although interested in a new channel of distribution (they supplied hundreds of learning objects), did not yet have clear business models to deliver content through the infrastructure. On the other hand, potential users, although interested in the CELEBRATE resources, found the number of available learning objects too limited. This led to a chicken and egg situation: not enough users to draw content providers' attention and not enough content to keep users.

6 Discussion

As a demonstration project, CELEBRATE was a success that proved the usefulness of exchanging and reusing learning resources. This being said, it also showed that proposing a theoretically sound interoperability solution is not sufficient to have this solution adopted.

In our opinion, it should be possible to overcome this limitation by:

- Limiting the role of the brokerage system to carrying and routing messages exchanged by the federation members rather than trying to enforce semantic interoperability. Semantic interoperability will become the responsibility of the federation members that will rely on the brokerage clients to support the negotiation of common metadata formats.
- Making the proposed solution more scalable by breaking the functionalities of the brokerage system into independent services (e.g., resource discovery, resource exchange, semantic interoperability, digital rights management) that can be used separately and combined with any (group) of the others. When connecting a new system to the federation, it should be possible to start with a limited number of services in order to make the integration effort proportional to the number of services being integrated.
- Initially focusing on linking repositories that have large collections of open content in order to obviate some of the more problematic DRM issues and to quickly make available the criticalmass of quality content necessary tomake the federation attractive.

• Trying to improve the quality and quantity of metadata and to lower their costs with new approaches to automatic metadata generation.
• Experimenting with new approaches to social tagging involving teachers as a way to improve the accuracy of the descriptions of "Learning Resource Type" and to help decrease the costs of volume metadata creation.

Since October 2005, these new approaches are partly applied in the context of a European project called CALIBRATE that aims to support the collaborative use and exchange of learning resources in schools. A more detailed description of the technical aspects of these approaches can be found in [CM06]. In addition, it is planned to evaluate automatic metadata generation and social tagging techniques during another European project named MELT that will start in October 2006.

Acknowledgments

The work presented in this paper is partially supported by the European Commission under the Information Society Technology (IST) programme of the 6th FP for RTD – as part of the CALIBRATE project, contract IST-28025. The author is solely responsible for the content of this paper. It does not represent the opinion of the European Commission, and the European Commission is not responsible for any use that might be made of data appearing therein.

References

[CM06] J.-N. Colin and D. Massart. LIMBS: Open source, open standards, and open content to foster learning resource exchanges. In Kinshuk, R. Koper, P. Kommers, P. Kirschner, D. Sampson, and W. Didderen, editors, *Proc. of The Sixth IEEE International Conference on Advanced Learning Technologies, ICALT'06*, pages 682–686, Kerkrade, The Netherlands, July 5 - 7 2006. IEEE Computer Society, Los Alamitos, California.

[CS03] J.-N. Colin and J. Simon. Authentication, authorisation, and rights management for the CELEBRATE brokerage system. Celebrate Deliverable D 3.3 part B (IST- 2001-35188). Also available as http://celebrate.eun.org/docs/D3_3_Part_ B.pdf, May 2003.

[Ian02] R. Iannella. Open Digital Rights Language (ODRL) Version 1.1. Also available as http://www.w3.org/TR/odrl/, September 2002.

[IEE02] IEEE Standards Department. IEEE 1484.12.1-2002, Learning Object Metadata Standard. Also available as http://ltsc.ieee.org/wg12/files/LOM_1484_12_1_v1_Final_Draft.pdf, July 2002.

[ML04] D. Massart and D.T. Le. Federated search of learning object repositories: The CELEBRATE approach. In M. Bui, editor, *2nd Int. Conf. of French-Speaking Vietnamese Computer Scientists, RIVF'04*, pages 143–146, Hanoï, Vietnam, 2004. Studia Informatica Universalis. Also available as http://e-ifi.org/rivf/2004/proceedings/ArticlesRIVR_04/p143-146.pdf.

[MVA03] D. Massart and F. Van Assche. Brokerage system design. Celebrate Deliverable D 3.3 part A (IST-2001-35188). Also available as http: //celebrate.eun.org/docs/D3_3_Part_A.pdf,May 2003.

[NVA03] L. Nirhamo and F. Van Assche. The CELEBRATE metadata application profile.

Celebrate Deliverable D 3.2 (IST-2001-35188). Also available as http: //celebrate.eun.org/docs/D3_2.pdf,May 2003.

[SC04] J. Simon and J.N. Colin. Celebrate: A federated model for exchange of learning objects. In *Proc. of theWorld Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education (ELEARN)*, volume 2004, pages 886–891, 2004.

[VAM04] F. Van Assche and D. Massart. Federation and brokerage of learning objects and their metadata. In Kinshuk, C.K. Looi, E. Sultinen, D. Sampson, I. Aedo, L. Uden, and E. Kähkönen, editors, *Proc. of The Fourth IEEE International Conference on Advanced Learning Technologies, ICALT'04*, pages 316–320, Joensuu, Finland, August 30 - September 1 2004. IEEE Computer Society, Los Alamitos, California.

A Technology Enhanced Learning Case from Birth to Deployment: Critical Analysis of the ALaRI Intranet Platform (Case Study)

Carola Salvioni

University of Lugano, Switzerland
carola.salvioni@lu.unisi.ch

Abstract. This paper aims at illustrating the necessities that led to the decision of building a technological learning platform for the ALaRI (Advanced Learning and Research Institute) academic institute, at University of Lugano (Università della Svizzera italiana), Switzerland. Following that, the paper will analyse the development of this platform, the difficulties met, the unforeseen events, the requested changes and modifications, pointing out the achieved successes, as well as the errors and failures occurred. The goal is that of learning also from the wrong experiences and not only from the best practice cases. In particular, what this article would like to put in evidence is how technology and communication are strongly joined and how only the good performance of both can contribute to provide the users of the platform with a really efficient and effective artefact enhancing the remote learning interactions.

From this perspective, I will investigate how failures that are apparently of technical nature may actually stem from lack of communication, or misunderstanding and incomprehension, among the persons responsible of the development of the platform (the principal stakeholders/the decision maker, and the developers team), and also between them and the final users. The following loop stands out how the phases of design, development and use involve different actors, often with different backgrounds as well as different cultures, who should be able to collaborate together to realize an efficient and effective elearning platform.

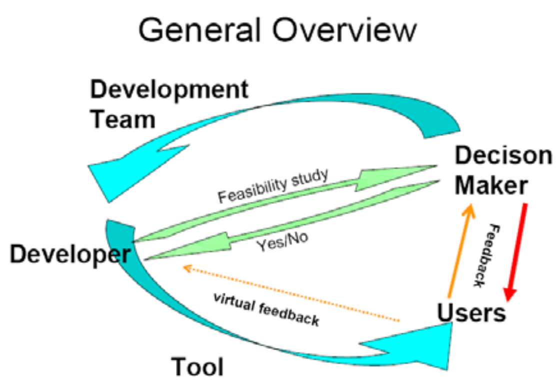

Fig. 1 General Overview

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing, EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 192-206, 2006.

Figure 1, starting from the decision maker, shows the communication flows and the working groups taking place at ALaRI environment. Basically, it represents two principal loops: the first one describes a technical and locked loop, where the technical aspects of the intranet platform are defined and developed by the decision maker and the development team, taking into consideration the ALaRI actors' requirements, their activities, and the specifications of the system. The second loop is wider, in the sense that decision maker, and also the developers, should consider the impact of the intranet release on the final users. This means to verify how the platform is really used, observing how the ALaRI actors interact with the intranet and moreover through it among themselves, and asking them explicitly through usability tests (task scenarios, interviews, and questionnaires) to get a feedback. The feedback from the final users should be of interest not only to the decision maker, but also to the developers in charge of the implementation of the platform. Then, further modifications and implementations should take into account what it went wrong and why final users are not satisfied.

Sometimes it is the communication flow in place (or its lack) inside each one of the two loops and between the two loops themselves that has generated incomprehension affecting the optimal realization of the platform.

According to this scheme (*figure 1*), it becomes necessary to learn to negotiate in order to reach a common agreement and arrive to a co-shared result, where it is clear that the final goal is the benefit of the entire ALaRI community and not only the personal or particular interest of one or a limited group.

In the following paragraphs I will illustrate the **ALaRI challenging approach**, and how the ALaRI platform would enhance the remote learning, together with a brief description of the ALaRI institute, its mission, its environment, the principal actors and their roles. Then, there will be an **analysis of the occurred risks about the ALaRI intranet** development and its use. Further **what did not work and why** will be explained, providing also **some general aspects from the occurred problems** in this specific case. Some considerations about **what it is possible to learn** from this experience **and how it is possible to benefit** from the occurred failures will follow. The successive object will be **instead what did work and the achieved successes**. Finally a set of **overall recommendations that can apply to other situations** to achieve satisfactory results will complete the analysis. The **conclusions** will close my reflections.

The ALaRI challenging approach

The ALaRI institute is active from 1999 at the University of Lugano, Switzerland, with the aim of promoting research, education and training in the field of the embedded systems design, through the synergic interaction of three principal actors: European academia, American academia and international high-tech industry.

Since 2000 ALaRI offers a master program in embedded systems design (the *Master of Advanced Studies in Embedded Systems Design*). This master program lasts one year, from September until July, and it finishes with the final workshop where the participants present their master research projects, developed during the year with the support of teachers, tutors, and industrial experts or other academic mentors. Since 2004 ALaRI has also introduced a new master program in embedded systems design (the *Master of Science in Embedded Systems Design*). It is a two-year graduate program (following the so-called *Bologna model* for European University studies).

The peculiar characteristic of the ALaRI institute is its plan of learning: an innovative approach to the working organization and learning environment.

Participants in the master's programs come from all over the world and during their stay at the institute have the possibility to explore and to study in depth the subjects related to embedded systems design, acquiring theoretical background and practice with design tools. Teaching is organized into teaching units ("modules") whose length may go from 24 to 50 hours, inclusive of theory, exercises and practice. Modules end with an individual evaluation that may include home assignments and a module project. With very few exceptions, lecturers (about thirty) are present at the institute in Lugano only during their period of teaching (normally distributed over 1 or 2 weeks). This last fact is one the basic factors that guided towards introduction of particular remote-teaching solutions for ALaRI.

Research projects run in parallel with conventional studies and complete the students' training, leading to the final master theses. The applied-research projects relate in general to actual industrial research, design activities and technological needs; they are assigned to each participant early in the academic year[1], and checked periodically through remote interactions by the Industrial Partners of the ALaRI community as well as by lecturers from the (remote) Faculty, who act as advisors. Both academic and industrial experts tutor the development of each project.

Several parallel projects may complete a larger research activity, where practical experience in teamwork allows participants to grasp the problems of design management from the perspective of work organization as well as financial relations.

Thus, during the master's programs, students are trained both to work on their own (and in team work) and to interact remotely with their supervisors (academic members and industrial collaborators) to develop research projects leading to their final master's theses. In this context, two main difficulties have been tackled. One has been the interaction between students and international lecturers, because of the limited physical presence of the lecturers at the Institute. The other has been the need to coordinate the workflows among the several actors at ALaRI during the academic year.

The above problems led to designing and building the ALaRI intranet: a web-based remote application accessible from the ALaRI web site – www.ALaRI.ch/intranet – with the aim of supporting and managing the relationships among the different actors around ALaRI community. Through the intranet, new social and technological dynamics have been developing at the institute, integrating learning in presence with remote cooperation in a complex and truly distributed reality (Dillenbourg & Schneider, 1995)[2].

---

1 In the first academic year for MSc students.

2 Within remote learning, a distinction has been made in the literature between a *collaborative learning* model and a *cooperative learning* one. The former addresses situations "in which two or more subjects build synchronously and interactively a joint solution to some problem" whereas the latter is "a protocol in which the task is in advance split into subtasks that the partners solve independently" (Dillenbourg & Schneider, 1995).

Further, this information system offers heterogeneous services integrated within several areas, accessible from remote places and in an asynchronous way (Negri & Bondi, 2004).

The main difficulties met during the development of this platform stem from the very fast and sudden growth of the institute together with its entire environment. In fact this led the decision maker and the designers to re-think very quickly the entire organization of the platform, extending the application, and facing the many different demands of the institute and of its actors, as they appeared, with the purpose of broadening and boosting the management of all the ALaRI activities on a unique remote platform. Further, when the ALaRI intranet building began (during the academic year 2002-03) there was no *ad hoc* application complying with ALaRI requirements; moreover the existing tools were neither modular nor integrateable, and interfacing them with each other was far from easily and efficiently feasible, if at all. So it was decided to create a new *ad hoc* intranet for the ALaRI institute.

In order to better understand the demands of the ALaRI institute, it is useful to have an overview of the seven principal profiles of the actors involved in the learning programs (i.e. *Scientific Council; ALaRI Staff; Faculty members; Industrial Sponsors; Students; Alumni;* and *Guests*), and of their mutual interactions by means of the ALaRI intranet.

The *Scientific Council*, consisting of the ALaRI stakeholders, is basically in charge of the ALaRI strategies, and it is responsible for the remotely supervising of all the research projects ongoing at the institute. Together with the *ALaRI Staff* (i.e. PhD students supervising some students' master projects, and intranet administrators who maintain and update the system) they have access to all documents (private and public) and to all ALaRI intranet data.

The *Faculty members* are professors and experts from academic and industrial environment who hold courses and whose materials are available on the ALaRI intranet. In some cases they also provide academic supervision for master projects, checking and evaluating – through the intranet platform – only the reports of those projects they are involved in.

Industrial Sponsors are academic or external collaborators interacting with the students during all the period of the project development, defining the milestones and the deliverables of their supported projects, and working with the team from remote places.

Students attending the two master's programs can perform different activities on intranet, working alone with the available teaching materials of the courses, or working with their team, supervisors and tutors about the master project they are assigned to. They can share together the ongoing results of the projects and upload new reports. Further, they have access to the intranet area with public documents of previous projects, where they can also upload other relevant materials interesting for the development of their research projects. In this way the intranet aims at being the main instrument for building the research projects. There is also a career area, where students can upload their *curricula vitae* and letters of intent, making them visible to the faculty members and sponsors. Finally, through the part-time job area, students have the possibility of applying for little on campus part-time jobs, posted by ALaRI staff, with the aim to cover basic living expenses during their stay away from the family.

Alumni (ALaRI former graduated students) have access the most recent public materials on intranet and private reports of their former master projects for a few years after their graduation. Moreover, they can also keep visible their *curricula vitae* and keep consulting possible job offers.

Finally, *Guests* are persons outside the ALaRI institute and its network, who may be interested in some research activities at ALaRI, and may find some opportunities accessing the public reports of master projects and other public documents.

This interactive information system wants to allow ALaRI actors with different roles to carry out asynchronous communications from remote places, supported also by an advanced data filtering system (logging in the own username and password) that assures different views of the data and of the several services according to user's profile.

These heterogeneous services in the intranet system are based on seven main general areas, concerning: *People* (the ALaRI actors directory, where several data, such as e-mails or *curricula vitae* can be visible to all or kept private), *Projects and Research* and *My project* pages (about the master's projects management), *Courses* (where all the learning material is collected, including professors' slides, references, suggested books, etc.), a knowledge repository called *ReSearch* (where it is possible to collect and to store the ALaRI know-how, i.e. theses, publications, articles, studies, and so on)*, Library, Career Centre* (where jobs or internships are posted by faculty members or industrial sponsors, and applied by students), and *ALaRI Jobs* (about ALaRI part-time jobs). Further, each of these areas is subdivided in specific and peculiar sections. Finally, *Policies* and *Help Index* online are available to illustrate to the user the whole structure of the application, the services offered and how access them, such as a sort of electronic manual.

In this way, the ALaRI intranet answers the problem of creating a virtual operative workplace, ensuring an interactive participation of all its members within a steady and secure environment.

Risks analysis of the ALaRI intranet

Such a technical learning system, in order to work properly, needs the active cooperation and methodical interaction of all its actors who, in turn, require easiness of use and immediate understanding of the available services.

The very quick development of the ALaRI intranet, although it has been focused on the building of useful technical functionalities, did not let to pay enough attention to the way in which these functionalities have been offered and to "the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments" (ISO 9241-11).

Thus, during the time of development and then of use, several elements have affected the proper and correct use of the e-learning system. The main tackled risks concern the following aspects:

- the necessity of creating, developing and implementing an *ad hoc* tailored platform, following the continual incoming requirements of the ALaRI actors;

- the goal to realize a functional and active platform as soon as possible, in order to improve the workflows within the ALaRI learning environment, reducing the necessity of e-mailing and enhancing the asynchronous interactions on the platform to bridle the acquired knowledge;
- the continuous updating and revisions of the initial specifications and requirements, due to the increasing number of users (students, teachers, and other profiles not strictly connected with the learning) and of organized activities – in fact the specifications phase, at the beginning of the project, and before starting the development of the intranet system, is very delicate, and it can never be totally definitive;
- a "home made" platform, created by young ALaRI internal developers, sometimes helped by some ALaRI students interested in this project. Thus, it has been necessary to motivate young developers and students to work on a tool from which experience they can resell their acquired knowledge;
- the staff turnover: persons working on the platform changed during the time, making it necessary to hand over intermediate products to somebody else, in order to go on with the implementation of the intranet;
- and consequently work has been performed in a broken/irregular way (in fact the intranet building started in the academic year 2002-03, and now it is still under implementation), so opening another problem:
- the traceability of the tool, i.e. the possibility to document each phase of building and implementation of the intranet;
- moreover, the increasing complexity of the project required a continuous and punctual supervision of the development of the platform (also valuating the limits of the tool itself), but the person in charge of this had also to follow several other activities. As a consequence, difficulties in the intranet use were noticed and discovered late, when the user was not able to perform some tasks and the specific activity could not be carried out;
- finally, the initial difficulty in involving all the ALaRI actors in the use of the platform, making them aware of its services and really facilitating their interactive activities, was a further problem. In fact at the beginning only the students after a brief training seemed to be disposed to use the platform; while professors and other actors did not use it, and in the worst case they did not even know the existence of it.

What Did not Work out as Hoped and Why

Here I would like to analyze what did not work out, and try to understand why. During the summer 2004, it was performed a first usability test, since the use of the platform did not achieved the hoped results. From it and a successive my research (then published in Salvioni, 2005) it was clear that, especially during its first release, the ALaRI intranet was very few used compared to the offered services to the students, faculty members, and industrial sponsors: only some of all the services on the intranet were really known, and few services were really used.

From the users' point of view, two main difficulties concerned on one hand the practical approach to the intranet system, and on the other hand the lack of consciousness about sharing the use of the platform with the other ALaRI actors to increase the know-how of the community.

The analysis conducted showed that, while the technical part of the platform was generally well developed (just few strictly technical problems), limited attention was paid to its interface, because not enough customized according to the final users' demands. In fact, as here below listed, several aspects of usability did not work, generating drawback and disappointment. Such aspects regard:

- semiotic issues, such as the meaning of labels, headings or keywords that should synthesize the contents to which they refer; or the interaction images, i.e. the meaning of any non-textual sign or symbol used for navigation purpose. For instance, some label names do not help users understand their contents, such as the title *ReSearch* that should suggest the whole ALaRI repository, but it is not clear at all; so also the labels *Main Projects* and *Master Projects* (section of *Projects and Research* area) do not explain the difference of the contents they cover, running the risk of losing confidence in the site. Then, about the interaction images issue, there are troubles stemming from the lack of conventional and intuitive symbols, as instead we are used to recognize on web pages: such as the click buttons here represented as little blue triangles in little white squares; or the difficulty presented by underlined words that sometimes are links, and sometimes not
- cognitive problems about the arrangement of information and the user's cognitive effort to read an intranet page overloaded or with redundant terms, but also an intranet page lacking of information that prevents from efficiently completing a specific activity or a task. This can lead to compromise the efficacy of the intranet communication. For instance, on *Projects Search* page (sub-menu of *Projects and Research* area) there are too much information crowding the page, so that it looks like a book page to be read carefully rather than an intranet page with immediate and intuitive services; also on *Library* and *ReSearch* areas there are long list of mixed documents, not divided by subject or type of text, or by author. On the contrary sometimes the lack of details or definite deadlines (about an activity), like on *Part-time Job* area, can prevent from the completion of a task
- graphic elements such as the limit (due to the tool) of getting only square or rectangular areas
- navigation, when it hampers the easy access to some information of interest. For instance, on *Guiding Themes* page (in *Projects and Research* area) four clicks are needed to reach public documents; whereas this path could be simply reduced to two clicks. Then, on intranet pages there is not any backward button to make easier the navigation to the previous visited page (there is only the back functionality offered by the browser)
- technical difficulties about the lack of clear feedback messages, such as error messages that are not in a natural language, but in code, hampering in this way the user to understand how to repair it; and also the lack of messages confirming the successful conclusion of an operation (e.g. the correct uploading of a document-on private or public area-and its availability to the

right addressees). Or the difficulty to remember passwords that must have specific characters, such as an upper case, a number, a specific length, etc.

Then, some errors, that might seem to come from technical troubles, really show failures during the first specifications phase, such as the denied access to read documents of interest. In fact, for instance the second supervisors (the so Italian called *contro-relatore*) found to have no access to read student's theses, just few days before the final discussion – the reason was that during the specifications phase this particular profile was not considered as an ALaRI intranet actor.

Really these troubles slowed down the adoption and the use of the intranet, especially at the beginning, because users were prevented from completing the execution of tasks (in fact, during the first usability test - summer 2004 - just one user out of eight was able to complete his task).

The principal reason was a not suitable attention to the customization of the user interface; but it would have been important also to valuating the limits of the tool itself in advance. Thus, inopportune choices for the realization of the interface would have been avoided.

Other problems are about the maintenance and updating of data and educational materials on the intranet system, for instance when there are personal data to change (about a lecturer, or a student) or course materials to update. This problem was crucial especially at the beginning, because of two reasons: first, developers had not enough time to control all the critical information; second the users were not enough made aware about the necessity of controlling the data of their competence, e.g. the staff users should check administrative data and details about part-time job or master projects; students should up load their profiles, curricula vitae, and the reports of projects according to the milestones; lecturers should provide course materials and assign marks to the students in due time, respecting the intranet policies.

The necessity of making aware the actors about the use of the intranet is an aspect very important that was not enough considered either by technical developers or by the decision makers. In fact this has also had an influence not only on the intranet use, but also on the consciousness of its role for the ALaRI community. For this reason, later online manuals for students and also for lecturers and sponsors were prepared and uploaded on the intranet; and now they are also considering inviting users to attend *ad hoc* training sessions, specific and tailored to the different users' profiles.

According to this perspective, technical developers should have the responsibility to capture how the product is perceived, learned and used, and the requirements that the product can fulfil. This leads to make three considerations: allowing the development of representation models in accordance with the user conceptual model; using cognitive theories in order to build understandable interfaces for information and data display; and evaluating final products also in terms of aesthetics features.

On this subject, the previous *figure 1* can help to understand what did not work out in terms of effective communication among all the ALaRI actors. In fact, while, since the beginning, the first technical loop has showed the good will of building a technical useful artefact for the community; the awareness of the necessity of collaborating and having good communication flows between the two loops, to get a very satisfactory intranet platform, came later, maybe too later.

It is enough to think over the gap between the development of the platform and its test of accessibility and use: during the academic year 2002/03 the intranet building started, but only during the summer 2004 a questionnaire and a usability test have been provided to the users, since the use of the platform did not achieved the hoped results. In fact at the beginning, in order to get the main necessary requirements, it was just provided a questionnaire via e-mail to some users, and the outcomes were discussed only among the technicians, while the users were not more involved in the development of the platform.

The lack of communication has also had repercussions on the display of some courses data on intranet, when for instance some important details were missing about the association of master programs courses and year of course; about credits associated to specific program and courses; or about the pre-definition of elective and fundamental courses according to the master program. Or when the designer considered valid some previous data, he made by himself decisions regarding a particular course, but without asking any details to the decision maker or to the responsible lecturer. This particular situation can occur in ALaRI because the intranet platform is developed by persons inside the institute, who were former ALaRI students. So it can happen that they take for granted some information about courses they already attended, whereas they should verify it.

Another issue concerns the policies and the rules decided by the ALaRI steering committee that are uploaded and implemented on the intranet platform. These policies affect all the educational organization and involve in also lecturers and sponsors. If ALaRI actors do not comply with these policies, all the educational system is compromised. For instance, it is important to respect the deadlines to perform several activities, e.g. the uploading of the master thesis on behalf of the student; or the reading and the evaluation of the thesis, or the uploading of the learning materials on behalf of the lecturer; and so on. But it must be clear that the policies on the intranet are established by the steering committee and they must not be perceived as constraints of the sytem. So it is crucial also to understand how to put the policies on the intranet in order to not discourage the users to work on it.

All these considerations underline that the occurred problems were not only around the user interface, but also about the maintenance and updating of the data on the intranet, the promotion of its use, and the relationships within the institute.

In short, the problems occurred in practice affect several perspectives:

a) the users' point of view about:

- the practical approach, i.e. interfaces not intuitive, lack of customization according to the different users' profiles, problems of usability aspects
- the awareness of being part of a community

b) the communication point of view:

- lack of deep analysis of the users' requirements
- belated request of feedback from the users
- lack of communications among all the ALaRI actors (developers, decision makers, final users)
- lack of suitable promotion of the platform and its services

c) the technical point of view:

- lack of previous identification of tool limits

What is it possible to learn from this experience? How is it possible to benefit from the occurred failures?

Negative consequences imply not only that users cannot achieve their goals with satisfaction, but also compromise the development of a real community identity whose principle of organization is based on the information system itself (Wenger 1998).

Thus, from this analysis three considerations arise, namely:

1. the possibility to create a very general and extensible model of the application, considering all the possible features and prerogatives, in order to have a flexible environment, broader than the first specifications, where it is possible to make changes and modifications without running into insuperable difficulties;
2. the development team should have a deep knowledge of the tool and it should be well coordinated and supervised;
3. and finally, more attention should be paid to the user interface, its maintenance and the promotion of the platform.

The first consideration highlights the crucial problem of the flexibility and of the amenability to modifications of a product, moreover when it is new and just born.

The second point involves two main aspects in ALaRI case. One is the necessity to motivate young developers and students to learn a software language, persuading them that it can always be a work experience to resell. The other concerns the methodology and difficulties proper of the system development that requires the need of portioning the application, subdividing the work in several blocks in order to run the developing phases of the projects in parallel. So doing, it would be easier to take into account users' feedback, and improving the platform step by step, finding possible failures in due time.

The last consideration points out the necessity of working closer with the final users, starting from the design of the application, through the accurate definition of the users' tasks, till the organization of training sessions to promote and enhance the use of the intranet. Then, these sessions should be organized in accordance with the user's profile, reminding that faculty members, students and industrial sponsors have very different features, and consequently they need different approaches to properly use the technology enhanced learning system.

The engagement of heterogeneous human and technical resources in the restoration of a working order can successfully bring to problem dissolution, but it needs a great effort to overcome possible incomprehension and disagreement. Using an own jargon, quarrelling about priorities, and an excessive assertion of own peculiarity become dangerous whenever drive the community of specialists to the isolation and estrangement from giving the waiting answers to a larger community of users (Scott, in Laurel, 1990).

It becomes also worth of value to estimate a costs preview, considering, besides a money budget, the human resources to dedicate on the activity, and the time spent both on the building and on the maintenance of the platform, and on the learning of its use.

Last, but not least, formulating a contingency plan can avoid being naïve in case of difficulty. In fact it aims at valuating the possibility that something does not work as planned, and thus, it helps to be aware of possible troubles that might occur during the development or the use of the system; in a dynamic environment such as ALaRI, it is extremely important to try to foresee changes and modifications that can have strong impacts, especially speaking about e-learning platform.

More generally, from the human and communication point of view, other elements may affect the use of the system, such as the users' habits and resistance behaviour.

It is not easy to change the habits of other persons, especially when they are well with the already existing technical tool (e.g. the simple e-mails). The individual resistant behaviour to adopt and use something new involves the matter about the comfort of the existing habit, the *status quo*; perceiving also associated risks (Szmigin I., 2003), as the here below scheme illustrates (*figure 2*).

<table>
<tr><th colspan="2">RISK</th><th>HIGH</th><th>LOW</th></tr>
<tr><td rowspan="2">HABITS</td><td>STRONG</td><td>a) Dual Resistance
(Social change)</td><td>b) Habit Resistance
(Evolution –continuous- and replacement innovations)</td></tr>
<tr><td>WEAK</td><td>c) Risk Resistance
(Radical –discontinuous- technological innovations)</td><td>No Resistance
(Fads and Fashion)</td></tr>
</table>

Fig. 2

Three types of risks are here above considered:

a) the dual resistance involves physical, social or economic adverse consequences, and it occurs when there are strong habit and high risk due to the introduction of innovation. This kind of risk is often found in the area of social change, e.g. e-business or internet shopping; or it occurs when the use of innovation, not yet fully tested, may not work effectively, or when its price is very high, but it should come down over time;

b) the habit resistance underlines performance uncertainty, because the stress is on changes in existing habits and practices rather than on innovation risk (and this is also the case of the adoption and use of the ALaRI intranet). This type of risk may also include resistance due to conflicts with a previous belief and cultural structure;

c) the risk resistance highlights side affects associated with the innovation: here the matter is not much of changing existing habit but more of introducing new ones. Often radical and revolution innovations generate new forms of habits that have a high risk perception, at least initially, e.g. the microwave oven.

When there is neither risk nor habit change the innovation is very welcome, e.g. the *Swatch* fashion. Thus the resistance in adoption may meet functional or psychological barriers. Functional barriers include product usage patterns, product value and risks associated with product usage, reflecting the ideas of complexity and relative advantage. While psychological barriers arise from existing habits, prior beliefs, traditions, and they can reflect the idea of a compatible technology. The barriers entailed by this above mentioned ideas are here below briefly described.

The complexity of a product implies the need of special training to use it. And in ALaRI case it is relevant both for the developers and for the final users. In fact, on one hand the developers had to learn a particular software language, standard but not very used, in order to build the ALaRI intranet platform; and on the other hand the final users found an interface not intuitive, with some usability troubles, that did not make easy its use.

The perception of the relative advantage has greatly affected the use of the ALaRI e-learning systems, especially on behalf of the faculty members. In fact some of them not only did not use the platform, but often did not even care to know it existed, while students (and alumni) appear to be more inclined to become familiar with the platform, perceiving its utility.

The introduction of a new system requires to change previous habits and learning a new model of communication with the students and with the other ALaRI actors, whereas faculty members were used to write simple e-mails to them, or to delegate work that now they can accomplish by themselves using the ALaRI intranet platform (such as providing students with pre-defined marks from a scroll menu). Thus, on one hand the intranet allows a more autonomous and independent management of several information, but on the other hand it also engage more strictly all the users to make such a system a real value for the whole ALaRI community.

Since the relative advantage is something extremely subjective, it becomes a critical activity also to identify the relative advantage that faculty members are disposed to value, and make it well visible and tangible, also long-term.

The compatible technology refers to the context of adoption and to the possibility of integrating the innovation within both the social and technological system already existent, verifying if the new product is consistent with the users' values and past experience. The ALaRI case is particularly interesting because its e-learning intranet system is mainly developed by and for people with engineering, technical and scientific background. Further it has been built for this specific and particular community. So at first sight it seems to be totally compatible with its social and technological system, where apparently in terms of conceptual model there is not any difference between who build and implement the system and who use it. Nevertheless, the resistances to use it show difficulties of usability and communication.

What did work successfully and the achieved results

What instead did work successfully around the ALaRI technology enhanced learning is here below described:

- the ***advanced data filtering*** based on user type and status has granted filtered access to shared information, protecting sensitive data and documents.

Navigational patterns are limited for a certain user by the access rules imposed on his/her account. For example, a sponsor cannot see actors associations for projects he/she is not involved in, whereas the scientific council or the ALaRI staff can.

- the intranet has proved to be the best solution to **keep important documents long-term**; whereas the short-term information are put on a *wiki* platform, more suitable for this purpose
- the **persistent storage** of project deliverables, achieved results and other documents **into the repository** has avoided losing ALaRI know-how acquired during these last seven years (the problem instead is to find the best way to visualize all this know-how to the users)
- on the platform, **policies and rules** are **well issued and accessible**, so that ALaRI actors have to respect and to comply with them, as for instance the uploading of report within defined milestones; or the uploading of master thesis within deadlines to allow the reading and the evaluation of it. And thanks to the policies and rules, a level of formality among the users, also working from remote places, is supported
- the system **makes easier the management of the ALaRI back office**, acting as a sort of "electronic secretary"
- **the ALaRI *alumni*** (the former ALaRI students) **follow-up** has been successfully managed through the intranet, offering them career opportunities and the access to the project results also after the finish of their master's courses
- the promotion of several services, besides the pure educational ones (the strictly e-learning platform)
- the physical closeness (of place and of age) has allowed developers to improve the customization of the staff's and student's interface more quickly and easier rather than the lecturer's and sponsor's ones, thanks also to the possibility to speak with them directly and have immediate feedback. Consequently staff and students have met less difficulty in the adoption and use of the system (but it is true that the interface is not intuitive and it is necessary to take more into considerations the different users' requirements)

Further, improvements of usability on the intranet have allowed:

- all users to **send suggestions**, critics, and recommendations to the intranet administrators for any requests or questions about the services of the intranet system. And, in this sense, the intranet home page and others particular pages are provided with the technicians' emails to contact
- to **send messages to the employer's private e-mail box**, informing when somebody applies for a job posted. This faces up to the problem to not check the intranet regularly, and so to not see students' applications for some time
- to **up load students' photos** near their names. This helps to recognize the students, associating their faces with the proper names more quickly. And in multi-cultural and multi-ethnic classes with students coming from all over the world, this little expedient gains a considerable importance, making easier the interpersonal relations

General recommendations

Abstracting from this concrete case, in my opinion some overall recommendations could include the following aspects to achieve satisfactory results:

a) About the technical building of the platform:

- the specifications phase is very delicate, and it can never be definitive
- it is necessary to create a very general and extensible model of the application to have a flexible environment, broader than the first specifications
- it is necessary to coordinate and supervise the development team
- the developers have to acquire a deep knowledge of the tool
- it is important to design the whole platform, but then to split the development phases, building one section at a time (e.g. first developing one user section, testing it and starting to use it, and then reviewing and redefining requirements not considered previously)

b) About the users' requirements:

- try to work close to the final users, if possible
- analyse carefully the several users' profiles
- customize the user interfaces according to the different users' site-views
- do not underestimate the usability aspects (such as cognitive, semiotic, navigational, technical, and graphical issues)
- maintain and up date data and information on the platform
- try to meet the user's expectation at first - negative experience discourages user
- provide the platform with online help manual, tailored for each profile

c) About the users' feedback:

- find user available to test the platform internally, before its release – identifying the critical users and trying to comply with their requirements
- request the users feedback through usability tests assigning tasks within specific scenarios, and observing and then evaluating how users perform them
- review and redefine requirements not considered previously
- improve the following phases of development with the provided feedback and make the suitable modifications
- consider users' resistance and habits, such as functional barriers, i.e. the complexity of the product and the perception of the relative advantage; and psychological barriers, i.e. the compatibility of the technology with the user's background and culture
- promote the use of the platform – at all levels through several actions (e.g. tailored training sessions)

d) About the financial issues:

- estimate a costs preview, i.e. efforts of money, human resources, time spent on learning the tool and building the system, the use of the platform, the maintenance of the data
- formulate a contingency plan, i.e. valuate the possibility that something does not work as planned.

Maybe these suggestions can apply to other situations and help to avoid the problems occurred in ALaRI
community.

Conclusions

The ALaRI intranet was principally thought to create an educational platform, able to enhance the elearning also from remote places, to develop the asynchronous communication - reducing the necessity of e-mailing - and with the goal of providing the ALaRI actors with a knowledge repository, where they can collect and increase the know-how acquired.

According to this analysis, it is clear that several difficulties have taken part in the complete adoption and use of the ALaRI intranet by the whole ALaRI community. These difficulties range from a not well customized interface, also due to a limited attention to the users' needs, to the time spent on building and implementation and to a lack of proper management of internal communication.

Consequently, in the production phase, various problems occurred to hand over intermediate products to new developers and to control and coordinate the ongoing activities.

Therefore a complex network of communications and relationships has affected the optimal realization of the product, but the originally intended outcome is not compromised, and the particular academic environment of ALaRI allows going on with the technology enhanced learning, trying to benefit from the previous failures.

References

ALaRI web site: http://www.ALaRI.ch

ALaRI intranet site: http://www.ALaRI.ch/intranet

Dillenbourg, P. & Schneider, D. (1995). Collaborative Learning and the Internet. ICCAI 1995 conference, available at http://tecfa.unige.ch/tecfa/research/CMC/colla/iccai95_1.html.

ISO 9241-11: definition of *usability*.

Negri, L. & Bondi U. (2004). The ALaRI Intranet: a Remote Collaboration Platform for a Worldwide Learning and Research Network. ED-Media Conference 2004, University of Lugano, CH

Salvioni C., From a young academic institute a broad minded approach: the working and learning environment of the ALaRI Intranet tool (case study), Microlearning 2005, Innsbruck, Austria

Scott K., *Interdisciplinary collaboration*, pp.31-44 in Laurel B., *The art of human-computer interface design*, 1990

Szmigin I., 2003, Understanding the Consumer , p.116

Wenger, E. (1998) Communities of Practice: Learning, Meaning, and Identity. Cambridge

Ambient Video Awareness: “It’s Great, but I Still Don’t Want It”

Peter Scott, Kevin Quick, Eleftheria Tomadaki, Jon Linney

Knowledge Media Institute, The Open University, United Kingdom
{Peter.Scott, K.A.Quick, E.Tomadaki, J.W.Linney}@open.ac.uk

Abstract. Video instant messaging tools are not as widely used as we would have predicted and have so far failed to fulfill their promise to become an indispensable tool of social presence, interacting within the workgroup environment and creating a sense of community. Whilst users are becoming comfortable with videoconferencing and software video meetings, the use of video in “awareness” is still very uncommon. Over a 2-year period, we have run 8 discrete Hexagon room studies on naturalistic “ambient video awareness”. Only one of these studies can be considered to be a (limited) success. This paper discusses some of the factors inhibiting the use of such tools in e-learning environments, based on users’ feedback on issues, such as the tool promotion, user interface, size of community and visibility concerns.

Keywords: video ambient awareness, collaborative media, group awareness

1 Introduction

The “potential of awareness information” using video cues has excited researchers since the very early days of remote video meetings [1]. A range of video, audio and text-based instant messaging tools offer awareness features that can be used for office or learning ‘group awareness’. Studies on the impact of these community tools have been very positive. In early systems, such as the XEROX and NYNEX Portholes [1], [2], a shared awareness was viewed as helping to build a sense of community using video broadcasting technology. Awareness in terms of video and text instant messaging tools can be achieved by denoting social presence with live images transmitted via networked computers and by exchanging text or voice instant messages. In social presence theory, the role of media is to provide valuable ‘cues’ about the presence of others: including facial expression, tone of voice and other key aspects of presence, such as clothing or hairstyle [3]. It is argued that face-to-face communication is rich because it includes deictic elements and objects, which are visible to both participants of the communication [4] and that this is critical to participants. Computer mediated communication for workgroup awareness was viewed in the past as a direct replacement of this aspect of face-to-face communication. Video technology can be used effectively in physically distributed workgroups around the world, saving travel costs and minimizing the time taken to complete a group task [5]. Video instant messaging tools can enhance computer-supported group-based learning, which is an important part of contemporary

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing, EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 207-214, 2006.

education, focusing on concepts such as 'cooperative' and 'collaborative' learning, motivated by learning environments similar to original working processes [6]. However, where video is involved, issues of surveillance, invasion of privacy and concerns about being on view to the community are common. The evidence of the last ten years is that video instant messaging and awareness tools have failed to become an indispensable tool of the everyday communication in e-learning and workgroup environments, despite advances in the technology that made it genuinely usable outside of the research lab.

This paper focuses on the video awareness tool Hexagon. Despite deployments into over 8 different target communities and some very positive feedback, the tool has failed on the one single measure of an effective piece of software: does it continue to be used once the initial novelty factor and research enthusiasm have worn off? This is a very high standard for much experimental work, and on this measure only 1 community of the 8 can be considered to be a limited success.

2 Hexagon Video Presence Technology

Hexagon is part of a research programme on telepresence, which focuses on issues such as ambient presence awareness and working and learning in public. It is a simple applet designed to run in a web page, using Adobe Flash™, a pervasive and cross-platform browser plug-in, which typically requires no additional software installation. Hexagon users share regularly updated, live, personal webcam images, laid out on a grid of hexagons. Features such as a text chat facility and a voice communication mode, allow large groups to interact with each other.

Hexagon provides a 'room-based' view of connected participants to specific 'room instances'. Some Hexagon rooms allow guest access, whereby users can enter without registration and can typically remain for a time-limited period with limited functions. Registered 'room users' can send instant text messages to other users individually, or as a group, can have an audio chat with individuals and can look at the "room history" of user attendance. A user's webcam image appears as a hexagon, in a grid of other user hexagons. Users can move the hexagons around on this grid, and can zoom in and out on them, and users without a camera appear as grey in the grid. The images are very low refresh Adobe Flash™ movies, and update independently with a new frame every 20-30 seconds. The most recent 'image refresh rate' allows the applet to update without overly taxing a client's personal computer and network. Simple graphical effects are used to indicate to the present community that users interact with each other, e.g. text chat sent from one user to another, is animated by a small spinning 'envelope' graphic moving between the two relevant hexagons. The applet has been tested with 50 simultaneous webcam connections in a single room, and is theoretically capable of supporting many more. However, no 'real' room uses in this study have exceeded that number of video connections. Fig. 1 shows an annotated view of the main 'hexes' screen, including the views of 7 different webcams, involving users or specific locations. Individual status indicators can be set showing whether the users are 'busy' - as in many other instant messaging tools.

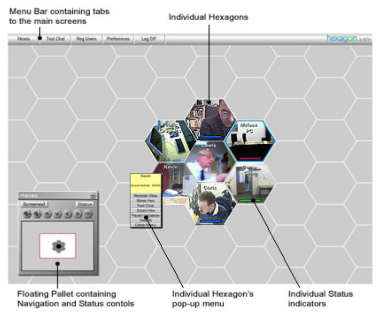

Fig. 1. A view of the *(hexagon)* screen showing *(7 participants)*.

The Hexagon technology was designed to support ambient awareness in a coherent community. In a working office context, we envisaged that remote workers would get an increased sense of community by seeing co-workers and office locations; and that they would use ambient cues to interact more effectively, e.g. to quickly gauge availability, engagement in work on the phone or meetings from video cues. In learning contexts, we envisaged that groups of tutors and students could mingle in such a space to make use of the video for convenient opportunistic learning interactions. The technology supports a number of work and learning models, from 'student drop-in centre' or 'public helpdesk', to acting as a 'jumping off point' for video meetings or other interactions, to a full 'virtual learning space'.

3 Evaluation

Over the last three years, the Hexagon system was provided freely to a range of companies, research projects and organizations. All but one of these groups have taken enthusiastically to the technology, but failed to convert their interest into a stable, long-term working model for video presence in their community. Most of the workgroups have deployed the system to a small number of enthusiasts, who have used the technology for only a few weeks. Once the novelty factor has worn off, the working models that remain have been insufficiently compelling to bring users back to the system. This section includes an analysis of Hexagon's failure to become an in indispensable tool for social presence and interactivity in different workgroups.

The Hexagon applet was prototyped in the summer of 2003 and tested with a range of user communities through to 2004 under various models. The current studies started in April 2004, with detailed recording of activity in each room. The most heavily used 'room' (the Knowledge Media Institute's own lab room) has recorded around 19,000 logged-in connections. However, in addition to this one successful room, 17 further user-communities were offered access to the technologies to deploy in a naturalistic setting. None of these studies have come close to the success of this initial context. This list includes a number of large 'corporate-level' organizations, specifically the e-learning and training departments of: a multinational telecoms company, a multinational energy company, a multinational computing networks company, a large UK-based broadcasting organization, and a UK-based government supported civic organization, communications department. Also, by more 'local level' organizations: a small USA-based independent music teaching company, a local UK-based innovations organization to support small enterprises, and a UK-based schools-networking organization. It has been trialed by 3 organizations within the Open University, and by University groups in South America, North America and Central Europe and has been used with "project-based" highly distributed groups in 3 pan-EU projects. The typical pattern of use in our studies is illustrated below. Almost all of these trials exhibited a similar pattern to the illustration, which appears to be a form of "adherence failure" in which the technology evidently fails to 'stick' with a given community. In all cases, users appear to like the technology and to report minimal technological problems, but still do not continue to use it after the initial trials.

3.1 The 'Prolearn' Hexagon

On 23rd September 2005, an EU funded network of excellence in Professional Learning (see: http://prolearn.tv/) conducted a webcast using the "Prolearn" Hexagon room as an 'audience presence space'. Those 'tuning in' to the broadcast event were invited to join the Prolearn Hexagon study to see the remote audience and to interact with other attendees and the speaker. The event served to excite a small community with the potential of 'ambient presence' technologies, bringing webcam users into the room for a short while. The event was 'attended' by 16 Hexagon clients from all over this European community (although this figure includes some 'contextual cameras' in the presentation itself) (Fig. 2). Overall, the room in this week had 501 chat messages between 34 unique IPs of participants. The webcast audience included attendees from the computer science department of the Katholieke Universiteit Leuven, Belgium. This group of enthusiastic students and researchers returned, bringing more webcams to this Hexagon room the following week (requesting full accounts that would enable them to remain in the room past the 'guest allocation time out') and remained for four further weeks. Figures 3 through 7 illustrate the use of the room over five weeks, with peaks through to the early afternoons (Monday to Friday). Fig. 3 shows some minor activity over a weekend, but most activity was clearly in the working week.

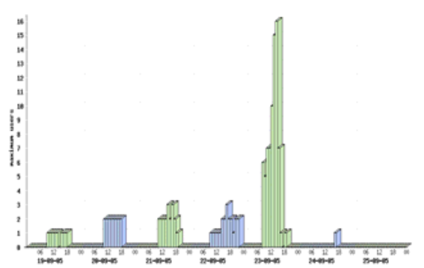

Fig. 2. *(Prolearn Hexagon) Room* Week View *(19-25 Sept 2005)*

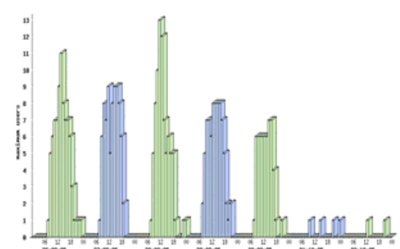

Fig. 3. *(26 Sept-02 Oct 2005)*; 1069 Chat Messages, 49 IPs

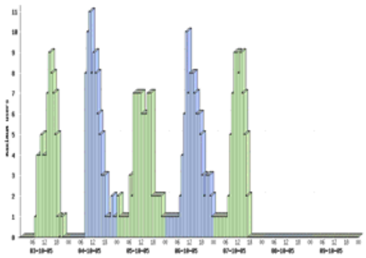

Fig. 4. *(03-09 Oct 2005)*; 424 Chat Messages, 29 IPs

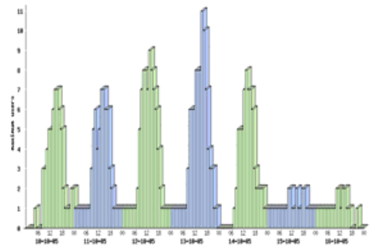

Fig. 5. *(10-16 Oct 2005)*; 456 Chat Messages; 25 IPs

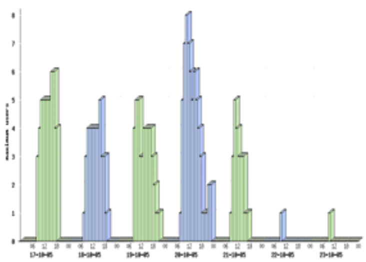

Fig. 6. *(17-23 Oct 2005)*; 87 Chat Messages, 16 IPs

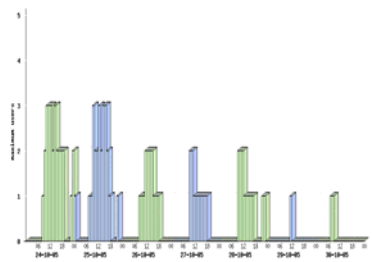

Fig. 7. *(24-30 Oct 2005)*; 3 Chat Messages, 15 IPs

Overall, there was significant room activity with over 2000 text chat messages generated in this short time. Little use was made of person-to-person audio in this time (only 5 audio chats in the first week and then 5 over the remaining 5 weeks). However, as can be readily gauged from the sequence, the level of presence in the room gradually fell to a core of 4-5 users (the most active of the KUL students and researchers). In the latter of these weeks, whilst 15 unique IPs came and went from the room, a maximum of only 3 were co-present at any one time. Evidently, this was below the threshold for this community and signals the end of this phase of its use. The room remains open, to date, and since this October activity has hosted 3-4 users on infrequent and irregular occasions. Whilst all 8 trials have been different with respect to their initiation, most have followed this general pattern, with users reporting a continued enthusiasm for the technology, but 'measurably' NOT using it.

3.2 The 'KMi' Hexagon

The Knowledge Media Institute (KMi) occupies a single floor in one building in Milton Keynes in the UK. It has a large open plan central area where some researchers and graduate students work in 'cubicle' spaces, surrounded by 1 and 2-person enclosed offices. The enclosed offices all have full glass panel doors, to allow visitors an unrestricted view inside. Workers often have multiple computers, and webcams are freely available. The 'KMi' Hexagon room has been in use every single day since this work began. We can consider this to be a relatively naturalistic study, because whilst KMi lab members have been encouraged to join this room, through occasional emails (4/5 over 3 years), no management pressure or negative sanctions have been used to oblige participation. We examined the detailed log for a complete calendar year: Aug 2005 to Jul 2006 inclusive. This showed that some of 52 possible accounts for this room, 33 “registered users” used Hexagon somewhat during that period. There were a total of 7,500 connections by those registered users in that time, with a further 360 accesses by ‘guest’ users. Fig. 8 shows the most active 19 registered users with over 10% connections to the KMi Hexagon room during a weekday in this calendar year (Monday to Friday). Some 14 active users with less than 10% connections on weekdays have been excluded from this chart.

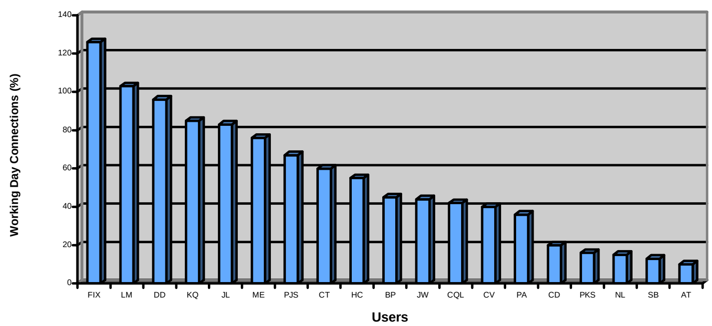

Fig. 8. Connected weekdays to KMi Hexagon Room, 1 Aug 2005 to 31 Jul 2006

The chart measures (at least) one connection by the user to the room on a day in that year (excluding weekends, but not taking into account any other holiday or exclusion periods). Ergo is a percentage of the maximum possible working days the user could be connected. Some anomalies with the figure should be noted. The ‘most active’ user FIX is over-represented, as this is a generic account for fixed cameras in the laboratory, which are automatically on and overlooking public spaces when relevant computers boot up. Ergo, one or other of these are logged into Hexagon for 90% of the year, being 126% of possible working days. In the same way, users PJS and PA are workers in the lab who leave Hexagon switched on permanently. Their connections do not show up sufficiently in these daily connection statistics as their machines remain on and do not ‘log’ many daily connections, unless restarting their computers. One other issue is that users CQL and AT joined the lab during the sample period and so their % attendance in the Hexagon room actually corresponds to a proportional >90% of their possible use of their membership of this community. These caveats mean that 11 working individuals connected on at least half of the weekdays, (that they possibly could have done), in this calendar year. Interestingly, 7/18 individuals in Fig. 8 have single offices, whilst the remainder have a double office, and a few also work in an open plan context. The Hexagon applet does not automatically launch and must be opened and maintained in an open browser window. It is likely that 1 or 2 users may have set it as a browser default page, or have scripted its automatic opening, but most users go to some real trouble to ‘make the application' work. Although the Hexagon room concept seems to work well for a proportion of KMi denizens, the majority of lab workers do not use it.

4 Why Do Non-Users NOT Use Ambient Video Awareness

It is notoriously hard to reach non-users of any technology or system, and even harder to motivate them to explain why they do not use it. It may have been badly explained to them, or not explained at all. It may not make sense to them, or fit in with their working or learning style. They may simply not like it. The Knowledge Media Institute is a large and busy research laboratory. Where Fig. 8 shows active users of the system, there are 19 registered users not shown whose use is less than 10% of possible working days and a further 14 members of the lab who have never requested an account. In July 2006, we sent a questionnaire to these 33 non-users. Eighteen researchers, male and female, provided their feedback on 15 question topics. More than half of the researchers, who answered the questionnaire, have worked for more than a year in KMi, with 8/18 being employed more than two years. Just under half of the respondents (8/18) were very-low-users (under 10% in our 2005-6 sample) and the remainder were non-users. All of them use other instant messaging tools for regular communication, but said that they liked the Hexagon interface.

It appears that the main factor for not using Hexagon, according to more than half of the respondents, is that they do not like being visible to the community all the time;

"I don't like the idea of me being on video camera all the time. I don't mind being on camera when I 'want' to be on camera (in a video conference) but I don't like the idea of constant surveillance". (MG, Open Plan non-user, Male).

"I don't like the idea of being on-camera all the time. It feels like an infringement of my privacy." (CD, Open Plan non-user, Male).

Visibility concerns have been observed in the past in other live image broadcasting tools for office awareness. Negative statements, such as "feelings of instant dislike for strangers" are described regarding the AT&T Picturephone, one of the first video teleconferencing systems [5]. Negative user reactions to the camera, such as camera shyness, threat of surveillance and loss of control over privacy were also spotted in the use of NYNEX Portholes [2]. In the case of Hexagon, these feelings were most common amongst 'open plan' office inhabitants who were already very visible to the lab community. This might initially make their concerns seem rather odd. However, it may represent a 'resistance' factor – in that they could perhaps not close their door to the community (not having one) but could at least leave their webcam off! Other users noted that, even if they did not find the awareness concept intrusive, they found the applet to be too dominant, eg. they did not want the intrusion of seeing all the others:

"I want the instant messaging applications to be silent and noticed only when I need them or when I am being messaged." (AS, Open plan non-user, Female).

Or worse, that it was more interesting than their work:

"It diverted my attention from work, when I had a hard problem to solve I started to watch hexagon instead." (MS, Double office non-user, Female).

Another issue is that Hexagon video awareness competes with a range of other technologies that provide awareness and communications functions. Users reported that there were at least 8 different systems that they used on a regular basis and that provided some competing functions. They also reported that the working context seemed largely irrelevant in such a context:

"... because everybody I work with is always in the office, the functionality of Hexagon was a bit redundant." (MS, Double office non-user, Female).

"Since all the users are situated within KMi I always found it more convenient to visit the person myself". (AN, Open plan non-user, Male).

Others noted a preference for other, more traditional technologies:

"…by phone sometimes it is easier". (AO, Open plan non-user, Female).

Another reason why Hexagon is not as widely used as predicted by its designers is that it was not promoted enough so that potential users can realize the functions related to the sense of community and take advantage of it in terms of social presence and interaction within the same work environment or whilst working remotely. The context of using video instant messaging also matters; five occasional users noted that it was useful to see whether a person in a different physical location was present, but their team members are already visible, working in the same lab area.

We should note that no software is embedded in a community out of context. The roles of individuals, champions and enthusiasts can make a very big difference to the uptake of a technology. The KMi Hexagon succeeds because it has contained evangelists for 'ambient presence' since it began! All the other studies have not made the 'critical mass' to make the Hexagon room aspect of their community robust, such that it could survive the inevitable temporary loss of key members. Ambient video presence is indeed as exciting as Dourish and Bly [1] hoped, over ten years ago, but we still have not quite learned enough about how to make it realize that potential.

References

1. Dourish P. and Bly S.: Portholes: Supporting Awareness in a Distributed Work Group. ACM (1992)
2. Girgensohn A., Lee A., Turner T.: Being in Public and Reciprocity: Design for Portholes and User Preference. Human Computer Interaction (1999)
3. Short, J., Williams, E., & Christie, B.: The Social Psychology of Telecommunications. London: Wiley (1976)
4. Nardi B.: Beyond Bandwidth: Dimensions of Connection in Interpersonal Communication. Computer Supported Cooperative Work (2005) 14:91-130
5. Edigo C.: Videoconferencing as a Technology to Support Group Work: A Review of its Failure. Proceedings of the ACM conf. on Computer-Supported Cooperative Work (1988)
6. Strijbos J.W., Martens R.L., Jochems W.M.G.: Designing for Interaction: Six Steps to Computer-Supported Group-Based Learning. Computers and Education May (2003)

Acknowledgements. This research is supported by the 'Network of Excellence' Prolearn, which is funded by the Information Society Technology programme of the European Commission. The network is focused on innovative aspects of technology enhanced professional learning (see: http://www.prolearn-project.org/).

TEL Communities of Practice

October 2, 2006

Crete, Greece

Workshop Chair

Nikos Karacapilidis (University of Patras and RA Computer Technology Institute, Greece)

Program Committee

Nikolaos Avouris (Greece)
Simon Buckingham Shum (UK)
Daniel Burgos (The Netherlands)
Bernadette Charlier (Switzerland)
Vassilis Christophides (Greece)
Brigitte Denis (Belgium)
Erik Duval (Belgium)
Christina Evangelou (Greece)
Rose Dieng-Kuntz (France)
Eric Dubois (Luxembourg)
Liliane Esnault (France)
Denis Gillet (Switzerland)
Thanasis Hadzilacos (Greece)
Nikos Karacapilidis (Greece)
Vangelis Karkaletsis (Greece)
Thibaud Latour (Luxembourg)
Miltiadis Lytras (Greece)
Dora Nousia (Greece)
Vincent Quint (France)
Cecile Roisin (France)
Peter Scott (UK)
Constantine Spyropoulos (Greece)
Manolis Tzagarakis (Greece)
Christine Vanoirbeek (Switzerland)

Preface

TEL-CoPs'06 (http://palette.cti.gr/workshops/telcops06.htm), the *1st International Workshop on Building Technology Enhanced Learning solutions for Communities of Practice*, was set up to promote and stimulate the exchange of knowledge on current research trends in technology enhanced learning solutions that aim at addressing the multiplicity and complexity of needs of Communities of Practice all along their lifecycle. The workshop advocated for approaches that build on the synergy of concepts such as multimedia information authoring and reuse, knowledge management, and argumentation. It aimed to bring together scientists and engineers who work on designing and/or developing the abovementioned solutions, as well as practitioners who evaluate them in diverse real environments. Particular interest was given to approaches that are built according to well-established pedagogical principles.

TEL-CoPs'06 was held in conjunction with *EC-TEL'06*, the *1st European Conference on Technology Enhanced Learning* (Crete, Greece, October 1-4, 2006). It was supported by and organized in the context of the *PALETTE FP6 IST project* (http://palette.ercim.org).

This volume contains 18 papers corresponding to the presentations given during the workshop. Out of 22 initial submissions, 12 were accepted as full papers and 5 as position papers. All papers were blind-reviewed by at least 2 members of the workshop's Program Committee**.** We are particularly happy to also include in this volume the paper of Chris Kimble, our invited speaker, entitled "Communities of Practice: Never Knowingly Undersold".

This volume would not have been completed without the active support of many persons. We first thank the authors of the included papers. Then, the members of the Program Committee for their help in the overall organization of this workshop, as well as their great effort during the reviewing process. The support of various PALETTE partners, and especially that of ERCIM, is acknowledged too. Our thanks also go to the organizers of EC-TEL'06, and particularly to Peter Scott, for hosting our workshop and helping us solve various administrative and organizational issues. Finally, we thank Elia Tomadaki for her valuable work towards nicely putting together the material included in this volume.

Nikos Karacapilidis
Patras, Greece, October 2006

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 217, 2006.

Communities of Practice: Never Knowingly Undersold

Chris Kimble

University of York
kimble@cs.york.ac.uk

Abstract. This paper was prompted by the growing ambiguity about what is meant by the term Community of Practice and what such communities are supposed achieve. Like John Lewis' famous tag-line "Never Knowingly Undersold", the term "Communities of Practice" has proved to be both durable and capable of holding many levels of meaning and seems like an appropriate metaphor for the way that the term Communities of Practice is used by some.

This paper will show how the use of the term has changed from the early exploratory works of Lave and Wenger (1991), through the later, more theoretical, works of Wenger (1998a) to the current, more "business friendly", version propounded by Wenger, McDermott and Snyder (2002). It will argue that, just as when buying goods from a retailer, when dealing with the Community of Practice, one should also follow the dictum 'let the buyer beware'.

1 Introduction

Communities of Practice are an area of increasing interest for academics, consultants and practitioners. Perhaps this interest is not too surprising: they provide a useful socio-cultural description of the process of the creation and reproduction of knowledge, an account of agency and structure that can be applied to the business environment, as well as a social constructivist theory of learning applicable to groups. However, the very utility and popularity of the term has lead to it being used in a variety of different, and potentially conflicting, ways. This, in turn, has lead to an increasing number of articles that are critical of the way in which the term is used.

For example, in an earlier paper (Kimble & Hildreth, 2004) we questioned the applicability of the concept both to the modern business world in general, and to the virtual world of distributed working in particular. Similarly Cox (2005) offers a critical review of four different interpretations of Communities of Practice from the viewpoint of a management ideology while Roberts (2006) examines the limits of the usefulness of the concept and identifies the different ways in which it is used by management academics. This paper will continue that debate by examining the evolution of the concept of Communities of Practice during three key periods of its development.

The body of the paper is taken up with a review of literature on Communities of Practice. It begins by considering, principally, the two works from 1991 that first introduced the term: "Situated Learning: Legitimate Peripheral Participation" (Lave & Wenger, 1991) and "Organizational Learning And Communities of Practice" (Brown

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 218-234, 2006.

& Duguid, 1991). This is followed by an examination of Wenger's later work centred around "Communities of Practice: Learning, Meaning, and Identity" (Wenger, 1998a) and concludes with some of the more recent 'consultancy based' work of Wenger such as "Cultivating Communities of Practice" (Wenger et al., 2002).

Following the lead of Cox (2005) and Roberts (2006) this takes an analytical approach to the literature and provides, for each period:

1. Some background to the period under examination. Here the aim is to place this particular view of Communities of Practice in its historical context.
2. An analysis of the way in which the term is used. Essentially we ask 'what is a Community of Practice, what does it do and how does it work?'
3. A summary of the key features of the view of Communities of Practice from this particular period.

The concluding section of the paper will offer some general observations on the way in which the usage of the term in the literature has changed and some advice to reader of that literature.

2 Never Knowingly Undersold

The claim "Never Knowingly Undersold" is one that has been used continuously since 1925 by the John Lewis Partnership, a chain of upmarket department stores in the UK. Essentially, it states that if a customer can buy the same item cheaper elsewhere, John Lewis will refund the difference.

The phrase "Never Knowingly Undersold" has been in constant use for over 80 years and has proved a durable and eye-catching headline, however, the claim is not quite so straight forward as it seems. The comparison must be with *exactly* the same product (brand, model, colour, size etc) which both John Lewis' and the competitor must hold in stock. Crucially for the 21st century world of retailing, the guarantee does not apply to web based companies and, more subtly, the type of goods offered by the John Lewis Partnership tend to be 'top of the range' goods with specialist service contracts so that the number of valid comparisons a customer can make is somewhat limited.

Notwithstanding this, the phrase "Never Knowingly Undersold" has been emulated by countless other businesses. Perhaps one explanation for this success is that it seems to signify certain desirable qualities (e.g. a guaranteed 'best buy' from an upmarket store) even when, on closer inspection, this is not all that it seems.

Some critical reviews have suggested that the term Communities of Practice shares similar properties to this slogan. For example, Fox (2000) suggests that viewing an organization as a community of practice can help deflect attention away from more contentious issues because, as Liedtka (1999) notes:

> *"... to see a business organization as a community of practice is to see it as held together by a shared concern for both the outcomes it achieves for stakeholders (be they customers or shareholders) and the personal development and learning of its members" (Liedtka, 1999, p 7)*

Similarly, Gherardi, Nicolini and Odella (1998) note that the 'positive, virtuous and consensual overtones' of the term can mask the tensions inherent in interactive social learning. Although, this consensual view of shared goals and shared concerns, which occurs more often in the later literature, is not necessarily wrong, it is in conflict with some of the early views, as Henriksson (2000) points out:

> *"Quite contrary to their intentions, the metaphor* [of community] *downplays the very dynamic tensions, struggles and pluralism that Lave and Wenger in their original book seemed to wish to convey." (Henriksson, 2000, p 10)*

While such disparities may not be a problem to (for example) consultants trying to sell their expertise, they are much more fundamental to the work of the academic and it is these subtle distinctions of meaning that this paper sets out to explore.

3 The Early Period (1991 – 1995)

3.1 Historical Context

Many of the current notions of Communities of Practice first originated in the late 1980s in the Work Practice and Technology group at the Institute for Research on Learning (IRL) at the Xerox Palo Alto Research Centre (PARC). The research in IRL at PARC brought together ideas from several different academic disciplines and occupational backgrounds and consisted of an interdisciplinary group of researchers that included Lucy Suchman, Jean Lave, Etienne Wenger, John Seely Brown and Paul Duguid.

For many years, what were termed Behaviourist Models of learning had been dominant. These held that learning was principally concerned with the process of transmission of knowledge from teacher to learner; essentially, knowledge was viewed as an object that could simply be "transferred" from one person to another. However, during the 1970s and 1980s there began to be an increasing interest in what were called Social Constructivist models of learning. These saw learning not as a process of transmission of knowledge from one individual to another, but as a process in which knowledge was mutually "co-constructed". Much of the conceptual basis for these theories were founded on the work of Vygotsky (1978) who was concerned with the ways in which individuals learn within communities. Vygotsky believed that knowledge was socially constructed through collaboration and interaction in activities and used the notion of a Zone of Proximal Development (ZPD) to describe the way in which a learner interacts with others in a particular activity.

The two key texts that we will consider from this period were both published in 1991. The first, by Lave and Wenger (1991), is "Situated Learning: Legitimate Peripheral Participation"; the second by John Seely Brown and Paul Duguid is "Organizational Learning and Community of Practice: Toward a unified view of working, learning, and innovation" (1991). Both of these works have much in common and share much of the same source material (e.g. (Cain, Unpublished), (Marsall, 1972), (Lave, 1988), (Jordan, 1989), (Orr, 1990b) and (E Hutchins, 1991)) and although they both approach Communities of Practice in slightly different ways, they are both primarily concerned with theories of learning.

3.2 Situated Learning: Legitimate Peripheral Participation

The focus of the book is on informal learning in social situations; the book mainly drew on previously conducted studies of Liberian tailors, Mayan midwives, non-drinking alcoholics, butchers in supermarkets and navy quartermasters.

3.2.1 What is a Community of Practice?

The main objective of Lave and Wenger's work was to explore an alternative theory of learning to that of the dominant behaviourist models. At this point, they were content to leave the definition of a Community of Practice as a largely intuitive notion (Lave & Wenger, 1991, p 26) considering the value of their description of a Community of Practice to be primarily as a heuristic device that could highlight issues that had previously been overlooked. One the most frequently cited definitions of a Community of Practice comes from this work and describes a Community of Practice as:

> *"... a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping Communities of Practice." (Lave & Wenger, 1991, p98)*

It continues

> *"A Community of Practice is an intrinsic condition for the existence of knowledge, not least because it provides the intrinsic support necessary for making sense of its heritage ... the social structure of this practice, its power relations, and its conditions for legitimacy define possibilities for learning." (Lave & Wenger, 1991, p 98)*

3.2.2 What does it do?

Lave and Wenger (1991) were primarily concerned with situated learning, and their notion of a Community of Practice is closely related to this. It is largely based on the idea of learning through apprenticeship. A Community of Practice is seen as a mechanism for the reproduction of existing knowledge through active engagement with others in some form of 'practice'. Viewed in this way, learning is essentially the process of socialisation into a community.

Over time, the knowledge that is acquired in these communities begins to constitute both a sense of identity of oneself (as a member of that community) and becomes part of one's identity in the eyes of the others. Consequently learning becomes part of *"... generative social practice in the lived in world"* (Lave & Wenger, 1991, p 35).

Lave and Wenger call this complex reciprocal interrelationship between the practice and participation "mutually constitutive" (Lave & Wenger, 1991, p 117). Such communities are described as "enacted", that is that members can be thought of as 'performing' or 'improvising' their roles in the community as they go about their everyday activities (Tsoukas & Chia, 2002).

3.2.3 How does it work?

Lave and Wenger use the concept of Legitimate Peripheral Participation (LPP) to describe the underlying process of how this division of labour and responsibility is achieved.

> *"Legitimate Peripheral Participation provides a way to speak about relations between newcomers and old timers and about activities, identities, artefacts, and communities of knowledge and practice" (Lave & Wenger, 1991, p 29)*

By connecting participation and meaning, Lave and Wenger take Communities of Practice beyond a simple forum for learning and link membership of a Community of Practice to aspects of the members' social identity. Based on Cain's observations (Cain, Unpublished) of Alcoholics Anonymous meetings Lave and Wenger (1991, pp 79 - 84) illustrate many of the aspects of how LPP allows a Community of Practice to function.

In an Alcoholics Anonymous meeting, members tell stories that are a means of reinterpreting the past, understanding the present and visualising the future in terms of an alcoholic's identity, the ultimate goal being to conceive of oneself as a non-drinking alcoholic. Stories are told, retold and elaborated as the novice moves from peripheral to full participation in the community.

3.3 Organizational Learning and Communities of Practice

Brown and Duguid's (1991) discussion of Communities of Practice is mostly based on Orr's ethnographic studies of service technicians in Xerox (Orr, 1987, 1990a, 1990b). As the full title implies, the goal is to bring together theories of working, learning and innovation in order to provide new insights into organizational learning and the role of communities in the workplace.

3.3.1 What is a Community of Practice?

The starting point for Brown and Duguid's (1991) discussion of Communities of Practice is the difference between the way an organization describes a person's work and the way the work is actually carried out in practice. The former they describe as "canonical practice" and the latter as "non-canonical practice". Their aim is to show how, when canonical accounts of work break down, Communities of Practice continue to get by through improvising new solutions.

They describe Communities of Practice as interstitial communities that exist in the 'gaps' between work as defined, and the tasks that need to be done. They use the term to describe groups that are (a) fluid and dynamic *"... constantly adapting to changing membership and changing circumstances"* (Brown & Duguid, 1991, p 41); *(b)* emergent *"That is to say their shape and membership emerges in the process of activity, as opposed to being created to carry out a task "* (Brown & Duguid, 1991, p 49) and most crucially (c) exists, *"... outside the organization's limited core world view"* (Brown & Duguid, 1991, p 51).

3.3.2 What does it do?

Brown and Duguid argue that most organizations believe (or wish to believe) that complex tasks can be mapped onto a simple canonical 'map' that workers can follow without the need for either understanding or insight.

> *"Through a reliance on canonical descriptions (to the extent of overlooking even their own non-canonical improvisations), managers*

> *develop a conceptual outlook that cannot comprehend the importance of non-canonical practices." (Brown & Duguid, 1991, p 42)*

They argue that the reality of the technician's work is far more complicated and is as much about maintaining social relations with their customers and peers as it is about machines; consequently,

> *"... the reps must - and do - learn to make better sense of the machines they work with than their employer either expects or allows." (Brown & Duguid, 1991, p 43)*

Thus, in addition to the maintaining social relations, Communities of Practice also serve:

> *"... to protect the organization from its own shortsightedness" (Brown & Duguid, 1991, p 43)*

3.3.3 How does it work?

Brown and Duguid acknowledge the role of LPP in fostering learning (Brown & Duguid, 1991, p 48) but highlight three overlapping categories of their own - "narration", "collaboration" and "social construction" - which they claim get to the heart of the way these communities work.

Narration reflects the complex social web within which work takes place: stories have a flexibility that makes them both adaptable and particular. Collaboration is based on the exchange and elaboration of shared narratives, both across the organization and within communities. Finally, turning to Social Construction, Brown and Duguid comment:

> *"Simultaneously and interdependently, the reps are contributing to the construction and evolution of the community that they are joining what we might call a "community of interpretation", for it is through the continual development of these communities that the shared means for interpreting complex activity get formed, transformed, and transmitted." (Brown & Duguid, 1991, p 47)*

The collaborative telling and re-telling of stories contributes both to the construction of a technicians' own identity, and reciprocally to the construction and development of the community in which they work.

3.4 The Concept of a Community of Practice in the Early Period

Although there are some obvious differences in the focus of Lave and Wenger (1991) and Brown and Duguid (1991) both agree about what sort of group Community of Practice is and why they exist. For both sets of authors, Communities of Practice are seen as being primarily concerned with learning and Communities of Practice are seen as autonomous groups

Given the context from which the idea of Communities of Practice emerged, it is perhaps not too surprising that there is such a clear focus on learning. Although the precise mechanism by which this learning takes place is not always clear, the general thrust of the argument is that knowledge is not an abstract, immutable object that can be passed from one person to another but is situated, mutable and socially constituted. The process of learning is seen as one that is ongoing; over time, meanings are contested, negotiated and re-negotiated through participation, both in the community and in the practice. The learning that takes place is based on a particular activity performed in a particular community; consequently, what is learnt in that community might only be seen as being valid within that community.

Perhaps less obvious is the degree to which both see Communities of Practice as essentially 'autonomous groups'. Both see Communities of Practice as being outside the 'formal' organization: Brown and Duguid (1991) deal with interstitial communities while Lave and Wenger (1991) focus on learning outside of the formal constraints of the classroom; but beyond that both see them as being somehow self generating and existing primarily for the benefit of their members. Lave and Wenger (1991) describe how

> *"... agent, activity, and the world mutually constitute each other" (Lave & Wenger, 1991, p 33)*

while Brown and Duguid (1991) use Daft and Weick's (1984) notion of "enactment" to describe how:

> *"... their shape and membership emerges in the process of activity, as opposed to being created to carry out a task" (Brown & Duguid, 1991, p 49).*

For both, Communities of Practice are seen as being 'wild' or 'untamed' in the sense that one might view a wild animal: they exist independently of the formalised world of organizations and are driven by their own internal needs.

4 The Middle Period (1996 – 1999)

4.2 Historical Context

The area of key concern in the earlier papers was what was seen as outmoded and inappropriate models of learning. The underlying theme for this next period in Community of Practice literature is the pre-millennium sense of optimism that the economy and perhaps society in general, was undergoing a fundamental shift. For at least 30 years, authors such as, McLuhan (1964, 1989), Ellul (1964), Toffler (1972, 1980) Bell (1974) and (Hiltz & Turoff, 1978) had been predicting radical social change driven by technological change and for some things finally seemed to have reached a tipping point in the 1990s.

For a variety of reasons, the 1990s were a period when Big Business was looking for Big Ideas. Probably the most obvious manifestation of this was the "dot-com fever" of the late 1990s when stock market speculation and hype inflated the value of small hi-tech start-up companies (known colloquially as dot-com companies), to astronomical levels. The NASDAQ Composite index, which traded heavily in such companies, increased by more than 500% between 1994 and 2000 and many executives and employees of such companies, who were partly paid in stock options, became instant millionaires.

One of the readily identifiable "Big Ideas" of the period was "Knowledge Management". Prusak (2001) states that the term was first used in early 1993 although others argue that it was first used in the Journal 'Public Administration Review' as long ago as 1975, (e.g. Goerl, 1975). Whatever the truth is, it is clear from studies of bibliographic data such as Serenko and Bontis (2004) and Ponzi and Koenig (2002) that widespread interest in knowledge management did not really begin to grow until the mid 1990s. As Hildreth, Wright and Kimble (1999) point out, much of this interest was fuelled by globalisation, downsizing and outsourcing, each of which has implications for the rate at which organizations lose knowledge and the efficiency with which they can manage existing knowledge.

It is against this background that the works of the middle period should be considered. All of the works from this period have Wenger as the sole author and cover the period between his earlier collaboration with Lave and his later collaboration with Snyder and McDermott. The principle work we will consider here is Communities of Practice: Learning, Meaning, and Identity (Wenger, 1998a).

4.3 Communities of Practice: Learning, Meaning and Identity

In the opening pages of this book Wenger makes it clear that he is keen to establish the intellectual foundations of his work (Wenger, 1998a, p 11). The source material for the book is drawn from an ethnographic study of clerks in a medical insurance claims processing office. In this book, Wenger elaborates some of the terms from his earlier work (e.g. identity and participation), abandons others (e.g. LPP) and introduces some new ideas (e.g. dualities).

4.3.1 What is a Community of Practice?

In contrast to his earlier, more 'intuitive' definitions of a Community of Practice, Wenger now provides a much more concise definition of a Community of Practice that consists of just three interrelated terms: "joint enterprise", "mutual engagement" and "shared repertoire" (Wenger, 1998a, p 72 - 73). Here Wenger is much more concerned with Communities of Practice in the context of a formal organization:

> *"Communities of Practice are ... a different cut on the organization's structure - one that emphasizes the learning that people have done together rather than the unit they report to, the project they are working on, or the people they know." (Wenger, 1998b)*

In essence, Wenger now argues that Communities of Practice arise out of a need to accomplish particular tasks although, as before he continues to view them as self-directed and self-organizing systems.

> *"Communities of Practice ... reflect the members' own understanding of what is important. Obviously, outside constraints or directives can influence this understanding, but even then, members develop practices that are their own response to these external influences. Even when a community's actions conform to an external mandate, it is the community - not the mandate- that produces the practice" (Wenger, 1998b).*

4.3.2 What does it do?

A Community of Practice is a forum where learning, meaning and identity are negotiated; it is through practice in particular that we experience the world in a meaningful way, as practice "*gives structure and meaning to what we do*" (Wenger, 1998a, p 47).

Wenger's (1998a) view of a Community of Practice shares many similarities to Brown and Duguid's (1991). He sees part of the role of a Community of Practice being to make work habitable.

> *"a significant amount of the processors' communal energy goes into making their time at work a liveable realization of their marginality within the corporation and the insurance industry" (Wenger, 1998a, p 171).*

Similarly, he argues that they can contribute to the 'host' organization, although in contrast to Brown and Duguid (1991), the contribution is phrased in "Knowledge Management" terms:

> *"Communities of Practice are important to the functioning of any organization, but they become crucial to those that recognize knowledge as a key asset ... Knowledge is created, shared, organized, revised, and passed on within and among these communities." (Wenger, 1998b)*

Finally, like Brown and Duguid's (1991) "collective of communities", Wenger (1998a, p 127) views the organization as a "constellation of communities".

4.3.3 How does it work?

Unlike his earlier collaboration with Lave (Lave & Wenger, 1991), LPP no longer features in the explanation of how Communities of Practice function, now Wenger argues that all of the activities in a Community of Practice can be described in terms of the interplay of four fundamental dualities which he describes as:

> *"... a single conceptual unit that is formed by two inseparable and mutually constitutive elements, whose inherent tensions and complementarity give the concept richness and dynamism" (Wenger, 1998a, p 66)*

The four dualities Wenger identifies are participation-reification, designed-emergent, identification-negotiability and local-global, although the participation-reification duality, with its strong connection to Knowledge Management, that has been the focus of particular interest. Wenger argues that Communities of Practice can contribute to the knowledge assets of an organization both through the knowledge they develop at their core, and through the interactions at their boundaries. It is participation that plays a crucial role in the creation of knowledge in the core while reification has a particular importance for interactions at the boundaries of the community.

4.4 The Concept of a Community of Practice in the Middle Period

In line with Wenger's stated aim of establishing an intellectual foundation for his work, some of the vagueness of the earlier descriptions has been removed and the ideas behind a Community of Practice are generally presented in a more direct and analytical way. However, in many ways Wenger (1998a) bears some striking similarities to Brown and Duguid (1991).

While informal learning in social groups is still an important feature, it is now only considered in the context of formal organizational settings. All of the examples are taken from the workplace. Like Brown and Duguid (1991), the wider organization is viewed as consisting of a collection of inter-related communities and like Brown and Duguid (1991), Wenger (1998a) appears to view Communities of Practice as acting both as support systems for employees whilst simultaneously providing a benefit to the organization that contains them. Essentially this represents a move away from viewing Communities of Practice as a way of gaining insight into social leaning towards viewing Communities of Practice as a means of problem solving and sense-making within an organization.

The nature of a Community of Practice has also changed in another way. In the earlier works, there was little or no consideration of the world outside the community. Wenger (1998a) however is more explicitly concerned with this topic, particularly through his notion of reification. Similarly, by the use of the notion of a "constellation of communities" and by stressing the value that Communities of Practice can bring to an organization, Wenger links what happens inside the Community to the wider social context within which it is embedded.

Finally, while it is still clear that Wenger sees Communities of Practice as being emergent, he suggest that Communities of Practice can be 'guided' or 'nurtured' in some way, for example.

> *"They self-organize, but they flourish when their learning fits with their organizational environment. The art is to help such communities find resources and connections without overwhelming them with organizational meddling." (Wenger, 1998b)*

However much of this comment concerns the role of internal leadership rather than external strategic interventions. This represents a shift from the previous view of "wild" Communities of Practice toward something that can be 'nurtured', but nonetheless, the view remains that Communities of Practice are essentially 'untamed'.

5 The Late Period (2000 – 2003)

5.2 Historical Context

Ponzi and Koenig (2002) in their article "Knowledge Management: Another Management Fad?" describe the way in which "fads" in the academic literature emerge quickly, are adopted with great zeal, then rapidly decline. They ascribe this behaviour to the way in which certain groups (consulting firms, 'management gurus', mass media, business schools, etc) initially proselytize on behalf of a particular technique only to drop it later when it becomes unfashionable. They describe how Quality Circles, Total Quality Management and Business Process Reengineering have all followed this pattern and how Knowledge Management looks destined to follow them. It is against this idea of fads and fashions in management literature that we should consider the literature in this final section of the paper.

The preface to Cultivating Communities of Practice (Wenger et al., 2002) provides a clear illustration of the how the author's viewed the situation before the book was written. In an echo of Davenport's (1996) description of the growth of Business Process Reengineering they write how when they first met it seemed like *"the planets ... were aligned"*. All three were active management consultants and *"interest in Communities of Practice was exploding"*, for the authors it seemed that their book was destined *"... to provide a common foundation for this spreading movement"* (Wenger et al., 2002, p x).

However, within a few years it seemed the situation had changed. McDermott was writing articles entitled "How to avoid a mid life crisis in your CoPs" (McDermott, 2004) and a new wave of articles critical of the whole CoP approach were beginning to appear. Ponzi and Koenig (2002) indicate that the only real difference between a fashion and a fad is that fashions briefly show signs of maturity before declining. It is argued that these later works can be interpreted as attempts to demonstrate the 'maturity' of the CoP concept to delay the inevitable decline that must follow the initial evangelical zeal of the recent convert.

5.3 Cultivating Communities of Practice

The main work we examine here is Cultivating Communities of Practice (Wenger et al., 2002) however we will also include a number of later works, such as (Wenger, 2000), (Wenger & Snyder, 2000), (Snyder *et al.*, 2003), (Snyder & Briggs, 2003), (McDermott, 2004) and (Wenger *et al.*, 2005), which illustrate more clearly the way in which the focus of the Communities of Practice literature has changed during this period.

5.3.1 What is a Community of Practice?

Unlike his earlier book, this is not a theoretical work but is aimed specifically at practitioners; consequently, the majority of the book is given over to tips on how to cultivate Communities of Practice rather than an analysis of them. Thus Wenger, McDermott and Snyder (2002) simply state that although Communities of Practice can take many forms

> *"... they all share a basic structure ... a unique combination of three fundamental elements" (Wenger et al., 2002, p 27)*

Which are a domain of knowledge, a notion of community and a practice. In later a work, Wenger and Snyder describe Communities of Practice as:

> *"... groups of people informally bound together by shared expertise and passion for a joint enterprise* [which can] *drive strategy, generate new lines of business, solve problems, promote the spread of best practices, develop professional skills, and help companies to recruit and retain talent" (Wenger & Snyder, 2000, pp 139 - 140)*

while, Snyder and Briggs state that:

> *"Communities of practice steward the knowledge assets of organizations and society. They operate as "social learning systems" where practitioners connect to solve problems, share ideas, set standards, build tools, and develop relationships with peers and stakeholders." (Snyder & Briggs, 2003, p 7)*

5.3.2 What does it do?

Wenger, McDermott and Snyder state that they will concentrate on *"... the ability of Communities of Practice to steward knowledge inside organizations"* (Wenger et al., 2002, p 219). There is a similarly emphasis in all of the literature from this period on the role that Communities of Practice can play in Knowledge Management, for example Snyder, Wenger and Biggs (2003) argue that Communities of Practice *"... complement formal units and help organizations weave critical connections across formal groups to leverage knowledge for performance"* (Snyder et al., 2003). However, it is also clear that there is now a far grander plan for CoPs. The preface to the book states that:

> *"We share a vision that Communities of Practice will help shape society [and] provide new points of stability and connection in an increasingly mobile, global and changing world" (Wenger et al., 2002, p xii)*

The final chapter of the book lays out that shared vision:

> *"The principles that apply to our businesses ... also apply to the challenges faced by our society. The socioeconomic requirements for sustained prosperity ... demand that we apply these principles beyond the private sector." (Wenger et al., 2002, p 224)*

In similar style, Snyder & Briggs (2003) tackle the role that Communities of Practice could play in government, reducing "red tape" by cutting across bureaucracies that are *"... designed to solve stable problems for established constituencies through centrally managed programs"* (Snyder & Briggs, 2003, p 4).

5.3.3 How does it work?

The issue of how a Community of Practice functions is not really dealt with in this book or the related literature: it is mostly taken as given that Communities of Practice can achieve what the authors claim. However, Wenger, McDermott and Snyder (2002) do offer a variation of the five stages of development identified in (Wenger, 1998a), and describe a five stage 'life cycle' for CoPs.

Although the authors state that their model should not be taken too literally, there is no mistaking the inevitable sense of progression. Each stage addresses a particular issue that is described as *“... a tension between two opposing tendencies that the community must address before it can move on to the next stage”* (Wenger et al., 2002, p 69), and at each stage the authors offer a convenient range of strategies that can be deployed to achieve this.

5.4 The Concept of a Community of Practice in the Late Period

The concept of a Community of Practice in the late period represents a profound move away from earlier notions of Communities of Practice. Vann and Bowker

(2001) describe this as the commercialisation or commodification of the concept although Cox sums up the transformation more succinctly as

> *"The reinvention of Communities of Practice as a managerialist concept" (Cox, 2005, p 534)*

This is represents a major change in the way in which the term Community of Practice is understood. Firstly, Communities of Practice have now become manageable and unambiguously of benefit to the organizations that take the effort to do so. Although most of the literature from this period warns of the difficulty of managing Communities of Practice and some warns that Communities of Practice cannot be mandated, there is near universal agreement that, given the right degree of insight, skill and leadership, Communities of Practice can be made to deliver. As Wenger and Snyder put it *"These tasks of cultivation aren't easy, but the harvest they yield makes them well worth the effort"* (Wenger & Snyder, 2000, p 140).

Secondly, Communities of Practice are now directly linked the 'management' of knowledge, although there are few direct references to the term Knowledge Management. Instead, the term most often used is "stewarding" knowledge. Exactly what is meant by "stewarding" is never defined. The implication seems to be that Communities of Practice will act as "custodians" or "guardians" of knowledge on behalf of their host organization; thus, simultaneously avoiding any notion of the communities actually owning the knowledge and avoiding the use of the now slightly passé term Knowledge Management.

Finally, there is an explicit view that Communities of Practice can be geographically distributed and can even benefit from having a technological infrastructure to support their activities (e.g. Wenger et al., 2005). This is a significant change from the earlier works where the topic was hardly mentioned. Although, like the difficulty of 'managing' communities, creating effective distributed Communities of Practice is not claimed to be easy, it is now seen as possible and even desirable for distributed communities of several hundred members to exist.

Communities of Practice have become CoPs and CoPs have become a means to an end - CoPs are now not only 'cultivated' but have also been tamed.

6 The Changing Concept of a Community of Practice

Since the term was first coined in 1991, it has undergone a number of significant changes. It is also clear that the final period of literature represents the most profound shift in the way that the concept of a Community of Practice is used.

"Communities of Practice" have undergone a transition from being a heuristic device to a theory and from a theory to an application. At first sight, this might appear to be perfectly natural, as this path is one often followed in the natural sciences - hypotheses are generated, a theory is developed and later the theory is applied. However, in this case, there not linear progression but a dislocation between the theory developed in the early work and that which is applied later.

In the early work Communities of Practice were seen as being, to borrow a metaphor from Hutchins (1996), "in the wild" in the sense that they existed outside the systematised, planned and well ordered word of the formal organization. However, in the later works the metaphors that are used are those of “cultivation” and “harvesting”: Communities of Practice have simply become a tool that can be used to produce a particular outcome; much of the early theory concerning emergence, enactment and the ambiguous nature of the relationship between community and host organization has been lost.

This is more than a semantic nicety or an indication that the concept that has reached maturity; it is a radical departure from the way in which the concept was previously used. In the work from the middle period, Wenger used the notion of reification to explain how the ideas and values of a Community of Practice could achieve independent existence; here in the later works the notion of a Community of Practice seems to have achieved an existence independent of the theory that created it.

Although these changes have been a radical, this in itself need not be a problem. The whole raison d’être of concepts is that we use them as templates to structure and make sense of the world around us, and as the world changes, so must the concepts we use. There is nothing fixed about the way in which we use concepts, as Mutch (2003) notes:

> *“... we can use familiar concepts in new ways, or take concepts from one context to another and play with them”*

However, to quote Mutch again, as academics we must also

> *“... pay careful attention to our sources, making sure that we give due care to the consequences that the use of a concept brings with it”.*

In highlighting this latter approach Mutch (2003) notes that it brings with it the risk of textual exegesis, dogmatism and the unthinking adherence to the received word. It is not my objective to engage in *“textual exegesis”*, nor to be excessively dogmatic about the way in which the term ought to be used, but simply to highlight some of the different ways in which it can be used and draw attention to the potential this has for misconceptions and confusion.

The literature on Communities of Practice is used in pedagogy and in educational theory, e.g. (Barab *et al.*, 2004; Janson *et al.*, 2004; Schwier *et al.*, 2004); what has come to be called “CoP Theory” offers useful insights into both Knowledge Management and Distributed Working, e.g. (Janson et al., 2004; Papargyris & Poulymenakou, 2003; Schwen & Hara, 2003) and what might be called the “community” is used in areas such as Computer Supported Co-operative Work e.g. (Sharratt & Usoro, 2003; Trier, 2005; Zacklad, 2003) and Distributed Team Working e.g. (Kindberg *et al.*, 1999; Pemberton-Billing *et al.*, 2003).

So, should we simply reject large slices of this work because it is based on a ‘wrong’ interpretation of the theory? The answer to this is almost certainly 'No'. However, lack of attention to the context in which the term was originally used can create contradictions without meaning to by, for example, conflating a theoretical account of a Community of Practice based on LPP with another based on the notion of dualities. We began this paper with a suggestion that the marketing tag-line "Never Knowingly Undersold" and the term "Communities of Practice" had certain similarities and that sometimes, the term Community of Practice did not mean what it might at first be thought to mean. Finally, at the end of the paper we turn again to our original 'sales' metaphor and urge the reader to follow the advice 'caveat emptor' (or more accurately caveat lector) when dealing with this term in the literature.

References

Barab, S. A., MaKinster, J. G., & Scheckler, R. (2004). Designing System Dualities: Building Online Community. In S. A. Barab, R. Kling & J. Gray (Eds.), *Designing for Virtual Communities in the Service of Learning* (pp. 53-90). Cambridge, MA: Cambridge University Press.

Bell, D. (1974). *The Coming of the Post Industrial Society: A Venture in Social Forecasting.*: Heinemann.

Brown, J. S., & Duguid, P. (1991). Organizational Learning and Communities of Practice: Toward a Unified View of Working, Learning, and Innovation. *Organization Science, 2*(1), 40-57.

Cain, C. (Unpublished). *Becoming a Non-Drinking Alcoholic: A Case Study in Identity Acquisition.* University of North Carolina, Chapel Hill, North Carolina.

Cox, A. (2005). What Are Communities of Practice? A Comparative Review of Four Seminal Works. *Journal of Information Science, 31*(6), 527 – 540.

Daft, R. L., & Weick, K. E. (1984). Toward a Model of Organizations as Interpretation Systems. *Academy of Management Review, 9*(2), 284 - 295.

Davenport, T. H. (1996, January). The Fad That Forgot People. *Fast Company, 1,* 70-74.

Ellul, J. (1964). *The Technological Society*: Random House.

Fox, S. (2000). Communities of Practice, Foucault and Actor-Network Theory. *Journal of Management Studies, 37*(6), 853-867.

Gherardi, S., Nicolini, D., & Odella, F. (1998). Towards a Social Understanding of How People Learn in Organizations. *Management Learning, 29*(3), 273 – 297.

Goerl, G. F. (1975). Cybernetics, Professionalisations and Knowledge Management: An Excuse for Assumptive Theory. *Public Administration Review, 35*(5), 581.

Henriksson, K. (2000). *When Communities of Practice Came to Town: On Culture and Contradiction in Emerging Theories of Organizational Learning* (No. 2000/3): Department of Business Administration, School of Economics and Management, Lund University, Sweden.

Hildreth, P., Wright, P., & Kimble, C. (1999). Knowledge Management: Are We Missing Something? *4th UKAIS Conference: Information Systems - The Next Generation*. University of York: McGraw Hill.

Hiltz, S. R., & Turoff, M. (1978). *The Network Nation: Humman Communication Vai Computers*. Cambridge, MA: MIT Press.

Hutchins, E. (1991). Organizing Work by Adaptation. *Organization Science, 2*(1), 14-39.

Hutchins, E. (1996). *Cognition in the Wild*. Cambridge MA: MIT press.

Janson, A., Howard, L., & Schoenberger-Orgad, M. (2004). The Odyssey of Ph.D. Students Becoming a Community of Practice. *Business Communication Quarterly, 67*(2), 168-181.

Jordan, B. (1989). Cosmopolitical Obstetrics: Some Insights from the Training of Traditional Midwives. *Social Science and Medicine, 28*(9), 925-944.

Kimble, C., & Hildreth, P. (2004). Communities of Practice: Going One Step Too Far? *Proceedings 9e colloque de l'AIM*. Evry, France.

Kindberg, T., Bryan-Kinns, N., & Makwana, R. (1999). Supporting the Shared Care of Diabetic Patients, *ACM SIGGROUP Conference on supporting Groupwork* (pp. 91 - 100). Arizona, USA: ACM Press.

Lave, J. (1988). *Cognition in Practice: Mind, Mathematics, and Culture in Everyday Life*. New York: Cambridge University Press.
Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.
Liedtka, J. (1999). Linking Competitive Advantage with Communities of Practice. *Journal of Management Inquiry, 8*(1), 5 - 16.
Marsall, H. (1972). Structural Constraints on Learning. In B. Geer (Ed.), *Learning to Work*. Beverly Hills: Sage Publications.
McDermott, R. (2004, May - June 2004). How to Avoid a Mid Life Crisis in Your Cops. *KM Review, 7,* 10 - 13.
McLuhan, M. (1964). *Understanding Media: The Extensions of Man*. New York: McGraw-Hill.
McLuhan, M., & Powers, B. R. (1989). *The Global Village: Transformations in World Life and Media in the 21st Century*. New York: Oxford University Press.
Mutch, A. (2003). Communities of Practice and Habitus: A Critique. *Organization Studies, 24*(3), 383-401.
Orr, J. (1987). Narratives at Work: Story Telling as Cooperative Diagnostic Activity. *Field Service Manager*, 47-60.
Orr, J. (1990a). Sharing Knowledge, Celebrating Identity: War Stories and Community Memory in a Service Culture. In D. S. Middleton & D. Edwards (Eds.), *Collective Remembering: Memory in Society*. Beverley Hills: Sage Publications.
Orr, J. (1990b). *Talking About Machines: An Ethnography of a Modern Job.* Cornell University.
Papargyris, A., & Poulymenakou, A. (2003). Evolving Knowledge: An Exploration of Affinities between Knowledge Management and Communities of Practice, *Fourth European Conference on Knowledge Management*. Athens.
Pemberton-Billing, J., Cooper, R., Wootton, A. B., & North, A. N. W. (2003). Distributed Design Teams as Communities of Practice, *5th European Academy of Design Conference*. Barcelona, Spain.
Ponzi, L. J., & Koenig, M. (2002). Knowledge Management: Another Management Fad? *Information Research, 8*(1).
Prusak, L. (2001). Where Did Knowledge Management Come From? *IBM Systems Journal, 40*(1), 1002 - 1007.
Roberts, J. (2006). Limits to Communities of Practice. *Journal of Management Studies, 43*(3), 623 - 639.
Schwen, T. M., & Hara, N. (2003). Community of Practice: A Metaphor for Online Design? *The Information Society, 19*, 257-270.
Schwier, R. A., Campbell, K., & Kenny, R. (2004). Instructional Designers' Observations About Identity, Communities of Practice and Change Agency. *Australasian Journal of Educational Technology, 20*(1), 69 - 100.
Serenko, A., & Bontis, N. (2004). Meta-Review of Knowledge Management and Intellectual Capital Literature: Citation Impact and Research Productivity Rankings. *Knowledge and Process Management, 11*(3), 185 - 198.
Sharratt, M., & Usoro, A. (2003). Understanding Knowledge-Sharing in Online Communities of Practice. *Electronic Journal of Knowledge Management, 1*(2).
Snyder, W. M., & Briggs, X. d. S. (2003). *Communities of Practice: A New Tool for Government Managers*. Arlington: The IBM Center for The Business of Government.
Snyder, W. M., Wenger, E., & Briggs, X. d. S. (2003). Communities of Practice in Government: Leveraging Knowledge for Performance. *The Public Manager, 32*(4), 17 - 21.
Toffler, A. (1972). *The Futurists*: Random House.
Toffler, A. (1980). *The Third Wave*: Pan.

Trier, M. (2005). It-Supported Visualization of Knowledge Community Structures, *38th International Conference on System Sciences*. Hawaii.
Tsoukas, H., & Chia, R. (2002). On Organizational Becoming: Rethinking Organizational Change. *Organization Science, 13*(5), 567-582.
Vann, K., & Bowker, G. (2001). Instrumentalizing the Truth of Practice. *Social Epistemology, 15*(3), 247-262.
Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge: Cambridge University Press.
Wenger, E. (1998a). *Communities of Practice: Learning, Meaning, and Identity*. New York: Cambridge University Press.
Wenger, E. (1998b). Communities of Practice: Learning as a Social System. *Systems Thinker, 9*(5).
Wenger, E. (2000). Communities of Practice and Social Learning Systems. *Organization, 7*(2), 225 - 246.
Wenger, E., McDermott, R., & Snyder, W. (2002). *Cultivating Communities of Practice*. Boston, Mass: Harvard Business School Press.
Wenger, E., & Snyder, W. (2000). Communities of Practice: The Organizational Frontier. *Harvard Business Review, 78*(1), 139-145.
Wenger, E., White, N., Smith, J. D., & Rowe, K. (2005). Outiller Sa Communauté De Pratique (L. Langelier, Trans.). In L. Langelier (Ed.), *Guide De Mise En Place Et D'animation De Communautés De Pratique Intentionnelles* (pp. 47 - 66). Québec: CEFRIO.
Zacklad, M. (2003). Communities of Action: A Cognitive and Social Approach to the Design of Cscw Systems, *ACM SIGGROUP Conference on supporting Groupwork* (pp. 190 - 197). Florida, USA: ACM Press.

A Document Reuse Tool for Communities of Practice

Aida Boukottaya[1], Bernadette Charlier[1], Christine Vanoirbeek[2]

[1] Didactique Universitaire, University of Fribourg, Switzerland
[2] MEDIA research group, EPFL, Switzerland

{aida.boukottaya@epfl.ch, bernadette.charlier@unifr.ch, Christine.vanoirbeek@epfl.ch}

Abstract. With the rise of the Internet, virtual communities of practice are gaining importance as a mean of sharing and exchanging information. In such environments, information reuse is of major concern. In this paper, we outline the importance of enriching documents with structural and semantic information in order to facilitate their reuse. We propose a framework for document reuse based on an explicit representation of the logical structure as well as links to domain ontologies. Such explicit representation facilitates the understanding of the original documents and helps considerably in automating the reuse process. Document reuse automation is based on matching techniques that consider several criteria including semantic and logical similarities.

Keywords: Communities of practice**,** Document reuse, Self-describing documents, logical structure, semantics, Schema Matching.

1 Introduction

Communities of Practice (CoPs) are becoming more important as a mean of sharing information within and between organizations. A Community of Practice emerges from a common desire to work together; it can be defined as a network that identifies issues, shares approaches, methodologies, documents, experiences, and makes the results available to others [21]. With the rise of the Internet, virtual CoPs are gaining importance as a new model for virtual collaboration and learning. In virtual CoPs, the common space is provided by a suite of collaborative and communicative environments, ranging from simple mailers, forum, discussion lists, and audiovisual conferences to more advanced collaborative work environments that enable information and knowledge exchange and sharing.

In this context, the process of capturing and sharing a community's collective expertise is of major concern. In [6], author describes such process as a cyclic one composed by four basic steps: *find/create*, *organize*, *share*, and *use/reuse*. The "find/create" step concerns the creation of knowledge/information gained through research and/or industry experiences, publications, etc. The goal of the two next steps in the cycle, "organize" and "share", is to first filter and organise expertise (e.g.,

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 235-244, 2006.

creating different categories of knowledge related to specific purposes, linking such knowledge with available resources). Second, the expertise is shared for wide availability making use of the Internet and other techniques of information sharing such as conferences and collaborative work environments. The final phase of the cycle, "use/reuse," enables shared expertise to be used and reused in order to minimize information overload and maximize content usability which decreases considerably time, effort and cost. In this phase expertise is applied and reapplied to solve real-world problems. The results are then captured as part of learned lessons and new expertise is created which enables the cycle to begin again.

In this paper, we essentially focus on document reuse within CoPs. As in [15], we identified at least two kinds of document reuse: (1) by *replication*: from a single document, several presentations are produced; and (2) by *extraction*: portions of a document are taken from one document and moved to another (generally performed by means of the now popular "Cut&Paste" command).

Since documents reflect in general authors' vision and "understanding" of the Universe, document reuse process requires access to the intentions and interpretations underlying the original document. The capability of reuse suggests then the understanding of authors' representation of the Universe in term of concepts and semantic relationships among them. Such representations only exist "in the mind" of authors and usually are not apparent in the document itself. Moreover, when reuse requires crossing system and application boundaries, several problems arise due to the heterogeneities of such systems. One response to these problems is to structure documents by using Markup Languages such as XML [22]. The advent of structured documents on one hand leveraged a promising consensus on the encoding syntax for machine processable information and such resolves several issues, such as parsing and character encoding recognition. On the other hand, mark-up identifies meaningful parts of a document, and thus makes authors' intentions more explicit.

In this paper, we essentially address the second kind of reuse (extraction). We consider documents as an effective mean for storing explicit knowledge, and study the additional benefits of using structure and explicit representation of metadata and semantic information. This work is carried out in the framework of PALETTE project[1] aiming to provide communities of practice with a set of services concerning data production, exchange and reuse; reification of explicit and tacit knowledge about practices and advanced collaboration.

The outline of the rest of the paper is the following: Section 2 describes a motivating scenario based on the observation of LEARN-NETT community. Section 3 gives an overview of the benefits of structuring documents. Section 4 proposes a multi-layered

[1] The work presented in this paper is carried out in the framework of a collaboration between the EPFL Center for Global Computing and the University of Fribourg and funded within the FP 6 IP project PALETTE (FP6-028038): http://palette.ercim.org/

model for documents that is built using annotation facilities. Section 5 gives the conceptual framework for the proposed reuse tool.

2 Motivating Scenario

To elucidate the need for document reuse, we present a simple use case using observations we made to LEARN-NETT[2] community. LEARN-NETT is a virtual campus aiming at conceiving and trying methodologies for training teachers (also called students) based on a learning-oriented approach [8]. Students produce either group documents (reports, etc) or individual documents (dissertations, individual reflections). Tutors in LEARN-NETT community have a central role in the organization and the regulation of the students' groups. More exactly, they help students to express their needs, animate the work of the group, provide resources, regulate exchanges, and give quick feedback. For this, tutors rely on a pedagogical guide and a set of references and resources. Tutors are supported in their activities by a project coordinator. The coordinator participates in the elaboration of pedagogical guides and tools for tutors. He also produces a weekly report summarizing the project progress.

Produced documents reflect actors' experience and expertise. In this context, reusing such expertise is of major concern. For instance, a student group aiming to solve a real-world problem could reuse the expertise of previous groups. Instead of producing reflections, reports from scratch, we could maintain a material pool consisting of definitions, theorems and their proofs, exercises, book chapters, dissertations, reflections and examinations. When a student is producing a new document, he (or she) could reuse this existing material which reduces considerably time and effort. Students' researches (e.g., dissertations and scientific papers) could also be reused for designing tools and pedagogical guides for tutors. The major problem to address while reusing such documents is their heterogeneities. Heterogeneity arises in general from the fact that each author creates its own documents according to specific requirements and goals.

Based on these observations, we essentially distinguish two categories of heterogeneities: *organisational (structural) heterogeneity* and *semantic heterogeneity*. Organisational heterogeneities [12], [13] and semantic heterogeneities [20], [16], [10] have been well documented in the literature with a consensus of what each encompasses. In most cases, the distinction between the two can be characterized by differences in organisation (*how are the data in the document is organised?*) and interpretation (*what do the data mean?*). This distinction however is not always clear, since the organization of data often conveys semantic information. Semantic heterogeneity refers to domain level incompatibility. Examples include the attribution of different names for semantically equivalent concepts and the attribution of the same name for semantically different concepts. Organisational heterogeneity arises

[2] http://tecfa.unige.ch/proj/learnett/

when semantically similar entities are modelled using different descriptions. As an example, we can consider the organization of pedagogical units (using an ascending or a descending approach). An ascending approach presents to students concrete cases and tends to generalize them in order to extract a theory. This theorization supposes a good understanding of the real facts. In such a strategy, bricks representing examples of a concept are presented before bricks describing the theory of the same concept. Contrary to the ascending strategy, the descending one consists in presenting at first the theory, and then when this one is supposed to be understood, examples are presented in order to assimilate better the theory. The goals of the two strategies are the same, but the organisation of pedagogical units differs. Reusing documents suggests the capability to resolve such heterogeneities.

3 Structured document reuse

3.1 Why structuring documents?

Structured document refers to a document conforming to a pre-defined grammar or schema that describes the permissible document components and their logical organization [1]. XML is the mark-up language for presenting information as structured documents. The document structure (described in a DTD or more recently using an XML Schema [23]) can be utilized to facilitate several issues such as document authoring, document publishing, document querying and browsing, etc. Based on structure, it is easy to achieve replication. Different layout formats such as HTML (for Web sites), PDF (Printed documentation), WML (for wireless devices) could be generated automatically. However, dealing with structured documents has also some drawbacks. Reusing structured documents (by extraction) raises a number of fundamental problems to transform or to adapt their intrinsic structure. Structure transformation process is known to be extremely laborious and error-prone. It is typically attained by writing manually translators (often encoded on a case-by-case basis using specific transformation languages such as XSLT [24]). This is generally achieved trough three main steps: understanding the source and target schemas, discovering schemas' mapping by means of inter-schema correspondences, and translating mapping result into an appropriate sequence of operations in a given transformation language [14].

3.2 Schema matching

A serious obstacle for translating directly between two structured documents is that a mapping between both schemas needs to be carefully specified by a human expert. Manual mapping is known to be a time consuming and error-prone process. One response to this problem is *schema matching*. Schema matching is the task of semi-automatically finding correspondences between two heterogeneous schemas. Several applications relying on schema matching have arisen and have been widely studied by the database, AI communities and more recently document engineering community [18], [7], [17].

Mapping two schemas is a very challenging problem. Solutions to this problem have produced two types of matchers: *structural matchers* and *semantic matchers*. Structural matchers typically map two schemas according to their syntactic clues. Examples of such clues include element names, types, and common logical structure. See our previous work [4] for more examples of syntactic matchers. However, such clues are often unreliable and incomplete. For example the same labels may be used for schema elements having totally different meanings. In such conditions, the main challenge is not to only determine existing relations between schema elements, but also making sure that the matching process does not discover incorrect mappings. Moreover using only structural matching, semantic mismatches are largely undressed. In contrast, semantic matchers rely on explicit knowledge generally stored within a domain ontology[3] in order to improve mapping accuracy. Although these approaches use semantics, its use is limited to taxonomic knowledge to determine, for example, that the term used in one schema generalizes or specializes a term in the other schema. As a result, structural mismatches are not addressed although the structure of a document often conveys semantic information and traduces the designer point of view. We believe that both the logical structure of the document and additional semantic information relating to a domain of interest, are important for both identifying reusable document fragments and adapt them according to user needs.

4 Re-thinking document structure

In open and evolving environments, such as the ones used by communities of practice, the number of shared and exchanged documents is increasingly growing. As noticed in the motivating scenario (section 2), exchanged documents are of various formats. Examples include totally unstructured (documents containing raw text expressed in natural language), semi-structured[4], text documents (containing structural information such as chapter, section, sub-sections, etc), and highly structured documents based on predefined schema. In this context, one of the huge challenges we face that is the automation of such documents' content reuse. This difficulty is due to the lack of explicit structure and knowledge.

To address this problem, we propose a "*self-explaining*" document model. A document is considered to be self-explaining if it contains an explicit representation of its logical structure and semantics. As in [9], we conceive this model as a multi-layered model. The layout layer (or physical layer) reflects document format and publishing characteristics. It answers the question: "*how has to appear the document on a given publishing support?*" It is either embedded within the document in terms of typographic characteristics (Courier, Times, red, etc), or expressed outside the

[3] An ontology is a shared conceptualization of knowledge in a particular domain.
[4] Semi-structured documents are documents where the structure is often irregular, partial, unknown, or implicit.

document by means of style sheets (e.g., CSS Style sheets for Web documents). The logical layer represents an organization in term of structure (Chapter, paragraph, title, etc). It is expressed generally in terms of logical elements and can be either implicit in the document or explicitly expressed using schema languages. The meta-information layer includes two types of information: (1) meta-data describing the intrinsic properties of a document (e.g., title, authors, etc) and are generally expressed in languages such as RDF [19]; (2) domain vocabulary and taxonomies (expressed using ontologies and/or thesauri) relating document content to a specific domain of interest.

The first objective of our work is to make structured, semi-structured and un-structured documents self-explaining. For structured documents, the problem is quite easy since the layout structure and the logical structure are already separated. The problem is more complicated for semi-structured and unstructured documents. One solution to this problem is to offer annotation facilities. Annotation refers to new information such as comments, semantics and new structures placed over existing documents. The goal is to progressively *facilitate* and *motivate* authoring of structurally and semantically tagged document content.

4.1 Manual annotation Vs automated structure/semantics extraction

With the advent of structured documents, several researches and industrial efforts have been dedicated to the analysis of raw or semi-structured documents in order to structure or re-structure them. In [11], authors proposed the MarkItUp system designed to recognize the structure of untagged electronic documents; their approach is based on learning by example to gradually build recognition grammars. Authors in [2] used a constraint propagation method to extract logical structure of library references. Work described in [3] proposed an approach based on the use of a transformation language to interactively restructure HTML documents.

Research in information extraction and automatic metadata extraction generally rely on the existing of many documents (sharing the same format) with similar structure and semantics, which is very difficult and inapplicable to communities of practice where a variety of documents are produced with very differing format, structure and semantics. In this context, we advocate the use of manual annotations. The main difficulty is enabling and motivating non-technical users to structure and semantically enrich their documents.

4.2 Requirements for annotation tool

One of the fundamental problems we face when designing an annotation tool for a communities of practice, is to incite their members to take the effort to produce structured documents and then semantically link document elements to available

domain ontologies[5]. To answer this problem, we fix a set of requirements for the annotation tool we aim to develop:
(1) Ease of use: the proposed annotation tool should be easy to use; this could be achieved by providing authors with a convenient graphical interface that abstracts languages syntax (XML Schema, RDF, Ontology description languages). Moreover, authors should be provided by a set of predefined schemas (deduced from the analysis of CoPs activities) as well as domain ontologies in order to assist him/her to annotate document content easily. However, authors should also have the freedom to modify and/or add specific elements to predefined schemas in order to answer their own need.

(2) Annotation result representation and evolution: Annotation result should be presented in a graphical manner in order to help the user in the validation of the produced result. Moreover, in a CoP evolving environment, documents can easily evolve; the annotation result should be then adapted without redoing the whole annotation process. One solution is to structure annotations. Structuring annotation result greatly increases its reusability, especially when documents evolve.

(3) Motivating annotations: authors will be motivated to annotate their document content only if they experience the added value taken from this exercise. The idea is to provide CoP's members with a set of services that consume structured and semantically enriched documents and produce useful results. Document reuse tool is one of these services. In the context of PALETTE project, several services based on structured documents will be provided (information discovery based on annotations, publishing services, etc).

5 Document reuse tool: Conceptual Framework

The proposed information reuse tool consists of a set of Web services. Web services are defined as loosely coupled, reusable software components that refer to programmatic interfaces used in the Word Wide Web for application-to-application communication. A main characteristic of Web services is that they are self-describing, which means that they contain all necessary information advertising their functionalities. Web services are particularly interesting for virtual communities, as they allow non-technical community members to combine them in new value-adding services. Based on our previous work on structured document reuse [4] [5], we propose a conceptual framework (Figure 1) that encompasses the whole document reuse process. The framework consists of four basic set of services:

Document restructuring services: include (1) annotation service which has to manage links between original documents, predefined schemas and ontologies; (2) the structuring of annotation result. Document restructuring services use ontologies provided by domain knowledge management services. They also interact with evolution services to manage annotations' changes; and with validation services to

[5] A working team within the PALETTE project is focusing on developing evolving ontologies for CoPs

validate annotation results. To do all these tasks, document restructuring services rely on set of user interfaces. These services are currently under development in the context of PALETTE project. A set of tests and an evaluation process are planned with the help of several CoPs.

Matching Services: In order to reuse structured documents, we need to establish a set of similarities between the reused fragments and the document where fragments will be reused. To do this, we adopt a multi-criteria matching process. Each criterion is represented by a Web service. These services are extensible. As new criterion become available to resolve the schema matching problem, a new Web service is created. Examples of developed services include: (1) *Semantic similarity service*: measures the similarities between entities based on the meaning inferred from their names and their links to domain ontologies; (2) *Constraint similarity service*: relates schemas elements based on their respective constraints (specified in the logical layer). Such constraints include the use of Datatypes and integrity constraints; (3) *Structural similarity service*: relates schemas entities based on the similarity of the structural context in which they appear (defined by their ancestors and descendents in the logical model). The idea behind our proposed solution is to represent each element's context as a path and to then rely on a path resemblance measure to compare such contexts. To achieve this, we relax the strong matching notion frequently used in solving query answering problem. To compute path resemblance measure, we further use algorithms from dynamic programming. These services are finalized and details about related theory and algorithms can be found in [4], [5].

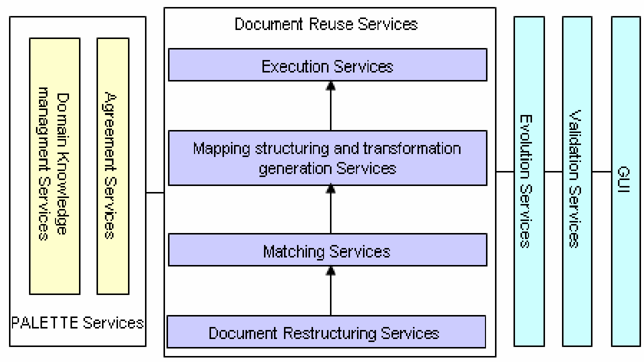

Fig. 2. Conceptual Framework for Document Reuse tool

Mapping structuring and transformation generation services: The main goal of these services is to combine all the above similarity measures and produce a mapping result that clearly defines source and target mapped entities, required transformation operations, and conditions under which the mapping can be executed. These services rely on validation services using graphical representation of the mapping result enabling the user to both valid mapping result and to add further constraints in a transparent manner.

Execution Services: These services generate automatically the appropriate transformation scripts based on the above mapping structure.

Additional services run along the entire reuse process, interacting with the former four modules. Domain knowledge management services are services that define lexical and domain-specific ontologies for CoPs. Agreement services are responsible for establishing a consensus on predefined schemas and/or ontologies. These two services are currently under development by other partners in the PALETTE project. Evolution services are responsible in keeping both annotation results and mappings in synchrony with documents changes.

6 Summary

Communities of practice are social networks of relationships that provide information, knowledge, and a space where people interact for mutual benefit. This paper studies document content reuse problem within CoPs. Faced with the diversity of documents formats, content and goals, a critical step in document reuse is to make such documents self-explaining. The main idea is that by enriching original documents with an explicit logical structure as well as linking content to available ontologies, we can assist authors in the reuse process. This is done by proposing a set of services able to determine similarities between original documents and reused fragments. We proposed a conceptual framework describing such services and their interactions. Currently, we are instantiating the framework in the context of several Cops participating to PALETTE project. In the future, the main task will be dedicated to the evaluation and enhancement of the proposed framework based on CoPs feedback.

References

1. Abiteboul, S., Buneman, P., Suciu, D.: Data on the Web: From Relations to Semistructured Data and XML. Morgan Kaufmann Publishers, 2000.
2. Belaïd, A., Chenevoy, Y.: Constraint Propagation vs Syntactical Analysis for the Logical Structure Recognition of Library References. Lecture Notes in Computer Science 1339, BSDIA'97, Springer, pages 153-164, Curitiba, Brazil, November 2-5, 1997.
3. Bonhomme, S., Roisin, C.: Interactively Restructuring HTML Documents. Computer Network and ISDN Systems, vol. 28, num. 7-11, pages 1075-1084, May 1996.
4. Boukottaya, A.: Schema matching for structured document transformations, PHD thesis, October 2004.
5. Boukottaya, A., Vanoirbeek, C.: Schema matching for transforming structured documents. ACM Symposium on Document Engineering 2005: 101-110
6. Burk, M., Knowledge Management: Everyone Benefits by Sharing Information, http://www.tfhrc.gov/pubrds/novdec99/km.htm, 1999
7. Cali, A., Calvanese, D., Giacomo, G., Lenzerini, M.: On the expressive power of data integration systems. In Proceedings of 21st International Conference on Conceptual Modeling (ER 2002), pages 338-350, Tampere, Finland, 2002.
8. Charlier, B., DAELE, A., Docq, F., Hecquet, G., Lebrun, M., Denis, B., Peeters, R., De Lievre, B., Deschryver, N., Lusalusa, S., Peraya, D. : Learn-Nett: une expérience

d'apprentissage collaboratif à distance, Actes de la 1e biennale des chercheurs en sciences de l'éducation, Bruxelles, mai 2000.
9. Christophides, V.: Electronic Document Management Systems”. Available at http://www.ics.forth.gr/~christop/ , 1998.
10. Garcia-Solaco, M., Saltor, F., Castellanos, M.: Semantic heterogeneity in multidatabase systems. In Bukhres, O.A and Elmagarmid, A.K., editors, Object Oriented Multidatabase Systems: A Solution for Advanced Applications, chapter 5, pages 129-202. Prentice-Hall, 1996.
11. Fankhauser, P., Xu, Y.: Markitup! an incremental approach to document structure recognition. Electronic Publishing, December 1993.
12. Kim, C., Seo, J.: Classifying schematic and data heterogeneity in multidatabase systems, IEEE Computer, 24 (12): 12-18, 1991.
13. Krishnamurthy, R., Litwin, W., Kent, W.: Language features for interoperability of databases with schematic discrepancies. In Proceedings of the ACM SIGMOD Conference, pages 40-49, 1991.
14. Kuikka, E.: Transformation of Structured Documents. Processing of Structured Documents Using a Syntax-directed Approach. PH.D. thesis, Computer Science and Applied Mathematics, University of Kuopio, 1996.
15. Levy, D. M., Document reuse and document systems. Electronic publishing, vol. 6(4), pages 339-348, December, 1993.
16. Naiman, C.F., Ouskel, A.M.: A classification of semantic conflicts in heterogeneous database systems. Journal of Organizational Computing, 5(2): 167-193, 1995.
17. Popa, L., Velegrakis, Y., Miller, R. J., Hernandez, M. A., Fagin, R.: Translating Web Data. In Proceedings VLDB’ 02, pages 598-609, 2002.
18. Rahm, E., Bernstein, P.A.: On matching schema automatically. Microsoft Research Publications, 2001. Available at http://www.research.microsoft.com/pubs.
19. RDF Vocabulary Description Language 1.0 (RDF Schema), W3C Recommendation, 2004. Available at http://www.w3.org/TR/2004/REC-rdf-schema-20040210/
20. Sheth, A., Kashyap, V.: So far (schematically) yet so near (semantically). In Hsiao, D, K ., Neuhold, E.J., and Sacks-Davis, R., editors. In Proceedings of the IFIP WG36. Database Semantics Conference on Interoperable Database Systems (DS-5), pages 283-312,. Lorne, Victoria, Australis, North Holland, 1992.
21. WENGER, E.: Communities of Practice: Learning, Meaning and Identity, Cambridge University Press, 1998.
22. XML Extensible Markup Language, W3C Recommendation, 1998. Available at http://www.w3.org/TR/REC-XML
23. XML Schema Part 0: Primer, W3C Recommendation, 2001. Available at http://www.w3.org/TR/2001/REC-xmlschema-0-20010502/
24. XSL Transformations (XSLT) 1.0, W3C Recommendation, 1999. Available at http://www.w3.org/TR/1999/REC-xslt-19991116

From the analysis of community activity to the appropriation of new tools. A methodological approach for the development of information technology solutions

Bernadette Charlier[1], France Henri[2], Amaury Daele[1], Manfred Kuenzel[1], and Lysanne Lessard[2]

[1] University of Fribourg, Didactique Universitaire, Boulevard de Pérolles 90, 1700 Fribourg, Switzerland
{bernadette.charlier, manfred.kunzel, amaury.daele}@unifr.ch
[2] Teluq-UQAM, LICEF Research Centre, 100, Sherbrooke St. West, Montréal (Qc) Canada H2X 3P2
henri.france@teluq.uqam.ca, lysanne.lessard@licef.teluq.uqam.ca

Abstract. More and more CoPs have chosen virtual environments and services to support their activities. However, recent research has underlined several problems: the lack of adequate scaffolding in terms of technical support and appropriate use of technology for communication and collaboration, the lack of tools and virtual environments to support real-life problem-solving and the reification of knowledge, the inadequacy of tools used by the communities in supporting individual and organizational learning processes as well as knowledge and identity building of CoPs. CoPs need new tools and services that are acceptable to them and capable of adapting to their existing virtual environment and evolving needs. Acceptability and adaptability of tools and services could be achieved through an iterative and participative process involving developers and CoPs' members in the co-development of scenarios of use. These scenarios can be considered as "boundary objects" facilitating the negotiation and collaboration between developers and CoPs' members. This process is experimented in the PALETTE project. In this contribution, we describe the characteristics of such scenarios of use and suggest a methodological approach to progressively design and represent these scenarios. In conclusion, we discuss questions and issues raised by the implementation of such an approach.

Keywords: community of practice, R&D methodology, participatory design

1 Introduction

For more than ten years, collaborative and networking processes have been recognised as an effective process for knowledge building and learning by professionals [7]. Wenger [12] has concretely described and analyzed the process by which adults enter in new communities of practice, learn and build their own identity. Wenger's social theory of

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 245-257, 2006.

learning focuses on learning as social participation, as "a process of being active participants in the practices of social communities and constructing identities in relation to these communities" ([12] p. 4). Social participation, community building, development of identity, learning and knowing are deeply interconnected and are articulated around negotiation of meaning. For Wenger, negotiation of meaning is at the root of any individual and collective learning. Its goal is to ascribe meaning to our life experience. Wenger insists on the two interrelated processes of *participation* and *reification*, and on their duality which is fundamental to negotiation of meaning and to learning. On the one hand, participation describes "the social experience of living in the world in terms of membership in social communities and active involvement in social enterprises" ([12] p. 55). Participation thus means being an active participant in a social community and developing both the individual and the community identities. On the other hand, the reification process is one "of giving form to our experience by producing objects that congeal this experience into "thingness"" ([12] p. 58). Both participation and reification are supposed to lead to learning since they contribute to the development of identity. Wenger also stresses that three dimensions must be present for practice to be the source of community coherence: dense relationships of *mutual engagement* organized around what its participants have to do; negotiation of a *joint enterprise* defined by the participants in the very process of pursuing it; a *shared repertoire* that combines both reificative and participative aspects, reflecting a history of mutual engagement and being a source for the negotiation of meaning. Of course, in day to day practices, we may find that these processes are lived differently according to the CoPs, their domain of interests and their history [3] [4].

It has also been recognized that web-based technologies could support CoPs. More and more CoPs have chosen virtual environment and services to support their activities either totally or partially. However, recent research has underlined the lack of adequate scaffolding in terms of technical support and appropriate use of technology for communication and collaboration (including web-based platforms, wireless communications, mobile devices and extensive use of multimedia contents), the lack of tools and virtual community environments supporting real-life problem-solving, the lack of support to reify knowledge and make it accessible to community members and beyond, and finally the inadequacy of the tools (forum, discussion lists, web-based training environments) used by these communities in supporting the individual and organizational learning processes as well as knowledge and identity building of CoPs. CoPs encounter the need for new tools and services to support their specific activities. If these new tools must be usable and efficient, they also have to be acceptable by each CoP and capable of adapting to its existing virtual environment and evolving needs.

The acceptability of a system is a combination of social and practical acceptability. Social acceptability refers to "whether the product will be used in the real world". Practical acceptability includes usability, but also reliability, compatibility, utility [9]. Social acceptability is namely related to the degree of the activity transformation induced by the uses of the new tools and services. This activity transformation may be encountered at different levels: aims, actions and operations. In other words, the computer artefacts interact with and change people's work and mind. In return people adapt the artefact to fit their work or transform the artefact and develop their schemata and competence to fit their work [10]. To support this acceptability and the adaptation of the services and tools, an iterative and participative process of co-development by developers and CoPs of scenarios of use is proposed. These scenarios can be considered to be “boundary objects”[1] facilitating the negotiation and collaboration between developers and CoPs. This process is experimented in the PALETTE project[2]. In this contribution, we describe the characteristics of such scenarios of use and suggest a methodological approach to progressively design and represent these scenarios. In conclusion, we discuss the questions and issues raised by the implementation of such an approach.

2 Characteristics of the scenarios of use

In regard to the purpose of the PALETTE project, which is both to improve and facilitate the functioning of the CoPs and to develop online services, the scenarios of use should have some specific characteristics:

- They should speak both to the CoPs and to the partners of the PALETTE project in charge of the development of the services. Both parties’ information needs must be met.
- They should depict the aims of the CoPs’ activities as well as the chain of actions and operations which constitute these activities.
- They should integrate the use of one or more instruments, possibly as part of a system of instruments.
- Following the participatory design approach, the scenarios should be enhanced and detailed all along the development process up to the description of the operations.

According to the classification of scenarios proposed by Rolland et al. [11], a scenario can be described in terms of form, contents, purpose and lifecycle. The figure 1 summarizes the choices made within the PALETTE project regarding the purpose of the scenarios:

- The form of the scenarios will be text-based, illustrated by graphical representations. Different software will be used, notably MOT+ which allows the graphical

[1] The term “boundary objects” was created by Leigh Star, in sociology of sciences, in order to describe the objects that coordinate, according to a given intention, diverse perspectives. Objects that belong to many communities and serve as links between diverse perspectives have the potential of becoming “boundaries” if these perspectives have to be harmonized.

[2] PALETTE is an integrated European project aiming at facilitating and augmenting individual and organisational learning in Communities of Practice (CoPs). More information can be found at http://palette.ercim.org/

representations to be exported in different standard formats (XML, IMS-LD, OWL) suited to the varied needs of the developers[3].

- The contents of the scenarios are descriptions of the activities of the CoPs (collaboration, information use, production of documents, knowledge management...) and their use of tools within a specific context (history, actors, roles…).
- The purpose of the scenarios is to meet the developers' information needs, to present a structured view of their own functioning to the CoPs and to build "boundary objects" useful for the negotiation, between the developers and the CoPs, of the scenarios themselves and the experimentation modalities.
- The lifecycle of the scenarios depends on the different negotiation stages within the participatory activities involving both the developers and the CoPs.

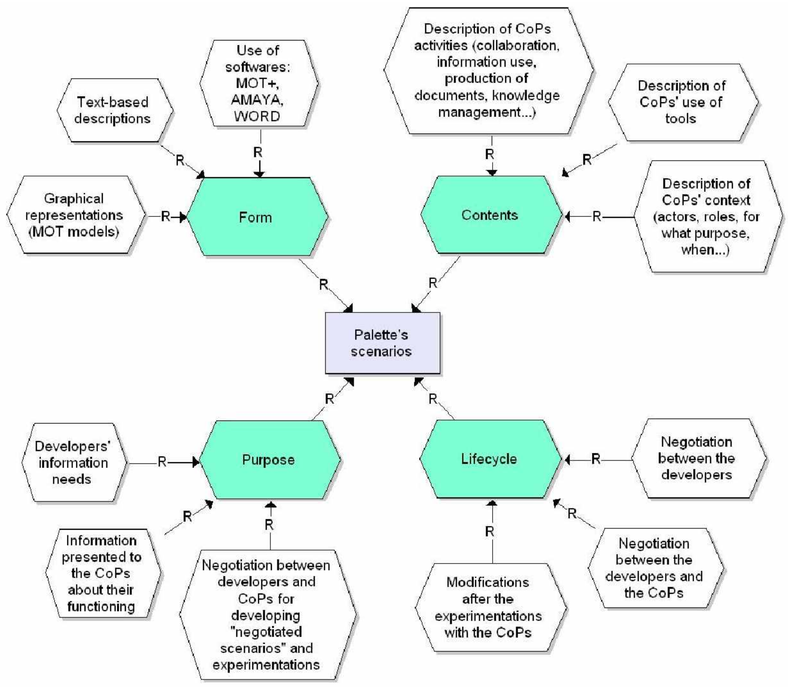

Fig. 1. Graphical model of the PALETTE's scenario of use

"R" means "Regulates" (or "has an effect on")	= Principles, objectives = Object

[3] More information about Typed-Objects Modelling Methodology as well as the MOT+ software can be found at http://www.licef.teluq.uquebec.ca/eng/index.htm.

An example of a specific scenario is presented in Figure 2. It is a graphical representation (form), describing a specific CoP activity – the decision making process concerning students' projects – (contents), which is used by the PALETTE's developers as a use case and presented to CoP's members in order for them to better understand their own functioning (purpose), and which will be negotiated and probably modified according to the vision of the CoP's members (lifecycle).

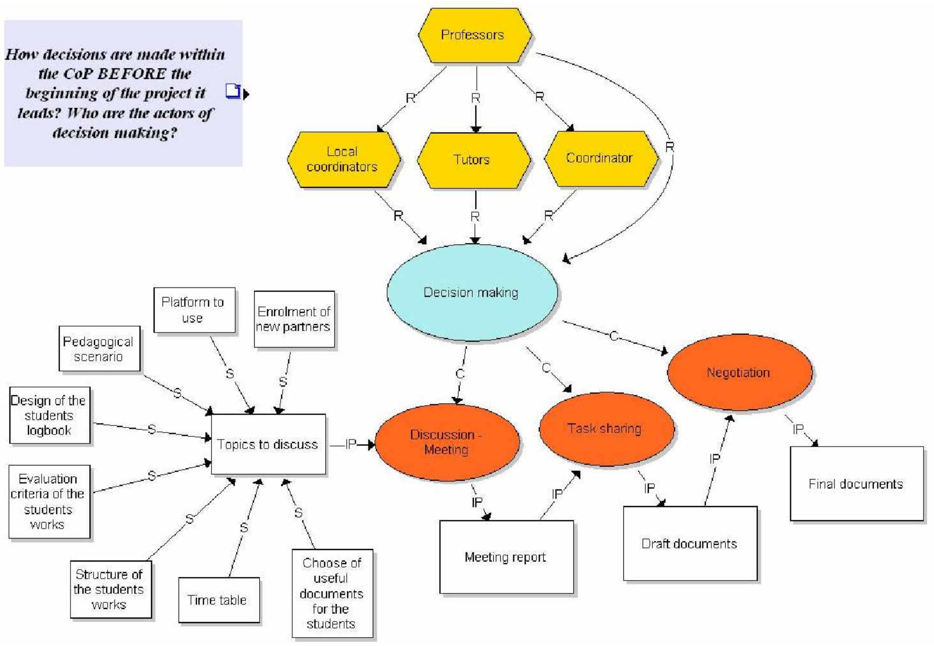

Fig. 2. Graphical model of a specific scenario of use

"R" means "Regulates" (or "has an effect on") "C" means "is Composed of" "IP" means "Input/Product-Output" "S" means "is a Sort of"	= Processes, actions = Actors = Objects, products

3 PALETTE's methodology

The scenarios of use and prototypes are conceived in stages with the participation of both developers and community members. This is fundamental to our methodology in which the representation of the CoPs' practice is elaborated in an iterative process which leads to the creation of the scenario and eventually to the specification of tools. The use of graphical representations such as the ones used in this article facilitates the exchange about the scenarios. They may be seen as a kind of boundary object between the two parties and must be understandable by both.

In this section we briefly describe the PALETTE's methodology represented in Figure 3 using three kinds of objects:

- The actors (oblate hexagons): the developers (the PALETTE's partners), which consist of the different Work Packages (WP) and sub-teams within the Work Package 1 responsible for the design of the methodology, and the CoPs with their delegates and members.
- The twelve processes of the methodology: the ones numbered from 1 to 10 happen one after the other while the first and last ones are recurrent. Indeed, throughout the ten stages, developers evaluate and follow-up the community's reflexive process on the transformation of its activity.
- The objects: the inputs/outputs in/from each process.

3.1 Analysing and categorizing tools (ongoing process)

This process intervenes at different times into the methodology and aims to provide an inventory and a categorization of tools developed by PALETTE's partners, used by the CoPs or existing on the market. Categories of tools are worked out according to different sources. The inventory produced is reused in different processes of the methodology: the modelling of the CoPs' activities, the design of prototypes and the dissemination to other CoPs.

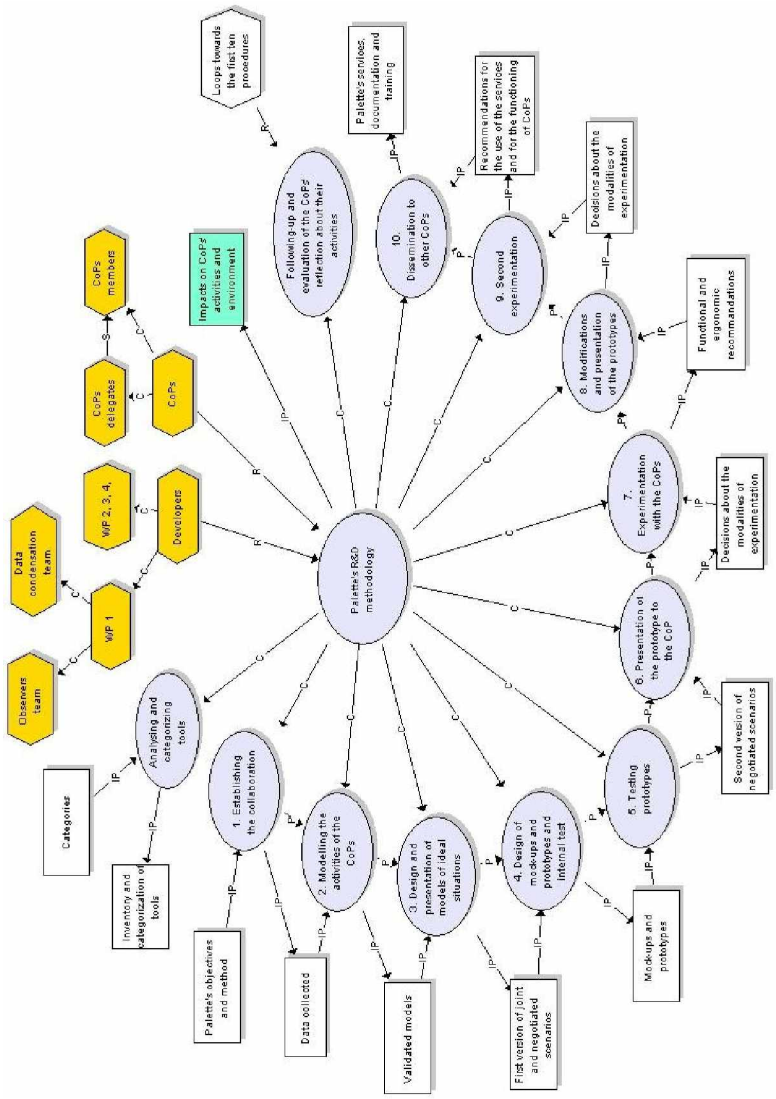

Fig. 3. Stages and on-going processes of PALETTE's methodology (with actors and inputs/outputs)

"R" means "Regulates" (or "has an effect on") "C" means "is Composed of" "IP" means "Input/Product-Output" "P" means "Precedes"	= Processes, actions = Actors = Objects, products

3.2 Establishing the collaboration with a CoP (Stage 1)

At the end of this stage, an agreement is reached between the CoP and the developers or the project is abandoned. To reach a collaboration agreement, the CoP – in its entity if it is small, or through chosen delegates if it is large – needs to understand:

- the intended stages of the methodology and the project's requirements;
- that ethical principles such as confidentiality will be respected;
- that it is in the community's interest to engage in the process and that it is free to retreat at any moment.

At this stage, negotiation allows to adapt the collaboration modalities to each CoP without modifying the purpose of the project.

After PALETTE's objectives and method have been presented and a negotiated agreement about the collaboration has been reached, the first participatory activity takes place. An initial set of data on the community activity is collected by the "Observers team" following an interviews' guide it has developed.

The interviews' guide provides the observers with a document which helps them to follow the methodological principles of the PALETTE project. It contains a description of the objectives and ethical issues of the interview process, the list of questions to ask as well as some tips.

3.3 Modelling the activities of the CoP (Stage 2)

This stage consists of a first analysis and modelling of the data collected. Five main steps conduct to the elaboration of "Validated models":

- Proposing grids for the data condensation/extraction process. This step mainly aims at choosing a representation mode useful both for the developers and for the CoP. The advices provided by Miles and Huberman [8] in the design of matrices have been useful. It has been chosen to present the data with short texts and graphical models.
- Processing the raw data in order to obtain the transcripts and the minutes of the interviews.
- Analysing the data following a method of category-specific analysis [1] [6].
- Presenting the functioning of the CoP based on the analyzed data using two different formats: text-based descriptions of and graphical models.
- Validating and enhancing descriptions and graphical models presented by the developers through discussions with the CoP.

This last step is important for the collaboration with the CoP because it could allow the CoP to develop a better understand its actual functioning. It also could arouse its interest in imagining new situations and solutions.

3.4 Design and presentation of models of ideal situations (Stage 3)

This stage (see Figure 4) is adapted from Checkland's Soft System Methodology [2]. At this point, the developers elaborate one or more possible technological and pedagogical solutions in order to model a new activity scenario representing an 'ideal' situation. This new scenario can then be compared to the actual situation by way of discussions with the CoP's members, structuring the negotiation process between the developers and the CoP. This aims to stimulate a reflexive process about the community's activity and to engage its members in the design of the new tools, in the definition of their use and in the identification of a strategy to support the appropriation process. Several meetings may be required in order to achieve a joint and negotiated scenario acceptable by the developers and the CoP and feasible in its particular context. At this stage, an acceptable solution is defined as one which does not bear too heavy a charge on the members of the CoP. Together, developers and members of the CoP thus try to optimize the workload induced by the use of new tools and new processes.

3.5 Design of mock-ups and prototypes and internal tests (Stage 4)

At this stage, the developers design and test a first version of the prototypes. It is a first internal diagnosis of the tools. These internal tests should confirm that the tools or services being developed actually correspond to the solutions previously negotiated. In addition, the developers try to establish a first measurement of the degree of acceptability by evaluating the instrumental distance [10] and the users' competencies necessary to implement the solution. Thus the developers among themselves develop a common vision of the solution.

3.6 Testing the prototypes (Stage 5)

The aim of this stage is to test the prototypes with delegates of the CoP. The test is designed to simulate authentic actions performed by the community. The delegates of the CoP and the developers strive to perform a second measurement of the degree of acceptability of the solution, and, if needed, negotiate a more acceptable solution. If this is the case, Stage 4 is repeated. Thus the developers and the delegates develop a common vision of the new solution.

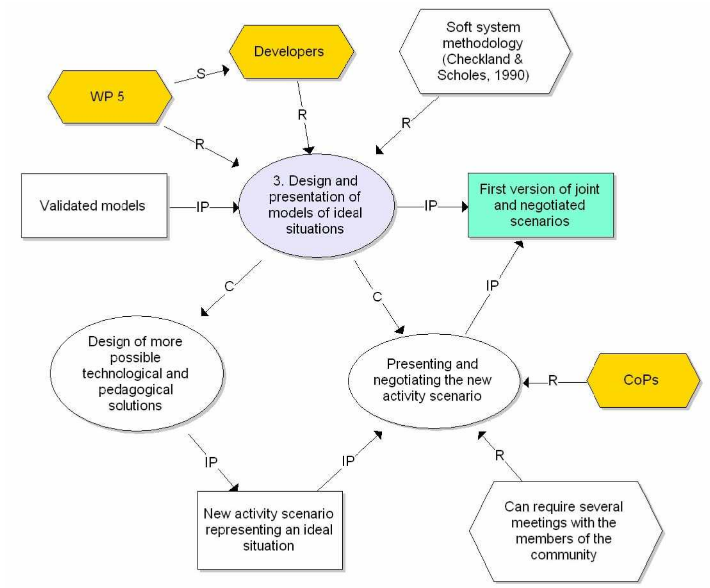

Fig. 4. Design and presentation of models of ideal situations (Stage 3)
"R" means "Regulates" (or "has an effect on")
"C" means "is Composed of"
"IP" means "Input/Product-Output"
"S" means "is a Sort of"

= Processes, actions
= Actors, principles
= Objects, products

3.7 Presentation of the prototypes to the CoP (Stage 6)

This stage aims to define modalities for the experimentation of the prototypes with CoP's members. These modalities could be different for each CoP. However two steps are required: the presentation of the prototypes or mock-ups to the CoP and a discussion about the modalities of the experimentation.

3.8 Experimentation with the CoP (Stage 7)

The seventh stage aims to experiment the prototypes by observing the instrumentation and instrumentalisation processes [10] as well as the individual and collective learning being carried out. To be reliable and valid, experimentation has to be led over a significant period of time.

- For the instrumentation process, observation focuses on the appropriation of the constituent functions of the tools (functions conceived by the developers).

- For the instrumentalisation process, observation focuses on functions created by the CoP's members (not conceived by the developers).
- For the individual and collective learning being carried out, observation focuses on the various types of mediation processes which lead to it: praxeologic, sociocognitive and reflexive mediation processes.

Based on these three observations, functional and ergonomic recommendations are made to improve the tools.

3.9 Modifications and presentation of the prototypes (Stage 8)

The developers modify the prototypes according to the results of the experimentations. Again, internal testing precedes the presentation of the new prototypes to the CoP and the negotiation about the modalities of a second experimentation. The prototypes could be then named "PALETTE's services, version 1".

3.10 Second (and further) experimentations (Stage 9)

Following the decisions about the modalities of the second experimentation, observations are conducted in the same way that was described in Stage 7. The product of this stage consists in providing recommendations for the use of the services and for the functioning of the CoP.

3.11 Dissemination to other CoPs (Stage 10)

This last stage aims at providing other CoPs and scientific communities with the project's products: the PALETTE's services, the documentation about these services and training.

3.12 Following-up and evaluation of the CoP's reflection about its activities (ongoing process)

The follow-up process influences the previous stages by accompanying the CoP through the reification of its activities and the production of knowledge. This reification is continually used and reused within the other processes through the different participative activities: interviews, validation of the scenarios of use, negotiation of the modalities of experimentation, etc. These activities, like in the CoP itself, provide a framework for the negotiation of meaning, reification of knowledge and reflection about the CoP's functioning and learning.

4 Conclusion: questions and issues raised by the implementation of the method

Conducting participative projects with CoPs raises specific challenges due to the nature of CoPs. These communities are not always stable bodies with a structured organisation. They use communication channels that are sometimes closed to outsiders. The interest of CoPs lies in their domain of practice, and the development, testing and appropriation of new tools is not a priority nor on every CoP's agenda.

The challenges lye in a) the appropriate choice of a communication channel, b) the choice of partners inside large CoP with whom the project can work, c) the management of the decision making process in general, d) the choice of criteria to identify CoP's members able to participate in the development of information technology solutions, e) the reliability of decisions, f) the transferability of experiences by one part of the CoP to the rest of the CoP or other communities.

a) The choice of a communication channel affects the policy of confidentiality. Shall the developers and the CoP's members use the existing CoP's channels such as forum, chat, mailing lists or the developers' channels which require separate logins?
b) Choosing the right partners inside the CoP is not easy. If the CoP's structure is somehow formalised, delegates might then provide data pertaining to Stage 1. The validation and testing of the solutions may be carried out by a special active subgroup willing to do so, or there may be a call to volunteers – both may bias the project.
c) There are many decisions to make internally and with the CoP. They concern the interpretation of the CoPs' functioning by the developers, the choice of the solutions, the length of testing and so on. However the decisional structure and procedure of a CoP are not often clear. In addition, the CoP's can discontinue involvement at any moment.
d) In special projects such as the development of information technology solutions to support CoPs' activity, one of the criteria for participation concerns the installation of software on one's computer. Not all CoP's members have the right to do so in corporate environments. Others don't want to install beta-versions of software that may destabilize their system. Finally, in non-corporate environments, CoPs may lack the technical ability to install and control server-based services.
e) Decisions are taken by some members of a CoP at a certain time, e.g. the use of a certain scenario to work with. There is a risk that new CoP's members or members that could not participate in the decision making process reject these scenarios. There is always a doubt about the reliability of the decision.
f) The transferability of experiences made with a motivated and willing group of CoP's members to the whole CoP, including the less active outer circle is important if a CoP adopts new ways of working and new tools. If the favourable experiences are not transferable because the "until now" silent majority boycotts the new culture, the CoP may be in danger.

References

1. Bardin, L.: L'analyse de contenu. PUF, Paris (1983).
2. Checkland, P.: Systems Thinking, Systems Practice. John Wiley & Sons, London (1981).
3. Daele, A., Charlier, B. (eds.): Comprendre les communautés virtuelles d'enseignants. Pratiques et recherches. L'Harmattan, Paris (2006).
4. Henri, F., Pudelko, B. : Le concept de communauté virtuelle dans une perspective d'apprentissage social. In A. Daele, & B., Charlier (eds.): Comprendre les communautés virtuelles d'enseignants. Pratiques et recherches. L'Harmattan, Paris (2006) 105-126.
5. Kaufmann, J.-C.: L'entretien compréhensif. Nathan, Paris (1996).
6. L'Ecuyer, R.: Méthodologie de l'analyse développementale de contenu : Méthode GPS et concept de soi. PUQ, Québec (1990).
7. Lewis, R.: Professional learning. Journal of Computer Assisted Learning, 11(4) (1995) 193-195.
8. Miles, M.B., Huberman, A.M.: Analyse des données qualitatives. 2nd edn. De Boeck, Brussels (2003).
9. Nielsen, J.: Usability Engineering. A P Professional, New Jersey (1993).
10. Rabardel, P.: Les Hommes et les Technologies : approche cognitive des instruments contemporains. Armand Colin, Paris (1995).
11. Rolland, C., Ben Achour, C., Cauvet, C., Ralyté, J., Sutcliffe, A., Maiden, N.A.M., Jarke, M., Haumer, P., Pohl, K., Dubois, E., Heymans, P.: A proposal for a scenario classification framework. CREWS (Cooperative Requirements Engineering With Scenarios). Report 96-01 (1996).
12. Wenger, E.: Communities of Practice. Learning, Meaning, and Identity. Cambridge University Press, Cambridge (1998).

A model for representing professional development through the participation in a virtual CoP: uses for developing enhanced services

Amaury Daele

University of Fribourg, Centre de Didactique universitaire, Bd. de Pérolles 90, 1700 Fribourg, Switzerland
amaury.daele@unifr.ch

Abstract. This paper presents a model of professional development through the participation in a virtual CoP. This model is rooted in a definition of professional development and of professional practice. The model is then used for analyzing the activity of a virtual CoP of tutors involved in a computer-supported collaborative learning training. The analysis provides guidelines for developing online services for supporting the activity of the CoP within a participatory design view. This research is part of a European project aiming at providing interoperable services for CoPs.

Keywords: community of practice, professional development, practice, modelling, R&D methodology, participatory design

Introduction

The call for papers of this workshop, in its 'motivation and background' section, pointed out that, despite to the development of new devices and services able to sustain the development of virtual CoPs, research underlines "the lack of adequate scaffolding in the form of both technical supports and usage of technology to:

- Express, represent and share practices;
- Debate and reflect about the practices and about the life of the CoP;
- Develop, reify and exploit knowledge inside and outside of the CoP;
- Facilitate engagement, participation and learning."

More than the lack of use of technology, this assessment also highlights the lack of understanding of the main processes underlying the functioning of a CoP as well as the learning achieved by the participants. Research has also identified many questions highlighting the difficulty to depict and to understand the conditions of processes such as involvement into a virtual group [8], debating and arguing at a distance [2], coordinating a virtual working/learning group [3], supporting confidence and human relations into a distributed community [17], etc. In addition, methodological questions also occur for inquiring into those groups [16] [9]: how to get in touch with the members, how to analyse in the same time different data such as interviews, emails or logs, how to validate the research approach, etc.?

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 258-271, 2006.

It is usual to notice non- or “wrong” uses of new technologies [6] [15]. But this does not necessarily mean “wrong” technologies or “wrong” users. This would rather mean “wrong” relation between the technology and the users or a lack of understanding of their way to work with – or without – technology. Quite often, old technologies are used for new purposes or activities for which they have not been designed. If they don’t work, it is not common to question the new purposes or activities themselves for better understanding them before to design new technologies or supports for the users.

When investigating a new research field, scientists usually firstly try to develop a general depiction of the processes and questions they intend to inquire into [18]. A first modelling aims at identifying main categories of meaning into the reality and to conduct exploratory research. Then validation or change of the first model can be done and new questions of research can occur.

The model presented in this paper aims at representing the main processes occurring into a virtual CoP, their connections and the conditions for their emergence and for the professional development of the participants. Then a use of the model will be presented into a European R&D project (PALETTE) for investigating one virtual CoP and exploiting this investigation for designing enhanced online information, knowledge management and mediation services.

1 Professional development and practice

Before the presentation of the model, it is important to define the two main concepts behind.

Several authors consider more and more professional development as a process supplied not only by prior training but also by interactions with professional peers and by personal reflexivity in and out the workplace [5] [12]. For example, a teacher develops her practice as professional in almost all the circumstances of her life, formally or informally, alone or in interaction with others, in or out her school. Lieberman (1996, quoted in [5], p. 3) gives some varied examples such as to hear colleagues speaking about new teaching practices, to get involved in decision groups in her school or to participate in professional networks. Outside school, she gives examples such as to participate in institutional working groups, to get involved in action-researches with universities or to participate in discussion groups. All these examples can take place into formal training but also in informal situations. More precisely, Donnay and Charlier [7] propose to define professional development with six specific characteristics. These authors have worked in the teachers training field but their definition is largely applicable to other professions. Professional development is a process:

- oriented: towards a goal, a project, a progress… that may be personal (one’s own practices) or larger (the project of the institution);
- situated: embedded into a specific context composed of work situations, relations with colleagues, an institutional history and a particular functioning and organization;

- that can be partially planned: it is relatively unpredictable because in the most of professions, professionals are assailed by requests from different people or devices. Professional learning can occur at each moment.
- dynamic and continuous: learning that has been achieved is reused in new daily professional situations and continuously enhances professional doing;
- sustained by a professional ethic: professional development occurs for improving a service, for example the students learning, the quality of products or the quality of services to customers;
- with shared responsibility: the professional is responsible for her professional development but her organizational environment is responsible for providing her professional development opportunities.

These characteristics highlight the informal aspect of the development of professional practices. Indeed, Donnay and Charlier [7] also describe four dimensions of professional development:

- the professional practices are often the starting and the arrival points of professional development that acts for enhancing them;
- professional development is often anchored in or even becomes confused with personal development;
- professional development lives on otherness: confrontation, debate, sharing, etc.
- professional development is related on the construction of professional identity.

Within these characteristics and dimensions, collaborative work and participation in a professional community appear as important actions for the professional development process, especially for confronting and improving one's practices. This implies that practice is at the heart of professional development or, following Donnay and Charlier [7], constitutes both the starting point and the arrival point of the process of professional development. According to Wenger ([19], p. 47), "The concept of practice connotes doing, but not just doing in and of itself. It is doing in a historical and social context that gives structure and meaning to what we do. In this sense, practice is always social practice". Thus practice includes the formal and the informal of a profession: representations, tools, language, documents, symbols, roles, etc. The action and the knowledge of a profession as well as the processes by which they have been constructed are also components of the practice. The Wenger's definition also includes the theories and the ideals relating to a profession as well as the actions and operations characterizing the practical doing of this profession.

Donnay and Charlier [7] otherwise highlight the difficulty to understand what professional practice or know-how is concretely because it is:

- not always available for the professional: it is constructed, alone or with colleagues, within professional situations which are not necessarily described with words. Practice is embedded in action and often used as routines not analyzed or consciously decided.
- not always accessible for others: it is constructed within specific contexts into a specific vision of the profession. For being accessible, practice has to be processed and decoded.
- not fully conveyed: because not fully verbalized. To specifically translate with words a complex professional action and the professional experience of someone is almost impossible.

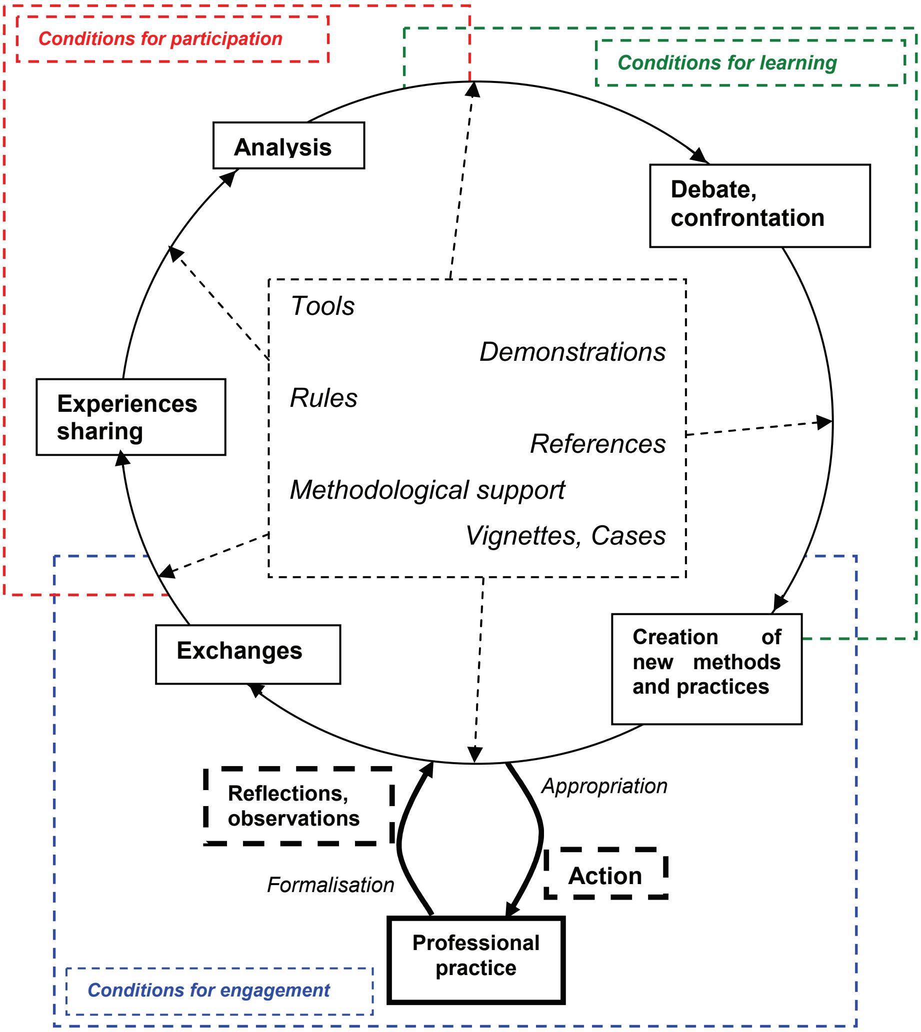

Fig. 1. Model of professional development within a community of practice

All along this cycle, participants can use and exchange objects such as:

- Tools (technical and conceptual) used in specific contexts and exchanged by the participants;
- Rules or references to regulations (administrative or legal for example) or to standardized practices classified by the profession;
- Methodological support such as advices from older colleagues;
- Demonstrations, i.e. argued discourses possibly based on literature;
- References to literature or to well-known standardized doing;
- Vignettes or cases such as little stories or anecdotes.

- peculiar to each professional: professional practice determines our professional identity all the way through our professional life and within a specific organizational context. In addition, professional practice is also full of emotions and affects.
- not always transferable: it is valid for its author as long as it is efficient in his/her context. The consequence is that professionals tend to generalize their own practices and it is not easy for them to change. However in return, practices are credible for other professionals and could be a part of a collective practice.

This large definition allows conceiving a model of professional development taking into account the complexity of a professional practice.

2 A model of the professional development within a CoP

In order to represent the different processes in action into the larger process of professional development, I built the model presented in the figure 1 [2], mostly based on the Huberman's *'Open' collective cycle* [10].

The entry point is the Professional Practice below the model. It is also the arrival point. At the workplace, a professional can encounter problems, ask questions, observe colleagues doing… in short, an event that arouses a reflection, not necessarily expressed but sufficiently explicit for leading her towards the community (the black central circle in the model). The practice is then formalized and "enters" into the community as an object which will be discussed.

Within this community, five processes occur from the interventions of the participants. In the model, they follow one another but we can imagine that they can occur independently or in another chain.

- Exchanges occur when a participant asks a question or proposes an observation made at her workplace or a problem. The exchange can be a question asking more information, a reformulation, a personal observation in another context, etc. "Exchange" is thus generally an answer to a message that can lead to a dialogue.
- The exchanges can lead to experiences sharing where participants develop their observations or their descriptions of their own contexts. Here, the answering participants get more personally involved in the conversation.
- An analysis can then occurs, i.e. a specific identification of what is exactly the problem, or a reference to literature or standard practices for explaining the problem or the practice described. Participants can then look for solutions together.
- The analysis can lead to a debate where different opinions are confronted with lines of arguments.
- A debate can possibly lead to the creation of new practices that the participants will try in their context. This leads then to action and appropriation by the participants in their workplace.

All these processes occur following a number of conditions. Three kinds of conditions occur before, during and after the participation in the community. For each participant, they combine together for defining, at one moment a specific configuration of variables that explain participation or learning.

- Conditions for engagement are related to personal characteristics of the participants, competences in the use of technologies, access to technologies, usual work environment, communities in which they take part and relations between those, personal representation of what is a community of practice, representation of one's professional development and learning processes, practices of reflexivity, etc.
- Conditions for participation are associated to personal characteristics (such as time available for participation, self-esteem, representations of one's competencies), participation support (such as animation and moderation of the community, rules for participation, framework given at the beginning to facilitate the exchanges between participants, usability of the tools, support to the new members), common project, security and trust issues, and shared language (own vocabulary developed within the community to speak about practice).
- Conditions for learning, professional development and changes of practice concern conceptions of learning, conceptions of changes, as well as conceptions of the community, the formalization of the exchanges, the role of the moderator to support individual learning and learning of the community and scaffolding opportunities to reflect on the learning process, and on the learning organisation.

This model can be used as a framework or as a grid of analysis for observing and understanding living CoPs.

3 The PALETTE project and its method

The PALETTE project[1] (6th European framework programme) aims at facilitating exchanges and learning in CoPs by developing online services and scenarios of use which will be implemented and validated with living communities. These services concern information management, knowledge management and collaboration. One of the original aspects of the project is that it is based on a participatory design methodology. Eleven communities of practice from three different domains (teaching, management and engineering) are actively involved all along the project through participative activities: interviews, tests of services, discussions about the designed scenarios, etc.

In this framework, there was a need of a clear vision of what a CoP is and how it works for professionally developing its members. This doesn't mean a "right" vision but a first well described vision for being discussed all along the project with the members of the communities involved. The model presented above was useful in this view and allowed to organize a first participative activity with the communities. A guide of interview has been designed with questions based in part on the processes, objects and conditions described in the model. Then the model has been used in part

[1] More information can be found at http://palette.ercim.org/.

for the analysis of the interviews. Finally the presentation of the analyzed data follows on the one hand the advices of Miles and Huberman [13] with the construction of matrices and on the other hand a specific methodology of knowledge modelling MOT, Modelling with Typed Objects [14].

In the section below, I present the analysis of the interviews of one community in the teaching domain. This community of practice groups tutors involved in distance training. These tutors discuss about the problems they encounter for tutoring their groups of students (future teachers in secondary schools) who have to work collaboratively on a specific project. In this paper, my goal is not to deeply analyse the functioning of this community but to simply show the usefulness of a model for understanding its functioning and further to design tools and services that take into account its real organization, as suggested in the introduction. So, I only take four examples, four "pictures" of processes lived by the community. Then I will discuss how these pictures can be used both for supporting the development of the community and for developing tools and services in phase with these "living scenarios".

4 Graphical representations of some results

The figure 2 simply depicts the documents produced or used into the community. This refers to the exchanged objects in the model presented in the figure 1. Three kind of actors are represented, two of whom are members of the CoP (the coordinator and the group of tutors and local coordinators); the students participate in the distance training organized by it. Nine sorts (link "S") of documents are produced by the large community while they use only two sorts of documents (scientific papers and bookmarks). The tutors and the coordinators participate in the production of researches, a pedagogical guide for the students and pedagogical tools for tutors. This last production is especially a product of the tutors' CoP. Thus this figure depicts a very productive CoP. However the bottom half of the figure shows that only one of the products is reused in the next years for designing new distance training scenarios. What the students produce is not reused nor researches or practical tools. This could depict a CoP without memory… while in the model of the figure 1 one condition of learning is precisely the organization of knowledge management and the formalization of the exchanges.

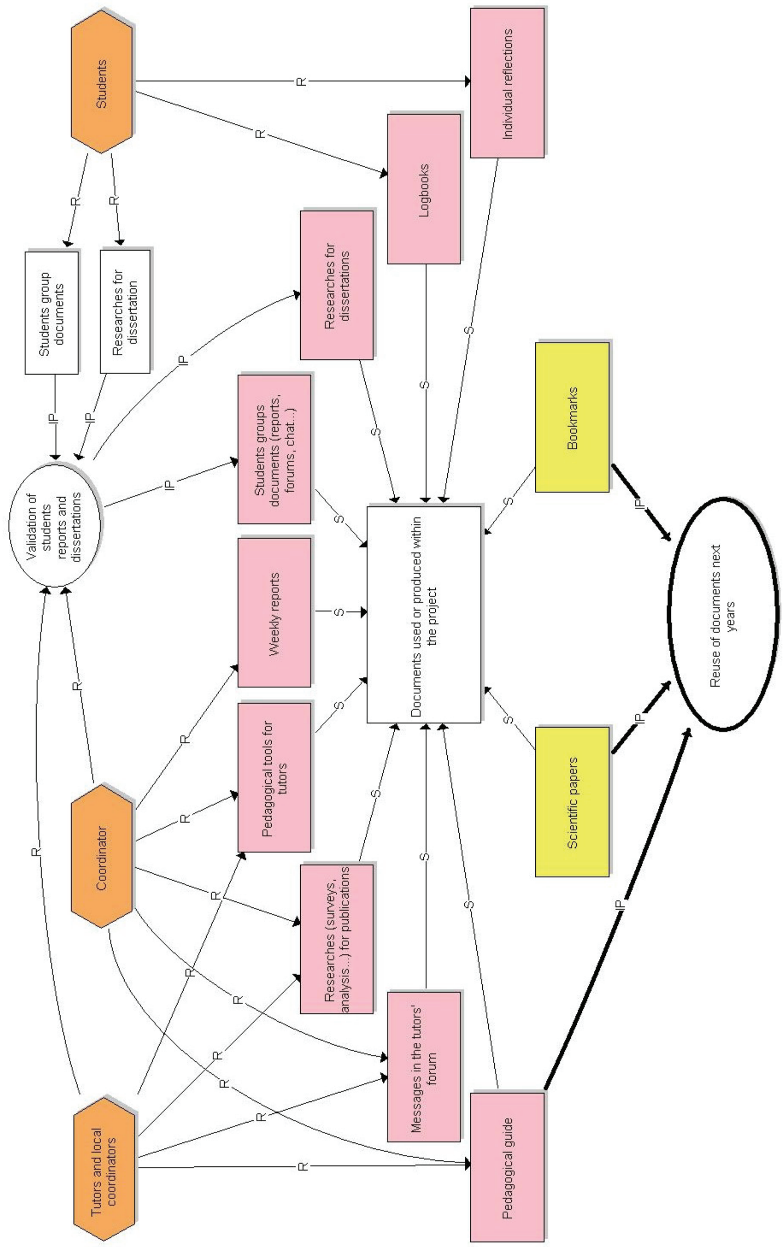

Fig. 2. Documents used and produced and actors involved

"R" means "Regulates" (or "has an effect on" or "acts on") "S" means "is a Sort of" "IP" means "Input/Product-Output"	= Processes, actions = Actors = Objects, products

The figure 3 aims at depicting the decision making process before the training project begins, i.e. before the students involved begin to collaboratively work, when preparing and organizing the training. The students (future teachers) are from different European universities and will form working groups. Three kinds of actors are involved: the tutors of the students groups, the local coordinators in each University and the coordinator of the project. A lot of topics have to be discussed: the enrolment of new universities, the platform to use, the pedagogical scenario, etc. The decision making process could be divided in 3 sub-processes:

1. Discussion in face-to-face meeting: different topics of discussion are selected into an agenda and the goal of the meeting is to organize the work for producing the scenario and sharing tasks. The product of this activity is a meeting report.
2. Following the meeting report, the tasks are shared and the actors work for proposing to the others draft documents.
3. A negotiation (comments and proposals of changes in the documents) then occurs for producing the final documents and organization which will constitute the architecture of the pedagogical scenario.

This process of decision making refers to the processes of analysis and debate in the model of the figure 1.

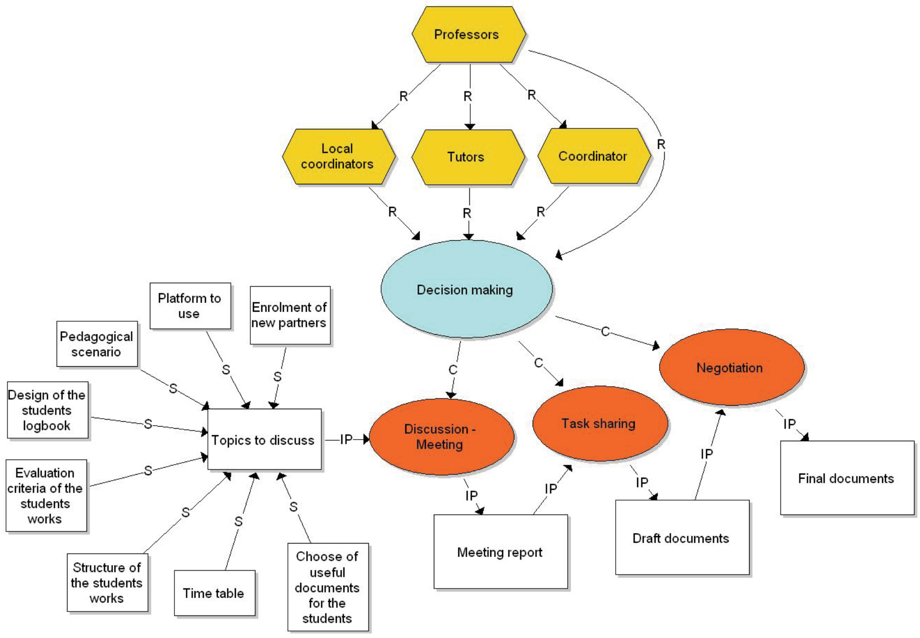

Fig. 3. Decision making process before the beginning of the training

"R" means "Regulates" (or "has an effect on" or "acts on") "S" means "is a Sort of" "C" means "is Composed of" "IP" means "Input/Product-Output"	= Processes, actions = Actors = Objects, products

However, during the project (figure 4), while students are involved with the tutors in working groups, decisions have regularly to be made relatively quickly. The normal and negotiated procedure is to organize monthly meetings with the tutors and local coordinators with an agenda based on problems, questions and topics that occur within the students working groups. A meeting report is written by the coordinator and information about the decision made is provided to all the participants (students, professors...).

However, it seems that sometimes, the project's coordinator has to make decision "on the fly", very quickly, for answering a specific question or because it would be too energy-consuming to organize a meeting with all the partners. Some interviewed people complain about this "parallel" process of decision making because they feel not involved in the process and they are not always informed about the decisions made by this way. This "hidden" decision making process is depicted with the dotted lines around the process "Decision by the coordinator".

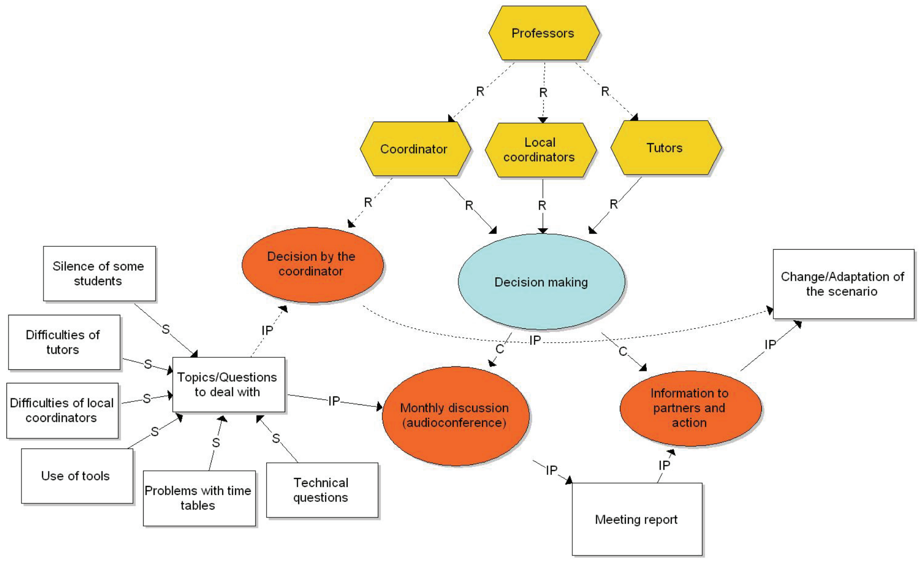

Fig. 4. Decision making process during the training

"R" means "Regulates" (or "has an effect on" or "acts on") "P" means "Precedes" "C" means "is Composed of" "IP" means "Input/Product-Output"	= Processes, actions = Actors = Objects, products

In the model of the figure 1, the coordinator (or moderator) of a CoP appears as a central element for the engagement, the participation and the learning of the participants. If the participants complain about the coordinator or if they don't trust in him/her, it could be a problem regarding the participation within the CoP.

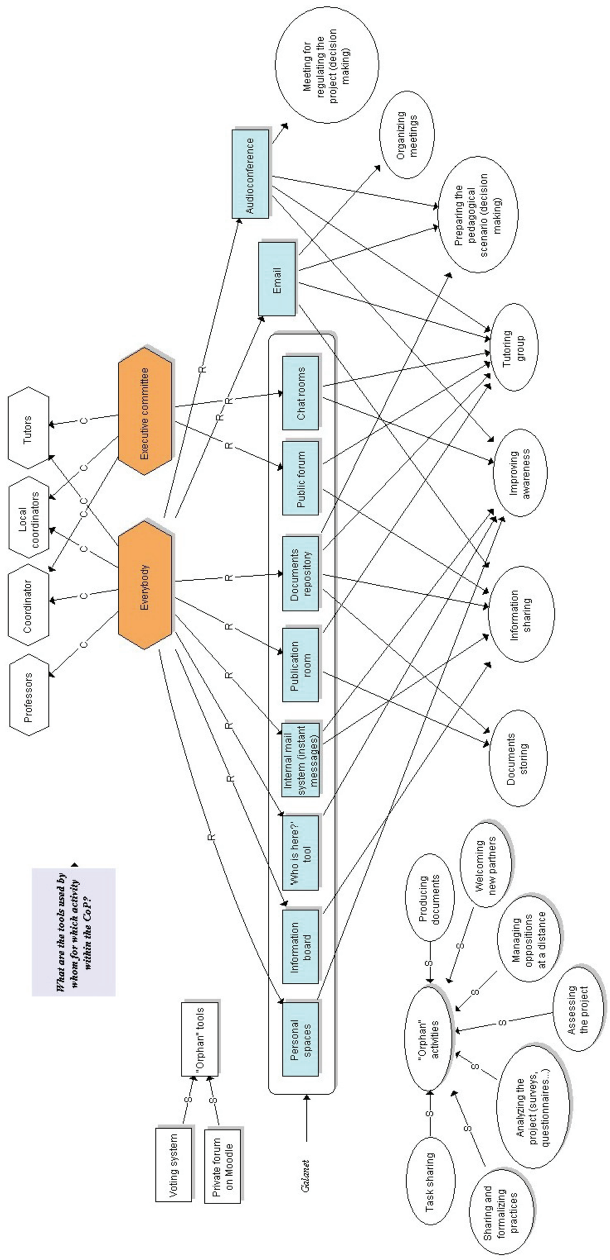

Fig. 5. Use of tools for activities within the CoP

"R" means "Regulates" (or "has an effect on" or "acts on") "S" means "is a Sort of" "C" means "is Composed of" "IP" means "Input/Product-Output"	= Processes, actions = Actors = Objects, products, tools

The figure 5 tries to depict three kind of knowledge:

- the tools used within the training project;
- the actors who use the tools;
- the activities supported by the tools.

Four types of actors are grouped in two categories: “Everybody” and the “Executive committee” for avoiding too much links between actors and tools. Height tools are integrated within the distance learning platform (Galanet). Two other tools are used: email (not a list of discussion) and audioconference (telephone). Two tools are “orphan” (= not really used): a voting system which was integrated within the platform but “let down” and a private forum for tutors which was not integrated within the platform. These 10 tools are used for specific purpose/activity (documents storing, information sharing, tutoring groups, organizing meetings, etc.). Seven activities are orphan: no tool is used for sustaining them.

For some of the orphan tools or activities, the interviewees complain: managing oppositions at a distance, producing (and searching for and into) documents, sharing practices and analyzing the project for improving it years after years. Globally, a question is asked: how to better organize or provide useful tools for sustaining the orphan activities?

In the model presented in figure 1, the use of tools appears as condition for engagement of the CoP’s members (competences in the use of the CoP’s tools and access to them) and for their participation (usability and acceptability of the tools). The tools used participate in the level of the members’ comfort into the CoP.

5 Uses and perspectives

In the PALETTE project, these analysis and depictions of the functioning of the CoPs are used for two purposes. On the one hand, the researchers keep in touch with the CoPs and will organize with them other participatory activities such as discussions with focus groups or tests of services or scenarios of use of tools. With the figures 2, 3 and 4 presented here, the researchers could show to the CoPs how they understand their functioning and the questions they ask about it. Regarding the examples above, questions like “how to better reuse documents produced?”, “does the decision making process satisfy everybody?”, “how to enhance it if need be?”, “which tools could support both the process itself and the communication of the decisions made to the participants?”… The CoPs involved in the project are voluntary and know that they possibly enter in a reflexive work. Discussions about these figures could help them to enhance their functioning.

On the other hand, these representations of the real functioning of CoPs will be used by the PALETTE’s partners who develop services and tools. They are asked to propose services in phase with the functioning of the CoPs and interoperable with the tools they already use. Clearly, the analyses presented in the figures above could help them to have a specific vision about how a CoP can work and evolve. For example, the partners in charge of the development of knowledge management services could orient their work around the formalization but also the reuse of documents and knowledge within a CoP. In addition, the partners developing mediation services have specific examples for proposing tools supporting argumentation and debate in order to make decisions.

From a participatory design point of view, these two uses of our analysis show that the researchers and the CoPs need each other for achieving their goals: developing useful and usable services for the ones and understanding and enhancing their functioning for the others.

From an action-research point of view, the model of the figure 1 has shown its usefulness for building a framework for the project. PALETTE is under way and its actions will surely provide enhancements for the model by specifying the processes and the conditions of engagement, participation and learning within a CoP.

References

1. Charlier, B.: Apprendre et changer sa pratique d'enseignement. Expériences d'enseignants. De Boeck, Brussels (1998)
2. Daele, A.: Développement professionnel des enseignants dans un contexte de participation à une communauté virtuelle: une étude exploratoire. Unpublished report for DEA in Educational Sciences, Université catholique de Louvain, Louvain-la-Neuve (2004)
3. Daele, A. : Animation et modération des communautés virtuelles d'enseignants. In: Daele, A., Charlier, B. (eds.): Comprendre les communautés virtuelles d'enseignants: Pratiques et recherches. L'Harmattan, Paris (2006) 227-248
4. Daele, A., Charlier, B. (eds.): Comprendre les communautés virtuelles d'enseignants: Pratiques et recherches. L'Harmattan, Paris (2006)
5. Day, C.: Developing Teachers. The Challenges of Lifelong Learning. The Falmer Press: London (1999)
6. Docq, F., Daele, A.: De l'outil à l'instrument : des usages en émergence. Charlier, B., Peraya, D. (eds.): Technologie et innovation en pédagogie. Dispositifs innovants de formation pour l'enseignement supérieur. DeBoeck, Brussels (2003) 113-128
7. Donnay, J., Charlier, E.: Apprendre par l'analyse de pratiques. Initiation au compagnonnage réflexif. PUN-Editions du CRP, Namur (2006)
8. Glazer, E.M., Hannafin, M.J.: The collaborative apprenticeship model: Situated professional development within school settings. Teaching and Teacher Education, 22 (2006) 179–193
9. Henri, F., Charlier, B., Peraya, D.: L'analyse des forums de discussion éclairée par l'étude des méthodes propres à cinq projets de recherche faisant usage de ce type d'analyse. JOCAIR 2006 conference, Amiens (2006)
10. Huberman, M.: Networks That Alter Teaching: conceptualizations, exchanges and experiments. Teachers and Teaching: Theory and Practice, 1(2) (1995) 193-211
11. Keiny, S.: A community of learners: promoting teachers to become learners. Teachers and Teaching: Theory and Practice. 2 (2) (1996) 243-272
12. Lieberman, A., Miller, L. (eds.): Teachers caught in the Action. Professional Development that Matters. Teachers College Press, New-York (2001)
13. Miles, M.B., Huberman, A.M.: Analyse des données qualitatives. 2nd edn. De Boeck, Brussels (2003)
14. Paquette, G., Léonard, M., Lundgren-Cayrol, K., Mihaila, S., Gareau, D.: Learning Design based on Graphical Knowledge-Modelling. Educational Technology & Society, 9 (1) (2006) 97-112
15. Perriault, J.: La logique de l'usage. Essai sur les machines à communiquer. Flammarion, Paris (1989)

16. Pudelko, B., Daele, A., Henri, F.: Méthodes d'étude des communautés virtuelles. In: Daele, A., Charlier, B. (eds.): Comprendre les communautés virtuelles d'enseignants: Pratiques et recherches. L'Harmattan, Paris (2006) 127-155
17. Shank, M.J.: Teacher storytelling: A means for creating and learning within a collaborative space. Teaching and Teacher Education, 22 (2006) 711-721
18. Van der Maren, J.-M.: Méthodes de recherche pour l'éducation. De Boeck/Presses de l'Université de Montréal, Brussels (1995)
19. Wenger, E.: Communities of practice. Learning, meaning and identity. Cambridge University Press, Cambridge, MA (1998)

An Example of Participatory Design Methodology in a Project which Aims at Developing Individual and Organisational Learning in Communities of Practice

Amaury Daele, Université de Fribourg, amaury.daele@unifr.ch

Martin Erpicum, Université de Liège, martin.erpicum@ulg.ac.be

Liliane Esnault, EM Lyon, esnault@em-lyon.com

Fabienne Pironet, Université de Liège, fabienne.pironet@ulg.ac.be

Hervé Platteaux, Université de Fribourg, herve.platteaux@unifr.ch

Etienne Vandeput, Université de Liège, evandeput@ulg.ac.be

Nathalie Van de Wiele, ePrep, nathalie.vandewiele@eprep.org

Abstract.

The experience described in this paper is being developed in the framework of the PALETTE[1] project by two teams of researchers involved in collecting information from some Communities of practice[2] (CoPs) then in providing this information through suitable formats to their technical partners in the aim of designing an interoperable and extensible set of innovative services and specific scenarios to be implemented and validated in CoPs of diverse context (teaching, management and engineering domains). The aim of our paper is to describe and analyse the methodology created and applied to support this process.

Implementing a Participatory Interview Process

The participatory design process for the whole project was implemented following an Actor-Network Theory (ANT) [Latour, 1999; Monteiro, 2000] driven perspective. The main idea of the early stages of this process is the enrolment, though participatory activities, of actors of different kind, according to ANT –meaning human actor such as CoPs' members, CoPs' observers, etc; and non-human actors such as the inter-

1 PALETTE (Pedagogically sustained Adaptive Learning Through the exploitation of Tacit and Explicit knowledge) is an 'Integrated Project' supported by the European Commission (DG Information Society and Media).

2 "Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly". "Because its constituent terms specify each other, the term "community of practice" should be viewed as a unit" (Wenger, 1998, p72).

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 272-277, 2006.

view process, the interview guide, the methodological tool for collecting and retrieving the data and the technical tools used for the interviews, for example – in order to settle the collaborative process necessary to collect useful data for the project.

The role of our two researchers teams, a CoPs' observers team and a Data condensation team, as actors of the participatory design process for the whole project, is depicted in the MOT schema below (see Fig.1).

The project has decided to work not only with previous knowledge or report from previous research on CoPs, but also with a number of existing CoPs (about a dozen). These existing CoPs, more or less formalised as such at the start of the project, are not members of the project, but are more considered as a "field of experiment". It is thus important to explore how the project could meet their own interests so that at least some members would be able to spend time with project members answering to interviews. This was the first role of the CoPs' observers' team. CoPs' observers are members of the project; they are the "correspondents" of the CoPs within the project and the "referring people" for other partners within the project when they need information about CoPs. They are also the key people regarding the design and implementation of the interview process.

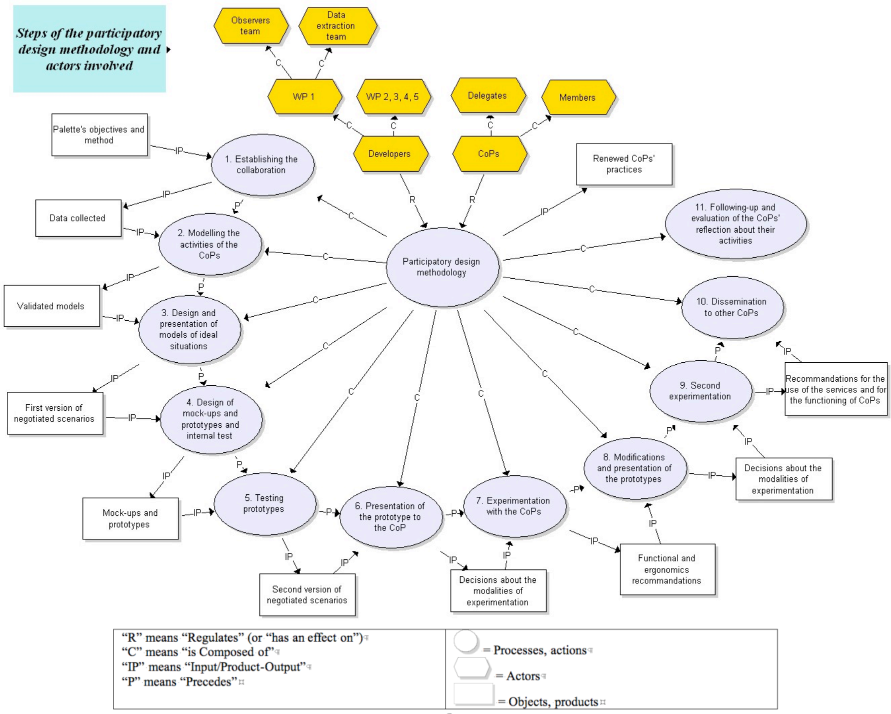

Fig. 1. PALETTE process of Participatory design methodology (MOT schema created by the PALETTE researchers : B. Charlier, F. Henri, A. Daele, M. Künzel)

The Role of the CoPs' Observers Team

The first step of enrolment was thus the one of CoPs' observers through two activities: their participation in designing the research methodology, and noticeably the interview guide and the collect of some knowledge about the CoPs involved through project members that had already some contact with these CoPs. The interview guide was thus constructed as a boundary object [Bowker and Star, 1999] between the project workgroup in charge of this part and the CoPs observers (see Table 1).

Table of contents

- 1 Description of the first interview's aim
- 2 Description of the PALETTE project
- 3 Tips for interviewers
- 4 Questions
  - 4.1 Origin of the community
    - 4.1.1 Could you describe the decision process by which the CoP has started?
  - 4.2 CoP's members
    - 4.2.1 Tell us about the members
    - 4.2.2 Could you describe with specific examples the process by which new members enter in the CoP?
    - 4.2.3 How do you describe the involvment of members? Tell us examples where members are very involved and other examples where not.
    - 4.2.4 How would you describe the relations between the members?
    - 4.2.5 Could you give us examples of 'central' members and of 'peripheral' members? Which clues do you use for classify members as 'central' or 'peripheral'?
  - 4.3 Self organization and organigram
    - 4.3.1 How does the community organize itself? Could you describe and give examples of:
    - 4.3.2 Who is the coordinator? Could you describe his/her roles by giving some specific examples?
    - 4.3.3 Can you describe with examples how the CoP manages the crucial stages of its evolution (questions or problems)?
  - 4.4 Organizational and outside context
    - 4.4.1 How could you describe the relationships between the CoP and its organizational context?
    - 4.4.2 How can you characterize the relations between the CoP and the outside?
  - 4.5 Future
    - 4.5.1 In your view, what is the future of the community?
  - 4.6 About the activities of the CoP
    - 4.6.1 Can you describe the activity of CoP compared to what it produces?
    - 4.6.2 What are the current results (in a large sense) of the CoP's production?
    - 4.6.3 In your view, does the CoP create knowledge? If so, can you describe this process of creation?
    - 4.6.4 Can you describe how and where the community finds/retrieves information? Can you describe the process?
    - 4.6.5 Can you describe the mediation process (collaboration, negociation, decision making on specific tasks) ?
    - 4.6.6 How would you describe the learning activities (or the development of competencies) of the members in the community?
    - 4.6.7 Can you illustrate (with examples) some situations of uses of tools (technological and organizational)?
      - 4.6.7.1 Which tools (technological and organizational) are used by CoPs?
      - 4.6.7.2 How could you caracterize the appropriation of the tools by members? Are they well accepted / used?
      - 4.6.7.3 Which tools (technological and organisational) could be useful for CoPs?

Table 1. Table of content of the Interview guide

Table of contents

- 1 Principles for conducting an interview
  - 1.1 Some basic references
  - 1.2 What is the role of CoPs in the project ?
  - 1.3 What is (are) the question(s) we want them to answer ?
  - 1.4 Ethical issues
  - 1.5 Which method for collecting data?
- 2 Conducting interviews in practice
  - 2.1 Before : preparation of the interview
    - 2.1.1 How to proceed ?
    - 2.1.2 Who will observe CoPs ?
    - 2.1.3 How many interviewees ? What sort of person do we intend to interviewe ?
  - 2.2 During the Interview : Tips
    - 2.2.1 Guidelines for Conducting Interviews
    - 2.2.2 The situation of Interview
      - 2.2.2.1 Semi-directing Interview or guided Interview
  - 2.3 After : Recording and Analysis
    - 2.3.1 Retranscription
    - 2.3.2 Analysis

Table 2. Table of content of the Methodology reference document

This interview guide was created using recommendations by Miles & Huberman (2003), with different issues (origin of the CoP, knowledge about the CoPs members, organization...) and a special attention towards software tools that CoPs are using or may need in their everyday life activities. Some general guidelines have also been provided in a Methodology reference document (see Table 2).

The Role of the Data Condensation Team

The second step of enrolment was the one of the project technical partners, who had to be willing to recognise the scientific value of the participatory design methodology and who were also included in the choice of the collaborative representation tool for the data. The MOT+ software is thus a provider of boundary objects between the work group in charge of collecting the CoPs data and the technical workgroups who are developing the tools.

The Data condensation team has started his work from the interviews and, by way of examples, they have proposed different kinds of data representations to our technical partners for their comments and potential proposals in what the follow-up of the process concern. They have managed like a MOT diagrams and vignettes (text format).

Our technical partners agreed on the five following data formats of interviews and other techniques: the audio record, the minutes by minutes timing, synthesis, MOT diagrams (on specific requests), retranscription of some audio records (specifically for KM services). They also add precisions about their requirements and priorities for the information to be treated by the CoPs’ observers team and the Data condensation team.

Some Important Participatory Activities

The interview process by itself is done following several participatory activities:
- the interview by itself is a face-to-face process, involving two CoPs' observers and one or several CoPs' members; technically, the interview is registered as an audio file through a dedicated software; the interview guide is mainly here to remind the interviewers about the categorisation process of the data collection methodology
- the transcription of the interview at two level: one as a "minutes report", enlightening the correspondence between the questions in the interview and the minutes where to find related material (see Table 3); and some more elaborate transcriptions, with more content, organised according to a pre-categorisation process;
- the validation by the interviewee CoPs' members of the transcriptions;
- other data may be extracted from interviews in the form of "vignettes" (small stories), illustrating some typical examples of the CoP’s life; such vignettes are written buy the interviewers and also validated by the interviewees.

The interviews transcriptions are thus boundary objects between the CoPs, the CoPs' observers' community and the project workgroup in charge of data collecting.

Name of the CoP : [redacted] a community of learners made up of 21 members : 15 teachers and 6 learners

Name and role of the interviewee [redacted] pedagogical manager, moderator, responsible for access and planning - and [redacted] (from 01:22:20 to 01:31:27) - a learner

Language of interview : French

Date of interview : 09-05-2006

Name of the observers : Martin Erpicum (ULg) – Nathalie Van de Wiele (ePrep)

Author of the minutes: Nathalie Van de Wiele

Email : nathalie.vandewiele@eprep.org

Other documents collected about the CoP :

- A[redacted]
- A[redacted]

URL of tools/documents used by the CoP :

- [redacted]

File : BADGE-CGE.ogg (1:59:00)

00:00:00	Presentation of Palette's objectives by the observers
00:01:06	Bruno presents himself (involved in continuing education and in data networks)
00:01:36	History of the CoP (a[redacted] created to provide a training suitable for working people)
00:02:10	The begining of the CoP (tools specifications, choice of a platform)
00:04:05	Training schema for [redacted] face-to-face intensive courses (with multimedia CD-Roms and paper documents) for 3 days a month and online courses
00:04:55	Characteristics required for the platform, choice of Telje
00:05:26	Duration of the training (6 months per CES, mixing practical training and conducting projects)
00:06:10	About the [redacted]a (specialized master - M2/D1 - for people having a L2 diploma plus 10 years of experience - the diploma is obtained in 2 or 3 years with 2 CES in 3 domains and is validated b[redacted] conducted in 1 year)
00:10:30	About parity (only one woman for 6 learners)
00:11:58	The interactivity between the learners (they come from different parts of France or North Africa, with an almost similar background, with the same aim : to obtain the [redacted]a)
00:14:10	How the CoP communicates to have new enrolled learner members (through workshops, press, Telecom Companies)
00:16:00	Creation of micro-communities (2 or 3 learners) inside the CoP for conducting projects (these projects are proposed by the teachers)
00:17:24	A first tool for this CoP : Telje (history of Telje - for Maghreb countries ; specifications : 1-for online courses, 2-for tests in limited time and corrections, 3-for interactive meetings - audio-meetings)

Table 3. An example of a minute by minute timing of an interview

The next step is the translation of audio and text data and their inscription (translation-inscription process in the meaning of ANT, see for example [Law, 1992] and [Callon, 1999]) into MOT+ schemata available for the whole project community, and especially the technical partners (see Fig.2). The MOT+ representation may also be sent back to CoPs' members, with comments, if they are interested.

Conclusion and Further Research

From a practical point of view, our experience could be used as a model by people who must, collaboratively and at a distance, understand and improve how CoPs act.. However, we have to be aware of two possible bias related to the status and involvement of the interviewees : the representativeness of the choosen CoPs and the status of the interviewed people inside the CoP to arrive to an understanding of the CoP functioning as realistic as possible.

With the information that was gathered yet, one CoP activity process (see graphical representation) gives a first idea of the services that could be further developed by PALETTE: technical services (how to produce reusable documents, how to annotate a document in an appropriate way) as well as pedagogical services (how to develop strategies that will make students more at ease for using a forum online), services that should in the end facilitate CoPs life.

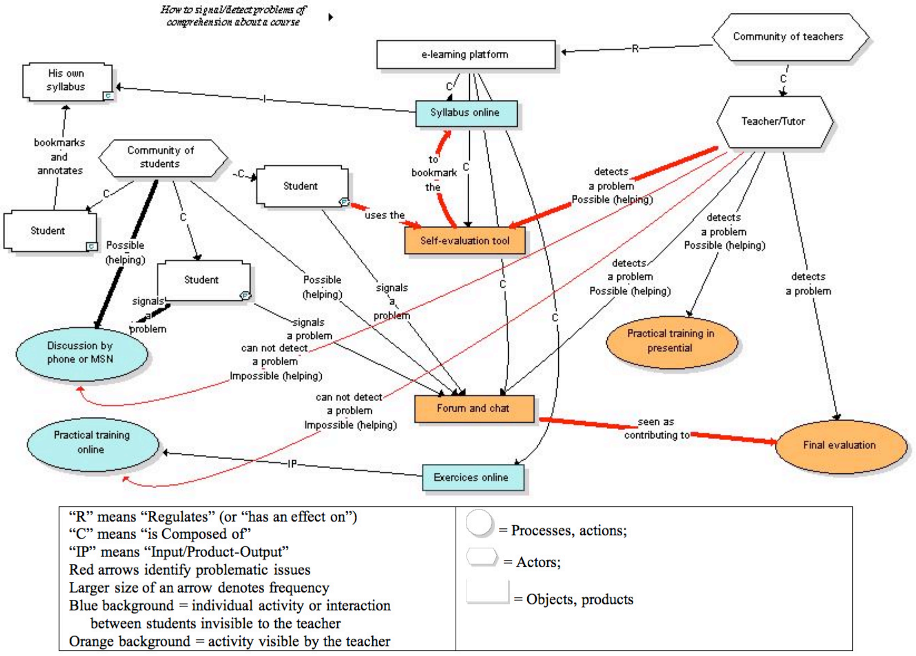

Fig. 2. Graphical representation with MOT+: How to signal/detect problems of comprehension about a course in TE CoP?

References

Bardin, L. (1983). L'analyse de contenu. Paris: PUF.

Bowker, G.C., and Star, S.L., 1999, Sorting Things Out, Classification and its consequences, MIT press, Cambridge, MA

Callon, M. (1999). Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of Saint Brieuc Bay. In M. Biagioli (Ed.) The Sciencer Studies Reader. New York and London, Routledge: 67-83.

Latour, B. (1992). Aramis, ou l'Amour des Techniques. Paris, Éditions de la Découverte.

Latour, B., (1999). On Recalling ANT, in Actor network Theory and After, John Law and John Hassard editors; Blackwell Publishing, Oxford, UK.

Law, J., 1992, Notes on the Theory of the Actor-Network: ordering, strategy, and heterogeneity, Systems Practise, 5(4), pp379-393

L'Ecuyer, R. (1990). Méthodologie de l'analyse développementale de contenu : Méthode GPS et concept de soi. Québec: PUQ.

Miles, M.B. & Huberman, A.M. (2003). Analyse des données qualitatives. (2nd edition). Bruxelles: De Boeck.

Monteiro, Eric, Actor-network theory. In: C. Ciborra (ed.), *From Control to Drift. The D*ynamics of Corporate Information Infrastructure, Oxford Univ. Press, 2000, pp. 71 – 83

Multimedia Authoring for CoPs

Romain Deltour, Agnès Guerraz, and Cécile Roisin

INRIA Rhône-Alpes
655 avenue de l'Europe
38334 Saint Ismier, France
{Romain.Deltour,Agnes.Guerraz,Cecile.Roisin}@inria.fr

Abstract. One way of providing technological support for CoPs is to help participants to produce, structure and share information. As this information becomes more and more multimedia in nature, the challenge is to build multimedia authoring and publishing tools that meets CoPs requirements. In this paper we analyze these requirements and propose a multimedia authoring model and a generic platform on which specific CoPs-oriented authoring tools can be realized. The main idea is to provide template-based authoring tools while keeping rich composition capabilities and smooth adaptability. It is based on a component-oriented approach integrating homogeneously logical, time and spatial structures. Templates are defined as constraints on these structures.

1 Introduction

In order to support the activities of Communities of Practice, the Palette project [6] will provide tools for document production and for document reuse in heterogeneous applications. The objective is to reduce the current limitations caused by the proliferation of data sources deploying a variety of modalities, information models and encoding syntaxes. This will enhance applicability and performances of document technologies within pedagogically consistent scenarios.

The LimSee3 project aims at defining a document model dedicated to adaptive and evolutive multimedia authoring tools, for different categories of authors and applications, to easily generate documents in standard formats (see the authoring process showed in Fig. 1). Our approach is to focus on the logical structure of the document while keeping some semantics of proven technologies such as SMIL [7]. This provides better modularity, facilitates the definition of document templates, and improves manipulation and reusability of content.

This paper is organized as follows: Sect. 2 presents a scenario example that will be developed throughout the paper and thereby analyzes CoPs requirements for authoring multimedia documents. We then define the main concepts on which multimedia authoring tools are based and we classify existing approaches in the light of these concepts. Section 4 introduces our LimSee3 document model and Sect. 5 shows how it can be used for the development of authoring tools tuned for specific CoPs. Last section presents the current state of our development and our perspectives in the context of the Palette project.

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 278-287, 2006.

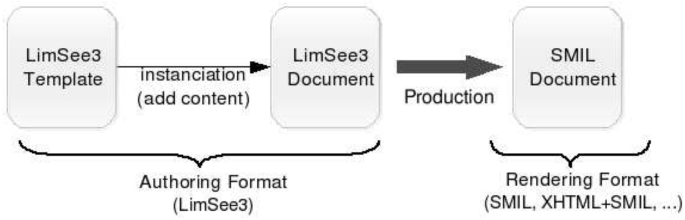

Fig. 1. The authoring process in LimSee3

2 Real-Life Example and Requirements of CoPs

The instrumentation of CoPs heavily relies on communication technologies. In this paper we are concerned with communication through sharing and collaborative authoring of information. We are studying scenarios where experience and knowledge are shared by means of multimedia data, such as annotated video or synchronized slideshow. The key point is that in CoPs, content readers are also content creators but usually have no skills in multimedia authoring. We develop below a concrete scenario of how a particular CoP shares information and then we identify the main requirements of multimedia authoring in such situations.

2.1 Experience sharing between reps

Studies of experiences at companies such as Xerox [8] have demonstrated that CoPs, as the copier repair technicians ("tech reps") CoP, are a very effective way for professionals to share informal or tacit knowledge gained from experience in the field. This sharing of tips, which could not be found in training manuals or classroom settings, was critical to help the tech reps do a better job and was even ultimately fostered by Xerox.

The practice of creating and exchanging stories has two important aspects. First of all, telling stories helps to diagnose the state of a troublesome machine. Reps begin by extracting a history from the users of the machine and with this and the machine as their starting point, they construct their own account. If they cannot tell an adequate story on their own then they seek help from specialists or colleagues (over coffee or lunch).

Brown took example on one service call observed by the ethnograph Orr in [12]. A rep confronted a machine that produced copious raw information in the form of error codes and obligingly crashed when tested. As the error codes and the nature of the crashes did not correspond, the case immediately fell outside the directive training and documentation provided by the organization. Unfortunately, the problem also fell outside the rep's accumulated, improvised experience ; his technical specialist was equally baffled. Solving the problem in situ required constructing a coherent account of the malfunction out of the incoherence of the data and the documentation. To do this, the rep and the specialist embarked on a long story-telling procedure. They explored the machine or waited for it to crash for collecting data such as logs, screenshots, sound records. The rep and specialist recalled and discussed other occasions on which they had encountered some of the present symptoms via phone calls, webcam records, user feedback... Each story presented an exchangeable account that could be examined and reflected upon to provoke old memories and new insights. Yet more tests and more stories were thereby generated. The story-telling process continued forming a purposeful progression from incoherence to coherence.

Ultimately, these stories generated sufficient interplay among memories, tests, the machine's responses, and the ensuing insights to lead to diagnosis and repair. Through story-telling, these separate experiences converged, leading to a shared diagnosis of previously encountered but unresolved symptoms. Rep and specialist were now in a position to modify previous stories and build a more insightful one. They both increased their own understanding and added to their community's collective knowledge. A story, once in the possession of the community, can then be used – and further modified – in similar diagnostic sessions.

The information units that are exchanged in this particular CoP are multimedia story documents that are composed of sequences of story steps where data elements are heterogeneous and multimedia. The challenges are to enrich information with the synchronization of data elements (for instance a phone call with the corresponding webcam excerpt) and to provide a document structure enabling knowledge sharing and reusability (of experience stories).

2.2 Basic requirements

The cooperative platform to be provided to the CoPs must have the two following basic features: (i) authoring tool of stories dedicated to tech reps ; (ii) access tool to read the existing stories on different devices (desktop PC, PDA, mobile phone...). Looking more closely at the ways in which CoPs participants are producing multimedia information, we can identify some requirements for the authoring and presentation platform:

1. Simple and efficient authoring paradigms – because CoPs members are not (always) computer science technicians.
2. Easy and rapid handling of the authoring tool – because new members can join CoPs.
3. Modular and reusable content – because multimedia information results in a co-construction process between members.
4. Evolutive structuring of documents – because of the dynamic nature of CoPs.
5. Use of standard formats – because CoPs need portability, easy publishing process and platform-independence.

Basically, our approach proposes a template mechanism to cope with requirements 1 and 2, a component-based structuring enabling requirements 3 and 4, and relies on proven standard technologies to ensure the last requirement. Before further stating our authoring model, we present in the next section the main concepts and approaches of multimedia authoring on which this work is based.

3 Multimedia Documents and Multimedia Authoring

In traditional text oriented document systems, the communication mode is characterized by the spatial nature of information layout and the eye's ability to actively browse parts of the display. The reader is active while the rendering itself is passive. This active-passive role is reversed in audio-video communications: active information flows to a passive listener or viewer. As multimedia documents combine time, space and interactivity, the reader is both active and passive. Such documents contain different types of elements such as video, audio, still-picture, text, synthesized image, and so on, some of which having intrinsic duration. Time schedule is also defined by a time structure synchronizing these media elements. Interactivity is provided through hypermedia links that can be used to navigate inside the same document and/or between different documents.

Due to this time dimension, building an authoring tool is a challenging task because the WYSIWYG paradigm, used for classical documents, is not relevant anymore: it is not possible to specify a dynamic behavior and to immediately see its result. Within the past years, numerous researches have presented various ways of authoring multimedia scenarios, focusing on the understanding and the expressive power of synchronization between media components: approaches can be classified in absolute-based [1], constraint-based [9], [11], event-based [14] and hierarchical models [7], [15]. Besides, to cope with the inherent complexity of this kind of authoring, several tools [1], [4], [10] have proposed limited but quite simple solutions for the same objective. Dedicated authoring, template-based authoring and reduced synchronization features are the main techniques to provide reasonable editing facilities. But we can notice that these tools generally also provide scripting facilities to enrich the authoring capabilities and therefore loose in some way their easiness.

Beside timelines, script languages and templates, intermediate approaches have been proposed through "direct manipulation" and multi-views interface paradigms. IBM XMT authoring tool [2] and SMIL tools such as LimSee2 [3] and Grins [5] are good examples. In LimSee2, the time structure of SMIL is represented for instance in a hierarchical timeline as shown in of Fig. 2 (4). Time bars can be moved or resized to finely author the timing scenario. This kind of manipulation has proven very useful to manipulate efficiently the complex structures representing time in multimedia XML documents.

However even if XMT and SMIL are well-established languages, the above-mentioned tools are too complex for most users because they require a deep understanding of the semantics of the language (e.g. the SMIL timing model). Moreover these models generally put the time structure at the heart of the document whereas it does not always reflect exactly the logical structure in the way it is considered by the author. Our approach instead sets this logical dimension as the master structure of the document, which is a tree of modular components each one specifying its own time and spatial structures. Additionally, the document can be constrained by a dedicated template mechanism.

A template document is a kind of reusable document skeleton that provides a starting point to create document instances. Domain specific template systems

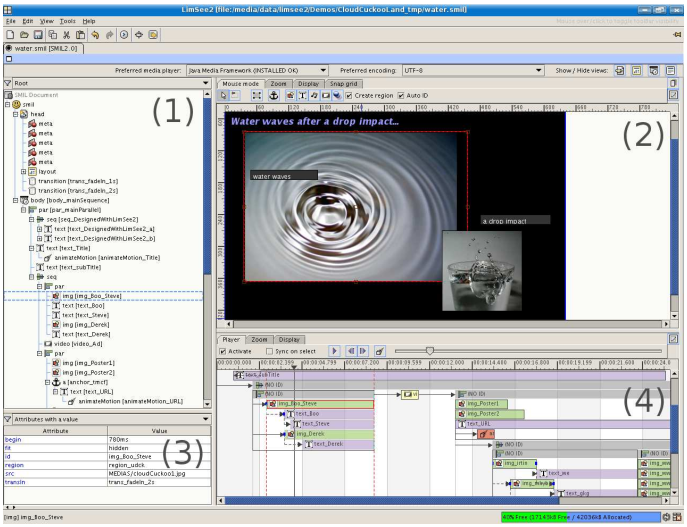

Fig. 2. Multiview authoring in LimSee2

are a user-friendly authoring solution but require hardly extensible dedicated transformation process to output the rendering format. We chose on the contrary to tightly integrate the template syntax in the document: the template is itself a document constrained by schema-like syntax. The continuum between both template and document permits to edit templates as any other document, within the same environment, and enables an evolutive authoring of document instances under the control of templates. There is no need to define a dedicated language to adapt to each different use case.

We believe that the combination of document structuring and template definition will considerably help CoPs in (i) reusability of materials, (ii) optimization of the composition and life cycle of documents, (iii) development and transmission of knowledge, (iv) drawing global communities together effectively.

4 The LimSee3 Authoring Language

4.1 Main Features

In the LimSee3 project, we define a structured authoring language independently of any publication language. Elements of the master structure are components that represent semantically significant objects. For instance a story report document is a list of step components. Each step is composed of several media objects and describes a phase of the story (failure description, machine exploration...). Components can be authored independently, integrated in the document structure, extracted for reusability, constrained by templates or referenced by other components.

The different components of a multimedia document are often tightly related one with another: when they are synchronized or aligned in space, when one contains an interactive link to another, and so on. Our approach, which is close to the one proposed in [13] is for each component to abstract its dependencies to external components by giving them symbolic names that are used in the timing and layout sections. This abstraction layer facilitates the extraction of a component from its context, thus enhancing modularity and reusability.

Finally, the goal was to rely on proven existing technologies, in both contexts of authoring environments and multimedia representation. The timing and positioning models are wholly taken from SMIL. Using XML provides excellent structuring properties and enables the use of many related technologies. Among them are XPath, used to provide fine-grained access to components, and XSLT, used in templates for structural transformation and content generation.

The authoring language is twofold: it consists in a generic document model for the representation of multimedia documents, and it defines a dedicated syntax to represent templates for these documents.

4.2 Document Model

A *document* is no more than a `document` element wrapping the root of the object hierarchy and a `head` element containing metadata. This greatly facilitates the insertion of the content of a document in a tree of objects, or the extraction of a document from a sub-tree of objects.

A *compound object* is a tree structure composed of nested objects. Each compound object is defined by the `object` element with the `type` attribute set to `compound`. It contains a `children` element that lists children objects, a `timing` element that describes its timing scenario and a `layout` element that describes its spatial layout.

The value of the required `localId` attribute uniquely identifies the component in the scope of its parent object, thereby also implicitly defining a global identifier `id` when associated with the `localId` of the ancestors. In Example 1, the first child of object `step1` has the local id `copyLog` and hence is globally identified as `step1.copyLog`.

The timing model, and similarly the positioning model, is taken from SMIL 2.1. The `timing` element defines a SMIL time container. The timing scenario of a component is obtained by composition of the timed inclusions defined by the `timeRef` elements, whose `refId` attributes are set to local ids of children.

```
<document xmlns="http://wam.inrialpes.fr/limsee3/"
  xmlns:smil="http://www.w3.org/2005/SMIL21/">
  <head><!-- some metadata --></head>
  <object localId="step1" type="compound">
    <children>
      <object type="text" localId="copyLog">...</object>
      <object type="image" localId="screenshot">...</object>
      <object type="compound" localId="AnnotatedVid">...</object>
```

```
    </children>
    <timing timeContainer="par">
      <timeRef refId="AnnotatedVid" begin="0s"/>
      <smil:seq begin="0s">
        <timeRef refId="screeshot"/>
        <timeRef refId="copyLog"/></smil:seq></timing>
    <layout height="100" width="100">
      <layoutRef refId="AnnotatedVid" left="0"/>...</layout>
</object></document>
```

Example 1. **A simple story step LimSee3 document**

A *media object* is actually a simple object that wraps a media asset, i.e. an external resource (such as an image, a video, an audio track, a text...) referenced by its URI. It is defined by the `object` element with the `type` attribute set to either `text`, `image`, `audio`, `video` or `animation`. The URI of the wrapped media asset is the value of the `src` attribute. Example 2 shows a text media object with local id `menuItem1` which wraps the media asset identified by the relative URI `./medias/item1.txt`.

Area objects inspired from the SMIL `area` element can be associated with media objects. They are used for instance to structure the content of a media object or to add a timed link to a media object. An area is defined as an `object` element with the `type` attribute set to `area`. For instance, in Example 2 the media object `menuEntry1` has a child area which defines a hyperlink.

Relations of dependency between objects are described independently of their semantics in the document. External dependencies are declared with `ref` elements grouped inside the `related` child element of objects. The value of `refId` of a `ref` element is the id of the related element and the value of `localId` is a symbolic name that is used within the object to refer to the related object. For instance, in Example 2, object `menuItem1` describes a text that links to the object `story.step1`, by first declaring the relation in a `ref` element and then using this external object locally named `target` to set the value of the `href` attribute of the link, using `attribute` and `value-of` elements taken form XSLT.

```
<object localId="menuItem1" type="txt" src="./medias/item1.txt">
  <related><ref localId="target" refId="story.step1"/></related>
  <children><object type="area" localId="link"/></children>
  <timing>
    <attribute name="begin">
      <value-of refName="target" select="@id"/>.begin</attribute>
    <timeRef refId="link">
      <attribute name="href">
        #<value-of refName="target" select="@id"/></attribute>
</timeRef></timing>...</object>
```

Example 2. **A LimSee3 object with external dependency relations**

4.3 Templates

Template nodes aim at guiding and constraining the edition of the document. In order to have better control and easy GUI set up, the language includes two template nodes: media zone and repeatable structure.

A *media zone* is a template node that defines a reserved place for a media object. It is represented by the `zone` element, that accepts a `type` attribute (`text`, `img`, `audio`, `video`, `animation`, `any`, or a list of these types) to define what types of media object can be inserted in this zone. The author can also specify content that will be displayed to invite the user to edit the media zone with the `invite` element (of any media type). For instance Example 3 shows a media zone for an image, with textual invitation. During the authoring process `zone` elements are filled with media objects inserted by the user.

A *repeatable structure*, represented by the `objList` element, is a template node that defines a homogeneous list of objects. Each item of the list matches a model object declared in the `model` child of the list. The cardinality of the list can be specified with the `minOccurs` and `maxOccurs` attributes. Example 3 shows a story template document based on an `objList` named `step-list`, and partially instanciated with three compound objects respecting the `step` model. Thanks to the use of XSLT-like syntax, the timing scenario can be specified independently of the content of children instances.

It is possible to lock parts of a document with the `locked` attribute, to prevent the author from editing anything. This permits for instance to guide more strongly inexperienced users by restricting their access to the only parts of the document that make sense to them.

```
<object localId="story" type="compound">
  <children>
    <objList localId="step-list" maxOccurs="20">
      <model name="step">
        <object type="compound">...</object></model>
      <object type="compound" localId="step1">...</object>
      <object type="compound" localId="step2">...</object>
      <object type="compound" localId="step3">...</object>
  </objList></children>
  <timing>
    <smil:seq begin="1s">
      <for-each
        select="children/objList[@name="step-list"]/object">
        <timeRef>
          <attribute name="refId">
            <value-of select="@localId"/>
    </attribute></timeRef></for-each></smil:seq>
</timing>...</object>
```

Example 3. **A partially instanciated story template**

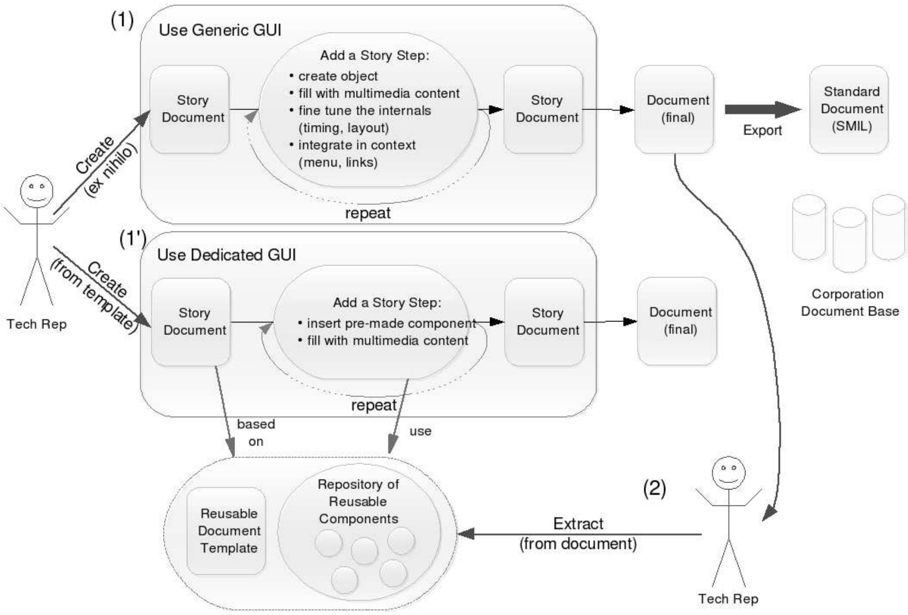

Fig. 3. Authoring with LimSee3

5 Authoring with LimSee3

Figure 3 (2) also shows the creation of a template document from an existing document. The main structure of the document, in this case a sequence of story steps, can be constrained by template nodes such as repeatable structures. Additionally, inter-object relations described in Sect. 4 facilitate the extraction of components from their context so that they can be reused in other documents. In the tech reps CoP, a possible workflow is to first create a story report from scratch (1), then to extract a template document from this report (2), along with a dedicated GUI, to ease the creation of further story reports (1'). This is a typical example of participative design leading to the development of a dedicated tool based on the LimSee3 generic platform.

The LimSee3 model leads to the development of authoring tools that fit the requirements of Sect. 2.2. We are defining a generic platform that permits to manipulate all the elements defined in the model (documents, compound objects, timing and layout details, relations...). It provides features based on the proven authoring paradigms described in Sect. 3 such as multi-views, timeline, structure tree an 2D canvas. In the reps CoP example described in Sect. 2, a tech rep could have used the generic GUI to create the story report ex-nihilo, as shown in Fig. 3 (1), incrementally adding story steps by creating and integrating new objects in the document (resulting in the LimSee3 document of Example 1). Once fully authored, the story report can be persistently added to the base of documentation maintained by the company, and published on demand to any output format (provided its semantics is included in the document model).

Another approach is to use a domain-specific template with dedicated GUI, as shown in Fig. 3 (1'). For instance, a template for a story report could consist in a repeatable structure of story steps. These steps could be instanciated from existing template components such as an audio zone for phone calls, a text zone for machine logs, ... The constraints of the template would guide the tech rep in the creation of the document, reflected in the GUI by dedicated buttons or menu items such as "add a story step", "insert a phone call record", or a form-based interface for adding titles or comments to multimedia content. In the underneath manipulated model, the tight integration of template nodes in the document ensures a smooth evolution from the template to the final document.

6 Conclusion

The model presented in this paper develops a practice-based approach to multimedia authoring dedicated to communities where collaborative and participative design is of high importance. It improves reusability with template definitions and with the homogeneous structuring of documents. This document model is being implemented as cross-platform java software. In the context of Palette, we will use this model to develop dedicated authoring tools for pedagogical CoPs.

References

1. *Adobe Authorware 7 and Director MX 2004*. http://www.adobe.com/products/.
2. *Authoring in XMT*. http://www.research.ibm.com/mpeg4/Projects/AuthoringXMT/.
3. *LimSee2*. http://wam.inrialpes.fr/software/limsee2/.
4. *MS Producer for PowerPoint*. http://www.microsoft.com/office/powerpoint/producer/.
5. *Oratrix Grins*. http://www.oratrix.com/.
6. *Palette*. http://palette.ercim.org/.
7. *W3C SMIL*. http://www.w3.org/AudioVideo/.
8. J. S. Brown and P. Duguid. Organizational learning and communities-of-practice: Toward a unified view of working, learning and innovation. *Journal Information for Organization Science*, 2(1):40–57, 1991.
9. M. Buchanan and P. Zellweger. Automatic temporal layout mechanisms. In *ACM Multimedia'93*.
10. X. Hua, Z. Wang, and S. Li. LazyCut: Content-aware template based video authoring. In *ACM Multimedia'05*.
11. M. Jourdan, N. Layaïda, C. Roisin, L. Sabry, and L. Tardif. Madeus, an authoring environment for interactive multimedia documents. In *ACM Multimedia'98*.
12. J. Orr. *Sharing Knowledge, Celebrating Identity: War Stories and Community Memory in a Service Culture*, pages 169–189. Sage Publications.
13. H. Silva, R. Rodrigues, L. Soares, and D. M. Saade. NCL 2.0: integrating new concepts to XML modular languages. In *ACM DocEng'04*.
14. P. Sénac, M. Diaz, A. Léger, and P. de Saqui-Sannes. Modeling logical and temporal synchronization in hypermedia. *IEEE J. on Sel. Areas in Comm.*, 14(1), 1996.
15. G. van Rossum, J. Jansen, K. Mullender, and D. Bulterman. CMIFed : a presentation environment for portable hypermedia documents. In *ACM Multimedia'93*.

Finding Communities of Practice from User Profiles Based On Folksonomies

Jörg Diederich and Tereza Iofciu

L3S Research Center, Leibniz Universität Hannover
Expo Plaza 1, 30539 Hannover, Germany
Email: {diederich, iofciu}@l3s.de

Abstract. User profiles can be used to identify persons inside a community with similar interests. Folksonomy systems allow users to individually tag the objects of a common set (e.g., web pages). In this paper, we propose to create user profiles from the data available in such folksonomy systems by letting users specify the most relevant objects in the system. Instead of using the objects directly to represent the user profile, we propose to use the tags associated with the specified objects to build the user profile. We have designed a prototype for the research domain to use such *tag-based profiles* in finding persons with similar interests. The combination of tag-based profiles with standard recommender system technology has resulted in a new kind of recommender system to recommend related publications, keywords, and persons. Especially the latter is useful to find persons to potentially cooperate with and to monitor the community to be able to enhance a user's current Community of Practice.

1 Introduction

For people in a community (such as professors and students in the research community), a well-defined profile expressing their current interests is highly valuable. As one main application, such profiles can help to find persons who work on related topics and, thus, help to facilitate cooperation within the community.

Two steps are necessary to create user profiles:

1. Determine the user profile schema, i.e., how the user profile should look like.
2. Determine how to populate the user profiles with actual data for particular users.

Both steps are interrelated: In general, the higher the accuracy of the user profile is, the more data the profile schema comprises, and a large schema in general leads to more complex handling and maintenance of the profiles. Especially the problem of populating user profiles with actual and accurate data is difficult to solve for large profiles as accurate data mostly is based on human inspection.

In this paper, we propose to use tagged corpora of objects to create user profiles in domains, where such folksonomies are available. The basic idea is to let people create their profiles by specifying the most relevant objects in the folksonomy. Afterwards, this *intermediate profile* comprising the objects is translated into the tag domain, assuming that the manually specified tags describe the objects with a high accuracy. Hence, the

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 288-297, 2006.

representation of the *final user profile* is based on the tags of the most relevant objects. This has the advantage that users only have to specify comparatively few objects to generate a reasonably large user profile. Furthermore, it is easier to find related user profiles as tags are typically shared by several objects.

We apply our approach to the domain of digital libraries, using a subset of the DBLP data set as object corpus, which has been enhanced with ‘tags’, e.g., the keywords that were manually specified by the authors of the publications. The resulting user profiles, generated by our prototypical *TBProfile system*, are represented by keyword vectors and are exported in RDF (as already proposed in the eLearning domain [5]), so they can be reused in other domains with similar tags. The TBProfile system uses standard recommender system technology on these profiles to recommend other publications, other relevant keywords (for refining the user profile), and finally other relevant persons. These persons, being relevant for the user, are potential candidates to collaborate with and, thus, to be added to the user’s Community of Practice.

This paper is organized as follows: The related work is given in Section 2. In Section 3 we describe our approach to creating and maintaining user profiles and present our experimental setup. Section 4 describes how to provide users with relevant recommendations based on these user profiles and how to build communities of practice. We conclude and outline future research directions in Section 5.

2 Related Work

There are different approaches to extracting user profiles from users’ past activities and using them for discovering and analyzing communities. In [4], the similarity between peers in social collaboration networks is used to improve search in a peer-to-peer network. The similarity is computed based on publications and their references. The user profile is build based on the publications the user has stored on her desktop. This approach is too broad as the documents a user stores are usually not focused enough. The system takes into account all publications found, including ones dealing with topics the user may no longer have interest in or that the user has stored without even reading them or working on the topic.

Middleton et al. [9] present a recommender system for online academic publications where user profiling is done based on a research paper topic ontology. The system monitors what research papers a group of person has downloaded from the web and stores them on a server. For all downloaded research papers, terms are extracted from the full text using standard information retrieval techniques to be able to represent the paper with term vectors. The system uses different classifiers to assign topics to the papers. User profiles are automatically built based on the vector-representation of those research papers, downloaded by a particular person in the monitored group of persons, and can be refined based on relevance feedback. Finally, the system gives recommendations for each user based on the user’s profile. While an automatic update of the profile based on actual browsing of papers (similar to other publication recommender systems [1, 11]) can reduce the efforts for creating and maintaining user profiles, this is in contrast to the issue that user profiles are typically rather stable over time, while the ‘browsing task’ is often focused on a short-term goal (e.g., help a colleague to find something or explore a topic which finally turns out not to be interesting). Hence, not all browsed documents are relevant to the user, even if we take into account the time spent on the respective document. Also, we would like to limit the collection of explicit relevance feedback which can create quite a workload for the user. Furthermore, the approach is pretty intrusive as it requires the monitoring of the browsing behavior of a group of persons. In contrast, our approach is based on publicly available information about objects and manually-assigned tags of objects. As manually assigned tags are assumed to be highly accurate, our approach does not suffer from the inaccuracy of an automatic classification system.

Existing systems to recommend publications in the domain of research are mainly keyword-based search engines (e.g., google scholar, ACM digital library etc.). They are mainly intended to fulfill short-term search objectives (find a paper with a specific title, find the paper for a specific author etc.). However, some papers are difficult to find based on keywords only, especially if a research domain is already well known. Furthermore, once a researcher has written a paper, she might turn to a different topic within her research interests, but still would like to be informed about the development in some of the topics, she has previously worked on. Hence, a recommender system for research papers [8] based on a long-term user profile is highly desirable. While the issue of user profiles has been found to be highly relevant for recommender systems [10], it has not been addressed sufficiently in the literature, and there are no existing systems which share the user profiles they are using to take advantage of the distributed knowledge about the users. This gap is intended to be filled by our TBProfile prototype.

3 TBProfile: A Tag-Based User Profile Generator

This section presents our approach to creating and maintaining user profiles. The basic idea is to relate a user with a set of tagged objects and store them in an intermediate user profile. The final representation of the user profile is based on the tags associated with the objects. An example set of objects (publications from the Semantic Web domain) forming an intermediate user profile is shown in Table 1.

Publication title	Tags (Keywords)
Magpie: supporting browsing and navigation on the semantic web	named entity recognition (NER), semantic web, semantic web services, ...
Bootstrapping ontology alignment methods with APFEL	alignment, mapping, ontology, ...
Swoogle: a search and metadata engine for the semantic web	rank, search, semantic web, ...

Table 1. Example: Intermediate user profile comprising a set of tagged publications

A user having selected only these three publications will be described by the final user profile shown in Table 2. Using the tags in the user profile has several advantages:

User	...	NER	Semantic Web	SW Services	Alignment	Mapping	ontology	rank	search ...	
A	...	1	2	1	1	1	1	1	1	...

Table 2. Example for the final representation of a user profile

– A more accurate description of the user's interests based on the content of the selected objects.
– A denser population of the user profile, i.e., less non-empty values (assuming that the objects are on average tagged with more than one tag). This approach can be extended to adding those tags to the user profile, which are clearly subsumed by another tag (such as 'RDF' being a sub-topic of 'Semantic Web'). These can automatically be derived, for example, using the GrowBag approach [2] and can further reduce the sparsity of the user profile.
– A lower dimensionality of the user profile if the number of tags is smaller than the number of tagged objects. For this purpose, a controlled dictionary [14] can been derived from the set of all tags. As tags are typically power-law distributed [7], removing the rarely-used tags can reduce the dimensionality of the user profiles by several orders of magnitude (in our experiments, 8600 tags out of 130,000 represented 60% of all occurrences of tags).
– A higher connectivity among the different user profiles as the user profiles are more dense and because the tags in folksonomies tend to be power-law distributed.

In our approach we want to support several different ways of creating user profiles starting from a corpus of tagged objects:

1. Search or navigate through the set of available tags, selecting a subset of the most interesting ones to be able to present the objects associated with this subset of tags, from which the user can select the most interesting ones. This can make use of automatically derived relations between tags as proposed in the GrowBag approach [2].
2. Browsing through the set of objects already existing in the user profile, adding / deleting objects and / or single tags.
3. Browsing through the list of recommended objects (such as publications or persons in the publication domain) and tags and adding the most interesting ones to the profile.

Each user has the possibility to individually modify her profile by adding new objects or removing objects the user is no longer interested in. Also, it should be possible to mark certain topics as 'not interesting': If an object has been tagged by several persons, not all the tags of an object may describe the interests of one particular person. In the publication domain, for example, this means that not all the keywords of a publications with several authors may be relevant for the interests of one particular author; the non-relevant keyword might be referring to a part of the publication written by another co-author.

The tags are typically gained using a manual 'tagging' approach (e.g., in the publication domain, the authors already provide a set of keywords describing their publications). Alternatively, keywords can be retrieved using Information Retrieval methods, for example, from the title, the abstract, or the full text of the publication, though they are typically of lower quality.

3.1 Approaches to Creating and Maintaining User Profiles

Which of the three earlier mentioned ways to creating user profiles are best suited for a particular user strongly depends on the type of user: For users without a profile, we first try to bootstrap a user profile based on the tags, the user herself has contributed to the folksonomy system (if existing). While this is easy in general folksonomy systems, problems arise in the publication domain because of missing user ids. Hence, it is necessary to match the user name with the names of all authors in the publication dataset and present a list of papers, where the author names match the user name. The user can subsequently process this list to eliminate publications from other authors having the same name.

If a new user has not tagged any objects herself, she can alternatively search the set of available tags to find those tags which best describe her interests. They are used as a conjunctive query to identify a list of potentially interesting publications. To accommodate too large / too small result lists, tags can be added / removed on-the-fly to get a reasonable size of the result list. Tag hierarchies as generated by the GrowBag system [2] can be used to easier navigate through related tags.

After having selected a set of tags, a user can preview and browse the current intermediate user profile comprising the list of objects that are annotated with these tags, adding interesting objects to the user profile or deleting those objects, which are no longer interesting. This also means that the tags associated with this object are added to or removed from the final tag-based profile. This approach enables an automatic assignment of cardinalities in the user profile. For example, if a user has selected five objects as interesting from which three are tagged with ‘Semantic Web’, the cardinality of the tag ‘Semantic Web’ in the user profile will be three. In contrast, if the user chooses the interesting tags directly, she would have to assigned the cardinalities manually.

Based on the user profile, the system can also recommend other possibly interesting items or even related tags (cf. Sect. 4). They can be used to further extend and refine the user profile, in case the user agreed with some part or with all recommendations. This is especially useful for people who already work in their community for quite some time and want to monitor the dynamics of the community.

After the user has finished editing her profile we want to export the profile in the RDF format (similar to a FOAF file) which the user can put on her homepage. This allows for an easy exchange of user profiles within a community. Furthermore, other tools can be used to change and maintain the user profile and re-introduce it again to our system later. Hence, we export both the tag-based user profile and also the collection of objects on which the user profile is based. For this purpose, we need unique identifiers for the objects, such as a URL. Moreover, users can also directly view their profile with any RDF viewer and see how their interests overlaps with their colleagues.

3.2 Experimental setup

The TBProfile system applies our ideas to the digital library domain, where the tagged objects are publications and the tags are the keywords, manually annotated by the authors of the publication.

We have used the DBLP collection of around $650,000$ computer science related publications, providing the URLs for about $330,000$ of the publications. As described in [2], all manually annotated keywords were extracted from the provided URLs using a wrapper-based approach. From about 53.000 URLs, proper tags could be found, resulting in a ‘folksonomy’ of tagged publications with around 130,000 popular unique tags. All tags were post-processed using acronym replacement (e.g., WWW → World Wide Web) and Porter stemming and the tags which were mentioned less than five times were filtered out. This resulted in a controlled vocabulary of about $8,600$ 'main' tags, representing 60% of all occurring tags due to the power-law distribution of tags.

The TBProfile system comprises also a web application which allows the users to select tags from the controlled vocabulary of tags, either by browsing the set of available tags or by starting from the set of defaultly assigned publications and using the recommender system. For the selected tags, a user can search for publications and select the ones relevant to her current interests. When the user has finished editing her list of publications, she can view her profile and get recommendations about other publications, tags, and persons.

As an example, Table 3 shows the tag-based profile of 'Wolfgang Nejdl', which has been gained only using his publications available in our tagged DBLP collection.

Keyword name	Occurrences	Global Frequency
XML	1	554
UML	1	302
Web services	1	193
Ontology	1	158
Adaptation	1	102
Semantic Web	5	190
Peer-to-peer	4	123
Personalization	4	92
Standards	1	61
Query languages	1	63
Hypermedia	1	93
Generalization	1	25
Web search	1	49
E-learning	1	59
Network management	1	49
Diagnosis	1	49
Ranking	1	31
Pagerank	1	38
Web engineering	1	35
Adaptive hypermedia	2	30
Meta-modeling	1	9
XML scheme	1	23
XMI	1	9
Asynchronous collaboration	1	8
Synchronous collaboration	1	5
Adaptive Web	2	5

Table 3. Tag-based profile of Wolfgang Nejdl

The column 'Occurrences' denotes the number of times the keyword appears in the profile and 'Global Frequency' represents how many times the keyword appears in all publications of the community.

Additionally, we also want to let the users explore different sources for the tags assigned to an object. In the digital library domain, this can be, for example, keywords derived from the publication title, or keywords derived from the abstracts. While manually created keywords usually have a very high quality, using keywords extracted from the title / the abstract leads to a larger set of tagged documents for the case that not all documents were manually tagged by the authors.

4 Using Tag-Based Profiles for Recommendations

One application of the created user profiles is to provide the user with recommendations about related objects or tags (i.e., to use in regular search engines), and related users with similar interest, who are candidates for collaborations. The main intention is to deeper analyze the research community.

4.1 Basic Idea

The basic idea is to use the tag-based profiles as input to standard recommender system technology [12], to be able to recommend related objects, tags and persons. Hence, we combine the 'user profile' aspect of collaborative filtering systems with the feature-representation aspect of content-based systems. This means, we combine the idea of letting users 'recommend' items, which is a different interpretation of users tagging objects, with the characteristics of legacy information retrieval systems and the derived content-based recommender systems, where objects are represented by their features, typically a vector of terms.

The TBProfile system comprises a user-item recommender system, that computes similarities between users based on a cosine function, that has been extended with the concept of an 'inverse user frequency' [3] as the analogue concept to TFxIDF in the recommender system domain. The similarity between two users $U1$ and $U2$ is computed as shown in Eq. (1)

$$cos\_iuf(U1, U2) = \frac{\sum_i v_{U1}(i) * iuf(i) * v_{U2}(i) * iuf(i)}{\sqrt{\sum_k (v_{U1}(k) * iuf(k))^2 * (v_{U2}(k) * iuf(k))^2}} \tag{1}$$

with $v_U(i)$ being the normalized 'vote' of user U for the item i, and $iuf(k)$ defined as shown in Eq. (2)

$$iuf(k) = log(\frac{\text{number of users}}{\text{number of votes for k}}) \tag{2}$$

As an example, for a user $U1$ having selected three publications for her profile with in total 10 distinct keywords K_{U1}, $v_{U1}(i)$ will be $1/10$ for $i \in K_{U1}$.

The neighborhood N_U for each user U is computed using the k-nearest neighbor approach [13] with $k = 20$. Finally, we compute the recommendation for a certain item I by aggregating the votes of all neighbors of U in a similarity-weighting [6] approach according to Eq. (3)

$$rec(U, I) = \frac{\sum_{j \in N_U} v_j(I) * cos\_iuf(U, j)}{\text{neighborhood size}} \tag{3}$$

The neighborhood size can at most be k, but may be smaller if only very few similar users are found for the given user U.

Our system can provide several kinds of recommendations:

1. Objects based on users.
2. Users based on objects.
3. Users based on co-tagging.
4. Tags based on users.
5. Users based on tags.

In the first case, the recommender system uses a standard user-object matrix to be able to recommend related objects (e.g., publications in the digital library domain [8]). In the second case, the matrix is transposed to be able to recommend users instead of objects. This is one variant to get information about other users in the community. In the third variant, the recommendation is based on a matrix of users having tagged the same objects. This can also be used to get information about people in the community. The fourth case is the first one, where we actually use the tag-based user profiles to create a user-tag matrix and finally recommend tags for the users in that matrix. By transposing this matrix, we are able to recommend users based on the tags users have annotated, which is the last variant described here.

4.2 Experimental setup

Our TBProfile application can give recommendation for publications, keywords and other users of the system. For our experiment we have selected the top 60 authors who have published publications with the topics “semantic web” and “OWL”. For these authors we have built their profiles based on the keywords of the papers they have authored. The intermediate profiles comprised on average 34 publications while the number of keywords per authors was only 16 due to the fact that only 20% of the publications in our database are tagged.

For the profile from Table 3 we show the recommendations in the following tables regarding recommended authors. We only provide the user with at maximum the top ten results.

Table 4 is the result of case 3, i.e., based on a co-author matrix.

Recommended author	score
Rudi Studer	0.0512828
Dieter Fensel	0.0362056
Ian Horrocks	0.0238108
Peter F. Patel-Schneider	0.0221371
Raphael Volz	0.022023
Alexander Maedche	0.0183598
York Sure	0.013157
Timothy W. Finin	0.0268965
Nenad Stojanovic	0.00993426
Enrico Motta	0.00619568
Daniel Oberle	0.0060706

Table 4. Recommendations based on coauthorship

These recommendations clearly focus on the ‘senior’ people, having long lists of publications. In this recommendation, tags have not been used at all. In contrast, the

Recommended collaborators	score
Steffen Staab	0.390822
Axel Polleres	0.311705
York Sure	0.299058
Siegfried Handschuh	0.253242
Nigel Shadbolt	0.214939
Dieter Fensel	0.21334
Ruben Lara	0.206428
Yuan-Fang Li	0.193029
Bijan Parsia	0.187487
Carole Goble	0.17375

(a) . . . based on keywords

Recommended collaborators	score
Siegfried Handschuh	0.411228
Rudi Studer	0.274152
Dieter Fensel	0.137076
York Sure	0.137076

(b) . . . based on publications

Table 5. Recommended collaborators. . .

recommendations based on the tags (cf. Table 5 (a)), are based on the content and are not related to the number of publications. Hence, also 'junior' people are recommended by our main scheme. For comparison, we also show the result of case 2 in Table 5 (b)), where we use the transposed user-publication matrix to recommend users. We can see, that only four persons can be recommended here, for other users of the system this list of recommendations was even empty. This is because the user-publication matrix is in general less connected than the matrix based on the tags as people tend to share tags and use some of them very often (the 'stars' in the power-law distribution).

5 Conclusions and future work

Having a well-defined user profile can be very helpful, especially in research communities where people are explicitly interested in finding out firsthand about what happens in their line of work. No matter if people are interested in finding new relevant publications, related topics or about people to collaborate with, their user profile can support the information flow in their Community of Practice. In this paper, we use the tags from a folksonomy system to build user profiles and feed them to a recommender system, especially to identify related persons in the community. This unique combination of the user profile aspect of collaborative recommender systems with the feature-based schema to describe user profiles (as used in content-based recommender systems) is intended to better capture the interests of the users in the recommendation process and to reduce problems with sparse user profiles. We have shown the TBProfile prototype, implementing a rudimentary system for creating tag-based user profiles in the digital library domain and using a user-item based recommender system to find potential people to extend a user's community of practice. Even though only 20% of the publications in our database are tagged, we have shown evidence that using tag-based profile can give more recommendations than standard object-based user profiles.

For future work, we want to focus mainly on the evaluation of our system, especially involving relevance feedback of real users by notifying them regularly about new interesting publications, persons, and keywords and using answers about the value of the recommendation to update the user profile. Furthermore, we want to compare the recommendations provided by different tagging schemas (manually tagged vs. automatically derived from the title or the abstract). You can see our current prototype at http://www.l3s.de/∼diederich/TBProfile.

References

1. N. Agarwal, E. Haque, H. Liu, and L. Parsons. Research Paper Recommender Systems: A Subspace Clustering Approach. In *International Conference on Web-Age Information Management (WAIM)*, pages 475–491, 2005.
2. W.-T. Balke, U. Thaden, and J. Diederich. The Semantic GrowBag Demonstrator for Automatically Organizing Topic Facets. In *Proceedings of SIGIR2006 Workshop on Faceted Search*, Seattle, USA, August 2006.
3. J.S. Breese, D. Heckerman, and C. Kadie. Empirical Analysis of Predictive Algorithms for Collaborative Filtering. In *Proc. of Conference on Uncertainty in Artificial Intelligence*, pages 43–52, Madison, USA, July 1998. Morgan Kaufmann Publisher.
4. P.-A. Chirita, A. Damian, W. Nejdl, and W. Siberski. Search Strategies for Scientific Collaboration Networks. In *Proceedings of 2nd P2P Information Retrieval Workshop held at the 14th ACM International Conference on Information and Knowledge Management (CIKM)*, Bremen, Germany, 2005.
5. R. Denaux, L. Aroyo, and V. Dimitrova. An approach for ontology-based elicitation of user models to enable personalization on the semantic web. In *Proc. of the International World Wide Web Conference (WWW)*, pages 1170–1171, New York, NY, USA, 2005. ACM Press.
6. J. Herlocker, J.A. Konstan, and J. Riedl. An empirical analysis of design choices in neighborhood-based collaborative filtering algorithms. *Information Retrieval*, 5(4):287–310, 2002.
7. A. Hotho, R. Jäschke, C. Schmitz, and G. Stumme. Information retrieval in folksonomies: Search and ranking. In York Sure and John Domingue, editors, *The Semantic Web: Research and Applications*, volume 4011 of *LNAI*, pages 411–426, Heidelberg, June 2006. Springer.
8. S.M. McNee, I. Albert, D. Cosley, P. Gopalkrishnan, S.K. Lam, A.M. Rashid, J.A. Konstan, and J. Riedl. On the Recommendation of Citations for Research Papers. In *Proc. of ACM Conference on Computer Supported Cooperative Work (CSCW)*, New Orleans, USA, November 2002. ACM.
9. S.E. Middleton, N.R. Shadbolt, and D.C. De Roure. Ontological User Profiling in Recommender Systems. In *ACM Transactions on Information Systems (TOIS)*, pages 54–88. ACM Press, 2004.
10. M. Montaner, B. López, and J.L. de la Rosa. A Taxonomy of Recommender Agents on the Internet. *Artificial Intelligence Review*, 19:285–330, 2003.
11. D. Pavlov, E. Manavoglu, D.M. Pennock, and C. Lee Giles. Collaborative filtering with maximum entropy. *IEEE Intelligent Systems*, 19(6):40–48, 2004.
12. P. Resnick and H.R. Varian. Recommender Systems. *Communications of the ACM*, 40(3):56–58, 1997.
13. B. Sarwar, G. Karypis, J. Konstan, and J. Riedl. Analysis of Recommendation Algorithms for E-Commerce. In *Proc. of ACM Conference on Electronic commerce (EC)*, pages 158–167, Minneapolis, USA, October 2000.
14. F. Sebastiani. Machine Learning in Automated Text Categorization. *ACM Computing Surveys*, 34(1):1–47, March 2002.

On the Use of Actor-Network Theory for Developing Web Services Dedicated to Communities of Practice

Liliane Esnault - esnault@em-lyon.com
EM LYON – 23 Avenue Guy de Collogue – 69134 Ecully Cedex – France
Romain Zeiliger - zeiliger@gate.cnrs.fr
Frederic Vermeulin - vermeulin@gate.cnrs.fr
GATE-CNRS – 13 Chemin des Mouilles – 69132 Ecully Cedex – France

Abstract. Communities of practices are more and more recognized by companies, individuals and groups as valuable places to share and create knowledge. Communities of practice have to be cultivated in order to fully create the value they may bring to their environment. They need interoperable, flexible, ubiquitous, and specific collaborative tools to support their work. Developing such tools and enabling their use among communities of practice requires adopting a Participatory Design approach. Actor Network Theory (ANT) is then used to define a methodology that fosters the participation of heterogeneous stakeholders to the design process. As a case study, we show that ANT concepts are useful to analyse the design context of an European project named PALETTE that aims at developing interoperable services for helping communities of practices to better cultivate themselves

Keywords: communities of practice, participatory design, actor-network theory, European projects

1 Introduction

Our focus is on reflecting upon a design methodology that could help providing a community of practice (CoP) with enough suitable and usable tools so that it is able to cultivate itself appropriately. Wenger et al. (Wenger et al. 2002) identify seven principles for cultivating communities of practice: design for evolution, open a dialog between inside and outside perspectives, invite different levels of participation, develop both public and private community spaces, focus on value, combine familiarity and excitement, create a rhythm for the community.
We are well aware that these processes of cultivating communities of practice go far beyond the design of tools. But collaboration, communication, knowledge management, document exchange, problem solving are activities that cannot be accomplished without a strong support from technology enabled tools, all the more so because communities members are scattered in different locations and even across different organizations.

Usual communication tools like e-mail, and forums are naturally the common basis for communication. But they are not efficient enough to really support the development of the activities of a community of practice to the point where it can start create value for

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 298-306, 2006.

itself and its environment. CoPs need tools that answer better to their specific needs and usages. They have - simply - to create, reuse, store, share, exchange, publish, represent and capitalize information. But the nature of the information, the content and the value of it are somewhat different than what a usual database or document management system can provide. The information that is manipulated in a community of practice is more often informal, declarative, textual or graphic, qualitative, practice-oriented, sometimes not well formalized or even expressed. It may deal with a lot of different subjects, the relevance and value of which are only decided by the community. Thus a community of practice needs tools that share some common features, among which:

- be available anywhere;
- allow flexible use, depending of the skills of the members regarding technology;
- cover a range of document management functions: creation, modification, publication, exchange, storage, retrieval, all on a collaborative basis;
- cover a range of information representation and modelling functions providing a mean for creating a common ground within the community;
- cover a range of knowledge management functions, related to the practice and the identity of the community, and the learning activities within the community;
- enable communication, collaboration and cooperation in the way that is useful for the community, both inside the community and between the community and its environment;
- allow to understand, represent, enrich, share members' expertise.

Such tools might be different - even radically - from the usual IT that are used in companies or for the day-to-day job. They are merely based on new technologies, open-source or "open-source minded" (the usefulness and quality of which are qualified by users, not by proprietary developers). They have to be interoperable, evolutionary, flexible *and truly* collaborative. They are likely to appear as a set (a "palette" of interoperable web services.

2 Designing web services for communities of practice: Actor-Network Theory and Participatory Design

The Participatory Design approach may be considered as a process of negotiation of usefulness to be achieved through reconciling the contrasting perspectives of various stakeholders, including users, designers and others. We argue that using ANT[1] to

[1] ANT was formerly the acronym for Actor-Network Theory. It is now used as itself, and even one of its first creators, Bruno Latour, recognises that it has become something different, and if it was created now, he would probably not have used the same words, specially the word network that he feels confusing now [Latour 1999]. We will then use ANT as a name and not as an acronym

analyse design situations where CoPs[2] are involved can help defining a suitable Participatory Design methodology.

There are different interpretations of the usefulness of technology. As stated by Abreu de Paula: "perception of usefulness is not statically embedded in its design, but is dynamically and constantly created and shaped by different social groups. In this respect, one important goal is to attempt to reconcile these often contrasting perspectives" (Abreu de Paula, 2004). While Participatory Design does not explicitly address the social construction of usefulness, it may be considered as framing the social interactions that eventually lead to a recognised useful system.

The main difficulty of Participatory Design remains the organization and management of an efficient participation – i.e. a participation that can truly influence the design process. Each actor of the design process is an expert of her domain and this expertise influences the design process. However actors are heterogeneous in respect to their disciplines, preoccupations and interests: they don't speak the same "language". For them to interact necessitates that they construct together a "common ground". This is achieved through participative activities that mediate participation. Examples of such activities include brainstorming meetings, prototype demonstration, scenario performing, role playing, design games. Participative activities are often hampered by suspicion and even conflict.

Some of these activities may focus on creating boundary-objects (Bowker and Star, 1999; Gasson, 2006) i.e. objects "to-think-with" that facilitate mutual understanding and trust among participants with various backgrounds. A mock-up, an intermediate version of the final product, a use-case or a scenario are classical boundary-objects. This concept is closely related to what Wenger says about reification: "reification … refer to the process of giving form to our experience by producing objects (…) In so doing we create points of focus around which the negotiation of meaning becomes organized"(Wenger, 1998).

ANT provides a conceptual framework helping formulating and building a design methodology that sustains efficient participation of heterogeneous. ANT portrays an alignment that differs from the traditional system development one along crucial dimensions: there is an open-ended array of "things" that need to be aligned including work-routines, incentive structures, system modules and organisational roles. It follows immediately that there can be no strict top-down control over such a collection of things (Monteiro, 2000). Actors' heterogeneity is one of ANT main originalities. An actor is characterized first hand by its capability to act and interact, its influence. ANT thus clearly acknowledges that a lot of "things" - humans and non-humans - do have an influence (McBride). The notion of participation is extended to take into account the

[2] Just as for ANT, we will use the term CoP to refer to a community of practice, following Wenger's recommendation that "community-of-practice" should be viewed as a unit (Wenger, 1998)

participation/influence of non-human actors, such as artefacts and organisations. This is obviously an interesting feature when describing a socio-technical system.

ANT concepts seem appropriate for preparing design strategies, in a Participatory Design context, that aim at "aligning the interests of the actor-network " i.e. having all their influences fit together. The alignment of the network is obtained through processes of translation: translation means both a move of some actor's interests and a translation - in the sense of change of language or representation - of those interests in order to align them with the interests of other actors. According to Callon (Callon, 1999), the translation process includes several steps, among which: *interessement* and enrolment. *Interessment* and enrolment focus on negotiating acceptable roles for the human actors.

The next ANT concept is inscription, meaning that "aligned interests [are] inscribed into durable material" (Law, 1992). A translation process supposes a medium or a material in which it is inscribed (boundary objects, for example, may support inscription). According to Akrich: "A large part of the work of innovators is that of inscribing their vision of the world in the technical content of a new object" (Akrich, 1992).

Finally, ANT introduces the concept of black-boxing. Back-boxes are "sealed actor-networks" (Stalder, 1997) whose alignment has been obtained, whose aligned interests have been inscribed in a stable association that is no longer questionable – except at a heavy cost. In this sense, a project plan is a black-box that has been sealed after a translation process has succeeded in aligning the interests of the project partners.

3. A case Study: the PALETTE European Project.

As an illustration of the concepts described above, we would like to present the context of a European Project named PALETTE[3]. It gathers about fifty researchers from thirteen Institutions in seven countries. The PALETTE project aims at facilitating and augmenting individual and organisational learning in communities of practice. To reach this aim, an interoperable and extensible set of innovative services as well as a set of specific scenarios of use will be designed, implemented and validated in CoPs of diverse contexts. The PALETTE services are classified into three categories: *information services, knowledge management services* and *mediation services*. PALETTE adopts a participative design approach, establishing a good balance between technological and pedagogical experts. Evaluation is integrated in the same process, in order to provide direct, frequent and detailed feedback.

It is expected that the adoption of the developed services and scenarios will result in

[3] (6th Framework Programme - Priority IST-2004-2.4.10 - Technology-Enhanced Learning). PALETTE stands for: Pedagogically sustained Adaptive LEarning Through the exploitation of Tacit and Explicit knowledge

- the facilitation of tasks performed by learning CoPs by removing barriers imposed by current approaches;
- the exploitation of diverse mental models, knowledge resources and competences of CoPs member through the social interaction of codified and tacit knowledge;
- the creation of new knowledge, which can lead to the evolution of the associated learning resources;
- the easy access and reuse of knowledge built by the CoPs;
- the increase of active participation of individuals in CoPs;
- the emergence of new CoPs, inside and outside organisations;
- the increase of the overall quality of learning in CoPs.

PALETTE will provide innovative models and technical solutions with regard to the following dimensions:

- efficient reuse and sharing of information among the CoPs' participants;
- user-friendly production and use of multimedia content to support the expression of practices (behaviour, rules, personal theory, etc.);
- efficient and effective support of the individual and organisational learning process, the incoming of new participants in a CoP, and the capitalization of knowledge.

PALETTE will implement the conditions for the exploitation and development of open source services by a large number of CoPs. Thus the PALETTE services and scenarios will not only address the needs of identified CoPs but also describe the conditions for their enhancement through the active participation of users in their development.

One of the first tasks of the project, which started in February 2006, was to settle a design methodology implementing the conditions for Participatory Design. It seemed that ANT was a good support for creating a common understanding of the methodological context of the project.

3.1 Using ANT to implement the participatory design methodology in Palette.

McBride (McBride) suggests a 7 steps methodology where ANT is used as an analytical tool "to identify actions which may speed the social embedding of the technology and the successful take-up of (a) system": identify stakeholders, investigate stakeholders, identify stakeholders' interactions, build actor-network models, identify irreversibility (provisional stabilities), identify inhibitors and promoters, identify actions for aligning the network (participative activities).

In PALETTE, we apply an analogous methodology to implement the Participatory Design process:

- the first steps consist in identifying the various stakeholders, their interests, the inhibitors and the promoters for the enrolment of these actors in the actor-network;

- then, by attempting to "align" these actors' interests, we will build the actor-network and an ANT-based description of the issues related to bootstrapping the participatory approach in Palette;
- finally we will propose a set of actions – mainly participative activities with boundary objects – and select a set of inscription medium with the aim to "enrol" the various actors and promote the social design and acceptance of the new technologies.

3.2 Building the actor-network: identifying and enrolling the actors, aligning their interests

There are a lot of actors gathered for the project purposes.

- CoPs, CoPs members, CoPs animators
- CoPs observers, community of CoPs observers
- Project, DoW[4], project coordination, project management
- Research teams
- Work Packages, tasks groups, sub-tasks groups
- Pedagogical tools: social sciences methodologies, interviews, scenarios, data collection methods, data representation methods…
- Methodological tools: ANT, MOT…
- Management tools: (reports, time-sheets, deliverables)
- Technical tools: from the project (existing and potential) and existing outside the project
- Technical tools designers and developers (called "Ts" in the project)
- Pedagogical tools designers (called "Ps" in the project)
- Methodological tools providers (Ts + Ps)

Most of them already existed before the project and will continue their life after the project: researchers, institutions, currently existing tools, some CoPs, etc.. Some of these actors had already build relationship between themselves, some other not. Some actors will exist only due to the project: the newly developed tools, the Work Packages, the deliverables, for example. The PALETTE actor-network is a dynamic entity which is made of all the heterogeneous actors (meaning human and non human, but also of different granularity[5]) and of all the links that tie dynamically these actors for the purposes of the project (and also for other possible reasons).

The situation of an actor within an actor network is not fully defined by the existence of the actor. Some links have to be knitted with other actors to materialize the presence of the actor in the network, through enrolment. Enrolling an actor within an actor-network means that there are some agreed common interests between this specific actor and the actor-network at some moment. Building the partnership between institutions

[4] Description of Work, the reference document for the project
[5] A workpackage, or an institution, or a project is made of a lot of persons and other elements; thus a person and a group of person are actors of a different level of granularity

(in fact groups within institutions) to submit a proposal to the European Call for Projects was a first kind of enrolment

Enrolling actors in an actor-network requires going through some participative activities where actors can discover and share their common interests. The CoPs are not members of the project, but it is really important that they become actors of the project. Thus, They have to be enrolled, by identifying some common interest between CoPs, and/or CoPs' members, and other actors of the PALETTE actor-network. The Participative Interview process that is used to gather data about the CoPs is the main step toward enrolling them.

Currently existing collaborative tools (like Lotus Notes or e-Rooms, or Moodle, etc.) are not partners of the project as well. But they are used by a lot of people and by CoPs outside the project. They have to be taken into account in the project, from a technical point of view - which is a matter of interoperability and standards - and from a user interface point of view as well. This is done through the Tool Inventory/Categorization process, which is the main participative activity through which tools are enrolled in the PALETTE actor-network. For "inside" tools (those developed by partners), the categorization is not the only enrolment process; another enrolment process is that they are used within the project (for example, a document management software is used to collaboratively publish project documents)

3.3 Inscribing aligned interest in scenarios of use

Translation and inscription are dual processes. In PALETTE, a successive number of translations are undertaken from CoPs to CoPs observers, then to interviews transcriptions, then to data condensation; the data are finally inscribed in data representation supports available as boundary objects for other actors. Different media are used for inscribing, like documents, story telling, vignettes, and MOT schemas (Paquette et al., 2006). Another example of the translation-inscription process is the activity aiming at clarifying the notion of scenario: what is a scenario, its content, its form, etc., according to the different PALETTE actors. Several participative activities are designed to make explicit the representations/interests of the actors and progressively "inscribe" a definition and typical contents/forms of scenarios useful for all the actors, according to [Iacucci & Kuutti].

3.4 PALETTE incremental project life cycle.

The organisation (structure and stages) of a project life-cycle is a key factor for the success of a Participative Design approach. Let say it in ANT terms: the building of the actor-network, its evolution throughout the project, the nature of the translation-inscription processes, as well as the nature and number of boundary objects depend on the type of project life-cycle. The project methodology used in PALETTE is based on an agile perspective (Schwaber, 2004, Highsmith, 2004): go for a "first design round", with some "sample" CoPs, a few data from interviews, a few tools, and try to build from this the first scenarios. This would allow us:

- to validate the methodology
- to validate the feasibility of the whole process;
- to understand better what the different steps are (especially the data representing and the scenario building);
- to explicit the processes of enrolment, translation and inscription and see if it fits really well and if everybody agrees with;
- to go further into inscribing communities practices and web services into scenarios of use.

From these scenarios, some adjustments (including possibly incremental or full new developments) could be done in the partners' tools to better suit CoPs users' practical situations. Then we will be able to re-loop the loop with other CoPs and other tools (to keep it simple, though there are all other actors involved). Step by step we will build, in a constructive perspective, our scenarios and use-cases.

The multi-rounds project life cycle allows going on rather quickly in the validation of the whole project system and enables actors working more collaboratively from the beginning.

4 Conclusion and further research

PALETTE has just started in February 2006. We are still in the process of looping the first design round. What we were able to agree upon so far is that descriptions of design situations based on ANT concepts have helped launching an efficient Participatory Design methodology. The inscriptions as MOT schemas, for example, were agreed a "good" boundary objects by both the Pedagogical and Technical partners. A lot has still to be achieved before the end of the project in January 2009. Nevertheless, we think that PALETTE is a good example of a complex socio-technical project, and that this experience of using ANT could benefit other kinds of complex socio-technical projects.

References

1. Abreu de Paula, R. 2004, The Construction of Usefulness: How Users and Context Create Meaning with a Social Networking System – Dissertation available at http://www.ics.uci.edu/~depaula/publications/dissertation-depaula-2004.pdf.
2. Akrich M., 1992, The des-cription of technical objects, in Bijker, W.E., and Law, J.(editors) *Shaping Technology / Building Society* , MIT Press
3. Bowker; G.C., and Star, S.L., 1999, *Sorting Things Out, Classification and its consequences*, MIT press, Cambridge, MA
4. Callon, M. (1999). Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of Saint Brieuc Bay. In M. Biagioli (Ed.) *The Sciencer Studies Reader*. New York and London, Routledge: 67-83.

5. Gasson, S., A genealogical study of boundary-spanning IS design, European Journal of Information Systems, Vol 15, N° 1, February 2006, pp 26-41
6. Highsmith, Jim, *The Agile Revolution*, Addison Wesley, 2004
7. Iacucci, G., and Kuutti, K., 2002, Everyday Life as a Stage in Creating and Performing Scenarios for Wireless Devices, in *Personal and Ubiquitous Computing*, Springer-Verlag
8. Latour, B., 1999, On Recalling ANT, in *Actor network Theory and After*, John Law and John Hassard editors; Blackwell Publishing, Oxford, UK.
9. Latour, B. 1992, The Sociology of a Few Mundane Artifacts, in Bijker, W.E., and Law, J. (editors) *Shaping Technology / Building Society* , MIT Press
10. Latour, B., 1996, Aramis or The Love of Technology, Harvard University Press, Cambridge, MA
11. Law, J., 1992, Notes on the Theory of the Actor-Network: ordering, strategy, and heterogeneity, *Systems Practise*, 5(4), pp379-393
12. Maner, Walter, http://csweb.cs.bgsu.edu/maner/domains/RAD.htm
13. McBride http://www.cse.dmu.ac.uk/~nkm/WTCPAP.html
14. Cooney, E.M., Millery, M., Larson, H., and Choriki, D., User Friendly: Dialectic Development of Technology-Enhanced Learning Environments, Workshop of the *2000 Participatory Design Conference*
15. Monteiro, Eric, Actor-network theory. In: C. Ciborra (ed.), *From Control to Drift. The D*ynamics of Corporate Information Infrastructure, Oxford Univ. Press, 2000, pp. 71 – 83
16. Paquette, G., Léonard, M., Lundgren-Cayrol, K., Mihaila, S., & Gareau, D. (2006). Learning Design based on Graphical Knowledge-Modelling. Educational Technology & Society, 9 (1), 97-112.
17. Stalder, Felix, 1997 http://felix.openflows.org/html/Network_Theory.html
18. Tilson, David and Lyytinen, Kalle, Making Broadband Wireless Services: An Actor-Network Study of the US Wireless Industry Standard Adoption, Sprouts: *Working Papers on Information Environments, Systems and Organizations*, Volume 5 Issue 3, 2005, pp 137-154
19. Wenger, Etienne, *Communities of Practice: Learning, Meaning and Identity*, Cambridge University Press, Cambridge, UK, 1998
20. Wenger, E;, McDermott, R, Snyder, W.M., Cultivating Communities of Practice, Harvard Business School Press, 2002

Personalization Services in Argumentation Tools: a Catalyst for Learning

Christina E. Evangelou, Nikos Karousos, Manolis Tzagarakis, George Gkotsis, Dora Nousia

Research Academic Computer Technology Institute, E-learning Sector
N. Kazantzaki, University of Patras,
26500 Rion, Greece
{chriseva, karousos, tzagara, gkotsis, nousia}@cti.gr

Abstract. Argumentation is considered as an essential element for effective learning since it enables learners to develop their points of view and refine their knowledge. Our aim being to facilitate CoP members as learners, we argue that argumentation tools should provide personalized features and functionalities in order to fit the specific individual and community learning requirements. More specifically, we propose a set of personalization services that can act as catalysts for individual and community learning. The proposed set of services has derived after the careful consideration of a generic Learner Profile, developed to formalize human actors in settings where learning takes place.

1 Introduction

As organizations start to acknowledge the significance of *Communities of Practice* in helping them meet their business needs and objectives, new efforts to better understand the processes of learning in these communities are constantly emerging [1]. The term Communities of Practice (CoPs) is commonly used to define groups of people who share an interest in a domain of human endeavour and engage in a process of collective *learning* that creates bonds between them [2]. Such communities are formed by groups of people having similar interests or goals, and are willing to share their knowledge, in-sights and experiences about specific work aspects, the ultimate aim being to learn from each other [3]. As stated in [2, 3], the key aspect to successful learning within a CoP is the provision of the proper means for information exchange and peer-to-peer collaboration so as to enhance the organizational knowledge flow.

On the other hand, modern learning theories support the value of communities and collaborative work as settings for learning [4]. As regards to collaborative learning, an especially valued activity is *argumentation* [5], meaning the process of introducing, supporting or defeating a set of alternative courses of action, based on structured arguments. More specifically, argumentation is considered as an essential element for effective learning since it enables learners to develop their points of view and refine

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 307-316, 2006.

their knowledge. This is because, during collaborative argumentation processes, participants focus on the same issues, share their knowledge and learn to negotiate conflicting opinions in order to reach a commonly accepted solution [6, 7]. As stated in [8], on-line collaborative argumentation can serve as a tool for informal learning situated in the context of CoP members everyday work experience. Still, it is generally acknowledged that traditional software approaches supporting argumentation are no longer sufficient to support contemporary communication and collaboration needs [9]. This is because they are focused in the logical structure of the argumentation, and they do not provide the means to support learning.

In our approach, argumentation tools are knowledge sharing environments where learning is taking place in the exchange of problem interpretations, interests, objectives, priorities and constraints, which may express alternative, fuzzily defined, or even conflicting views. In this vein, argumentation tools should satisfy the community members' needs to construct and refine their ideas, opinions and thoughts in meaningful ways, in order to successfully assist individual and community learning. At the same time, individual standpoints should be articulated in such a way that can be proven useful for the rest of the community's members. In addition to that, support should be offered for the development of learning skills, such as the interaction with other actors, as well as growth of the learners' autonomy and self-direction. Moreover, identification of CoP members' individual characteristics, as well as the culture, norms and incentive schemes of the community should be appropriately handled. For this, personalization services should be provided, so as to promote learning and to encourage creative, parallel and lateral thinking during argumentation.

In the following we present a set of proposed personalization services that has been developed to address the abovementioned requirements for the efficient and effective learning between CoP members during argumentative discourses. Towards this aim, we first performed a comprehensive literature and practice survey of related issues regarding Communities of Practice, Argumentation and Learning. Based on the findings of this research, we concluded that personalization services could enhance learning in both existing and to be developed argumentation tools. In order to propose a set of personalization services suitable for CoP members, we developed a generic Learner Profile model to formalize CoP members as human actors in settings where learning takes place. Our aim being to facilitate CoP members as learners, we present in this paper a set of personalization services for tools facilitating argumentation that can act as catalysts for individual and community learning. More specifically, we propose the development of a virtual environment for collaborative argumentation providing personalization services in accordance with the proposed Learner Profile. We envisage this as an environment where learners are able to express personal ideas and opinions, being provided with the proper means for the articulation and sharing of the learners' knowledge.

The remainder of this paper is structured as follows. Section 2 presents the proposed Learner Profile model. Section 3 presents the proposed set of personalized services towards learning and their relation to the proposed Learner Profile. Furthermore, it discusses implementation issues regarding the embedment of the proposed set of services to existing or under development argumentation tools. Section 4 presents a discussion about existing argumentation tools. Section 5 concludes this paper with some final remarks and our future work directions.

2 The proposed Learner Profile

Taking the above issues into account, we acknowledge learning as a major part of CoPs activities, and we argue that one of the most significant roles undertaken by almost all CoPs' members is the role of a learner. Related research findings about learners' modelling prove that due to the complexity of human actors and the diversity regarding the learning context, the development of a commonly accepted learner profile is a highly complex task [10]. For instance, the Learner model in [11] depicts a learner as a concept hierarchy but it does not refer to issues such as the learning object, or the learners' interactions with their environment and other people. However, it provides interesting information about a learner's cognitive characteristics and it provides a representation of knowledge assessment issues. Another related approach, the "PAPI Learner" conceptual model comprises preference, performance, portfolio, and other types of information [12]. Yet, this model includes only the minimum information necessary to satisfy the functional requirements and be maximally portable, and it does not provide any information about a learner's profile dynamic aspects. The IMS Learner Information Package specification [13] is a useful collection of information that addresses the interoperability of internet-based Learner Information systems with other systems that support the Internet learning environment. But, the aforementioned approaches cannot be employed for the representation of a community as a learning entity.

After the careful consideration of the above approaches, we developed a generic Learner Profile that can be employed for the representation of both individuals and communities as learners (see Fig. 1). Thus, the proposed model can be employed for developing customized services for both individual and group learners. More specifically, the proposed Learner Profile consists of two types of information, namely *static information* and *dynamic information*. Static information comprises information about the name, contact details, education, training, working experience etc. of the CoP members, as well as information about the CoP(s) they belong to. Such information is considered as domain independent in our approach. The Learner Profile dynamic information elements were chosen to reflect one's individual behaviour during his participation in a specific CoP's argumentation activities. Thus, all four dynamic elements, i.e. *preferences*, *relations*, *competences* and *experience* are to be implicitly or explicitly defined through the learner's interaction with a tool supporting collaborative argumentation. *Preferences* regarding the use of resources and services provided by the tool, as well as *relations* among individuals, CoPs and learning items (e.g. argument, URL, or document) can reveal the learners' different personality types and learning styles. *Competences* refer to cognitive characteristics such as the creativity, reciprocity and social skills. *Experience* reflects learners' familiarity and know-how regarding a specific domain. It should be noted that all dynamic elements of the proposed Learner Profile can be of assistance towards learning. Nevertheless, the domain of the issue under argumentation is a decisive factor. Thus, dynamic aspects of a learner's profile are treated as domain specific in our approach.

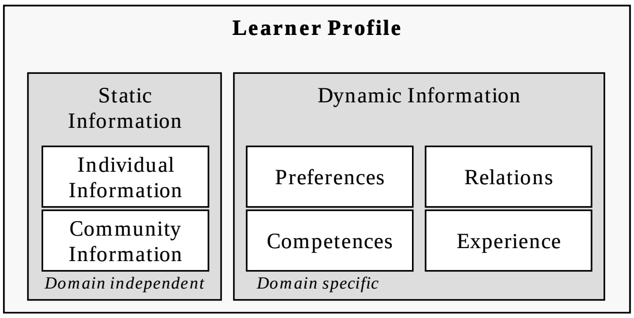

Fig. 1. The proposed Learner Profile

3 The proposed set of services

Perceiving users as learners, in the following we present a set of services that can augment argumentation tools towards facilitating individual and community learning activities. The proposed set of services has resulted out of a thorough investigation of the related literature, including case studies that consider diverse aspects of learning within a CoP. More specifically, CoPs consider *system awareness services* as one of the most valued services for argumentation tools. This kind of services comprises a set of notification actions for the provision of helpful personalized information about system events to CoP members. Such events could be the entrance of a related learner to the system, the creation, termination or any other related action over a specific discussion and the notification about the insertion of new content into the system (arguments, documents etc.). In order to enable this personalized awareness, terms such as "related" or "interesting" that define a relation between the learner and the content should be determined by the learner himself or automatically by the system through the manipulation of some characteristics from the user profile.

Personalized searching is another service that can facilitate learning activities, especially for autonomous learners. During searching, a Learner's Profile can provide useful information to rank search resources according to a number of factors, such as the learner's preferences, or even his competence and experience level. In this way, the system will be able to adapt to an individual user's needs. Moreover, the information about the user's domains of interest will provide additional information with which a search can be better contextualized, thus leading to more relevant results. Furthermore, reasoning mechanisms could be employed for providing the necessary filtering features for capturing and reusing the knowledge shared in past argumentation activities.

Another issue to be carefully treated regards the representation and visualization of arguments so as to assist the participants to better organize their thoughts and present them in a more clear way to the others. *Personalized presentation* of context can provide learners with a working environment that fits to their preferred visualization style. System personalization includes alterations in colours, fonts and text effects, enabling and disabling pieces of information in the working panel, predefinition of system responses in user actions etc. In this vein, filtering and recommendation of content services can further support learning. Content that is inserted in the system should be filtered according to each learner's preferences and be recommended as interesting incoming information. For instance, some of the attached documents of posted positions that contribute to the strengthening of an argument should be suggested for view. Furthermore, a document library could recommend some documents that are related to a specific learner (e.g. experienced learner's recommendations or popular documents).

Learner expertise and action tracking services can also assist learning in the community. Such services enable the community members to find and communicate with their co-workers in a more knowledgeable way. Furthermore, if coinciding with a community's norms and wills, such services could also be used for the assignment of weights regarding the weight of a member's arguments. Such services could be based on the learners' level of experience (as recorded in their profiles), in addition to attributes deriving from the users' participation in the community's activities.

Finally, *privacy policies and access control services* are a critical requirement for the employment of all the above services. These should be provided in order to satisfy the learner/users' need to know what information about them is recorded, for what purposes, how long this information will be kept, and if this information is revealed to other people. Platform for Privacy Preferences Project (P3P) is a W3C approach that supports the description of privacy policies in a standardized XML-based form, which can be automatically retrieved and interpreted by the user client [14]. Furthermore, the security assurance while establishing connections between users and services, or while accessing stored information, should be taken into consideration as well. Towards this end, two major techniques are broadly used to provide denial of access to data, i.e. anonymity and encryption. Anonymity cuts the relation between the particular user and the information about him, while information encryption provides protection of the exchanged personal data.

3.1 Acquisition of learner profile data

In order to enable the operation of the abovementioned personalized services, the Learner Profile has to be populated with the appropriate data. Such data can be acquired in two ways: *explicitly* from the users' preferences, and *implicitly* based on the users' behaviour within the system. The later could be based on a rule-based event engine. In this way, a personalized argumentation tool may comprise two kinds of personalization services, those explicitly and those implicitly initiated by the user. The former, refer to service approaches that adapt to the system based on the explicitly stated characteristics or preferences of the user. The later, refer to approaches that implicitly adapt to the system based on the user's actions within it. Implicit personalization mechanisms are automatically triggered by the system utilizing data in the proposed Learner Profile. In the following, we briefly describe each acquisition method.

Static information of the Learner Profile is explicitly provided by the user, as a required initialization step of the registration procedure. While such information is usually provided when registering to the system, users should be able to edit this set of profile information at any time. Such explicit data acquisition constitutes a subjective way of profiling, since it depends on the statements made by the user (e.g. experience level, competences etc.). Their subjective nature may influence personalization services in an unpredictable way (e.g. suggesting to a novice user a document that requires advanced domain knowledge because the user misjudged his experience or competence level). To cope with such issues, we are currently in the process of designing methods that assess explicitly stated profile data, based on the users' behaviour. We refer to these ways as *implicit* or *behaviour-based data acquisition*.

In general, the aim of implicit or behaviour based data acquisition is to assess experience, domains, competences of an individual user based on the users behaviour, leading to a quantification of profile information which provide a more reliable information source for personalization and decision making services. Implicit data acquisition utilizes the users' actions and interactions and attempts to extract information that can permit assessing or augmenting a user profile data. Towards this aim, a rule-based engine is required that recognizes user interactions and system events, and triggers computations that modify the users' profile data.

In our approach, a rule-based approach has been chosen so as to facilitate incorporation of new rules once they are observed or modification of existing ones if they prove to be too restrictive or even harmful. More specifically, we propose the development a set of rules that deal with resource access, as access to resources are logged and a number of rules operate on the logged data to provide additional information to resources and/or user profiles. These can be based on the frequency of access and the competence and experience levels of users (e.g. a document that is frequently accessed by novice users should augment the documents metadata with elements that mirror this fact so that this document can be recommended to any novice user entering a discussion). A second set of rules observing discussion contribution could control how user behaviour in the context of discussions will affect the users' competence and experience (e.g. users that actively and frequently participate can be assigned with a high experience level). Another useful indicator associated to the proposed learner profile is the reasoning about how a competence level of a particular user changes in time. This may provide useful insights about the learning capabilities of the particular user and the usefulness of the system.

3.2 Implementation issues

According to current trends in developing web-based tools, for reasons such as the reusability of components and agility of services, our approach builds on top of a service oriented environment. In order to exploit advantages enabled by the Service

Oriented Architecture (SOA) design paradigm, the proposed set of services should be based on web service architecture so as to enable the reusability of the implemented modules, as well as the integration or the interoperation with other services (from external systems).

Considering the above, an overall design for the enhancement of existing argumentation tools with personalized functionality towards learning is depicted in Fig. 2. In this approach, we sketch a generic architecture design in which a Learner Profile Service is the basis for the storage and the provision of each learner's characteristics to a set of proposed services that contribute to the system's personalization. Considering the set of proposed services as non-exhaustive, this "architecture" is open for the addition of new personalized services (see Fig. 2, block "New Service") and can use the Simple Object Access Protocol (SOAP) for both internal and external communication, following the web services standards.

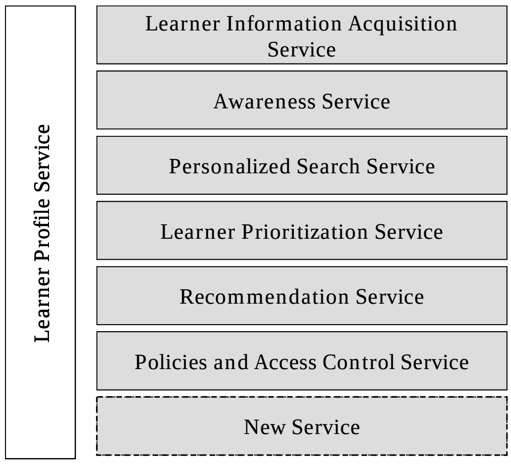

Fig. 2. The proposed services

4 Discussion

A major category of tools supporting argumentative collaboration provides the means for discussion structuring and user administration. *gIbis* [15], for instance, is a hypertext groupware tool that allows its users to create issues, make positions on these issues, and make arguments pro and contra these. *Sibyl* [16] a tool for managing group decision rationale. *QuestMap* [17] resembles to a "whiteboard" where all messages, documents and reference material for a project and their relationships are graphically displayed during meetings. *Compendium* [18] is a graphical hypertext system which can be used to gather a semantic group memory when used in a meeting scenario. *Araucaria* [19] provides an interface for the decomposition of text into argumentation premises and conclusions via a diagramming process. The *Rea-*

son!Able [20] argumentation tool provides a well structured and user-friendly environment for reasoning. Another educational software providing assistance in the creation and sharing of visual images of ideas is *MindDraw* (see http://info.cwru.edu/minddraw/), a thinker's tool that is useful for students and learners of all ages, from primary school through graduate training and professional practice.

The systems described above may be regarded as the most representative of a larger collection of argumentation systems. Nevertheless, a new generation of argumentation tools towards learning has emerged. For instance, in *Dialab* [21] is a logic game, aiming at assisting the development of the players' logic competency. The *Multiple Object Oriented* (MOO) [22] system is a synchronous, text-based environment where collaboration is established through the use of virtual spaces. Learning activities are modelled as problems to be solved through the scheduling of a virtual conference room. The *Collaborative Text Processing* (CTP) [23] system is a synchronous network-based word processor application. Activities take place through pairs of students that collaborate in this environment. An assignment which is given to the students ("task") and supporting information ("argument") are supplementary concepts that co-exist in the main word processor window. *CLARE* [24] is an asynchronous network tool aiming at supporting the task of collaborative knowledge construction. This task comprises two phases: *exploration*, which takes place individually and information is gathered to a common repository, and *consolidation* which takes place through evaluation, comparison and summarization of the information gathered. Finally, *Belvedere* [25] is a synchronous web-based learning tool designed for supporting learning activities. Belvedere provides an environment for constructing argumentation diagrams between individuals or groups of students. A special representation is used to declare the uncertainty level of the arguments submitted, whereas communication among partners is supported through chatting.

As derives from the above, existing tools facilitating argumentation primarily provide either visualization or collaboration functionalities, as they mainly focus on the expression and visualization of arguments. Argumentation tools developed for education support focus on the subject to be taught, not the learner. Existing approaches perceive users as static entities of the problem analysis, and even though they are efficient in terms of structuring a discussion based in argumentation, they do not provide personalized support, nor do they focus on collaborative learning activities taking place in such contexts.

5 Conclusion

In this paper we presented a set of services enhancing argumentation tools based on a generic Learner Profile. Our approach concerns an alternative form of on-line learning with different forms of interaction, and a new way of promoting community building. Its purpose is to aid researchers and developers in the development of *personalized argumentation systems*, i.e. tools that adapt their structure and services to the individual user's characteristics and argumentation behaviour. Our main goal being to support individual and community learning, the proposed set of services is based on personalized features and functionalities. We argue that it can further support learning, as well as the achievement of learning objectives, as it can assist CoP members in the development of learning skills such as the interaction with other actors, growth of their autonomy and self-direction. Nevertheless, in order to be creatively adapted in CoPs' everyday practices, the proposed services must fit into the specific culture, norms and incentive schemes of the community. Our future work directions concern the appropriate handling of these issues as well as the full development of the set of personalization services and its evaluation in diverse CoPs.

Acknowledgements

Research carried out in the context of this paper has been partially funded by the EU PALETTE (Pedagogically Sustained Adaptive Learning through the Exploitation of Tacit and Explicit Knowledge) Integrated Project (IST FP6-2004, Contract Number 028038).

References

[1] Quan-Haase, A. (2005). Trends in Online Learning Communities. SIGGROUP Bulletin, Vol. 25, No 1, pp. 1-6.

[2] Wenger, E. (1998). Communities of practice: Learning, meaning and identity. Cambridge University Press.

[3] Wenger, E. and Snyder, W. (2000). Communities of practice: The organizational frontier. Harvard Business Review, Vol. 78, pp. 139-145.

[4] Hoadley, C.M. and Kilner, P,G. (2005). Using Technology to Transform Communities of Practice into Knowledge-Building Communities. SIGGROUP Bulletin Vol.25, No 1, 31

[5] Resnick, L.B. (1987). Education and learning to think. Washington, DC: National Academy Press.

[6] Veerman, A.L. and Andriessen, J.E. (1997). Academic learning and writing through the use of educational technology. Paper presented at the conference on Learning & Teaching Argumentation, Middlesex, London.

[7] Veerman, A.L., Andriessen, J.E. and Kanselaar, G. (1998). Learning through Computer-Mediated Collaborative Argumentation. Available on-line: http://eduweb.fsw.ruu.nl/arja/PhD2.html

[8] Gray, B.(2004). Informal Learning in an Online Community of Practice. Journal of Distance Education, Vol. 19, No 1, pp. 20-35.

[9] Moor, A. and Aakhus, M. (2006). Argumentation support: from technologies to tools. Commun. ACM Vol. 49, No 3 (Mar. 2006), pp. 93-98.

[10] Dolog, P. and Schäfer, M. (2005). Learner Modeling on the Semantic Web?. Workshop on Personalisation on the Semantic Web PerSWeb05, July 24-30, Edinburgh, UK.

[11] Chen, W. and Mizoguchi, R. (1999). Communication Content Ontology for Learner Model Agent in Multi-agent Architecture. In Prof. AIED99 Workshop on Ontologies for Intelligent educational Systems. Available on-line: http://www.ei.sanken.osaka-u.ac.jp/aied99/a-papers/W-Chen.pdf

[12] PAPI (2000). Draft Standard for Learning Technology —Public and Private Information (PAPI) for Learners (PAPI Learner). IEEE P1484.2/D7, 2000-11-28. Available on-line: http://edutool.com/papi

[13] IMS LIP (2001). IMS Learner Information Package Specification. The Global Learning Consortium. Available on line: http://www.imsglobal.org/profiles/index.html

[14] Cranor, L., Langheinrich, M., Marchiori, M., Presler-Marshall, M. and Reagle, J. (2002). The Platform for Privacy Preferences 1.0 (P3P1.0) Specification. World WideWeb Consortium (W3C), 2002. http://www. w3.org/TR/P3P/.

[15] Conklin, E.J. and Begeman, M.L. (1987). gIBIS: A hypertext tool for team design deliberation. In Proceedings of the Hypertext'89 Conference, ACM Press, New York, pp. 247-252.

[16] Lee, J. (1990). SIBYL: A tool for managing group decision rationale. In Proceedings of the CSCW'90 Conference, ACM Press, New York, pp. 79-92.

[17] Conklin, E.J. (1996). Designing organizational memory: Preserving intellectual assets in a knowledge economy. Group Decision Support Systems Working Paper. Available online at: http://www.gdss.com/wp/DOM.htm.

[18] Selvin, A.M. and Sierhuis, M. (1999). Case studies of project compendium in different organizations. In Proceedings of Computer-Supported Collaborative Argumentation for Learning Communities Workshop held at Computer-Supported Collaborative Learning'99, Stanford, CA.

[19] Reed, C. and Rowe, G. (2001). Araucaria: Software for puzzles in argument diagramming and XML. Technical Report, Dept. of Applied Computing, University of Dundee.

[20] van Gelder, T.J. (2002). Argument mapping with Reason!Able. The American Philosophical Association Newsletter on Philosophy and Computers, pp. 85-90.

[21] Maudet, N. and Moore, D. J. 1999. Dialogue games for computer supported collaborative argumentation. In Proceedings of the 1st Workshop on Computer supported collaborative argumentation (CSCA99).

[22] Dillenbourg, P., and Baker, M.J. (1996). Negotiation spaces in human-computer collaboration. In COOP, E., & Jaspers, J. (1996). Using complex information in argumentation for collaborative Group (Ed.), Proceedings of the Second International Conference on Design of Co-operative Systems (pp. 186-206). Juan-les-Prince, France.

[23] Andriessen, J.E. and Erkens, G. (1996) Overeem text production. Paper presented at the UCIS '96 conference. Poitiers, France.

[24] Wan, D. and Johnson, P.M. (1994). Experiences with CLARE: A computer-supported collaborative learning environment. Proceedings of the 1994 ACM Conference on Computer Supported Work (pp. 1-29). North Carolina: Chapel Hill.

[25] Gray, B. (2004). Informal Learning in an Online Community of Practice. Journal of Distance Education, Vol. 19, No 1, pp. 20-35.

Awareness: An Enabling Feature for Mediated Interaction in Communities of Practice

Denis Gillet, Christophe Salzmann, Yassin Rekik

École Polytechnique Fédérale de Lausanne (EPFL),
CH-1015 Lausanne, Switzerland
{denis.gillet, christophe.salzmann, yassin.rekik}@epfl.ch

Abstract. The École Polytechnique Fédérale de Lausanne (EPFL) is currently using a Web-based experimentation environment to support laboratory activities in engineering education. The key service for the acceptance of the learning modalities and the appropriation of the environment by the students is a shared electronic notebook called the *eJournal*. This service is not only used by students to perform the required laboratory work; it is also used to sustain collaboration between students. Additionally it provides support for exchanges with other services integrated in the learning environment. By tracking the creation, the exchanges and the tagging of the digital assets stored in the *eJournal* database, awareness can be provided. This position paper presents how the *eJournal* and the associated awareness features are currently enhanced to effectively support interaction in laboratory-oriented communities of practice for members using either desktop or mobile client devices.

Keywords: e-Learning, Collaborative Learning, Awareness, Communities of Practice.

1 Introduction

Since the year 2000, the École Polytechnique Fédérale de Lausanne (EPFL) has been developing and deploying the *eMersion* Web-based environment to support remote and virtual experimentation activities in higher engineering education [1]. A shared electronic notebook called the *eJournal* turned out to be the key service for the students' acceptance of the proposed flexible learning modalities and for the appropriation of the Web-based environment. This service is not only used by the students to perform the required laboratory work; it is also used to sustain collaboration. Additionally it provides support for exchanges with other services integrated in the learning environment. By tracking the creation, the exchanges and the tagging of the digital assets stored in the *eJournal* database, real-time awareness regarding individual and group progresses can be provided. Consequently, the added value brought by the *eJournal* features is significant enough to compensate for the expected overhead necessary to learn its usage [2]. In addition, the flexibility given to the students to work collaboratively on campus or at distance using the same

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 317-322, 2006.

environment helps in better coping with their social habits and with the learning constraints [3].

In the context of the *Palette* European integrated project (http://palette.ercim.org/) the *eJournal* and the associated awareness features are currently enhanced to effectively support mediated interaction in academic laboratory-oriented Communities of Practice (CoPs). Only distributed communities interacting through Web technologies or mobile devices are considered here.

Laboratory-oriented CoPs are group of people interacting freely to deepen their knowledge and know-how through interaction and experimentation in a specific domain where laboratory equipment is involved. As example, educators, teaching assistants and students involved in a laboratory course form such a community. Researchers and technicians working on shared equipment or studying samples form another one. Teams of engineers involved in collaborative engineering activities [4] are also laboratory-oriented CoPs.

The roles, rules and assets characterizing the communities evolve as interaction occurs and knowledge level increases. In laboratory-oriented CoPs, the assets produced, exchanged and manipulated by the members can be more volatile, dynamic and rich than the typical information media found in other contexts. In addition to text documents, images, and videos, the laboratory assets also include experiment-related data such as measurements, statistics, mathematical equations and annotations, simulation models or analysis scripts. It as been shown that awareness in general, and context-oriented awareness in particular [5], plays a key role in supporting CoPs.

This paper is organized as follow. Section 2 gives a short overview of the *eJournal* service developed at the EPFL to support laboratory-oriented CoPs. Section 3 defines the hybrid community composed by both the users and the resources involved in laboratory-oriented CoPs. It also details the current developments to provide synchronous awareness. Section 4 finally sketches some envisioned features to provide mobile users with dedicated and ubiquitous awareness. The paper ends with concluding remarks.

2 eJournal Service

The *eJournal* is a more than a digital asset management system [6], an ePortfolio [7] or an electronic laboratory notebook [8]. It can be defined as an assets-based interaction system. Its core feature is designed as a mailbox, a familiar metaphor for users. Instead of simple emails, the *eJournal* contains digital assets of various types. Contrary to a mailbox that belongs to a unique person, the *eJournal* is shared by members of a team. The team members can either tag or annotate the assets at creation or later. Some context-related tags and metadata are also automatically added when the assets are created.

In addition to the mailbox-like area (bottom-part in Fig. 1), the *eJournal* integrates context and awareness areas that are always visible (top-part in Fig. 1). The idea behind this design is that the users should not have to look for basic context and awareness information elsewhere [9]. They should not even have to think about finding such information. It should be implicitly obtained while manipulating assets.

As an example, the *Team* area provides awareness about the role and rights for the user in the given context, as well as indications regarding the possible presence of other team members. The *Activity* area provides information regarding pending tasks. The *Folder* area provides a means to filter the context-oriented assets to be displayed. The *Category* column in the *Asset* area is used to summarize user and system-defined metadata.

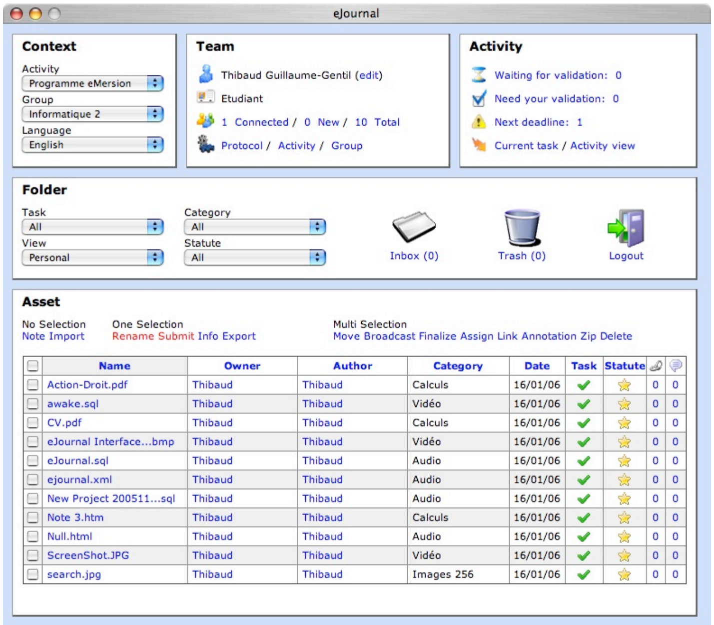

Fig. 1. The current *eJournal* user interface designed for laboratory-oriented CoPs.

The *eJournal* differs from typical digital assets management (DAM) systems in many aspects. First, the *eJournal* was initially designed for e-Learning applications where the process of creating the assets has more value than the assets themselves. DAM systems are typically designed for digital-repository applications (pictures, movies, documents, etc) where the value is only in the assets. In addition, the *eJournal* is a pivotal service to built more comprehensive systems integrating other asset-oriented components/services, while DAM are usually closed systems due to right management constraints. One could also compare the *eJournal* with forums or blogs supporting CoPs. Forums and blogs are driven by comments, some of those comments being possibly augmented by assets. The *eJournal* is driven by assets, some of those assets being possibly augmented by comments.

Interaction within the *eJournal* is mostly asynchronous since many of the actions performed do not required other components or users to be active or online at the same time. For this reason, the *eJournal* user interface only provides simple synchronous awareness indicators (as example, the current number of members online instead of the full list of their names). The state of these indicators may trigger interest for more detailed or additional information in some contexts. Hence, a supplementary synchronous awareness service with richer visualization features detailed in Section 3 is currently developed.

3 Synchronous Awareness Service for Hybrid Community

In Laboratory-oriented CoPs, not only the members, but also the equipment plays an important role in the knowledge construction and consolidation. Hence, one can consider both the members and the equipment as entities belonging to the community and interacting together in some ways. We define such a community as a hybrid one.

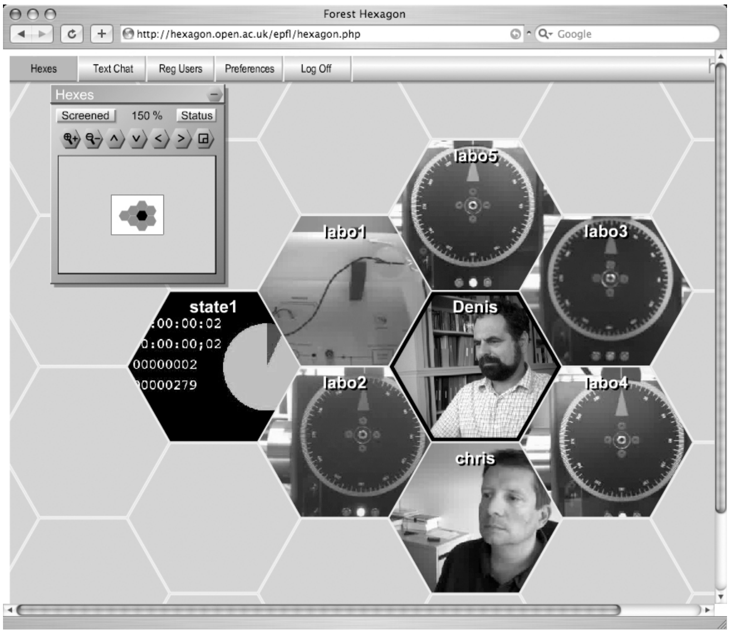

Fig. 2. Awareness about the people, the resources and the activities in a hybrid community.

Synchronous awareness in such a community may require knowledge about the presence of the members, the state of the equipment and the status of the activities. To provide this variety of information in a simple way, we have adapted the Hexagon tool (http://kmi.open.ac.uk/technologies/) developed by the Knowledge Media Institute of The Open University in the United Kingdom. The Hexagon is basically a virtual video chat room. The online members are visible and can be clustered or put away according to the user interests (Fig. 2). To be suitable for supporting a hybrid community, any relevant piece of equipment should also be considered as a member of the community. Hence, devices, such as the electrical drives displayed in Fig. 2, are visible in the virtual video chat room. To push further this idea of non-human entities joining the community, composite images are built using additional awareness information and pushed in video channels of the room (left-hand side hexagon). This feature is implemented by using a special video digitizer.

This enhanced awareness service complement the simple information provided in the *eJournal*. It is relevant for members at their workplace. In the next Section, a lighter and ubiquitous awareness service supporting mobile members is described.

4 Ubiquitous Awareness Service

Providing ubiquitous awareness to mobile members of a community does not mean cloning what is available on a desktop computer. One should focus on the necessary and sufficient requirements for people on the move, as well as the actual capabilities and features of current and next generation mobile devices. In other word, the service should be designed for the Today high-end devices which correspond to what the majority of people will be using in a one or two years horizon. In terms of PDA, mobile phones, portable play stations and audio/video players; we should consider audio and video Input/Output, GPRS, WiFi and/or 3G networks as available features.

According to these features, the proposed solution to provide ubiquitous awareness to mobile members of laboratory-oriented CoPs is to implement a feed-oriented client interface instead of a traditional email, calendar or agenda-like one. This service should be always active. In fact, RSS (Really Simple Syndication) or Atom feeds displayed by the so-called *Feed Navigator* client have the necessary structure to support awareness broadcasting, knowledge dissemination or assets delivery. A feed can be updated right away when something occurs in the laboratory-oriented CoPs (creation, event, action, discussion). It has a creator, a title, a summary (annotation), metadata (tags) and possibly an attached file (asset) or the URL of an asset-oriented service. The *Feed Navigator* will be designed to display these relevant elements in the most convenient way for minimizing the users actions and maximizing context-awareness. Feeds navigation through scroll wheels like the one found on *Blackberry* devices (http://www.blackberry.com/), or even more advance *iPod*-like tactile wheels will improve usability. The main difference between the *Feed Navigator* and an email client is that the user subscribes only to the feeds he or she wants to receive. In addition, instead of being only classified by date, size, sender, etc, the feeds could be classified according to elements like action request, action report, asset request, asset received, comment request, comment received, priority or deadlines.

5 Concluding Remarks

This position paper first presented the *eJournal*, an assets-based electronic notebook designed to support laboratory-oriented communities of practice. In addition to the assets themselves, the *eJournal* displays awareness information about the members, the resources and the activities of the community through compact indicators.

Validation carried out within laboratory-oriented communities of practice involved in e-Learning has shown that awareness about the ongoing activities is as important as the assets themselves to develop and sustain mediated interaction.

Considering the above observation, dedicated solutions to strengthen awareness for members using either desktop or mobile client devices have been proposed. The desktop solution relies on a virtual chat room. All the human and virtual entities belonging to a laboratory oriented CoPs can join this room. As a consequence, the presence of the members, the state of the resources and the achievement of the activities are visible in a glance. The mobile solution relies on a *Feed Navigator* that enables ubiquitous browsing of selected assets and activity-related information.

Acknowledgments. The elements presented in this paper result from various e-Learning projects and activities carried out with the support of the Board of the Swiss Federal Institutes of Technology and of the European Union in its sixth framework program (*ProLEARN* Network of Excellence and *Palette* Integrated Project).

References

1. Gillet, D., Nguyen Ngoc, A.V., Rekik, Y.: Collaborative Web-Based Experimentation in Flexible Engineering Education. IEEE Transactions on Education, Vol. 48, Num. 4 (2005) 696-704
2. Fakas, G.J., Nguyen Ngoc, A.V., Gillet, D.: The Electronic Laboratory Journal: A Collaborative and Cooperative Learning Environment for Web-Based Experimentation. Computer Supported Cooperative Work (CSCW), Vol. 14, Num. 3 (2005) 189-216
3. Gillet, D.: Introducing E-Learning Solutions and Flexibility in Higher Education: Objectives and Challenges. In: Innovations - 2006: World Innovations in Engineering Education and Research, iNEER in Cooperation with Begell House Publishers (2006)
4. Gräther, W., Koch, T., Lemburg, C., Manhart, P.: SAGE: Self-organized cooperative task management and group awareness for the coordination of distributed software development. Workshop on Challenges in Collaborative Engineering, Prague, Czech Republic, April 19-20 (2006)
5. Gross, T., Prinz, W.: Modelling Shared Contexts in Cooperative Environments: Concept, Implementation, and Evaluation. Computer Supported Cooperative Work (CSCW), Vol. 13, Num 3 (2004) 283-303
6. Natu, S., Mendonca, J.: Digital asset management using a native XML database implementation. In: Proceedings of the 4th Conference on information Technology Curriculum (Lafayette, Indiana, USA, October 16-18, 2003). ACM Press, New York (2003) 237-241
7. Carroll, N.L., Calvo, R.A.: Certified Assessment Artifacts for ePortfolios. In: Proceedings of the Third International Conference on Information Technology and Applications, Vol. 2 (2005) 130-135
8. Talbott, T.; Peterson, M.; Schwidder, J.; Myers, J.D.: Adapting the electronic laboratory notebook for the semantic era. In: Proceedings of the 2005 International Symposium on Collaborative Technologies and Systems (2005) 136-143
9. Y. Rekik, Y., Gillet, D., Nguyen Ngoc, A.V., Guillaume-Gentil, T.: Framework for Sustaining Collaboration in Laboratory-Oriented Communities of Practice. 7th Conference on Information Technology Based Higher Education and Training (ITHET), Sydney, Australia, July 10-13 (2006)

Tracking User Participation in a Large Scale Team Collaboration Environment

Dionysis Karaiskakis, Dimitris Kalles, Thanassis Hadzilacos

Hellenic Open University
Laboratory of Educational Material and Educational Methodology
Patras, Greece
{karaisk,kalles,thh }@eap.gr

Abstract. All students of the Hellenic Open University (HOU) attend undergraduate and postgraduate courses at a distance. The lack of a live academic community is reported by many as a drawback in their studies. Systematic exploitation of new communication and collaboration technologies is desirable in the HOU but cannot be imposed universally as the average student's IT competence level is relatively low. In this work we present the methodology for the development of an integrated communication environment in which collaboration spaces serving as open communities play a key role in user engagement in the whole communication environment. To track and evaluate user participation we propose analytic metrics which, when combined with our detailed knowledge of the internal workings of user groups, provide concrete evaluation of the community online activity.

Keywords: team collaboration, user participation, distance learning technologies

1 Introduction

The Hellenic Open University (HOU) provides education at a distance taking into consideration a tenet for the universal access of students to educational res ources. HOU is thus formally based on traditional practices (by mailing books and educational material, by encouraging students to personally communicate with their tutor, and by organizing a small number of student-tutor consulting sessions attendance in a small number of common advisory meetings per year). Thus, the use of new communication and collaboration technologies is not mandatory for students to complete their studies. Still, such technologies are being systematically used for publishing announcements and information of a general nature, and for providing basic supplementary electronic material and sources for further study.

Moving from a model where web technologies are used for publishing information to a model where such technologies constitute a basic working tool in the everyday life of at-a-distance-learning students is a huge undertaking, which addresses both

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 323-332, 2006.

technical and cultural issues. Both types of issues are closely linked to the diversity of the background of the students and of the tutors as well as the availability and ease of use of the underlying infrastructure.

As the only entry requirement of HOU students is the successful completion of high school studies, these students reflect the mean level of experience and competence in the use of electronic services in Greece which, to date, is not particularly high (2005: 59% of the population aged 25-54 has no basic computer skills [1]). This problem is aggravated in the uptake of collaboration or e-learning services, which demand the existence of a certain attitude by the users (beyond usage skills). Thus, planning for the development of electronic services should address the following problems:

- The need for universal access in services of *stratified* complexity (suitable for each team level in order for all to accept their use).
- The organizational aspects of scaling up in numbers and in complexity.

In this work we present aspects of our emerging methodology for designing the entire communication environment provided to the students and tutors as a supplementary service to help them in their everyday work.
The basic unit in HOU studies is the Thematic Unit (TU). One TU consists of one or more teaching groups (a tutor is assigned to each group, which must have at least 10 students, up to just over 30). Small TUs do exist with one tutor and just over 10 students. There are also some very large ones with about 1,250 students in over 40 groups. Currently ~200 TUs are offered and about 1,070 tutors are assigned to various groups in these TUs, encompassing in total about 28,000 students.
Collaboration spaces constitute a focal point in our environment. In those, users can engage in asynchronous communication, publishing content and opinions related to their work (content management and forum services). Given that access to these spaces is allowed for every student (and centrally managed) but that attendance and participation are by and large optional, these spaces function as emerging communities of practice.

Our aim is to define metrics to evaluate user participation in the communities. A comparative evaluation of the community online activity at the TU level will help us propose actions to promote user engagement and participation.
In particular, we explore aspects of a methodology for the quantitative and qualitative follow-up and evaluation of users' participation in combination with the participation of tutors who act as expert users providing advanced knowledge and guidance.

This rest of this paper is structured in five sections. Next, we offer a coarse description of the infrastructure. Following that, we elaborate on metrics for the role of the expert in communities of practice. We then analyze specific groups with respect to their comparative evaluation in terms of online collaboration and proceed to qualitative remarks on the impact of personal attitudes of tutors towards communication on the uptake of the collaboration infrastructure. We conclude by highlighting our research directions.

2 A High-Level Description of the Communication System

In HOU, a substantial part of the mandatory administrative procedures followed by students is done through a portal platform; a key example is the selection of TUs in which a student will be enrolled in the coming academic year.

Typically, such portal platforms do not support specialized services for educational purposes, thus paving the way for specialized LMS (Learning Management System) applications to be deployed. However, the latter tend to serve well advanced users only and are seldom harnessed to their potential.

Because of the (just) average level of IT literacy of students, the acceptance and exploitation of LMSs presents significant difficulties, when attempted at an almost universal scale. On the other hand, the exploitation of electronic services in organization and administration is more acceptable (experience in EU countries shows that the use of new technologies in the educational domain is first noticed for organizational purposes and later for educational ones [2]).

HOU tutors who manage to promote the emergence of student communities often rely on problem based learning as a constructivist learning instructional model [3] (even, subconsciously so). On the other hand the lack of a vibrant academic community in HOU constitutes an important problem for the students; in that respect HOU cannot match traditional campus-based universities. A high percentage of student drop out in HOU (at least, as far as the Informatics undergraduate program is concerned) is related to academic factors, especially a lack of confidence to pursue university-level studies and the perceived lack of adequate assistance (compared to what was initially expected) [4].

To address these needs, an integrated common communication environment was developed, based on a portal infrastructure. To-date it supports (see Figure 1) information services, content management services, and asynchronous team collaboration services, real time services and further education specific services.

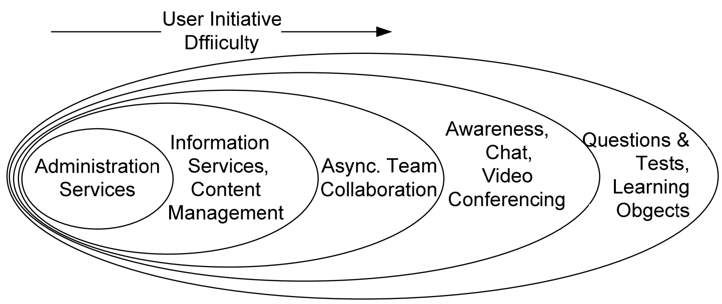

Figure 1: A hierarchy of services

All users and groups are updated in an LDAP server on an annual basis, with data drawn from the Student Registry MIS. Based on those user and group structures, working places were deployed for every TU, to support the communication and collaboration among students, with their group tutor, but also among tutors in the same TU. For each TU a content management space was created, along with a forum accessed by all TU members and a special forum accessed only by the TU tutors. In the collaboration spaces of large TUs additional spaces (*inner rooms*) were created to facilitate the private collaboration within one teaching sub-group (a tutor and all assigned students).

Videoconferencing services were initially provided by an independent application (with its own user and group management infrastructure). A new service has been installed and is now pilot tested to help users access and use the service in a seamless fashion, through the existing (unified) LDAP-based authentication scheme. The service provides video conferencing, chat and awareness services. Additionally, the (open source) Moodle LMS was installed and integrated; subsequently it has been extensively used by one TU to manage the submission and (automatic) grading of a large part of its homework assignments.

Note that all administrative services, content management, team collaboration spaces, teleconferencing and chatting services are hosted on different platforms but are all integrated through a common multi server Web Single Sign On domain to provide authentication. Figure 2 shows a high-level diagram of the overall infrastructure.

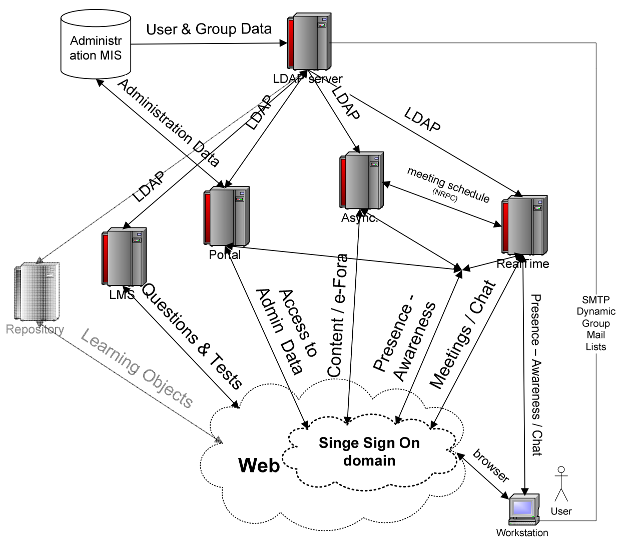

Figure 2: The server-services architecture

3. Measuring the Role of the Expert

We will start discussing some aspects of measuring the role of the expert by drawing on statistics generated by our platform. We will first introduce the concepts using a couple of examples before presenting the detailed results for all TUs.

Participation of group members is defined as the average number of visits per month per community member ($P_m = \Sigma\ V_n/n$), where a visit is defined as a sequence of successive page visits, with each page visit at most thirty minutes apart from the previous one.
While there is a substantial qualitative difference between passive and active user contribution in the community, we believe that such differentiation is only significant in the scope of individual user assessment [5]. When the focus is on the overall comperative evaluation of the community activity (as in our case), the total number of reads and posts is a sufficient metric.
Participation was examined in correlation with the activity of the expert (which is expressed as a percentage figure: *Exp_Activity* = *Exp_Visits* / 100* *All_Visits*).

For example, with reference to Figure 3, we note that the members of group G_{37} visit the workplace on average 20 times per month (roughly once per working day), whereas that rate is about 5 visits per month for the members of G_{188} (*y*-axis). A group index denotes the size of the group (as does the corresponding circle area). Furthermore, we also note that, within G_{188}, about 6% of its overall traffic was generated by the tutors whereas in G_{37}, this climbs up to about 9% (*x*-axis). Last, the dark filling of the G_{37} circle denotes a postgraduate group. At this point we urge the cautious reader to treat the above as a gentle introduction to the nomenclature and defer a comparative discussion (of groups G_{37} and G_{188}, among others) to Section 4.

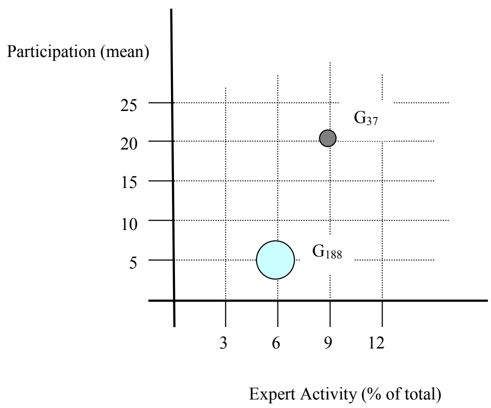

Figure 3: A measurement example

Figure 4 now shows the aggregate results. Data regarding an undergraduate program (consisting of 13 TUs) and an affiliated postgraduate program (5 TUs) were analyzed.

In 7 of those TUs the use of collaboration services was almost null and thus we analyzed the activity in the remaining 11 (6 undergraduate and 5 post graduate), accounting for a total of 2,086 engaged users.

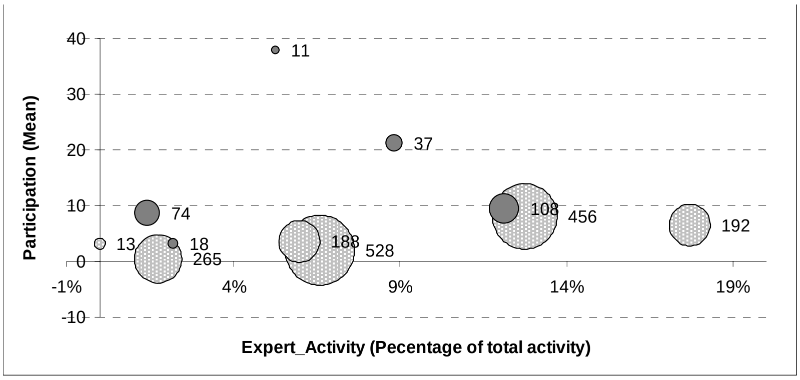

Figure 4: The measurement results

The distributions of visits within each group are not identical (not surprisingly). As a side-product we computed two standard statistical measures of these datasets, namely *kurtosis* and *skewness*. *Kurtosis* as a metric for tail size in a distribution provides a way to estimate the homogeneousness in the distribution of participation in each group. We report the *kurtosis*, in **Figure 5.**

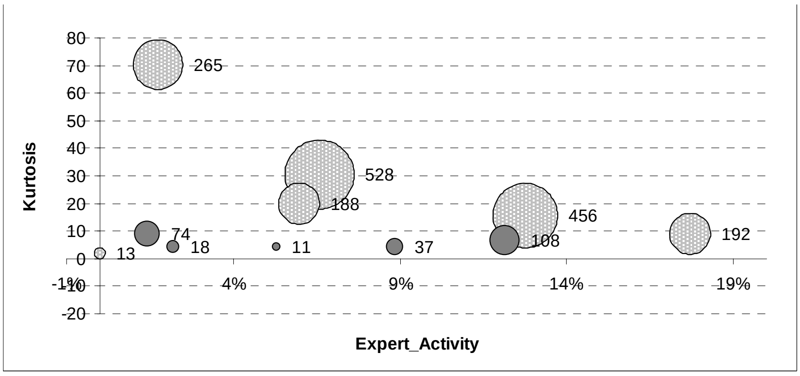

Figure 5: Data set *kurtosis* – small numbers indicate more even distributions

Skewness provides a direct way to estimate the relation between the number of users who are strong participators and those who are not. In all cases Skewness is positive, (ranging from 2 to 7) meaning that very active members are significantly outnumbered by the less active ones (especially in undergraduate groups). The differentiation here between groups is less pronounced than in kurtosis case, suggesting that this pattern is traced in all groups.

4. Discussion vis-à-vis a Detailed Analysis per Group

Before we discuss the results, it is useful to remind the reader that the systematic recording and analysis of activity in these spaces directly aims at tracking characteristic access patterns and at depicting problematic situations or highlighting efficient models of operation. In a working place, interaction between all the members of teams is desirable, particularly so for students. The role, however, of the tutor may be decisive since he, as an expert among other members, may be able to also open up new subjects and not simply respond to questions. Encouragement and participation by an instructor helps a community form more readily [6].

The interpretation of the particular results is facilitated by the fact that we have a detailed knowledge of the internal workings of the reported groups. Such knowledge is easily diffused among people who regularly share their tutoring experiences.

There are several axes of interpretation, which we will attempt to follow. Some finding will be recurring and we urge the reader to interpret these as non-orthogonal indications of the dynamics that exist in group collaborations. At this stage of our research, we seek to strengthen these indications by pointing out the common issues wherever they may be detected.

We start by discussing groups G_{108}, G_{74}, G_{11}, G_{37} and G_{18} (with reference to Figure 4). These groups all refer to postgraduate modules; we enumerate them in the respective expected order that a student would enroll in them. The figure reflects a strong indication that increased tutor activity raises student participation but group size adversely affects such participation (which is not unexpected since it is difficult to mobilize all group individuals when working at a distance).

It is intriguing that G_{74} and G_{108} are relatively close in the respective student participation axis yet so far apart in the tutor activity axis. We believe this is because tutors in the G_{108} are consistently active in their workplace involvement, both in terms of communicating between them and with their groups. Frequent communication raises issues which, from time to time, transcend the boundaries of a discussion forum and may re-appear in a neighboring forum, generating new rounds of collaboration.

A further, subtler, reason is that the study module related with G_{108} is the first module that these postgraduates take. This instills a community culture and when these students move on to the study module related with G_{74}, they are highly (and recently) aware of the benefits of community collaboration and presence is reinforced even without tutor involvement. This also refers to committed students who enroll in those study modules at the same year; they seem to be able to easily spot a good practice and stick with it. We thus note the flow of benefits from a module to another.

Such flow is also apparent, yet more subtly so, when analyzing the apparent strong student involvement of (senior postgraduate) groups G_{11}, G_{18} and G_{37}. It might be tempting to compare G_{11} with G_{18} based on tutor involvement (undoubtedly, measurably apart) but subtler issues arise. It is interesting to note that G_{11} is a module with a heavy software project management component, where the successful carrying out of assignments sometimes dictates the collaboration between students. That those students were already aware of the benefits of workplace collaboration facilitated their electing of the workplace to communicate during assignments. Note that both G_{11} and G_{18} refers to one student group per module (and, hence, one tutor) and therefore there is no room for intra-tutor collaboration. This is in contrast to G_{37} where two tutors were involved in student tutoring and two further tutors are involved in developing educational material for the module, as well as communicating with the students as regards educational matters. So, a substantial part of the traffic generated by the tutor component of G_{37} does in fact refer to communication between tutors. In the G_{18} group, the tutor has not embraced workplace collaboration and, hence, the students have been consulting the workplace for relatively static information (for example, meeting dates and venues) and no academic discussions were made.

Summarizing the postgraduate case, a unifying theme seems to emerge. This theme is that having instilled a collaboration culture in earlier modules has been fundamental in sustaining student workplace involvement. It is reasonable to assert that we must invest as early as possible to educate the student population in workplace collaboration. Such indirect knowledge is only gained by example but is exploited in subsequent study years where tutors may ease their activity without a negative impact on student participation (allowing for obvious deviations in tutoring style); the system seems to have gained momentum. We note that the emergence of this common qualitative characteristic is best demonstrated by the kurtosis figure, which demonstrates that irrespective of tutor activity (after an initial investment), students' access of the workplace more closely resembles that of a normal distribution. Interestingly enough, the *kurtosis* figure also suggests that the postgraduate groups demonstrate a more balanced way of how they access the workplace.

We now turn to discuss groups G_{528}, G_{265}, G_{456}, G_{188}, G_{192} and G_{13}, which all refer to undergraduate modules (the first three ones being junior modules and the latter three being advanced modules). As observed in the postgraduate modules, the larger the module the smaller the student participation. However, in the undergraduate modules, which are on average substantially larger than the postgraduate ones, we also observe that the collaboration workplace is mostly frequented by tutors in advanced modules. The first year modules display erratic performance which can be also traced to their nature and educational content. For example, G_{265} is a mathematics foundation module where the near-zero student participation can be attributed to a number of factors. Most important and influential among these are, the lack of maturity in students' perception of the subject and of academic study requirements in general, as well as the limited know-how of students and tutors in collaboration technologies. That only 2 tutors (out of 25) engage in some collaboration activity is best captured, again, by the kurtosis figure, where that group is a clear outlier.

A similar behavior is also demonstrated by the G_{528} group which, again, contains students at the start of their academic path and contains informatics foundations subjects. From then on, two clearly different paths are obvious. The first refers to the G_{456} group. Students in that group have been typically exposed to the learning curve (in terms of academic and attitude requirements) demanded by the mathematics and informatics foundations and coupled with a strong tutor investment in collaborative technologies display the relative emergence of a collaboration culture (with a healthy kurtosis figure) even at such a relatively large group size.

It is most instructing to see that such a culture is readily harnessed by the G_{192} group which has a reasonable participation index that is based on the majority of the student members. However, this is not the case with the G_{188} group and we are considering the possibility that this may be linked to the educational content of that module. The module covers theoretical computer science and it may be argued that modules with a relatively strong mathematics component are less suitable for collaborative work.

5. Qualitative Issues in the Tutoring Communities of Practice

Since HOU communication is traditionally based on Email and telephone, attendance in the working places is not obligatory. In HOU, the tutor has a mainly supporting and advisory role. However, HOU students are in general professionals that do not easily engage in activities which do not carry a direct practical profit. The emergence and the evolution of the collaboration spaces of TUs as communities of practice is closely linked to how much these can satisfactorily address the real needs of their users.
We have noted several problems that may limit user engagement and participation:

- Access problems (lack of basic skills and/or adequate infrastructure).
- Lack of time (full-time or part-time employment and family matters may limit the availability of time to study to just some time-chunks during weekends).
- Lack of apparent activity in the collaboration space by others is aggravated by physical isolation [7].

In the previous section we offered some insight as to why some student groups seem to be more active than others. We will now slightly deviate from analyzing the above data based on numbers and will try to shed some more light into the qualitative aspects of why some groups seem to shun online collaboration. In doing so we again exploit our intimate knowledge of the internal workings of those groups, however, we urge the cautious reader to note that no part of our analyses does in any way publicize individual data about any participant.
The starting point for our qualitative discussion is group G_{74}. It is very interesting to note that this group has a very low tutor activity because one of its most active tutors is strongly opposed to the use of collaboration technologies due to his strong preference of Email in the organization and carrying out of tutoring activities. This was, thus, a negative result.
How does one counter such a negative stance? The answer might lie within deploying a symmetrically strong opposition. Such behaviour was first spotted in group G_{108} (but not in this particular academic year that these results are based on). Specifically, one of the most active tutors was strongly opposing the deployment of the portal-based collaboration spaces due to his strong preference to a then-existing open-source

system for forum discussions. That opposition was unfortunately aggravated by several “teething” problems in the operation of the portal, at that time. It took a very focused and sustained contribution by at least one other tutor, in terms of generating fruitful discussions in the collaboration place forum, to establish a culture of actually using the collaboration place for further work (coupled, of course, with increased system availability). As the portal gained credibility and opposition grew smaller, it turned up that group participation was sustained even if fruitful discussions were now forthcoming at a more relaxed pace compared to the initial phase.

6. Further Work Directions

There are a number of limitations in our approach. For example, we know that a small number of sub-groups frequently engage in collaboration based on technologies that have not been integrated into our infrastructure, apart from email (text or voice) chat mechanisms or virtual classrooms. Such collaboration statistics are much more difficult to collect reliably and we believe that this (pessimistically) skews our results. Our recent infrastructure upgrade that allows chat and meeting sessions to be organized tightly integrated with the collaboration software will increase the seamless availability of such services to our academic community and will also boost our ability to collect essential usage statistics. After all, we hope to use our detailed knowledge of some modules to progressively refine our indices to also reflect as accurately as possible the situation in all other modules (currently at about 200), without requiring us to invest in understanding all of them. Not surprisingly, we are approaching the problem of the technology uptake in a rather conventional fashion, first trying several approaches on rather receptive users before applying the new concepts to more reluctant (subconsciously so) ones.

References

1. Eurostat, the Statistical Office of the European Communities. News Release 20/6/2006: The e-society in 2005, http://ec.europa.eu/eurostat/
2. Eurydice:The information network on education in Europe: ‘Key Data on Information and Communication Technology in Schools in Europe 2004 Edition’ http://www.eurydice.org
3. J.R. Savery, T.M. Duffy(1995). Problem based learning: An instructional model and its constructivist framework. *Educational Technology*, 35(5): 31-38.
4. M. Xenos, Ch. Pierrakeas and P. Pintelas (2002). A survey on student dropout rates and dropout causes concerning the students in the Course of Informatics of the Hellenic Open University. *Computers & Education* 39: 361–377.
5. Hazari, Sunil (2004) “Strategy for Assessment of Online Course Discussions”, *Journal of Information Systems Education*, Vol. 15, No. 4. Winter 2004, pp. 349-356
6. R.E. Brown (2001). The process of community-building in distance learning classes. *Journal of Asynchronous Learning Networks*, 5(2).
7. M. Taplin (2000). Problem-based learning in distance education: Practitioners' beliefs about an action learning project. *Distance Education* 21(2): 284-307

Towards a Holistic Personalised Support for Knowledge Sharing in Virtual Learning Communities

Styliani Kleanthous and Vania Dimitrova

School of Computing, University of Leeds, UK
{stellak, vania}@comp.leeds.ac.uk

Abstract. Virtual learning communities bring together people from diverse backgrounds and provide the basis for knowledge construction and sharing. Important processes for the community to function as a whole have been identified and examined through existing systems. Although existing systems attempt to support these processes, the absence of a complete community model, and the personalisation and adaptation to the individual rather than the community compose the main obstacles to their holistic success. A computational framework is proposed, to support the community to function as an entity rather than concentrating to the individual person.

Keywords: Virtual Learning Community, Transactive Memory, Shared Mental Models, Cognitive Centrality, Cognitive Consensus, Knowledge Sharing

1 Introduction

During the last decade, academics and practitioners have been searching for techniques to support knowledge expansion and sharing [1]. Online communities appear to be an exceptional approach which brings together people from diverse backgrounds, provides support for collaboration, and – through collective knowledge sharing – provides a basis for the creation of shared understanding [1, 2]. The term Online Community has been used in a broad context for Virtual Community, Community of Practice, and Learning Community. Authors coming from different disciplines vary in their perception of what constitutes a ‘community’ [3]. For this study, we consider Virtual Learning Communities (VLCs) that may exist in either organisational or educational context and have the following characteristics: common purpose, identified by the participants or a facilitator; commitment to the sharing of information and generation of new knowledge; shared resources; participants are more likely to be at different stages of their professional/academic life; high level of dialogue, interaction and collaboration; equal membership and leadership; knowledge construction. The above characteristics can be part of both Learning Communities [2], and Communities of Practice [2, 4]. Indeed, as shown by Lewis and Allan [2], many communities of practice function as learning communities, where learning is a result of interactions within a particular social context.

However, learning within VLC may be hindered by several technological factors (e.g. communication barriers, diverse technical background, technological constraints)

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing, EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 333-344, 2006.

and social factors (e.g. different background, interests, and understanding of the problem). A common misconception is to believe that VLC will be effective when people and technology are present. As stressed by Fischer and Ostwald [5], appropriate support for the effective functioning of online communities is needed. This requires a good understanding of what is happening within a community, and what processes influence the success of knowledge sharing.

A review of existing systems that support VLCs will be presented here. We will examine how these systems facilitate knowledge sharing and effective functioning of a community as an entity. The discussion will be based on processes which are crucial in successful VLCs, and therefore should be supported by the computer systems. Based on the review, we will point at future research directions and will outline our plans for utilising techniques from user modelling and user-adapted interaction to provide personalised support for knowledge sharing in virtual learning communities.

2 Support for the Functioning of VLC

This section outlines processes identified by research in organisational psychology and considered as essential for the effective functioning of teams, groups, and closely-knit communities. We will show, with the help of scenarios, how these processes relate to integrating newcomers, motivating existing members, improving resource organisation, and facilitating collaboration in VLCs.

2.1 Processes which should be supported

Research in organisational psychology has identified that effective teams and groups operating in the boundaries of an organisation build transactive memory, develop shared mental models, establish cognitive consensus, and become aware of who their cognitively central and peripheral members are [6-11]. These processes can also be applied to a broader context to inform what support should be provided to a VLC.

Transactive Memory (TM) deals with the relationship between the memory system of individuals and the communication that occurs between them [11, 12]. The focus is on encoding, storage and retrieval of information. Therefore, a transactive memory system can provide the ability to recall previously visited areas and subjects, and to identify relevant knowledge [10, 11].

The notion of transactive memory and the development of transactive memory system has been proven to be very promising for the functioning of teams and groups [6, 7, 10, 11]. Wegner [11] points out that transactive memory is concerned with “the prediction of group and individual behaviour through an understanding of the manner in which group processes and structures information”. Transactive memory helps group members to divide responsibilities for different knowledge areas and be aware of one another’s expertise. The key for a transactive memory system to function is that the divergence of information held in members’ heads must be known to the others. To illustrate, assume that member A’s memory can act as an extension of member B’s memory. If B is aware of what A knows, he/she should be able to get access to A’s knowledge and the information A possesses.

Shared Mental Models (SMM) are defined as the "team members' shared, organised understanding and mental representation of knowledge about key elements of the team's relevant environment" [10]. Studies confirm that collaborative knowledge exploitation can be improved if group members have a shared understanding of the environment, situation and task at hand [13]. One of the main objectives of community formation is through knowledge sharing and communication to develop a shared understanding of the context in which community members act, and to create a shared understanding of the world [1, 14].

Cognitive Consensus (CCs) deals with shared conceptualisations between members and shared understanding of the meaning concepts encapsulate [10, 15]. The idea is for the members to agree, or be aware of the different definitions behind a concept and come at a compromise on how that term is used inside a given community.

Cognitive Centrality (CCen) considers the importance of the contribution of individual members with regard to the community's context [8]. Members who share a significant amount of valuable information for the whole community become cognitively central and play a vital role in the smooth functioning of a community. On the other hand, peripheral members can sometimes hold unique knowledge, and can also be important for effective knowledge sharing.

2.2 Support needed

The above processes can affect the functioning of VLC, and can point out what support may be needed. This will be illustrated here with several scenarios. We will show that support to a VLC has to be tailored to the community's needs and serve both newcomers and oldtimers [16]. Furthermore, personalised support should add value to the creation and sharing of knowledge between members and facilitate the functioning of the community as a whole.

Support to Newcomers

Newcomers are newly joining members who need to identify their role in the community and what they will gain from it. Support is needed to quickly integrate these members to the community's knowledge processes, which can improve their learning experiences and can have a positive effect on the overall functioning of the community.

For example, consider a person named Chris who is interested in social tagging for e-learning and is joining a VLC where members share information about technology-enhanced learning. Chris has no background of what was happening previously in the community, does not know about the interests and knowledge of other members, is unsure whether there are any relevant resources on the topic he is interested in, and does not know what he can contribute to the community. Chris should be helped to identify people or knowledge important to him in this community. Support should be provided also to introduce Chris to the community by identifying what he knows and making other members aware that he is holding valuable knowledge, which refers to *transactive memory*. Furthermore, because social tagging is identified as a peripheral topic for this community, Chris may be encouraged to elaborate on its relation with personalised learning, which is the main focus, i.e. *cognitive centrality,* of this community. This will be beneficial for him (he may discover relationships he was unaware of and may become a more central member to this community) and for the community (new topic will be connected to the community's context which can improve the processes of knowledge sharing and construction).

Support to Existing Members

Existing members (oldtimers) should also be helped to integrate and become active participants in the community's knowledge processes.

For example, consider Jane who is an existing member of this community and is interested in intelligent tutoring systems. She is regularly uploading and downloading resources and is actively engaged in discussions with other members. Jane is one of the *cognitively central* members of this community. Assume that another member – Mark – is interested in student modelling which Jane is familiar with (because she has participated in discussions on the topic and has uploaded relevant resources). Support should be provided to help Mark and Jane discover that they have joint interests, so that they both, as well as other members of the community can benefit from combining their knowledge and extending the community's *transactive memory*.

Jane is now working on a new project and needs to find information on ontologies - a topic she is not very familiar with. She can be helped to allocate relevant resources within the community and establish contacts with members knowledgeable in the area, which is related to the community's *transactive memory* system. Jane may also be encouraged to upload more resources on ontologies and discuss the link of this topic with technology enhanced learning. If the new topic is of interest to many members, it will become close to the community's *cognitive centrality*.

The community has to adapt to changes in its environment which may lead to a shift of the central area of interest and transformation of participation. [16]. Consequently, active contributors may become passive members, while others who used to be peripheral participants may become cognitively central [8, 9]. For example, Jane may gradually reduce her participation or stop contributing to the community. If changes over time are detected, *cognitively central* members like Jane who are moving to the periphery can be encouraged to participate more actively in the community's knowledge processes.

Support to Improve Organisation of Resources

People categorise and organise their resources differently according to specific characteristics, different conceptualisations, searching habits, etc. [17, 18]. Confusions may happen and disagreements are inevitable [19], which can have an impact on the effective functioning of an online community [17, 20, 21]..

Consider for example several members of the community interested in the use of context in systems for technology-enhanced learning. Each member uploads resources important to them and relevant to the projects they are engaged in. Jane considers context from an Artificial Intelligence perspective and links it to encoding different viewpoints in an ontology. Chris associates context with the conditions in a learning environment, while Mark is engaged in a mobile learning project where context is used to represent location-based information. Appropriate support for effective knowledge sharing would encourage members establish common procedures how to categorise and locate information, which can be part of a *shared mental model*. Furthermore, discrepancies in individual members' conceptualisations, which refer to the lack of *cognitive consensus*, and how they affect the organisation of resource (e.g. a paper may be belonging to more than one category or similar papers may belong to disconnected categories) should be detected and pointed to the community.

Support to Encourage Collaboration
People participating in a VLC share an information space and may be engaged in active communication. These are preconditions for collaboration, which is often associated with effective VLCs where members either work together on a joint project or share a common desire to produce better services [22]. Collaboration among community members can be encouraged in two ways. Firstly, support should be provided to help members build a common understanding of what the purpose of the community is, who is involved and what their interests are, what tasks people are involved in, what is happening in the community and how it progresses over time. These issues relate to building a *shared mental model* and developing a good *transactive memory* system.

Secondly, interaction between community members can be encouraged to create more opportunities for collaboration. Possible situations when members will benefits from communication with others can be identified. For instance, when a lack of *cognitive consensus* is suspected, members may engage in clarification interactions. Referring to the above example with different use of context, Chris, Jane, and Mark may be directed to discuss the different interpretations of the concept. Another possibility to encourage interaction is when members are found to share common interests or to have complementary knowledge. For example, Chris and Jane may be encouraged to discuss the similarity between folksonomies (linked to Chris' interest in social tagging) and ontologies (related to Jane's new project).

To sum up, TM, SMM, CCs, and CCen relate to the effective functioning of a community and are critical in defining personalised support tailored to the needs of the community. TM is important for quickly integrating newcomers to the community, improving the benefits of existing members to motivate their participation, and encouraging collaboration. SMM is a prerequisite for effective knowledge sharing and is directly linked with document organisation and information localisation; it is also an important factor for facilitating collaboration among community members. CCen can be helpful for relating the knowledge of newcomers and existing members to the community's context, and monitoring changes happening within the community over time. CCs can point at similarity and difference of individual members' viewpoints, which can affect resource organisation and can trigger interactions that may result in collaboration activities.

3 Existing Technologies to Support VLCs

We will now review what computational methods have been developed to address TM, SMM, CCen, and CCs, by using several representative systems:

- **Answer Garden** [23] supports the building of organisational memory by helping people find and share answers to questions they come across;
- **BSCW** [24] is built as a general tool for cooperation over the web and supports the main knowledge sharing activities, e.g. upload/download/search for resources, synchronous/asynchronous communication, version control;
- **Comtella** [25] is a small-scale application for sharing of class-related web resources among students, it focuses on motivating participation;
- **GIMMe** [26] is a web-based system that serves as a central repository for storage and access to email conversations within an organisation;
- **KSE/Jasper** [14] is knowledge sharing environment of information agents which are associated with each user and are capable of organising, summarising and sharing knowledge from a number of sources ;
- **MILK** [27] supports communities of interest within an organisation by integrating knowledge associated with people, communities, and informal knowledge, its core component is a metadata management system;
- **NuggetMine** [28] is an intelligent groupware application that facilitates opportunistic sharing of information nuggets (e.g. URLs, book titles, articles, information about an event) among a group;
- **OntoShare** [29] is an ontology based knowledge sharing environment which makes extensive use of advanced Semantic Web technologies to provide individualised support for members of a community of practice];
- **TeamWorks** [30] is a collaborative environment to support communities of practice which provides tools for communication, storage and capturing of data, and maintains document recommendation based on loyalty.

These systems are selected because they address, to a certain degree, the concepts presented in Section 2.

Transactive Memory

The building of transactive memory is supported, to a certain degree, by all systems. *A search facility* to help users allocate relevant knowledge and people is the most common technique used to facilitate the development of TM. BSCW [24] provides a standard search function through resource titles, while MILK [27] allows searching for experts or information in the community based on the information stored in people's profiles and on the metadata associated to resources. However, this approach is prone to inaccuracy: metadata is defined by members who upload the resource and the profiles are based solely on the users' interactions with the system. These problems are addressed in KSE/Jasper and OntoShare which provide enhanced search facilities based on keyword extraction from the entire documents [14, 29]. Moreover, KSE/Jasper and OntoShare enable users to search for other members with similar interests based on dynamically maintained user profiles open for inspection and change by the users. Answer Garden and GIMMe also illustrate the use of natural language processing techniques to provide support for the development of transactive memory [23, 26]. Answer Garden uses text retrieval engine to allocate "expert" answers to a user's question, and employs simple dialogue to clarify that question. Although identifying expertise can be related to TM, Answer Garden maintains anonymity of user contributions which does not allow allocating community members who hold that expertise. GIMMe uses latent semantic indexing to facilitate search through a vast repository of email conversations, and extracts group categories based on previously visited issues, which can be important for TM,

While search relies on users pulling for information, *notifications and recommendations* are push techniques. BSCW notifies users every time changes are made to the community space (who uploaded what and who read what), which may implicitly help for developing awareness of who knows what. However, users may not notice important information because the notifications are not tailored to the user's current interests, as this is done in OntoShare based on simple content-based filtering mechanism. TeamWorks [30] also provides tailored notifications by recommending resources relevant to the current topic under discussion. While recommendations have been found as useful personalisation techniques, their current application in VLC focuses solely on support for an individual and the benefit for the development of TM is yet to be shown.

Semantic-enhanced technologies have also been applied to support the developing of TM. NuggetMine and MILK use metadata about resources to associate newly added pieces of information with old ones [27, 28]. However, this approach relies only on metadata and does not take into account information about people who shared/read the resources, which is crucial for the construction of TM. GIMMe and BSCW maintain a hierarchal structure of categories that can facilitate knowledge allocation. However, the categories are feely constructed by users and become messy, which may hinder resource allocation and expertise finding, and is not very helpful for the development of TM. OntoShare instead uses ontology of domain categories to identify knowledge and similarities between users.

Shared Mental Models

Making members aware of what is happening in the community considered important and supported by the majority of the systems in different ways and up to a level. *Visualisation* techniques to allow users become aware of what is happening in the community in general have been used for the development of SMM by two systems. The development of SMM is promoted in Comtella [31] by galaxies visualisations which illustrate the convergence of topics. BSCW also uses visualisation techniques to support the development of SMM. Users can explore a map of the information space which shows each folder and the activities in it, indicated with small rectangles. Another visualisation shows how many papers are in a folder presented as towers in a city. Visualisation techniques are useful for an overview of what is happening in the community but appear insufficient for a deep understanding of the conceptual processes within the community.

Semantic – aware techniques have been explored to support the development of SMM in Jasper II, MILK, and TeamWorks. Jasper II supports the creation of shared understanding by capturing the individual perspective in the form of annotations typed in by the users [14]. Similarly, MILK supports contextual awareness in the community based on meta-information users are typing [27]. However, meta-data provided solely by users may be inaccurate, incomplete, or contradicting. A shared ontology is used by MILK to allow users to associate documents uploaded to the terms on the ontology tree. In this way, users have to agree to a specific point of view represented in the ontology, which may not always be shared by all community members. TeamWorks [30] facilitates the development of shared understanding by recommending resources to community members based on what others are reading.

Cognitive Consensus

A shared ontology has been used in two systems in an attempt to support CCs. OntoShare and MILK are both using an ontology from where users can choose words to assign to the resources they upload. If a relevant word cannot be found, users can enter a new work that is added to the existing ontology. Using a shared ontology dynamically expanded by contributions from community members can help the community establish cognitive consensus. However, understanding ontologies can be a challenging task for VLC users who are likely to lack knowledge engineering skills.

TeamWorks provides a *controlled vocabulary* [30] for users to categorise their resources. The interface is more intuitive and the users are not burdened with complex ontological structures. However, none of the approaches takes into account that subjective views that are not necessarily agreed within the whole community can be put mistakenly in the shared ontology/vocabulary. Moreover, both approaches appear to work at a surface (word, phrases) level, while CCs requires considering the understanding community members have about a concept [10].

Cognitive Centrality

Cognitive centrality is addressed partly in Comtella by a *reward mechanism* aimed at encouraging participation in online communities. Each member earns points based on how others are rating the resources he/she has uploaded [25]. Comtella uses *visualisation techniques* to present cognitive centrality. In a recent version of the system, stars with different size and brightness give an indication of who is contributing valuable resources (judged by the ratings). In an earlier version of the system, galaxies represent topics that may be of interest to the community. The closer to the centre of the galaxy a member is, the more central (judge by the number of papers uploaded) he/she is considered to be [31]. The mechanisms used for calculating cognitive centrality in Comtella are quantitative and do not take into account the cognitive influence of a member and the relevance of their contribution to the community’s context.

Table 1 gives a condensed summary of the technologies reviewed.

4 Discussion

Although systems attempt to support TM, SMM, CCen, CCs, the absence of a complete community model, and the personalisation and adaptation to the individual rather than the community compose the main obstacles to their holistic success. Our research aims at the development of a framework for holistic personalised support based on a community model and using that model to support the building of TM, SMM, and CCs. The computational framework will consist of two major parts. The first will deal with the development of a community model, which will represent the whole community and will focus on the processes discussed in Section 2. The second will deal with offering adaptive support to improve the functioning of the community.

Fig. 1 illustrates the architecture of our framework following the general architecture of user-adaptive systems defined in [32].

Table 1. Summary of the technologies that support TM, SMM, CCs and CCen

Process	Technologies to support this process
TM	**Search**: Basic search through document titles {BSCW} Search through metadata using user profiles {MILK} Extract keywords from resources and link with user profiles {OntoShare, KSE/JASPER II } Text retrieval techniques based on keywords {Answer Garden} Latent semantic indexing {GIMMe} **Notifications and recommendations:** Notify about changes {BSCW} Recommend resources and people on user profile {OntoShare} recommend based on current task {TeamWork} **Semantic-aware techniques:** Metadata to associate information {NuggetMine, MILK} Category hierarchy {GIMMe, BSCW} Ontology {OntoShare}
SMM	**Visualisation** Clusters of common interests {Comtella} Awareness of what is happening in the community {BSCW } **Semantic-aware techniques** Metadata to identify common interests {KSE JASPER II, MILK} Shared Ontology to create connections between people {MILK} Recommend resources to be read by everybody {TeamWorks}
CCs	**Shared Ontology** {OntoShare, MILK} **Controlled Vocabulary** {TeamWorks}
CCen	**Reward mechanism** {Comtella} **Visualisation** {Comtella }

For the development of the community model, we will focus on the analysis of tracking data collected from an existing VLC application. Two year tracking data from an existing VLC with some 25 researchers with common interests working together on virtual research projects and sharing documents with the BSCW system that supports resource sharing and collaboration over the web will be used[1]. The BSCW data consists of information on who uploaded what resource on the community's space; who accessed which resource and when, who ranked and modified it; which members joined and left the community and when. This information is in an xml like format and is being processed with data mining tools**.** The tracking data is being analysed to see what information we can get to identify existence of TM, SMM, CCen, and CCs. Learning or knowledge construction, information sharing and collective efficacy (i.e. how much the group members believe that they can be successful as a group) will be examined in relation to the development of SMM, TM and CCs in the community. Having this done, we will enhance what we have with semantically enriched information such as metadata of the objects, considering the specialisation area of the person who posted that object

[1] The tracking information is taken from the BSCW interface, available to all members of the community. The experimenter is a member of this community. Aliases have been used instead of users' real names to comply with privacy regulations concerning data analysis and presentation of results.

and keywords provided. We will also use existing ontologies of areas relevant to our community (for example, the VLCs we are analysing are focusing on issues related to the Semantic Web for which example ontologies have been developed[2]) to compare against the data that we have. Ontological reasoning techniques will be used to identify relations between topics and to decide what interventions from the system may be needed.

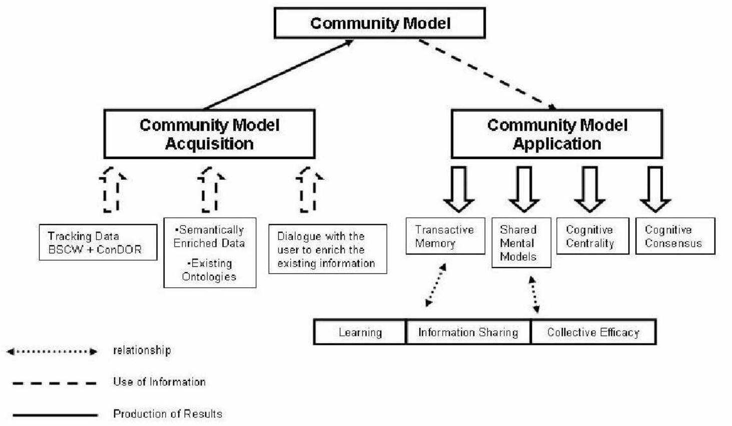

Fig. 1. General Structure of the Community Modeling and Adaptation Framework

Only analysing tracking data and ontologies will not be sufficient to find consensual knowledge and shared mental models. To model these, we will use in addition a system-user interaction to get additional information and complete the community model. The dialogue approach has been successfully used in our research group to gather knowledge of individual users [33] and can be adapted to capture and clarify aspects of collective knowledge.

As pointed by one of the reviewers, security of the system is an issue that inevitably will have to be dealt with. As the system has not yet designed or implemented, an initial thought is that registration and use of log-in names and passwords will be mandatory for users to enter the community's space.

Once the community model is developed, it will be used to provide support to the community and to help its members improve the TM system of their community, develop SMM and CCs between them and become aware of cognitively central or peripheral members. This will help us point at issues that support information sharing, learning and development of collective efficacy, and to help the community build a good TM system and a shared understanding of the domain they are working in.

[2] For example, https://wiki-sop.inria.fr/wiki/bin/view/Acacia/KnowledgeWeb

References

1. Puntambekar, S., *Analyzing collaborative interactions: divergence, shared understanding and construction of knowledge.* Computers & Education, 2005. In Press, Corrected Proof.
2. Lewis, D. and B. Allan, *Virtual Learning Communities: a Guide to Practitioners*. 2005, Berkshire: Open University, McGraw Hill.
3. Preece, J., D. Maloney-Krichmar, and C. Abras, *History and Emergence of Online Communities*, in *Encyclopedia of Community*, B. Wellman, Editor. 2003, Berkshire Publishing Group.
4. Wenger, E., *Communities of Practice: Learning, Meaning, and Identity*. 2001, Cambridge: Cambridge University Press.
5. Fischer, G. and J. Ostwald, *Knowledge Management: Problems, Promises, Realities, and Challenges.* IEEE Intelligent Systems, 2001. **16**(1): p. 60 - 72.
6. Hollingshead, A.B., *Perceptions of Expertise and Transactive Menory in Work Relationships.* Group Processes and Intergroup Relations, 2000. **3**(3): p. 257 - 267.
7. Hollingshead, A.B. and D.P. Brandon, *Potential Benefits of Communication in Transactive Memory systems.* Human Communication Research, 2003. **29**(4): p. 607 - 615.
8. Ilgen, D.R., et al., *Teams in Organizations: From Input - Process - Output Models to IMOI Models*, in *Annual Review of Psychology 2005*. 2005, University of Leeds: Leeds. p. 517 - 543.
9. Kerr, N.L. and R.S. Tindale, *Group Performance and Decision Making.* Annual Review of Psychology, 2004. **55**: p. 623 - 655.
10. Mohammed, S. and B.C. Dumville, *Team mental models in a team knowledge framework: expanding theory and measurement across disciplinary boundaries.* Journal of Organizational Behavior, 2001. **22**(2): p. 89 - 106.
11. Wegner, D.M., *Transactive Memory: A Contemporary Analysis of the Group Mind*, in *Theories of Group Behavior*, B. Mullen and G.R. Goethals, Editors. 1986, Springer - Verlag: New York. p. 185 - 208.
12. Hollingshead, A.B., *Communication, Learning and Retrieval in Transactive Memory Systems.* Journal of Experimental Social Psychology, 1998. **34**(5): p. 423 - 442.
13. He, J. *Knowledge Impacts of User Participation: ACognitive Perspective.* in *SIGMIS '04*. 2004. Tucson, Arizona, USA.
14. Merali, Y. and J. Davies. *Knowledge Capture and Utilization in Virtual Communities.* in *In Proceedings of the First International Conference on Knowledge Capture*. 2001. Victoria, British Columbia, Canada.
15. Mohammed, S. and E. Ringseis, *Cognitive Diversity and Consensus in Group Decision Making: The Role of Inputs, Processes, and Outcomes.* Organizational Behavior and Human Decision Processes, 2001. **85**(2): p. 335.
16. Wenger, E., *Communities of Practice and Social Learning Systems.* Organization, 2000. **7**(2): p. 246.
17. Berlin, L., et al. *Where did you put it? Issues in the design and use of a group memory*. in *CHI '93: Proceedings of the SIGCHI conference on Human factors in computing systems*. 1993: ACM.

18. Indratmo and J. Vassileva. *Human and Social Aspects of Decentralized Knowledge Communities*. in *Proceedings of the First Workshop on the Semantic Desktop: Next Generation Personal Information Management and Collaboration Infrastructure*. 2005.
19. Wu, H. and M.D. Gordon. *Collaborative Filing in a Document Repository*. in *SIGIR '04*. 2004. Sheffield, South Yorkshire, UK.
20. Golder, S. and B. Huberman. *The Structure of Collaborative Tagging Systems*. 2005 [cited; Available from: http://arxiv.org/abs/cs.DL/0508082.
21. Wu, H., M.D. Gordon, and K. DeMaagd. *Document Co-Organization in an Online Knowledge Community*. in *CHI 2004*. 2004. Vienna, Austria.
22. Dillenbourg, P., *What do you mean by 'Collaborative Learning'?* in *Collaborative-learning: Cognitive and Computational Approaches*, P. Dillenbourg, Editor. 1999, Elsevier: Oxford. p. 1-19.
23. Ackerman, M., *Augmenting Organizational Memory: A Field Study of Answer Garden.* ACM Transactions on Information Systems, 1998. **16**(3): p. 224.
24. Wolfgang, P., et al., *Presenting Activity Information in an Inhabited Information Spaces*, in *Inhabited Information Spaces Living with your Data*, N.D. Snowdon, F.E. Churchill, and E. Frecon, Editors. 2004, Springer: UK.
25. Cheng, R. and V. Julita. *Adaptive Reward Mechanism for Sustainable Online Learning Community*. in *Artificial Intelligence in Education '05*. 2005. Amsterdam, NL.
26. Lindstaedt, S. *Towards Organizational Learning: Growing Group Memories in the Workplace*. in *CHI*. 1996.
27. Agostini, A., et al. *Stimulating knowledge discovery and sharing*. in *GROUP '03: Proceedings of the 2003 international ACM SIGGROUP conference on Supporting group work*. 2003: ACM.
28. Goecks, J. and D. Cosley. *NuggetMine: intelligent groupware for opportunistically sharing information nuggets*. in *IUI '02: Proceedings of the 7th international conference on Intelligent user interfaces*. 2002: ACM.
29. Davies, J. and A. Duke, *OntoShare - An Ontology -Based Knowledge sharing System for Virtual Communities of Prectice.* The Journal of Universal Computer Science, 2004. **10**(3): p. 262 - 283.
30. Gouvea, M.T.A., Motta, and Santoro. *Recommendation as a Mechanism to Induce Participation in Communities of Practice.* in *Computer Supported Cooperative Work in Design II: 9th International Conference, CSCWD 2005*. 2006. Coventry, UK.
31. Bretzke, H. and J. Vassileva. *Motivating Cooperation on Peer to Peer Networks*. in *User Modeling 2003: 9th International Conference, UM 2003*. 2003. Johnstown, PA, USA.
32. Jameson, A., *Adaptive Interfaces and Agents*, in *Human-Computer Interaction Handbook*, J.A. Jacko and A. Sears, Editors. 2003, Erlbaum: Mahwah, NJ.
33. Denaux, R., V. Dimitrova, and L. Aroyo. *Integrating Open User Modeling and Learning Content Management for the Semantic Web*. in *User Modeling 2005*. 2005. Edinburgh, Scotland, UK.

Informal learning theories and tools to support knowledge management in distributed CoPs

M.C. Pettenati[1], M. Ranieri[2]

[1]Electronics and Telecommunication Department
[2]Educational Sciences Department
University of Florence (IT)
{mariachiara.pettenati, maria.ranieri}@unifi.it

Abstract. In this work *informal learning* theories and practices and *social networking* features are taken as starting points to build a reference collaboration model to support collaborative knowledge construction in Distributed Communities of Practices. Sample web 2.0 applications to fit the collaboration model purposes are then described. The provided model can give contribution to the design and to the improvement of a specific collaborative virtual environment to support knowledge management in DCoP.

Keywords: Informal learning, learning 2.0, web2.0, distributed CoPs, knowledge management

1 Introduction

Communities of practices cover a central role in the processes of knowledge management [1][2] as they are "the heart and the soul of knowledge sharing"[3]. Since the purpose of the CoP is typically achieved through the understanding and continuous renegotiation of joint enterprises by its members, a crucial problem that must be addressed in the online environment is to devise methods and tools to support:

- expression, representation and sharing of practices
- development and exploitation of knowledge inside and outside of the CoP
- self/group-reflexivity and metacognition about the practices and about the life of the CoP itself

Indeed, these knowledge management functions have close relation with the collaboration features typically emerging in *informal learning* contexts since in the attempt to maintain a reciprocal engagement in the achievement of a common goal the

E. Tomadaki and P. Scott (Eds.): Innovative Approaches for Learning and Knowledge Sharing,
EC-TEL 2006 Workshops Proceedings, ISSN 1613-0073, p. 345-355, 2006.

CoP members aim at acquiring *significant learning*; from this perspective, as it was pointed out by Wenger [2], a CoP can be seen as "shared learning histories".
This work is therefore framed and rooted in the background context of *informal learning theories* and *practices*.
Definitions of informal learning have been given in Cedefop glossary [4] and in the Communication of European Commision in 2001 [5][6]. In these documents *informal*, *formal* and *non-formal learning* are respectively defined as:

- *Formal learning*; learning that occurs within an organized and structured context (formal education, in-company training) and is intentional from the learner's perspective. Normally it leads to a formal recognition (diploma, certificate).
- *Non-formal learning*; learning embedded in planned activities that are not explicitly designated as learning, but which contain an important learning element. Non-formal learning is intentional from the learner's point of view.
- *Informal learning*; learning resulting from daily life activities related to work, family, or leisure. It is often referred to as experiential learning and can to a certain degree be understood as accidental learning. It is not structured in terms of learning objectives, learning time and/or learning support. Typically, it does not lead to certification. Informal learning may be intentional but in most cases, it is non-intentional (or 'incidental'/random).

In the new-born research context of *informal e-learning* theoretical reflection and applied research is still at the beginning and e-learning and knowledge management can derive a significant boost from these "social networking attitudes and practices". Informal learning is a highly natural practice because it is deeply rooted in our daily behavior; spontaneous relations, interactions and conversations support informal learning practices, contributing to the creation and transmission of knowledge [7]. In informal learning practices the social behavior and the support of technologies converge toward the "network"; a network made by people and resources, a *social network*, unified by personal needs or common goals, interaction policies, protocol and rules and telematic systems all together favoring the growth of a sense of belonging to a community.

In this paper we try to provide a reference model to support online collaboration accounting for new practices and technologies of social networking currently wide spreading in the Internet. The need to reflect and research on such a model is grounded in some critical issues: just to mention some as, reference literature points out [1] [8] [9][10]online collaboration suffers the mediatization of interaction context, has to face the problems of social grounding, is conditioned by trust and reputation, requires group culture development and must face the issues related to the representation and management of knowledge.

To this extent in paragraph 2 we analyzed background conditions for networks of subjects collaborating online deriving *enabling functions* in informal learning contexts emerging in social networks. Then, in paragraph 3, we present the reference collaboration model which envisages a layered structure where the layers of "Organization" and "Collaboration Management" are supported by functions and conditions of an enabling layer named "Social Networking". In paragraph 4 we discuss tools and technologies which could support the collaboration model.

The model aims at giving suggestions to designer of online collaboration environment for CoPs in order to maximize the advantages deriving from the effective networking to enhance and improve knowledge management functions.

2 Enabling conditions for collaboration in Distributed CoPs

Collaboration in online environment is harder than in presential situation [1] [3]. This is due to the fact that the integration level normally achievable in presence is typically higher than in network-mediated environment where technology itself is erroneously considered to be capable of providing "group awareness". Actually, just to mention two underestimated problems that technology can bring, the difficulties of representing a group and the competences of its members in the technological environment as well as the lack of direct contact could weaken the sense of belonging and quickly lower the motivation to collaborate.
A crucial role is therefore played by designing a collaboration system (that is a grounding method availing of several tools) in its integrated aspects, accounting for subjects, technologies and environment.

Scenarios which become always more common highlight that through informal channels new learning and knowledge management spaces more easily are enabled, thanks to people and their ability to "networking" and reciprocally learn in a natural and spontaneous way [11]. The reference model for collaboration proposed in the next paragraph aims at fostering these potentialities. This model was inspired by the analysis of the strengths emerging in the context of informal e-learning in social network, to evaluate the integrability and/or transferability in other context, such as knowledge management in CoPs.

From this perspective in Table 1 the main difference between social networks and CoP are schematized as fort their sharing/cooperation/collaboration characteristics.

Table 1. Distinctions among the CoP and Social Network, adapted from [1]

Entity	**Social Network**	**CoP**
Goal	Relation based on individual interests, debate, confront on specific topics; multiplicity and heterogeneity of joining interests and motivations	Create and expand knowledge; develop individual skill
Belonging	Spontaneous and autonomous motivation	Self-selection based on expertise or passion for the topic
Duration	Non-defined	It evolves and ends organically

		according to the relevance of the topic and of the reciprocal interest
Cohesion and enabling factors	High level of trust (relevance of reputation), sense of responsibility, high technological skills, distributed reflexivity and evaluation (non autonomous, nor heteronomous but socially spread) Type of relation: share/evaluate	Passion, trust, identification with the groups and their expertise Type of relation: share/collaborate/cooperate

A model for collaboration in online communities should first of all satisfy some general “effectiveness conditions” (the term *satisfy* is on purposely adopted instead of *implement*, because the functions that follow are hardly hardcoded in a technical system; they are more likely enabled or supported by the implementation of specific functions whose analysis is beyond the scope of this paper but could be object of future investigation).

The effectiveness conditions are [1] [10]:

- to avoid non sustainable situations (ex. lack of technology expertise, non availability to collaborate, etc.)
- to reduce initial gaps as for contents as well as for technology
- to favour group creation
- to favour social interactions and development of sense of belonging
- to assume collaborative roles and tasks (timing, roles, interactions)
- to support self and group reflexivity and metacognition

These conditions can only partially be sought in tools and technical solutions, but can be enabled by a proper methodology [1][13].

Under these premises, in order to support expression, representation, development and sharing of knowledge in the CoP, we need to look for tools and methods allowing to represent, manage and value *interactions and connections among people*, *relations discussions and conversations*, *knowledge objects*.

3 A Model for Collaboration in Distributed CoPs

To comply with the objectives detailed in the previous paragraph, we hereafter propose a model for collaboration. This model is derived from a collaboration model presented by A.Calvani in [1], which we consider the starting point of our analysis. Indeed, the model in [1] accounts for effectiveness conditions and principles which are considered to be fundamental for collaboration as highlighted in reference literature [10]. However, while in [1] the model is conceived to provide useful steps to support an online collaborative group, the model is rooted in a *formal* educational context, thus being framed by a “technology alignment” external layer. In contrast the model we present is framed by a Social Networking external layer which accounts for the benefits of informal learning and collaboration contexts, as described before. Moreover, in [1] the purpose is to support generic “online groups”, while the reasoning here conducted is motivated by the analysis of the specific type of group (a Distributed Community of Practice). Although the model could be easily extended to other group types, we believe that the distinction in the analysis is crucial to the effective implementation of the collaborative functions in telematic environments [12]

The model in Fig. 1 envisages four concentric layers each of them implementing the conditions to support the effective realization of the functions of the contained layers.

The most external layer is the "SOCIAL NETWORKING" layer implementing the proper contextual conditions to create a social climat and a shared social grounding, supporting:

- *generation and support to motivation*: in informal e-learning contexts the *motivation* is *spontaneous*; it is often induced by *fun* and *pleasure* that individual have in their network activity; it is also rooted in the *positive interaction* among people (a subject can more effectively and efficiently pursue his objective if the other subjects pursue theirs);
- *group culture*: in informal environment the sense of belonging (*membership*) to a group is spontaneously supported by the intensity of sharing interests on a topic; regardless from the expertise – which can be widely disomogeneous among members – it is still the awareness of the positive interaction with others that sustain *mutual understanding* and *social grounding*;
- *social climat*: in informal contexts it is the awareness of being useful to other community members which increases the *self-esteem* and foster the *motivation* for a wider visibility (for instance being linked, have positive reputation, produce and/or proposed new contents); in this contexts the respect to others, the (often tacit) agreement of *respect*, and *socioquette* (rules for an aware conversation)[1], make the online relational environment a "*trusted*" environment.

In more formal context, such as for CoP, these conditions are certainly more difficult to attain.
Indeed, it is the very purpose of the Social Networking layer to constitute the effective condition for the activation of more structured collaborative activities such as those required in the life of DCoPs.
In order to borrow the potential above illustrated, the designer of the environment will therefore need to adopt technologies and methodologies to support:

1. *the perception of the meaning*: the subject must perceive as really meaningful (useful to himself) the objectives attainable in the DCoP activities and acknowledge that collaboration can derive real advantage;
2. *visibility/reputation/self-esteem*: the dialectic individual-group must enable activities to value the individual in the group and allow each member of the group being valued by others;

[1] The term "Socioquette" has been used in applied research by the Educational Technology Laboratory of the University of Florence. It indicates a set of rules and behaviour criteria that should be followed by people engaged in online collaboration. See also [1]

3. *self-perception of usefulness*: the subject must perceive the significance of its contribution to group activities in order to consider himself a useful contributor to other's goals.

Putting emphasis on this dimensions will not only support sharing, cooperation and collaboration in Distributed Communities of Practices, but can indirectly promote participation of the individuals to other informal learning networks, which certainly is a uncontrollable but desirable and enriching side in this context.

"ORGANIZATION" and "COLLABORATION MANAGEMENT" layers have the functions to support more specifically the activity of collaborative groups (also in more formal contexts). They must be implemented according to appropriate instructional methodologies [13], typically oriented to project work and based on a system of rules (objective, roles, etc.) to which the DCoPs members are required to comply. Both layers could consequently be implemented by a methodology and sustained by technological functions available in current collaborative learning environments.

Eventually the central nucleus of the model, the "RIFLEXIVITY" layer supports the fundamental function of the subject and the community in its capability of becoming aware of its collaboration and learning processes to this extent this layer must implement:

- self-representation and group-representation functions
- self-evaluation and group-evaluation-functions
- distributed-evaluation functions

In collaborative activities basing on Social Networking distributed-evaluation functions could also be envisaged through which the individual, the group and the community refer in specific moments of the collaboration process (for instance during the production of a product or a document or at a end of a given activity). Contacting external experts in the domain, receive feedback etc. are functions accountable to this purpose. The centre of the model brings thus back to its periphery of Social Networking.

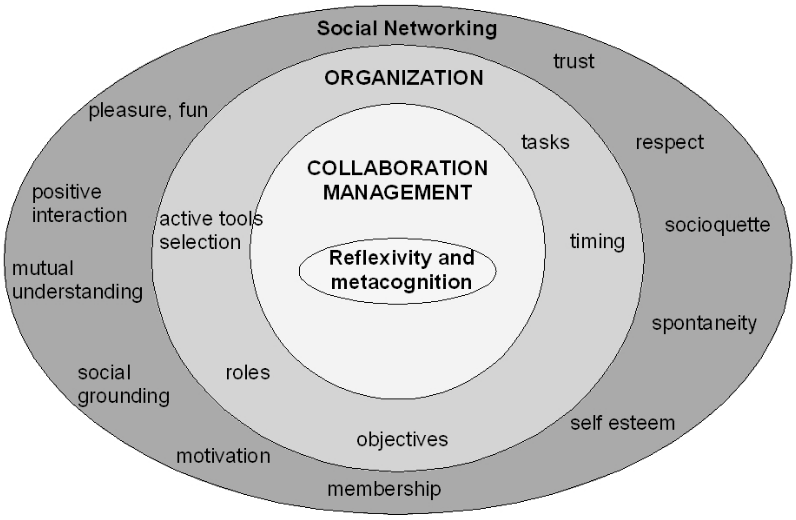

Fig. 1. Reference model to support collaboration in Distributed CoPs

4 Tools and technologies for the collaboration model

The further step in the analysis leads us to the problem of evaluating and devising if tools and technologies exist or can be developed in order to match the requirements and purposes expressed by the former model.

A possible answer can be given by the technologies and tools now referred to as *web 2.0* software [14] [15]. We acknowledge that web 2.0 is a term which is hard to define because of the amorphousness of the concept. However we share Paul McFedries [16] tentative definition according to which web 2.0 is "a second phase of the evolution of the World Wide Web in which developers create Web sites that act like desktop programs and encourage collaboration and communication between users"[2].

McFedries identifies the main characteristics of the Web 2.0 "movement", highlighting the social perspective of relation, collaboration and user-participated architecture:

- *content is user-created and maintained* (peer production, user-content ecosystem)
- user-created and maintained content require *radical trust*
- *application usability* allows rich user experience
- *combining data from different sources* leads to creation of new services (mashup)

2 http://www.wordspy.com/words/web2.0.asp

- services get better as the number of users increases in an *architecture of participation*

With respect to the model depicted in Figure 1, for each layer we indicate technologies and tools which could serve to desired scopes.

SOCIAL NETWORKING layer

Conditions and functions of this layer can be widely supported by the use of web 2.0 technologies. Indeed, such technologies will provide useful functions for Collaboration Management and Organization layers, but their use, framed in a proper methodology, will provide the enabling conditions for *generation and support to motivation*, *group culture* and *social climat* development.

Social Networking layers and its contained layers will therefore be bridged by the adoption of technologies and methodologies. In Table 2 where we highlight McFedries [16] "social" characteristics of some sample web 2.0 tools which could support Social Networking layer needs.

Table 2. Sample web 2.0 applications: description and "social networking" characteristics

Web Application	Description	Characteristics
Social networking, online social networks	Category of Internet applications to help connect friends, business partners, or other individuals together using a variety of tools.	Architecture of participation
Social network search engines	Social network search engines are a class of search engines that use social networks to organize, prioritize, or filter search results.	Architecture of participation
Blogs	A weblog, (or blog), is a website where entries are made displayed in chronological order. They often provide commentary or news on a particular subject, typically combining text, images, and links to other blogs, web pages, and other media related to the specific topic.	User-created and maintained content
Blog guides	Specialized search engines for searching blog and news contents	Architecture of participation
Social tagging, (folksonomy)	Ad hoc classification scheme (tags) that web users invent as they surf to categorize the data they find online	Architecture of participation, trust
Social bookmarking	Saving and applying keywords to one's personal collection of Web site bookmarks on a site that enables other people to share those bookmarks	Architecture of participation, trust
Web Syndication, Web feed management	Web syndication is a form of syndication in which a section of a website is made available for other sites to use through to making Web feeds available from a site in order to provide other people an updated list of content from it (for example one's latest forum postings, etc.).	User created and maintained content, Content aggregation
Tag clouds	A list of tags user in the site with some kind of visual indication of each tag's relative popularity (ex. large font). Web sites that implement tag clouds functions	Architecture of participation

	allow both finding a tag by alphabet and by popularity. Selecting a single tag within a tag cloud will generally lead to a collection of items that are associated with that tag	
Peer production news	Websites combining social bookmarking, blogging, and syndication with a form of non-hierarchical, democratic editorial control. News stories and websites are submitted by users, and then promoted to the front page through a user-based ranking system	User created and maintained content, trust
Wikis	Collaborative web sites that allows users to add, edit and delete content	User created and maintained content, trust
Collaborative real time editing	Simultaneous editing of a text or media file by different participants on a network.	User created and maintained content
Content aggregation and management, Mashup (web application hybrid)	A website or web application that combines content from more than one source	User created and maintained content, trust, architecture of participation

ORGANIZATION and **COLLABORATION MANAGEMENT layers**

Functions needed for the services of these layers are typically supported by collaborative learning environments[3].

The purpose of the collaboration model here envisaged is that the functions of these layers be combined and supported by contextual functions of the Social Networking Layer. More specifically the virtual learning environments could evolve their functions according to the directions schematized in Table 3:

Table 3. Current and envisaged functions of a telematic collaborative environment

Virtual Learning environment macro functions	**Typical**	**Extra collaboration-oriented functions in the direction of Fig. 1 model**
User management	Roles (authentication, authorization, registration), workspaces, group management, portfolios, student tracking, etc.	User links (blog connections, web syndication etc.), representation of multiple presence of the users in different communities and groups
Content	Content edition and upload, document	Group content creation (es.

[3] See for instance Edutools reviews and comparisons on available e-learning environments http://www.edutools.info/index.jsp?pj=1

Management	repository, learning object repository, whiteboard, journal, etc.	digg news, wikis,social tagging, social bookmarking, collaborative editing etc.), link to related contents (blog guides, social network search engines, mashups, etc.)
Communication Management	File exchange, forum, mailing list, chat, VoIP, etc.	Link to podcasting records, etc.
Organization/planning management	Calendars, todos,	Shared calendars, project management tools
Self-group evaluation	Quizz, assignments, etc	Support to self- and group-reflexivity (es. tag clouds, thinking types, connection to external experts, reflection boards [1] etc.).

REFLEXIVITY and METACOGNITION layer
The functions of this layer are at the heart and centre of the model in that they constitute the process of knowledge construction (reflection on the processes and products, self-reflexivity and self-evaluation); they are transversal to technologies but can find valuable support in web2.0 tools.
From one side the representation of the sociality which is typical of such applications already provides input which support awareness towards the objectives and aims undertaken by the participants; functions such as social bookmarking and social tagging are solutions encouraging confront and reflection and providing possible useful link to other information sources. Blogging and social networking functions favour self-narrative and conversational practices which imply self-reflexivity and “distributed” evaluation. Therefore, collaborative environment can be improved with “reflection” [1] tools and spaces which encompass the social dimensions and represent the subject scollaborating in the social network.

5 Conclusions

In this paper we provided a model for online collaboration which could meet the needs of collaborative knowledge construction in a Distributed Community of Practices.
The envisaged model aims at indicating enabling conditions to support “relation and interaction” in information sharing, learning, cooperation and collaboration for the members of a Distributed Community of Practice, basing on informal learning and social networking theories and practices.
The conditions highlighted for each layer of the presented model are the grounding dimensions to support the activities of the community itself. We believe that the provided model together with a collaboration methodology and available web 2.0

technologies (such as those here described as sample) can give contributions and to the realization and improvement of a specific environment tailored for a DCoP needs.

The analysis conducted in this work provides ways for further investigations aimed at defining a reference model where new social networking practices and attitudes and available and upcoming technologies could harmonize in methods and proper development guidelines to lead toward a situation of truly enabled collaboration and lifelong learning.

References

1. Calvani, A.: Reti, comunità e conoscenza: costruire e gestire dinamiche collaborative. Erickson, Trento (2005)
2. Wenger, E.: Communities of Practices: learning meaning and identity. Cambridge University Press, New York (1998)
3. Denning, S.: Pommier, M., Shneier, L., Are There Laws of Knowledge Management? February (2002). In Internet: http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan007798.pdf
4. Cedefop Glossary. In: Making Learning Visible. Cedefop, Thessaloniki (2000)
5. European Commission: Communiqué Making a European Area of Lifelong Learning a Reality. Brussels (2001)
6. Colardin, D., Bjornavold, J.: Validation of Formal, Non-Formal and Informal Learning: policy and practices in EU Member States. European Journal of Education, 1 (2004) 69-89
7. Cross, J.: Informal Learning for Free-range Learners. Internet Time Group LLC. In Internet: http://www.jaycross.com/informal_book/nutshell.htm
8. Jonassen, D.: Computers in the classrooms: Mindtools for Critical Thinking. Prentice Hall, New Jersey (2000)
9. Bullen, M.: Participation and critical thinking in online university distance education. Journal of Distance Education, 2 (1998) 1-32
10. Dillenbourg, P., Baker, M., Blaye, A., O'Malley, C.:The evolution of research on collaborative learning. In Reinmann, P., Spada, H. (eds.): Learning in humans and machines: Towards an interdisciplinary learning science. Pergamon, Oxford (1996) 189-205
11. Downes, S.: E-learning 2.0. eLearn Magazine, 10 (2005)
12. Pettenati, M.C., Ranieri, M.: Dal sé alle reti: nuove pratiche di social network per la collaborazione in rete. In Bonaiuti, G.: E-learning 2.0. Erickson, Trento (in press)
13. Ranieri, M.: E-learning: modelli e strategie didattiche. Erickson, Trento (2005)
14. Hinchcliffe, D.: Web 2.0 Blog. In Internet: http://web2.wsj2.com
15. O'Reilly, T.: What Is Web 2.0. In Internet: http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html
16. McFedries, P.: The Web, Take Two Technically Speaking. IEEE Spectrum, June (2006)
17. Granieri, G.: Blog Generation. Laterza, Bari (2005)

Political, Dialectical and Conative Aspects of a Collaborative Decision Making Tool for CoPs

Fabienne Pironet
Université de Liège, CRIFA – fabienne.pironet@ulg.ac.be

Abstract. Designed for and evaluated by computer science researchers, medical doctors and civil and mechanical engineers, the Collaborative Decision Making (CDM) tool HERMES (Karacapilidis and Papadias, 1998, 2001) is about to be adapted for another kind of audience, i.e. the communities of practices (CoPs) under the name "COPE_IT!" (http://copeit.cti.gr/) and currently developed in the framework of the project PALETTE (Pedagogically sustained Adaptive Learning Through the exploitation of Tacit and Explicit knowledge). The aim of this paper is to suggest three directions of development that would provide new functionalities to this CDM tool having to take into account some essential characteristics of CoPs and that, like HERMES did, intend to "augment classical decision making approaches by supporting argumentative discourse among decision makers" (Karacapilidis and Papadias, 2001: 1-2).

Keywords: CoP; Collaborative Decision Making; Argumentation.

1 Introduction

Depending of its nature (its level of development), its field of interest, its size and its organizational mode, a CoP will use a CDM tool for different purposes related either to the life of the CoP (operational decisions) or to members' practice outside the CoP ("domain" decisions) (Künzel, 2006). So, we can at first sight identify at least four possibly essential differences with the situations for which HERMES has been developed:

1. the type of subjects to submit to a decision making process (technical and accurate vs pragmatical and large),
2. the type of arguments supporting decisions (scientific proofs vs probable opinions),
3. the recognized reliability of participants (experts vs more or less experts),
4. the number of participants (few vs numerous).

These four possibly essential differences are, in my view, sufficient to suggest that some aspects should specifically be taken into account when developing a comprehensive tool for CoPs. These aspects are, at least, three a) political (about the quality and quantity of participants), b) dialectical (about the quality of arguments and proofs) and c) conative (about the motivations and emotions of participants), and could lead to create some new functionalities for COPE_IT!.

I will argue in favour of the addition of new functionalities using a very short and simple discussion taken and freely implemented adapted from the COPE_IT!'s testing Web site where the issue is "Where to build a factory?".

2 COPE_IT!'s Basic Principles

Once an issue is proposed, each participant (the list of which is accessible to users and not closed) is invited to add alternatives or potential choices to solve the issue as well as positions in favour or against these alternative solutions during the predefined time allowed for discussion.

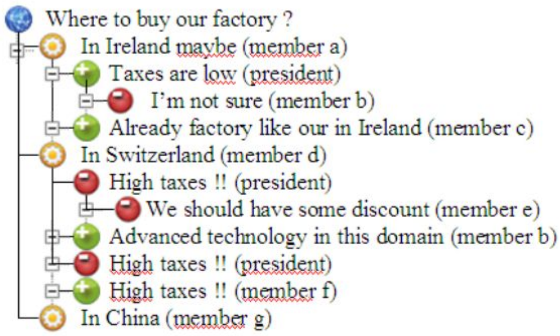

Fig. 1. An example of discussion.

Participants are invited but not obliged to comment or justify their interventions.

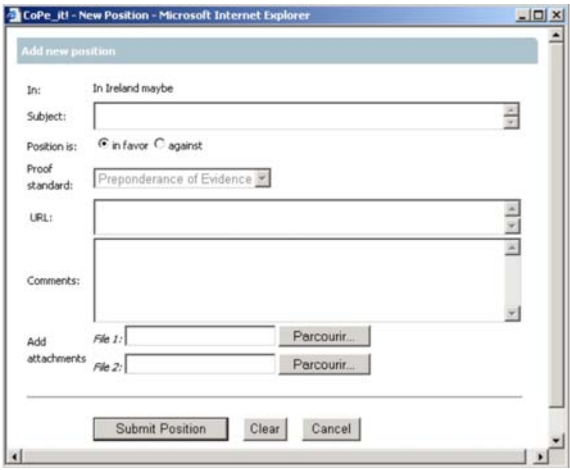

Fig.2: Complementary information about a position

Even if COPE_IT! is not conceived as an automatic decision maker (it is "only" a support for CoPs to make a decision), the arguments or reasons are weighted so that "recommended" choices can appear. This supposes that the tool is equipped which algorithms that allow calculating which the strongest or most "recommended" alternative is.

In HERMES, the weight of alternatives and positions was calculated according to their level of activity: "an active position is considered as "accepted" due to the discussion underneath (e.g. strong supporting arguments, no counter-arguments), while an inactive position is (temporarily) considered as "discarded" or "rejected". So, according to the adopted proof standard, a position *p* is active if a) at least one active position argues in favour of it (Scintilla of Evidence), b) if there are not any active positions that speak against it (Beyond Reasonable Doubt), c) when active positions that support it outweigh those that speak against it (Preponderance of Evidence)" (Karacapilidis and Papadias, 2001: 7-8).

As it can happen that two alternatives receive the same score, HERMES offered the possibility to introduce constraints (also subject to discussion), i.e. preference relations of the type *x is more (less) important than y* or *x is of equal importance to y*. This functionality is not yet accessible in COPE_IT!, but there are good reasons to make it part of our tool.

In both figures above, we observe that all positions have the same weight, that all alternatives and positions can be supported by only one participant unless it is repeated, that one participant repeats one of his positions so that it is active again, that a very subjective position ("I am not sure") is opposed to a rather objective one ("High taxes"), that a same position is "against" for the president while it is "in favour" for member f, that none of the participants has commented nor justified his positions and, finally, that both alternatives received the same score.

Each of this observation raises a question about the efficiency of the CDM tool. Indeed, is it enough to propose a patchwork of opinions to make the decision making collaborative? Does the result really reflect the position of every participant? Does it really help to make a decision? The functionalities exposed below should help to ameliorate the way to calculate positions' activity as well as the quality of arguments and proofs. Some of them would probably require some short preliminary training on argumentation or lead to the creation of an Argument Builder Tool as the one proposed by Karacapilidis and al. (1997).

3 Some New Functionalities for COPE_IT!

3.1 The Political System of a CoP

Because most of the CoPs function as a democracy, the political system of COPE_IT! by default could be democracy. But perhaps some participants, if there are more expert (for a domain decision) or are more responsible (for an operational decision) should be sometimes enabled to enjoy an aristocratic status. COPE_IT! could then have a functionality allowing a preliminary choice between several political systems that would determine the weight of some participants.

- ❑ Democracy (one person = one vote)
- ❑ Aristocracy (some persons have more than one vote)

Username	Number of votes
Username	Number of votes
Username	Number of votes

Add another username

3.2 A Support Function for Positions

Even if most of the CoPs function as a democracy, it is not enough to calculate the activity of an alternative only on the base of the number of positions in favour or against it. The number of participants supporting it is also important. So, each position could be followed by a button “Support” as well as by an indication of the number of votes in favour of this position. Of course, one and the same participant could only once support a position.

Other advantages of this functionality are that it would encourage participants to be more active in the discussion and that it will not be necessary to repeat a position to make it active again or to make it more.

Advanced technology in this domain	Support	x votes
High taxes	Support	x votes

3.3 Obligatory “Comment” Field or “Justification” Field

Depending on the argumentative culture of the CoP and on the argumentative skills of its member, positions will be argued or not, well-argued or not. It could be then useful to make the “Comment” field obligatory. The immediate effect of such a constraint is that it will be impossible to pitch a position without any justification and this will of course contribute to guarantee a minimal seriousness (and perhaps also the well fairness) of the discussion.

Making the “Comment” field obligatory is interesting for operational decisions; bur is not enough to evaluate the quality of an argument in the case of domain decisions. Indeed, in such a case, positions in favour or against an alternative could be either scientific proofs or probable opinions, subjective or objective. In the example above, it is clear that the position “I am not sure” is a very subjective position, but the position “High taxes” could also be very subjective (depending on the level of information of the participant that proposes it).

To give participants information about the kind of justification that is given to a position so that they can better evaluate it, it would be useful to replace the comment field by an obligatory justification field where the proposer could choose between the following justifications (not exhaustive list):

- Scientifically proved and unquestionable fact
- Scientifically proved but questionable or questioned fact
- (Widely) recognized fact
- Observed fact by myself
- Observed fact by several people
- Common belief
- Individual belief
- Other

Of course, it is not enough to assert that a position is scientifically proved and unquestionable so that participants adhere to it immediately. The proposer keeps always the opportunity to refer to an URL or to attach a document to support his claim.

The option “Other” allows the proposer to write anything (s)he likes in support of his/her position, e.g. justification that are not at all intellectual but rather emotional (conative aspect).

Other advantages of this functionality are the following: first, it could favour the collaboration between participants, e.g. if I propose a position that I justify saying that it is a (individual or common) belief and that someone bring new information about it, saying that it has been scientifically proved or saying that it is a fact that I observed and that other people comment saying that they also observed this. Second, it would explain why a same position can be “against” for a participant and “in favour” for another one (i.e. because the justification or the point of view is different).

Should this distinction of justifications between domain decisions and operational decisions be adopted, it would be necessary to add a preliminary function determining the screen that will appear when a participant wants to add a position.

3.4 A Self-Weighting Function for Positions

For positions relying on probable opinions, probably the most frequent in a CoPs, as scientific theories are generally not their specific subjects of interest, it could be useful to create a function through which a participant could self-weight his own position by mentioning its degree of conviction on a scale from 1 to 5, for example.

This would not ensure that a position is truer nor more reliable, but it would give participants a better idea of what others believe and to what point they are ready to change their mind or not (conative aspect). Other participants could then, if the support function is developed, indicate if their share this position and at the same degree of conviction.

Advanced technology in this domain Support x votes degree 1
x votes degree 3

4 Conclusions

The above proposed functionalities, some of which are to be placed before the discussion begins (choice of a political system, choice between domain and operational decisions), are all related to political, dialectical and conative aspects of a collaborative decision making process and quite simple to introduce. They are all about the way to better evaluate the weight of alternatives and positions so that it can really help CoPs' members to better evaluate the positions held by participants and to make a decision that reflects the positions as near as possible.

But it is clear that they should completed by other useful functionalities, perhaps more complex to develop, aiming at

- making the discussion more dynamic: e.g. allowing a participant to modify his (and only his) interventions while keeping a review of all the changes made so that one can later analyze how the discussion evolved;
- making the discussion more ethical: e.g. determining the role and the prerogatives of a moderator towards disruptive or disrespectful participants), etc.;
- targeting the scope of the discussion. Indeed, anyone who gets into a decision making process (individual or collaborative) aims at making the best choice, but the best is relative to several aspects: the best for whom? In terms of what (truth, pleasure, usefulness, beauty, efficiency, time saving, costs, etc.)? If this objective is not clear and explicit at the very beginning, discussions can become very long, misleading or upset - of course a lack of accuracy of the issue would lead to the same effects. It would be then useful to develop functionalities such that both the issue and its "orientation" are or can be negotiated before getting into the discussion as such. Unless this should be the occasion of a discussion in itself, this could be done either through, like in HERMES, the possibility to introduce constraints in the course of the discussion or through a preliminary function giving the choice between the several options of the best solution sought-after;
- keeping tracks of the previous discussions and decisions so that the CoPs' members (especially for CoPs where there is a high turn-over) can refer to it in the future (Knowledge Management functionalities).

References

1. Karacapilidis, N., Papadias, D.: HERMES: Supporting Argumentative Discourse in Multi-Agent Decision Making. In: Proceedings of the 15th National Conference on Artificial Intelligence. Madison, WI, AAAI/MIT Press (1998) 827-832
2. Karacapilidis, N., Papadias, D.: Computer Supported Argumentation and Collaborative Decision Making: The HERMES System, Information Systems, Vol. 26, No 4 (2001) 259-277
3. M. Künzel: General Concepts of CoPs Exchanging on their Professional Activities on Special Interests. PALETTE internal report (July 2006) 16-19
4. Karacapilidis, N., Trousse, B., Papadias, D.: Using Case-Based Reasoning for Argumentation with Multiple Viewpoints. In D. Leake and E. Plaza (eds.), Case-Based Reasoning: Research and Development Springer-Verlag, Berlin, Lecture Notes in AI, Vol. 1266 (1997) 541-552

Evaluation of Virtual Learning Environments Using Logs and Social Networks

Vlad Posea[1], Dan Mihaila[1], Stefan Trausan-Matu[1,2], Valentin Cristea[1], and Alexandru Gartner[1],

[1] "Politehnica" University of Bucharest, Computer Science Department
313, Splaiul Independentei
Bucharest, Romania
{vposea, dan.mihaila, trausan, valentin}@cs.pub.ro
[2] Romanian Academy Research Institute for Artificial Intelligence
13, Calea 13 Septembrie
Bucharest, Romania

Abstract. The paper presents an evaluation method for e-learning platforms, based on different types of measurements collected in logs of interactions during learning sessions, and on the analysis of collaborative learning activities performed using social networks visualization of the relations established among users during the experiments. The evaluation was used to highlight the ease of access to different platforms' resources in two case studies: Sintec and Moodle. Problems encountered during the evaluation and possible solutions to be considered in future work (in the FP6 Cooper project) are also presented.

1 Introduction

In order to evaluate the environments to be used for e-learning, a number of criteria have been defined (e.g. [9]). Two major approaches may be identified: evaluate the platform's capabilities [4], [5] and evaluate its actual usage in a real working environment by analyzing the learners' behaviors and results [11], [13], according to given benchmarks [12]. The second approach is very important in the context of communities of practice and collaborative e-learning environments, where the evaluation should mainly determine the ease of access to shared resources, and the support offered to collaborative activities. Following these ideas, the paper presents a comparative evaluation of the usage of two learning environments, based on analysis of time and frequency aspects and logs and on visualization of social networks. The first is the rather well known Moodle environment (http://moodle.org). The second is the knowledge-based collaborative learning system Sintec [15], developed at the National Center for Information Technology (NCIT) in the University "Politehnica" of Bucharest (UPB).

The paper is organized as follows. Section 2 presents the evaluation of the two platforms using logs analysis from time and frequency perspectives. The analysis

E. Tomadaki and P. Scott (Eds.): EC-TEL 2006 Workshops, pp. 362-368, 2006.

aims to find how effectively are the learners using the platforms and to possible identify some improvements. Section 3 presents an evaluation of platforms' collaborative tools, based on visualization of social networks. The problems identified during the experiments, some possible solutions, and several conclusions for improving the evaluation method are reported in Section 4.

2 Evaluation using time and frequency-based log analysis

In our experiments, we were interested to evaluate the ways actors (students, teachers, editors) are using the Sintec and Moodle platforms, and to derive some reference results that could be used in the comparative analysis with other platforms. We will firstly consider the differences between the way Sintec and Moodle were used for reading the learning documents on the web. These differences are due to the following factors: (1) in Sintec, the learning materials were all uploaded from the start of the class, while in Moodle, the materials were uploaded gradually; (2) in Moodle, students and teachers used also the collaborative tools, while in Sintec they did not. Using the log records of the activity of 69 students for Sintec and 248 students for Moodle, several indicators (discussed also in [10]) were computed. It is remarkable that, even if the number of indicators was not high and some of them were not available on both platforms, several conclusions can be drawn about the way platforms were used.

Table 1. The most important evaluation indicators for the Moodle and Sintec experiments (“NA“ – not available – means that the indicator couldn't be calculated because the logs weren't explicit enough or because the feature wasn't used for teaching that course)

Indicator	***Moodle***	***Sintec***
Average time spent / page (seconds)	61	21.24
Median of the times spent per page	45	NA
Average time / session	297	1635
Median of the times spent / session	NA	952
Average time spent on the platform (seconds)	13571.5	4466
Relative frequency of the home page	33%	23.3%
Average number of hits / page	409	284
Percentage of users that posted in forums	0.564	NA
Number of posts / user	2.02	NA
Number of posts / topic	1.74	NA
Length of reply (words)	28	NA

The **average time per session** was influenced by the way course materials were loaded on the platforms. It reflects the fact that, in Moodle, where the materials were uploaded incrementally, the students accessed more often the web site. They logged once a week to download or read the newest materials, while on the Sintec platform they mostly downloaded all the materials at once. This indicator together with the

number of logins can suggest how to improve the process of posting resources on the learning platform. It is better to post resources periodically in order to encourage students to log in more often, be more active in the class, use more intensively the communication tools, and easier stay in touch with the latest news posted by the tutors.

The **time spent** per page was strongly affected by the **relative frequency of accessing the home page**. The value of this indicator (relative frequency) is extremely high. It shows that users had troubles with using the interface, because they had to return too often to the home page in order to find another page of interest. This is also showed by the combination between the **average time spent per page** and the **median of the times spent per page**. This difference shows that there are many intermediate pages browsed very fast by the user just in search for relevant pages. These indicators also suggest possible improvements in the platform. For example, the results show that the resources need to be re-organized in a different way. One solution would be the use of a tree-menu to allow most of the resources to be accessed from one page or from a few pages. Another way to improve these indicators is also the integration of a recommender system to lead directly to the page of interest.

In the experiment with Sintec, no logs of the collaborative tools were recorded and, therefore, no such indicators were computed. In the case of Moodle, the forum collaborative tools were available to students but their use was not mandatory or even rewarded. The very small number of posts per user and especially the number of replies shows that the students preferred alternative communication channels. Even so, the average length of the posts shows that the replies given were rich in content.

In conclusion, even if users have used the 2 platforms differently, by using the methodology and the proposed indicators, we could draw an important number of conclusions.

3 Evaluation of collaborative tools using visualization techniques

Several techniques may be used for analysing the activity of the users in a forum, for example, sorting messages by author, date, and subject. Another approach is focusing on the convergence of the multiple threads that characterizes the weaving messages (this model is used in the Moodle's forum).

Graphical visualization techniques are extremely useful in various domains. Such an approach may be used also in the evaluation of collaborative tools. The idea is to generate a graphical view representing the social network [14] of the collaboration starting from the usage logs of a VLE (Virtual Learning Environment).

The social network depicts actors' relationships and presents a perspective of their social context. The nodes of the network represent actors (teachers and students) and the arcs represent the interaction between them. This type of network is essential for understanding social dynamics [14].

In our approach, the graphical representation of the social networks was generated from the Moodle logs using the Graphviz tool (http://www.graphviz.org/). Figure 1, which illustrates the social network of one of the forums, represents some actors who interact through messages: they initiate a thread or post reply-messages in that thread. There are five actors that had at least three reply-messages from the others. Their nodes are grey-filled. In our scenario, the actor with the id "2" is a teacher. He started a thread and many other actors responded to that message. A reply message from an actor to another actor's message is represented through an oriented edge from the first one to the second one.

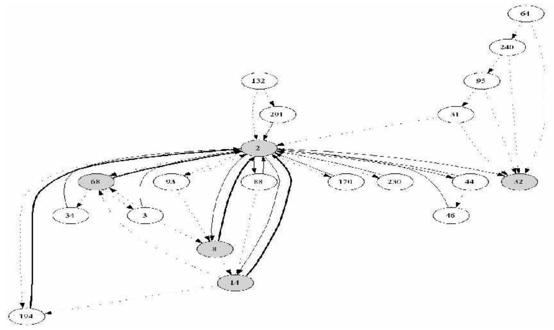

Fig. 1. View of a part of a social network, generated from the logs of the Moodle's forum. Dotted lines represent one message (reply), normal lines represent two or three messages (replies), and bold lines represent a number of messages (replies) greater than four.

For analysing the social network generated from the Moodle's logs, we considered several indicators. First, we used the "location" of the actors in the network, measuring the **centrality** of a node [2]. This feature helps to determine the importance or prominence of an actor in the network. In our scenario, the node with the id "2", which is a teacher, has an important role in the graph. He initiates threads, posts messages and reply messages to the others. There are other nodes, coloured in grey, which have an important activity in the forum. We will see below how centrality and centralization help to analyse if there are "strong" connected teams among the students and the important role of the teacher in the communication process.

Table 2. The most important indicators for the actors in the social network in Figure. 1

Indicators/Actors	2	8	14	32	68
Centrality	17	3	3	5	3
Density	0.85	0.15	0.15	0.25	0.15

Density represents other indicator, describing the general level of cohesion in a social network or the number of different people the actor interacts with [2]. The average density being low shows that students do not interact within the platform. Density is higher for the teacher meaning he keeps in touch with his students.

Another aspect of social networks that we found useful for our evaluation is **network reach** [1]. It is important for social aspects to see if an actor gets the information directly from the main actors (teachers, project managers) or if this information is got indirectly from peers. In our scenario, the length of the largest path is two, but the predominant path has the length one. This means that students interact directly with the teacher, and that, either they do not ask questions to peers, or there is no other competent peer to answer their questions or problems.

One challenging task is to select the most relevant peers and their appropriate answers for an actor, which has a problem to solve. In [6], problems like “what is relevant?” or “to how many peers should we send the query to achieve optimal results?” are studied and three criteria of selection rose: connectivity-based selection, reputation-based selection, similarity-based selection.

To achieve the goal of selection of a competent peer, we need to compute another indicator, **centrality eigenvector** [3]. This metric, used in [8] for web page ranking, and studied in [7] for trusted e-mail addresses, is very difficult to apply to the actors in our approach. For example, if a page links to a good (trusted) page, it is a candidate for having a high rank as well [8], but in our case, if an actors replies to an actor with a high rank (maybe teacher) means nothing. However, if a highly ranked actor replies to a normal actor, he might be a candidate for achieving a greater rank. In our future work, we will include in considering these replies a semantic context, which it will help actors to receive a greater rank and to become a competent peer. As we have seen above, the teacher has the highest rank in our scenario and this rank is built on the ranks of the other actors.

The centralization [16] of the network shows that the teachers communicated well with the students but also shows that there aren't strong teams in the group of students because the network is centralized around the teacher. This is confirmed by the cohesion [16] indicator which shows that we can't identify groups larger than three people, one of them being a teacher. That shows that the learning process wasn't team-oriented or, if it was, the teams were not working well together or they were not using the platform features.

In conclusion, the social networks can provide a large numbers of indicators that offer information about the way students and teachers collaborate in the learning process. These indicators can and might be correlated with indicators obtained from questionnaires and logs.

4 Conclusions and future work

This paper presents the results of an ongoing research on the evaluation methods for e-learning platforms. The evaluation proposed here is based on different types of measurements collected in logs during learning experiments, and makes use of social networks. The method could be used in the design and evaluation of e-learning platforms. It is thought to be used in evaluating the Cooper platform that is a collaborative, project-oriented e-learning environment under development in the STREP EU project with the same name (http://www.cooper-project.org). In this respect, one important aim of our research is to establish a proper evaluation methodology, and to gather data from other systems for a comparative analysis.

Another purpose of evaluating the usage of several e-learning platforms is to establish some benchmarks for the indicators we will measure in the Cooper platform, and to identify what other logging mechanisms are needed in order to obtain more significant evaluation indicators.

An important aim of the evaluation is the improvement of e-learning environments by eliminating the detected drawbacks. As discussed above, one of the major issues concerning Moodle is the long length of the paths that users followed to reach a useful web page. The use of a Recommender Service (also a main idea of the Cooper project) would be extremely useful in providing shortcuts to different resources.

Acknowledgements This work was partially done under the FP6 projects COOPER (www.cooper-project.org) and EU-NCIT (http://euncit.hpc.pub.ro)

References

1. Albert, R., Barabasi, A.-L.: Statistical mechanics of complex networks. Rev. Mod. Phys. 74 (2002) 47–97
2. Anklam, P.: KM and the social network. In Inside Knowledge, Vol. 6, Issue 8. (2003)
3. Bonacich, P., Lloyd, P.: Eigenvector-like Measures of Centrality for Asymmetric Relations. Social Networks, http://www.sscnet.ucla.edu/soc/faculty/bonacich/Asymmet.pdf [Accessed April 2006] (2001)
4. Business Readiness Ratings for Open Source: A Proposed Open Standard to Facilitate Assessment and Adoption of Open Source Software - http://www.openbrr.org/docs/BRR_whitepaper_2005RFC1.pdf [Accessed April 2006]
5. Business Readiness Ratings for Open Source: Assessment Sample for Moodle - http://www.openbrr.org/docs/BRR_Worksheet_25Jul05_Moodle.xls [Accessed April 2006]
6. Chirita, P.A., Damian, A., Nejdl, W., Siberski, W.: Search Strategies for Scientific Collaboration Networks. L3S Research Center, University of Hannover. Publications site (2005)
7. Chirita, P.A., Diederich, J., Nejdl, W.: MailRank: Using Ranking for Spam Detection. L3S Research Center, University of Hannover. Publications site (2005)
8. Chirita, P.A., Olmedilla, D., Nejdl, W.: PROS: A Personalized Ranking Platform for Web Search. L3S Research Center, University of Hannover. Publications site (2003)
9. EduTech LMS Evaluation - http://www.edutech.ch/lms/ev3/ [Accessed April 2006]
10. Juvina, I., Trausan-Matu, S., Iosif, G., van der Veer, G., Marhan, A.M., Chisalita, C.: Analysis of Web Browsing Behavior - A great potential for psychological research. In Pribeanu, C., Vanderdonckt, J. (eds.): Task Models and Diagrams for User Interface Design. Proceedings TAMODIA 2002. INFOREC Publishing House, Bucharest (2002)
11. Markham, S., Ceddia, J., Sheard, J., Burvill, C., Weir, J., Field, B., Sterling, L., Stern, L.: Applying Agent Technology to Evaluation Tasks in E-Learning Environments. Proceedings of the Exploring Educational Technologies Conference, Monash University, Melbourne, Australia July 16-17, 31-3 (2003)
12. The Institute for Higher Education Policy: Benchmarks for Success on Internet-Based Distance Education (2000)
13. The University of Iowa: CMS Selection methodology - http://www.uiowa.edu/~provost/elearning/cms_selection/ [Accessed April 2006]
14. The University of Melbourne: What is a social network? - Network-based behavioural, social and policy processes -

http://www.psych.unimelb.edu.au/cnss/assets/process_summary.pdf [Accessed April 2006]
15. Trausan-Matu, S., Cristea, V., Udrea, O. (eds.): Intelligent e-Learning (in Romanian). PolitehnicaPress, Bucuresti (2005)
16. Wikipedia – *Social Networks* - http://en.wikipedia.org/wiki/Social_network [Accessed April 2006]

Virtual Action Learning: Experiences from a study of an SME e-Learning Programme

Jean-Anne Stewart and Gillian Alexander

Henley Management College, UK
{Jean-anne.stewart, Gillian.Alexander}@henleymc.ac.uk

Abstract. This paper presents the findings from a project investigating management development for SME managers using an action learning programme, combining both face-to-face workshops and a virtual action learning environment. The project aimed to address 3 main objectives: reworking results from previous European projects to disseminate to a wider audience, creating a learning network/ community amongst the project partners and to undertake 3 learning trials with SMEs in UK, France and Italy. This paper principally addresses the findings from the UK trials, which ran between February and April 2005, and provides valuable learning to all those interested in developing future learning programmes aimed at SMEs.

Keywords. e-learning, action learning, management, development, programme, SME

1 Introduction

1.1 Why consider Virtual Action Learning for SMEs?

SMEs (small and medium-sized enterprises) represent 99% of all businesses in Europe and account for more 50% of the employment and turnover figures in the UK. Small businesses in the UK (employing less than 50 people) represent 47% of employment and 37% of turnover. (Small Business Survey, 2004). However only 24% of SMEs provide vocational education and training compared to 80% of large enterprises (employing over 250 people). SMEs play a key role in generating employment and creating economic wealth, but skill deficiencies in SMEs are adversely affecting their ability to reach their growth potential (British chamber of commerce Surey, 2002). By their very nature, SMEs are small, constrained by time and budget and reluctant to engage in learning programmes, therefore the purpose of research projects such as ENSeL is to investigate how SMEs can be engaged in appropriate learning interventions to address this major challenge. Action learning has previously been successfully used with SMEs on earlier projects and this study aims to investigate the effectiveness of virtual action learning to engage SMEs.

1.2 ENSeL Project Organisation

The ENSeL project, coordinated by Henley Management College (HMC), aimed to share the learning from five EU funded projects/networks all of which contained a core e-learning element. The projects being integrated included the **PeLM** project

E. Tomadaki and P. Scott (Eds.): EC-TEL 2006 Workshops, pp. 369-384, 2006.

(Programmes in learning through e-learning for managers), **eLIVE** (eLearning and Knowledge Management for European SMEs), **ESeN** (European SME e-Learning Network), **ROCKET** (Roadmap to communicating knowledge essential for the industrial environment) and **EQUEL** (e-quality in elearning, the EQUEL Virtual Centre of Excellence).

The initial project tasks culminated in a review of the learning frameworks emerging from EQUEL and the other represented EU projects. These were then formulated to make them suitable for European SMEs. These principles of learning for SMEs were drawn on prior project experience with SMEs and have been reviewed in light of the results of the ENSeL project. During the review, an approach to the SME trial design emerged that was similar to action learning (Revans, 1980), but also included a virtual environment. Action learning is certainly not a new development in the education of managers. Indeed some of the early approaches to management development (Wilmott, 1994) saw an emphasis on sharing experience and less on content. The Syndicate or ‘Set’ method was devised for this purpose with the rationale of helping managers to ‘help themselves’ via practical problem solving around real life issues. Some of the advantages of virtual action learning directly address the needs of SMEs: flexibility, cost benefits, location is not a barrier, freedom to work at own pace, less disruption to work schedules and an opportunity to shape the learning agenda or content.

Based on the characteristics of the target audience for the trial, namely SMEs, ENSeL has elaborated some learning principles to inform the use of sustainable networked learning in SMEs. These principles are grounded in the position papers about e-learning in Higher Education, which are the final output of the EQUEL project, and draw mostly on theories supporting social learning, socio-cultural approach to learning and social constructionism (Hodgson and Watland, 2004).

1.3 ENSeL Learning Principles

The following principles informed the design of the SME trials at the beginning of the project. These were later revised in view of the findings, as discussed in the final section of this paper:

1. Our focus is on learning and learner-managed environments.
2. Learning is better supported in collaborative settings and dialogue plays a major part in the collaborative learning process.
3. Social interaction allows for co-construction of knowledge, which promotes engagement of learners in work based and problem-based learning.
4. The role of the facilitator/animator is essential for collaborative e-Learning.
5. Critical reflexivity is an important part of the learning process for evaluating and examining both the learning process itself and the resultant actions taken.
6. Learning is situated and context dependent.

2 Literature Review

2.1 Learning in SMEs

Specific considerations with regard to learning place certain requirements on any learning programme for SMEs, as summarised in Figure 1 (Alexander, 2006).

Considerations	Programme Requirements
Increasing competition and development of markets are major concerns for small businesses (Bolden, 2001). There is a high 'churn' of SMEs in the UK (SBS, 2003a).	Involvement in competence development activities has a positive effect on the individual SME's competitiveness and performance (Observatory of European SME's 2003, No.1 'Competence Development in SME's').
Formal methods of teaching and learning are not necessarily the most appropriate way of engaging, motivating and transferring knowledge to today's workforce (Williams, 2003). Formal training is not the best way of learning for SMEs (Atwell, 2003).	Non-formal (informal) learning constitutes the most important way of acquiring and developing the skills and competencies required at work (Eraut, 2000)
The primary concern within SME's is keeping the company running on a day-today basis (Cranfield, 2005). Enmeshed in the practicalities of running their businesses, SME leaders have lost any interest they may once have had in theoretical issues (Inglis, 1994).	Training has to be focused on the specific needs of the enterprise (Unisys, 2005). Active learning focuses on solving real problems and the learner's experience 'accounts for as much as the teacher's knowledge' (Knowles, 1984)
The SME leader's own negative attitude to change and learning (Observatory of European SME's 2003, No.1 'Competence Development in SME's'). Time devoted to learning is considered by many as lost time (Unisys, 2005)	When individuals are involved in the learning process dealing with issues of relevance to their careers they become motivated learners (Bray, 2002). To get effective motivation the learner should be put in the centre of learning, 'the starting point must be a question from the learner'. (Unisys, 2005)
SMEs are driven primarily by profit (Hilton & Smith, 2001) SMEs expect impact on bottom line (Unisys 2005, LSDA, 2002)	Promotion – no matter how good the training and support material, It has to be carefully promoted and delivered to be effective. It must go to considerable lengths to highlight the commercial benefits of business improvement (non – commercial benefits can be promoted as secondary benefits once the main commercial message has got thought). The aim is to make SMEs actually want to take part in the initiative and to make them see management development as integral to good business practice (Hilton & Smith, 2001).

Learning is a cost, and the SME owner does not always consider it as an investment for the future (Unisys, 2005).	The programme should have a measurable impact within the organisation and should be affordable and value for money (Bolden, 2001).
SMEs use a short term approach, they only set up a training action plan when they face real problems (Unisys, 2005) Just-in-time (JIT) learning fulfils SME short term information needs (Unisys, 2005)	Approaches to learning, training and development in small firms needs to take account of the shorter planning time frames they use by relating learning opportunities and benefits to these shorter time frames.(Stanworth *et al*, 1992).
Time pressures (Bolden, 2001)	SMEs like courses to be flexible and modular so that they can dip in and out, taking 'bite-sized' pieces (a few hours at a times) as they see fit and as their workload permits (Unisys, 2005). Due to time pressures close locality of programmes is also important (LSDA, 2002; Kirby, 1990)
eLearning is beginning to have an impact on learners, and particularly those demanding flexibility, accessibility and connectivity (Bisoux, 2002) Growing pressure in many industrial societies to identify the most constructive and cost effective ways of using ICT as a resource for learning (Guile, 1998).	Some of the advantages of e-learning directly address the needs of SME's: flexibility, cost benefits, location is not a barrier, freedom to work at own pace, less disruption to work schedules. (Unisys, 2005)
Much of the knowledge developed, often by the owner/ manager, remains tacit and unshared. The new kinds of knowledge are *'tacit'* and '*developmental',* and are practical as opposed to being theoretical as they are derived from action and experience. (Williams, 2003)	Communities of practice could support inter-firm collaboration (Van Winklen, 2003). Learning can be better supported in settings of collaboration, where they interact with each other and learn from each other (Esnault & Ponti, 2004)
Learning has increasingly become seen as dependent on the activity of the learner (Knowles, 1984, Williams, 2003). SMEs are generally action orientated and learn by doing (Kirby, 199	The Action learning method requires that the problems to be solved are real ones. They are not manufactured for the learning situation. Action learning is a method for individual and organisational development… people tackle important issues or problems and learn from their attempts to change things (Pedler, Brook & Burgoyne, 2003).

Isolation of the enterprise owner is a barrier to learning. Learning is a social activity (Esnault & Ponti, 2004)	An informal environment should be built to aid networking. The network should provide a forum for exploring ideas with peers, and give support to individuals (Birchall *et al,* 2004). Network learning broadens access and participation of SMEs in real-life learning environments (Ponti, 2004) Network technology offers the opportunity to facilitate, strengthen and connect SMEs in order to build and enhance networks of business at the regional, national, or international level (Esnault & Ponti, 2004)

Figure 1: Considerations to SME learning and programme requirements

2.2 Action Learning

Taking into account recent theories on situated learning and the programme requirements outlined in Figure 2, a learning approach based on Revans' work on action learning (Revans, 1980) is likely to be the most appropriate for SME owner/managers. "*Action learning is a method for individual and organisational development. Working in small groups, people tackle important issues or problems and learn from their attempts to change things*" (Pedler, Brook and Burgoyne, 2003). There are four elements:

1. Each person joins in and takes part voluntarily.
2. Each participant must own a managerial or organisational problem on which they want to act.
3. Sets or groups of action learners meet to help each other think through the issues and create options.
4. They take action and learn from the effects of that action (Pedler *et al*., 2003).

There are a number of requirements for action learning: the set, the project, the set adviser, set meetings, and workshops.

2.3 E-learning in SMEs

Although action learning addresses many of the requirements of learning programmes for SMEs, it may be that a combination of e-learning and action learning may be even better. Some of the advantages of e-learning directly address the needs of SMEs: flexibility, cost benefits, location is not a barrier, freedom to work at own pace, less disruption to work schedules. However, there are some disadvantages, such as self-discipline, loneliness, and dealing with large quantities of electronic materials. When adapting an action learning programme to e-learning, Bray (2002) warns that the pedagogic baggage that both tutors and associates carry is clearly a barrier that needs to be overcome, as is developing different interpersonal tools of communication and style. Ingram et al. (2000) also warn that care must be taken with both hard (hardware, software, administration, financial support) and soft (human relationships, communication, goodwill) critical success factors. This has implications for the set members, set meetings and workshops, resources, and the set adviser.

2.4 Networked Management Learning

Hodgson and Watland (2004) defined networked management learning as learning that is supported by ICT used to connect learners with other people (learners, tutors, mentors, etc.) and to learning resources and information of various kinds. Network technology offers the opportunity, through the use of computer-mediated communication and/or via the internet, to catalyze, strengthen and connect SMEs in order to build and enhance networks of business at the regional, national, or international level. Among the other aims, technology holds the potential to connect individuals/groups/organizations to resources they need for their work activities; to create a sense of community where people can share knowledge but preserve diversity; to organize events that bring business and other institutional actors to support a collaborative and cooperative approach to learning. The ENSEL project can be most closely defined as a trial in networked management learning.

3 Methodology

3.1 The Research Design

The design of the research can be considered as a case study or three individual case studies, if dealing with one trial at a time. This was an empirical investigation aimed at understanding the different ways in which SME managers described their experience of networked management learning. The purpose of the study was not testing hypotheses but exploring what participants thought and felt about their participation in the trials by asking questions that led them to relate their experiences and explore their attitudes to networked management learning. Qualitative data was collected using registration forms, one-to-one interviews, focus groups and facilitated face-to-face workshops, in addition to questionnaires. Quantitative data was collected using participant questionnaires, completed at the beginning and the end of the trial.

3.2 Participants

The trial included a total of 56 SMEs in UK, France and Italy. The 29 UK trial participants included healthcare professionals, financial services managers, IT and telecom consultants, manufacturing and engineering company owners and managers, recycling business managers, providers of educational services, music publishers, website developers and suppliers of social and leisure services.

3.3 The Trial Design

The trial was designed as a blend of face-to-face and online activities, coordinated by facilitators, as shown in the ENSeL Roadmap (Figure 2). The trial design aimed at moving away from traditional pedagogical and didactical approaches by allowing participants to learn through the group process. Throughout the trial, the participants were encouraged to keep track of their learning and to develop their capacity for reflection.

Figure 2: Roadmap of the SME trial design

The virtual action learning was facilitated throughout the programme, with one facilitator allocated to each learning set of between 5 and 8 participants. The learning sets worked through a schedule of activities agreed at the first workshop, with each product being reviewed by the set members at weekly intervals. The groups decided on the nature of the products and these were typically short documents or presentations, which evolved to summarise their challenges and actions (An example is shown in Appendix A). These virtual reviews consisted of questions being posed and stories and experiences shared to support each participant with their specific business issues. The facilitator was available to provide additional resources as requested by the group and entered the virtual discussion area at least every 48 hours.

3.4 The Initial Workshop

The first workshop was successful in many ways. The groups worked well together and there was very positive feedback on the action learning approach. The groups identified their challenges and started in different ways to agree their approach to the interim working using the virtual learning platform. The time spent on coffee breaks and lunch involved much sharing of experiences between the group members, generally described as 'feeling that they were not alone with their problems – there were others in the same boat'. Informally they offered help and suggestions to each other.

However, there were some aspects of the workshop that did not go as well as expected. For many, there was a lot covered in one morning, and the pace was too fast. Secondly the technology was not available for the training session and the short demonstration given was not sufficient to give the participants any confidence in being able to use the virtual learning platform after the workshop. Finally the participants were not all comfortable with the vague nature of the proposed tasks. This was particularly evident amongst the more traditional industry groups, who really wanted clear tasks, explicit delivered course content and a precise structure to their learning programme. This was least evident amongst the group of entrepreneurs, who quickly grasped the idea of defining tasks, allocating work amongst the group members and appointing one group member as co-ordinator.

3.7 Virtual Learning

Following the initial workshop, the groups were registered for the discussion forum and expected to continue their group activities on-line. However there were significant technical problems that meant that this could not happen. Different groups resolved these technical problems, in different ways. One group decided to abandon the discussion forum within the first week and communicated entirely by email. This group had also appointed a co-ordinator and went on to collaborate very successfully. Another group moved onto a very structured tool based approach where they worked individually on a one-to-one basis with the facilitator. The other groups persevered longer with trying to use the discussion forum, but unsuccessfully. This led to a complete lack of collaboration between the group members. Thiswas one of the reasons that caused the interim workshop in the UK to be changed to allow a face-to-face session, as well as on-line presentations. Email communication was continued throughout the trial, but as discussed, only one group worked collaboratively and the other groups worked on individual tasks as guided by their facilitator.

3.8 The Interim Workshop

The primary deliverable was intended to be a presentation of the group's activities and results from the first half of the trial and these presentations were to be reviewed by the other groups. All the presentations were published in the discussion forum and sent by email. A small group of UK participants met face-to-face for an afternoon and the presentations were reviewed constructively during the session. The French SMEs adopted 'Skype' for their interim workshop to supplement the discussion forum. The groups also raised the issue of needing more structure to the learning programme, and this resulted in the UK group generating (in the face-to-face session) a diagnostic tool, which they then worked through on a step-by-step week-by-week basis. They also decided to include their individual learning reflections with the weekly summaries.

3.9 The Final Workshop

This event was scheduled as a morning and lunch session, as discussed earlier. The groups' task was to present their summaries of challenges, activities and action plans to each other and then summarise to the other groups in the plenary session. They spent almost the whole morning working in their learning sets, with only about one hour in large group presentation and discussion. The groups spent a significant amount of this time considering their reflections on the programme and their learning.

4 Summary of Results

4.1 SME Perspectives of the Trial

The participants recorded their experiences in groups and individually on the post-trial questionnaires. Analysis of the questionnaires resulted in 73% stating that they had met at least some of their objectives, and 67% stating that they would be able to apply their learning in their personal and professional life within 12 months. There were 90% of participants who agreed that it had been useful to share with others and 77% felt that they had become more effective managers. It was interesting to note that whilst there was a poor response to questions about the on-line collaboration area, 73% of participants found the help of the facilitators very useful. Some of the SME comments are summarised below:

	SME Comments
What was successful?	Very enjoyable and useful face-to-face sessions – encouraged virtual collaboration Encouraged further thinking on management issues Personal (one-to-one) discussions over drinks / lunch Structured tools and templates very helpful, especially the Challenge Diagnostic

	Facilitators helped to push it along during the virtual learning phase Access to facilitators and group members by email Face-to-face sessions preferred, maybe due to 'age' of participants (felt virtual learning may be more easily adopted by younger people) Collaborative aspect was great Learning from others was very worthwhile Realising shared issues (it can be lonely as an SME) Generation of insights Access to resources (e-Library) was valuable Really helped to reality check the business and re-focus on the basics and essential of business Realised that interpersonal development was more important than academic learning
What was NOT so successful?	Technology was very slow and not intuitive Lack of collaboration following face-to-face sessions Wanted more structure and direct content (some) in the programme Disappointed in the lack of commitment of other members of the group Difficult to schedule time for remote learning and give up if it doesn't work easily or quickly
Recommendations for Future	Clearer structure at the beginning and more tasks with deadlines More face-to-face sessions More time spent bonding as a team, rather than group Get the right virtual learning platform (fast, intuitive, simple)

4.2 Facilitators' Perspectives

Following the trial, the facilitators held a small workshop to review the trial and produced the following reflections. In view of the comments from the SMEs, identical comments are not reiterated here, and only additional comments and observations are included. The trial facilitators agreed the following:

• The initial workshop and marketing information should have contained more detailed information on the structure and expectations of a virtual action learning programme

• Successful virtual collaboration was also supported by informal communication such as telephone conversations, one-to-one emails and meetings in pubs etc.

• The scheduling of face-to-face events at about every 4 to 5 weeks was about right to maintain interest in the virtual action learning

In summary, the facilitators considered that there are constant opposing challenges to running such programmes, such as structure, timing, numbers of participants, and technology. The participants expect clear objectives, tasks and outcomes to varying degrees depending on their preferred personality type and learning style. Some want a lot of detail, and others will require only high-level information. Too much detail can be restrictive and too little creates uncertainty. The group size of between 4 and 8 people is good for action learning sets, whereas a larger number, over 30 is better to create lively virtual discussions. It was essential to build trust between the participants themselves, as well as in the programme providers.

5 Conclusions and Implications for Further research

The overall conclusion of this study is that it is possible to successfully engage SMEs by using an engagement strategy that communicates in terms of meeting by SME needs and addressing their current business problems. The combination of face-to-face and virtual action learning worked well on this project, and helped to encourage the SMEs to join the programme. The need for a clear structure to the programme was underestimated and in the future more attention should be given to informing potential participants of the structure, tasks and the expectations of their involvement.

The facilitation of the trial was successful in many aspects, however, possibly due to the technical issues; this role took significantly more time and effort than expected. There was a need for facilitators to be in communication almost on a daily basis and use a flexible style to motivate the participants. There were times when a ‘light touch’ of facilitation was sufficient and also times when the participants looked for clear directions and guidance. In light of these experiences and following a careful reflection of the findings, the ENSEL project partners revised the initial 6 learning principles to the following 8:

1. Our focus is on learning which has a perceived value to the learners
2. Responsibility for the learning process is shared (between all actors in this process)
3. Learning is situated and context-dependent
4. Time has to be allowed to build relationships
5. Learning is better supported in collaborative settings and dialogue plays a major part in the collaborative learning process
6. Social interaction allows for co-construction of knowledge, which promotes engagement of learners in workbased or problem-based learning
7. The role of the facilitator / animator is essential for collaborative learning
8. Critical reflexivity is an important part of the learning process for evaluating and examining both the learning process itself and the resultant actions taken.

5.1 Implications

This study raised several interesting points for further research. Firstly, there was a tendency by both participants and facilitators to blame many of the problems with virtual learning on the technology problems. It would be valuable to investigate how much this masked other issues about using a virtual action learning approach. Some of the participants expressed the view that their lack of collaboration and motivation in using virtual learning was down to their age (average in 40s) and stated that a younger generation brought up with the internet and web-based learning at schools and colleges would be more accepting of virtual learning environments. The findings of these trials indicate the possible model, below:

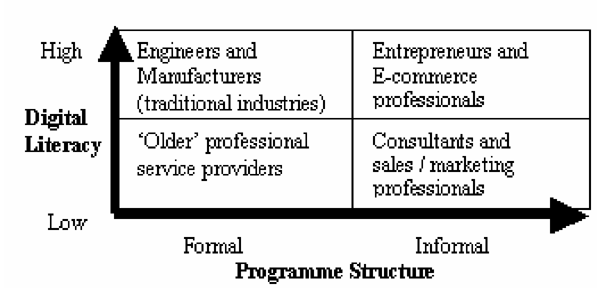

Figure 3: Structure / Digital Literacy Matrix (Stewart and Alexander, 2006)

The above model attempts to illustrate that those with a higher digital literacy and greater acceptance of the more informal problem-based action learning tended to come from businesses of entrepreneurs, with innovative new products and services, often exploiting new technology. Many of these were providing complex information technology products and offering unique web-based services.

Those with a higher digital literacy that preferred the more traditional formal type of programme, tended to be from the more traditional industries and were often initially educated in engineering and science based disciplines. For many of these, this was their first experience of an action learning programme. Whilst the majority of the participants realised benefits at the end of the programme, they tended to be very suspicious of a programme with a facilitator, rather than a teacher.

The participants with lower digital literacy were very reluctant to use technology. The requirements for participants attending the ENSEL programme had been stated as they needed to be able to use email and access the internet. There was one example of a participant who met these criteria, but his first email was written in the style of a very formal business letter. This indicated challenges in the attitude towards the technology, not just the technical skills of sending emails.

Those that were reluctant to use technology preferred both formal and informal structures. Some, who referred to themselves as an 'older' generation, stated that they had come from a tradition of formal, structured education at school and college, where you were taught to read books, learn facts and listen to the teacher. This group reflected that a younger generation brought up to question and challenge, research on the Internet, complete online examinations, and use technology for study and leisure, would have more easily accepted virtual action learning.

The group of people with low digital literacy but a preference for informal learning emphasised their satisfaction at the face-to-face events and appreciated the opportunity to discuss quite loosely-defined problems with the others in the group. Comments were made concerning trust, especially when there was the potential that the other members of the group might be competitors. This was particularly evident in the Italian trial, which resulted in a reluctance to collaborate and share knowledge, apart from at face-to-face events. This category of participants was particularly emphatic on the need to spend time getting to know the people in the group first. The above model indicates the challenges in engaging SMEs for virtual action learning programmes and the need to provide programmes that either encompass all approaches or, alternatively, are targeted at a particular group. For those that fall into the category of lower digital literacy, this would need to be addressed, prior to engaging them in action learning programmes supported with technology.

The type of challenges the SMEs worked on in this programme often involved revealing aspects of their businesses and personal effectiveness that they were comfortable to talk about in face-to-face meetings but were reluctant to submit to on-line discussion forums. There needs to be a more in-depth investigation on to how to facilitate trust, collaboration and open communication in a virtual learning environment. The constant tension between the business pressures on SMEs to be totally dedicated to their companies and the benefits of taking time out for learning and reflection should be investigated further, to attempt to identify ways to allow the participants to develop trust and simultaneously does not involve them spending several days away from their business.

Overall, this project has made some interesting findings and provides valuable insights into developing effective virtual action learning programmes for SMEs.

The digital literacy matrix above provides an indication of how action learning sets might be set up to reflect both the differing needs for structure and the variation in digital literacy. This trial has indicated that virtual action learning was most effective in the low structure/high literacy quadrant. Those in the low structure/low literacy quadrant could benefit from either traditional face-to-face action learning programmes or alternatively, they could start the programme with a well-designed, succinct training programme to help develop their digital literacy skills. The facilitator for such a group would also need to be able to address and resolve technical queries and therefore should possess technical competencies, in addition to facilitation competencies.

Those that are in the high structure quadrants could be allocated into action learning sets containing similar participants and the set facilitator should pay particular attention to ensure that there are people in the set with specific knowledge and expertise to encourage rich action learning experiences in the group. Once the group appreciate the action learning process, this group would then be able to move to virtual action learning. This implies that it would take longer and more face-to-face meetings would be needed before this group could move onto virtual action learning. Those that are in the formal structure and low digital literacy quadrant would also need to spend additional time on a training programme to help develop their technical skills. Therefore this group would be the least appropriate group to engage on a virtual action learning programme.

This research project was designed to investigate the potential benefits of virtual action learning to engage SMEs in learning programmes, in order to address the major challenge of developing skills in SME owners and managers. The learning principles originally drawn for prior projects and literature were refined to reflect the insights gained during the project. These can now be used to design SME learning programmes. The digital literacy matrix can be used to assist selection of participants to both action learning programmes and virtual action learning programmes, taking into account the dimensions of structure and digital literacy. For those in the low structure / high literacy quadrant, benefits of the ENSeL virtual action learning programme were described as follows, and appropriate use of this model should bring similar benefits to many other SMEs.

'The ENSEL Programme enabled me to gain greater awareness of my personal limitations – I have since promoted my more able staff and am learning to tolerate less perfectionist standards which are really quiteadequate for the job. This was important and is helping me to trust my staff more'

'I have a much clearer understanding of what I can delegate and more importantly, the tasks I must not delegate, such as leadership and communicating my vision to the staff'.

'I can now articulate the values of my company and communicate my passion for our products and our people'.

'I have been trying to decide whether I should offer a broad range of services or just specialise in a few, and I have recently tailored an offering for a specific customer, with the help of the learning group. I am also encouraged to build better relationships with my existing customers.'

'All the people in our learning set faced some very similar challenges. We were concerned about how we could grow the business, but still preserve the special nature of our products and people. I now feel more confident about my ability to do this.'

'Even though the project has finished, our group still meet and communicate virtually. There is a real comfort in knowing other people facing the same sort of problems and working it through together.'

This study has also indicated several challenges for future research and important practical issues to address, such as the low level of digital literacy in the SMEs involved in this programme. Despite the relatively small number of participants in the ENSEL trial programmes, the findings can be seen as making a significant contribution to this field of research.

Acknowledgements. We would like to thank the ENSeL project partners; IBM, Grenoble Ecole de Management (GEM), SAGO spa, Lancaster University, Catholic University of Louvain, Karolinska Insitutet, E.M.Lyon, University of Liege, Goteborgs Universitet, Learning Lab Denmark, Inspire Research Ltd.

References

1. Alexander, G. (2006*) SME Learning Needs*, Unpublished MBA Dissertation, Henley Management College, UK.

2. Attwell, G. (2003). *Report on Brussels Seminar: Exploring Models and Partnerships for Elearning in SMEs. Developing New Pedagogies and Elearning in SMEs.* Report on a seminar on Exploring models and partnerships for elearning in SMEs, held in Stirling, Scotland and Brussels, Belgium, in November 2002 and February 2003.

3. Birchall, D., Hender, J. and Alexander, G (2004), Virtual Action Learning for SMEs – a review of experiences gained through the ESeN Project*. Henley Management College*

4. Blackburn, R. and Hankinson, A. (1989), Training in the Smaller Business: Investment or Expense? Industrial and Commercial Training, Vol. 21, No. 2.

5. Bolden, R. (2001), *Leadership Development in Small and Medium Sized Enterprises: Final Report*, Centre for Leadership Studies, University of Exeter.

6. Bray, J. (2002), *Virtual Tutoring in Hospitality: A 'Learnt System' of Professional Practice.* International Journal of Contemporary Hospitality Management, Vol. 14, No. 1, pp. 21.

7. Cranfield University (2005). *Six classic barriers to growth and how to overcome them. Press release,* Cranfield University School of Management

8. Eraut, M. (2000). *Non-formal learning, implicit learning and tacit knowledge in professional work*. In Coffiel, Frank The Necessity of Informal Learning publ Bristol, Policy Press

9. Esnault, L. and Ponti, M. (2004*). The theory and practice of computer supported collaborative learning*. EQUEL project position paper

10. Guile, D. (1998). Information and Communication Technology and Education. *London, Institute of Education, University of London.*

11. Hilton, M. and Smith, D. (2001) *Professional education and training for sustainable development in SMEs*. European Foundation.

12. Hodgson, V., & Watland, P. (2004). *Researching networked management learning*. Management Learning. 35 (2): 99-116.

13. Inglis, S. (1994), *Making the Most of Action Learning*, Hampshire: Gower.

14. Ingram, H., Biermann, K., Cannon, J., Neil, J. and Waddle, C. (2000), *Internalizing Action Learning: A Company Perspective*, International Journal of Hospitality Management, Vol. 12, No. 2.

15. Kirby, D. (1990*). Management Education and small business development: an exploratory study of small firms in the UK*. Journal of Small Business Management, Vol.28 Issue 4, p78

16. Knowles, M. S. (1970) *The Modern Practice of Adult Education. Andragogy versus pedagogy*, Englewood Cliffs: Prentice Hall/Cambridge.

17. Knowles, M.S. (1984), *The Adult Learner: A Neglected Species*, Houston: Gulf Publishing.

18. Learning and Skills Development Agency (LSDA), 2002. *Working towards skills: Perspectives on workforce development in SMEs.* Research report

19. Lave J., & Wenger, E. (1991*). Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press: New York, NY.

20. Observatory of European SMEs (2002). *SMEs in Focus*. Main Results from the 2002 Observatory of European SMEs. (KPMG/ENSR). Enterprise Directorate-General of the European Commission. Office for Official Publications of the European Communities, Luxembourg.

21. Observatory of European SME 2003, No.1 'Competence Development in SMEs'. Enterprise Directorate-General of the European Commission. Office for Official Publications of the European Communities, Luxembourg

22. Pedler, M., Brook, C. and Burgoyne, J. (2003), "Motion Pictures", *People Management*, April, pp. 41-44. *23.* Ponti, M. (2004). *Towards a conceptual framework for analysing the sustainability of elearning networks in SMEs.* Positioning paper for the ENSeL project

24. Revans, R.W. (1980) *Action Learning*. Blond and Briggs, London

25. Small Business Service *(2003a) VAT Registrations and Deregistrations, 1994-2002.* www.sbs.gov.uk/statistics.

26. Small Business Service (2004) *SME statistics UK 2004: SBS 2004.* www.sbs.gov.uk/statistics.

27. Stanworth, J., Purdy, D. and Kirby, D.A. (1992), *The Management of Success in "Growth Corridor"* Small Firms, Small Business Research Trust Monograph.
28. Stewart and Alexander (2006) – *Engaging SMEs in an E-Learning Trial* – Paper presented at the Networked Learning Conference, Lancaster University, April 2006.
29. Unisys (2005). *Final Report: E-Learning in continuing vocational training, particularly at the workplace, with emphasis on small and medium enterprises.* Directorate General for Education and Culture EAC-REP-003
30. Van Winkelen, C. (2003), Inter-organisational Communities of Practice'. Working Paper, Henley Management College
31. Williams, S. (2003). *The Learning Manager: Knowledge, action and social practice*. Working Paper, Henley Management College
32. Wilmott, H. (1994) *Critical management learning* in J. Burgoyne & M. Reynolds (Eds) Management Learning: integrating perspectives in theory and practice (London, Sage), 161-176

Appendix: A

Peter's Challenge (names have been changed):
One of my business challenges is Leadership, particularly leading the company through a period of change. During my short corporate working life (redundant twice, sacked once) I never got to a position of leadership. I have no leadership training, no role models, no mentors (the attraction of the course?). As the business has grown from wife, husband plus one (now 10 of us this week) then my role has become one of leader. The more the company grows and changes the more this will become my role. So what skills do I need? How do I get them - are they inherent or can they be learnt? What are the leadership issues? Should I bring someone else in to lead? How do I communicate my deep vision for the business? Of course I have a view on each of these questions but how do others deal with them and are there examples of good leadership from which we can all learn? So this is the second area of focus for The X Company.

Feedback from other set members:

ISSUE	FROM	FEEDBACK
Leadership	**Karen**	I would recommend paying for and attending a training programme specifically for leadership development and self-awareness of leadership strengths/areas for development. Mentoring also good. Would suggest Peter looks to his own skills prior to bringing in another person to lead.
	Jerry	You've probably got a lot of skills already but just don't know it. Is there anyone you know who could mentor you? What about a non-executive director to help you work through many of the

		growth issues including leadership? I learnt my management skills on the job and was lucky in so far as I had some fabulous role models. The skills I most admired in my leaders and tried to embody were trust, authority, leading by example and conviction. In terms of communicating your vision, (this leads on from my previous comments); Define it - you may well be able to do it in-house, but an external resource would be more objective and find it easier to research employees and customers. Communicate it - share it with all stakeholders (not in a cheesy way) Live it - ensure it's expressed clearly and consistently in everything you do and say.
	Alex	If I could answer this one I might be able to help myself more. My instinct is that as a business grows, the leadership skills required change. Paradoxically the very skills required to start from zero become counterproductive in later growth. Once again, I am relaxed about the 'vision thing', which is what most business founders are ultimately remembered for. Finding training, mentors, networks (like this) and consultants seems a way forward where resources are available. In the end, delegation (ouch – I said it) to others with complementary skill sets must be the answer.
	Amir	I also face a similar issue regarding no formal training and no mentor to help exercise my business idea. Have you considered applying for a Leadership course? You may find this article somewhat interesting: http://www.businesslink.gov.uk/bdotg/action/ It gives a very brief description of management team skill sets.
	David	What is it you REALLY want to do because your contribution is likely to be greatest in this area. Promotion to the point of incompetence does not work. Many courses do exist if leadership is necessary and can be learned and practised. Communicating vision is believing and living it. Does this make sense?

Emergent Knowledge Artifacts for Supporting Trialogical E-Learning

Yannis Tzitzikas[1,2], Vassilis Christophides[1,2], Giorgos Flouris[2], Dimitris Kotzinos[1,2], Hannu Markkanen[3], Dimitris Plexousakis[1,2], Nicolas Spyratos[4]

[1] Computer Science Department, University of Crete, GREECE
[2] Institute of Computer Science, FORTH-ICS, GREECE
[3] EVTEK University of Applied Sciences, FINLAND
[4] Laboratoire de Recherche en Informatique, Universite de Paris-Sud, FRANCE
Emails: {`tzitzik` | `christop` | `fgeo` | `kotzino` | `dp`}`@ics.forth.gr`, `hannu.markkanen@evtek.fi`, `spyratos@lri.fr`

Abstract. This paper elaborates on scenarios for collaborative knowledge creation in the spirit of the trialogical learning paradigm. According to these scenarios the group knowledge base is formed by combining the knowledge bases of the participants according to various methods. The provision of flexible methods for defining various aspects of the group knowledge is expected to enhance synergy in the knowledge creation process and could lead to the development of tools that overcome the inelasticities of the current knowledge creation practices. Subsequently, these scenarios are projected to various knowledge representation frameworks and for each one of them the paper analyzes and discusses related techniques and identifies issues that are worth further research.

1 Introduction

Classical learning theories are based either on the *knowledge acquisition* metaphor (i.e., a learner individually internalizes a body of knowledge) or on the *social participation* metaphor (i.e., a group of learners collaboratively appropriate a body of knowledge). Although widely accepted, these theories do not sufficiently capture innovative practices of both learning and working with knowledge (i.e., knowledge practices). Only sharing of knowledge in action, i.e., sharing the process of learning itself, is a reliable base for developing a shared cognition (seen both as a group and an individual characteristic). In this context, the emerging theory of *"Trialogical Learning" (TL)* focus on the social processes by which learners collectively enrich/transform their individual and shared cognition. According to TL, knowledge creation activities rely heavily on the use, manipulation and evolution of shared knowledge artifacts externalizing a body of (tacit or explicit) knowledge [29]. By representing their cognitive structures or knowledge practices under the form of artifacts, individual learners can interact with themselves as well as with external tools (e.g., computers, information resources) to negotiate the meaning of concepts and signs embodied in these artifacts and thus,

E. Tomadaki and P. Scott (Eds.): EC-TEL 2006 Workshops, pp. 385-399, 2006.

finally reach a common understanding of the problem at hand. We could therefore consider as cornerstone of trialogical learning the notion of shared objects of activity, a notion that is quite general to accommodate the requirements of various application contexts. For instance, a video that records how group members carry out their tasks, could be considered as a shared knowledge artifact which the group could annotate (with free text or with respect to an ontology), analyze and further discuss (e.g. for capturing tacit group knowledge). Moreover, and more interestingly, a knowledge artifact could take a more formal substance (e.g. for capturing explicit group knowledge) as in the case of documents (e.g. a survey paper), conceptualizations (e.g. a data/knowledge base), or even software code exchanged within a group. Hereafter we shall use *knowledge artifact* to refer to what is being created and/or shared by a group of learners (and could be a set of words, documents, concept maps, ontologies, annotations, etc).

It is worth mentioning that the paradigm of Trialogical E-Learning can be very useful within Communities of Practice (CoPs) as it can facilitate the negotiation of meaning and it can contribute to the development of explicit and innovative knowledge inside a CoP [9].

In order to communicate and meaningfully interpret their individual viewpoints, cooperating learners need to agree on a common conceptual frame of reference. Models and techniques that allow diversification and flexible amalgamation of different world views are still in their infancy. In this paper, we investigate various ways to build emerging knowledge spaces. We have used the trialogical learning paradigm for eliciting the functional requirements. In particular, we focus on the various methods to form the common knowledge of a group by combining the individual knowledge of its members. The provision of flexible methods for defining various aspects of the group knowledge is expected to foster knowledge creation processes and could lead to the development of tools that overcome the inelasticities of the current knowledge creation practices.

The rest of this paper is organized as follows: Section 2 describes a TL scenario for collaborative knowledge creation, and Section 3 discusses the underlying principles and interactions. Section 4 describes various ways to build emerging knowledge artifacts from individual group knowledge (of various forms), and identifies knowledge management requirements. Finally, Section 5 summarizes and concludes the paper.

2 Motivating Scenario for Trialogical Learning

2.1 Collaborative Literature Review and Annotation

A set of N research papers, say $P = \{p_1, \ldots p_N\}$, is given to a set of K learners $A = \{a_1 \ldots a_K\}$ who could be students, researchers, or co-workers in a company. The goal of this group is to understand the topics discussed in these papers and to build an ontology, say O, that represents the main issues discussed in these papers. Moreover the group has to annotate these N papers according to the derived ontology, i.e. specify $d(p)$ for each $p \in P$ where $d(p)$ denotes the description of p with respect to O. We could also assume that there is an additional constraint saying that the ontology should not have more than C concepts. The learners, hereafter *actors*, have to collaborate (synchronously or asynchronously) in order to carry out this task.

Note that various combinations of (N, K, C) values describe different real-life scenarios. For instance, $(50, 1, 20)$ could describe what a MSc student should do in order to write the state-of-the-art of his MSc thesis. Of course, this scenario does not fall into trialogical learning, but is rather an instance of monological learning (acquisition metaphor). Values like $(150, 2, 50)$ might describe the collaboration between a professor and a graduate student for finding a topic for a PhD thesis. Values like $(100, 10, 10)$ may describe a group (comprising 10 members) of a research lab that is trying to join a research area by studying the 100 related papers that have been published the last 5 years and trying to identify the 10 main topics of the area (subsequently each member of the group would be responsible for one topic). Finally, big values for K, say 1000, could model the effort for developing an international standard.

2.2 Grading and Progress Assessment of Individuals and Groups

A related rising question is whether the "quality" of the result of this collaboration (i.e. of O and $d(p)$'s) should be measured and if yes how. We can identify two broad cases. According to the first, there is an external (human or machine) observer who can grade the result, while according to the second there is not any external party. For instance, we may assume that there is a certain "solution" ontology (ideal or criterion), denoted $O^{(i)}$ that is unknown for members of the group. For example, $O^{(i)}$ could have been provided by a tutor if there is one (or the tutor might have provided a set of admissible ontologies instead of one ontology). Subsequently, appropriate metrics could be employed in order to measure the "distance" between $O^{(i)}$ and O_{s_i} and at every point in time (state s_i), so that the members of the group can judge if they progress or not. Of course not only the group work but also the individual work could be graded. Recall that according to [30, 13], for effective collaborative learning, there must be "group goals" and "individual accountability"[1].

In the case where there is not any external party we could probably only measure the degree of agreement between the members of the group. If O_A expresses the knowledge that all members of A accept to be correct, then the bigger O_A is, the better the group goes (assuming there is not any other constraint like C in the previous scenario).

3 Emergent Knowledge Artifacts Spaces

This section discusses issues that are important for supporting the previous scenario. In particular, Section 3.1 introduces personal and shared knowledge

[1] Based on the successful results of experiments reported in [13]: fifty percent of each student's individual grade was based on the average score (of the group members) while the remaining fifty percent of each student's grade was individual.

artifacts and clarifies their relation, while Section 3.2 shows how a set of learners can interact on the basis of their personal and shared knowledge artifacts. It also discusses synoptically additional issues.

3.1 Personal versus Shared Knowledge Artifacts

To abstract from representation details we shall hereafter use the term knowledge base (KB) to refer to an ontology or to an ontology-based information base (i.e. to a set of objects annotated with ontological descriptions).

Although trialogical learning focuses on shared artifacts, learners should be able to construct and evolve their own models. Let KB_a denote the knowledge base of an actor a. Now let KB_A denote the "shared" (or common) knowledge base of a set of actors A. The important issue here is the relation between KB_A and KB_a (for $a \in A$). Below we identify three broad cases:

- *UNION-case*. Here KB_A is obtained by taking the union of the KBs of all participants, i.e.: $KB_A = \cup\{ KB_a \mid a \in A\}$. Note that KB_A could be inconsistent if there is a notion of consistency. For example, if the task is to annotate a video with argumentative maps, then consistency is not a very strict issue. If on the other hand the task is to develop an ontology (for subsequently building a bibliographic database) or a software module, then consistency is a very important issue.
- *INTERSECTION-case*. Here KB_A is obtained by taking the intersection of the KBs of all participants, i.e.: $KB_A = \cap\{ KB_a \mid a \in A\}$, so it comprises statements "accepted" by every participant.
- *QUANTITATIVE-case*. Here KB_A is defined by a quantitative method, e.g. it may comprise all sentences that are accepted by at least a percentage of the actors. Obviously, UNION and INTERSECTION are special cases of this case.

3.2 Interaction through Knowledge Artifacts

Suppose that we want to design and develop an application for supporting various forms of collaboration (e.g. asynchronous and synchronous) and supports personal and shared knowledge artifacts. Figure 1 sketches a possible UI[2] for that application that could serve as a proof of concept and as a gnomon for identifying and analyzing the associated technical requirements and challenges.

The UI is divided in two main areas: the left area allows managing the personal space, while the right area allows managing the group space. In the left area each learner is free to do whatever she wants, so everything is editable in that area. The right area shows the shared artifacts and this area is the key point for collaboration and for supporting trialogical e-learning. For instance, and assuming the scenario described earlier, each user may develop her own ontology at the left area, while the right window shows the group ontology O (according to the method that O is derived from the personal ontologies).

[2] This sketch is by no means a proposed UI design.

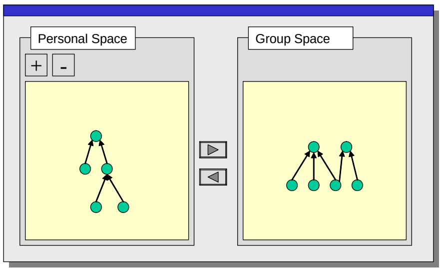

Fig. 1. An indicative UI for trialogical E-learning

The relationship between personal space and group space is very important. The button labeled by "$\rightarrow$" allows a user to copy the desired parts from her ontology to the group space. The button labeled by "$\leftarrow$" allows a user to copy the desired parts from the group ontology to her personal space.

An option that keeps the button "$\rightarrow$" permanently pressed would allow synchronous collaboration in the sense that every change at a learner's ontology is immediately reflected (propagated) to the group ontology (e.g. blackboard-based collaboration). Symmetrically, an option that keeps the button "$\leftarrow$" permanently pressed would propagate the changes on O to the personal space[3]. Deletions are handled analogously and are discussed in Section 4.2. We could call systems (and UIs) that allow this kind of collaboration/interaction *synodic*[4].

Above we have sketched the basics of a trialogical e-learning scenario. Of course, the scenario (and the UI) can be enriched with a plethora of auxiliary functionalities. Below we identify the most important ones according to our opinion:

- The *group space* view could be *customizable*, e.g. instead of showing the group ontology, one participant may want to see the ontology derived by considering the ontologies of only a *subset* of the participants. In general, the shared knowledge base could be defined with a set theoretic expression over subsets of A. For example, $K_{(\{a_1\}\cap\{a_2\})\cup(\{a_3\}\cap\{a_4\})}$ could capture the scenario where two groups (a_1, a_2) and (a_3, a_4) collaborate in the sense that the joint work of each group is integrated. Moreover, the group space could be *optionally managed* by a person whose role would be to accept or reject the changes that the participants forward to the group ontology.
- The *provenance* of every statement should be saved and be available at any time (e.g. this link was added by learner a_2). Moreover, the participants should be able to *annotate* every element of their personal or group space. The annotations could be textual or ontology-based.
- *Usability* is always a very important issue. For instance, by placing the mouse on top of an element of the group ontology, a balloon should open showing who provided this info (or what percent of the actors agree with this). More-

[3] This is not reasonable if O is defined by union, but it could be reasonable if O is defined by intersection or quantitatively.

[4] Of (or relating to) a synod, where *synod* is a council or an assembly.

over the *visualization* of knowledge artifacts is a very important, challenging and open issue (some related issues are discussed in brief in [24, 35]).
- The UI could be enriched with *teleconferencing* services allowing the participants to discuss in real-time while using the system.

4 Synthesizing Knowledge Bases

To support the scenario described in Section 2, we need to support the formation and evolution of A, of P, of O, and $d(p)$'s. In order to identify the distinctive knowledge management requirements for supporting e-trialogical learning, we will first present an approach for supporting personal and shared knowledge artifacts and then we will investigate various forms of knowledge bases starting from the very simple ones. The reason for trying to identify the key knowledge management requirements (that originate from TL), is to investigate how we could support them by extending accordingly the core knowledge management technologies (and not by developing yet another e-learning application).

4.1 Supporting Personal and Shared Knowledge Artifacts

Now we will divide the personal space of an actor into two spaces: one private and one public. The group (shared) space is derived from the public personal spaces of the actors.

Each actor a_i has two unique *identifiers*: one *private* and one *public*. The first, denoted by a_i^p, is associated with every "statement" (e.g. construct or update operation) concerning his personal space. The second, denoted by a_i, is associated to every statement he has forwarded to the group space. Let KB_i^p denote the knowledge base comprising all statements with identifier a_i^p, and KB_i denote the knowledge base of statements with identifier a_i. Normally, it should be $KB_i \subseteq KB_i^p$, that is the public personal base of a user should be subset of the personal private base of that user. However, in social life sometimes persons forejudge or "pretend" that they accept facts although they don't really believe them (e.g. because all other persons do, or for strategic reasons). In such cases the relationship $KB_i \subseteq KB_i^p$ does not hold. For this reason, and in order to leave learners free, we shouldn't impose any constraint among KB_i and KB_i^p.

The important point here is that the synthesis (or amalgamation) of all KB_i's forms the shared artifacts of the group (i.e. the shared artifacts according to trialogical learning). Let's now return to our application scenario, and suppose the case where there is one tutor who has also provided to the learners a preliminary version of the ontology O_{pre} (on which the learners should work on). We could capture this case by considering that initially it holds $KB_i^p = O_{pre}$ for each $i = 1..K$.

4.2 KB = A Set of Words

In order to identify the distinctive knowledge management requirements for supporting trialogical learning (if any), we will start from very simple forms of knowledge bases.

Suppose that a knowledge base is just a set of words (i.e. a set of strings). In our application scenario, this corresponds to the case where the ontology (that the learners have to create) has the form of a set of keywords.

For every actor $a_i \in A$ we have two knowledge bases: KB_i^p and KB_i. The first is a set of pairs of the form (w, a_i^p) while the second (KB_i) is a set of pairs of the form (w, a_i) where w is a word. At the beginning of a learning session it could be $KB_i^p = KB_i = \emptyset$ for each $i = 1..K$, although this is not a necessary constraint.

Consider now an actor a_i who uses the left area of the UI and creates a KB_i^p. Now suppose that he selects some elements of KB_i^p, say a word w, and presses the "$\rightarrow$" button. One reaction to this event can be:

1. A new pair (w, a_i) is created.
2. The group KB is updated according to this information (depending on the way that the group KB is defined).

Now suppose the user selects some elements, say a word w, from the group space (rightmost area), and presses the "$\leftarrow$" button. One reaction to this event can be:

1. A new pair (w, a_i^p) is created. This step makes the assumption that the user agrees with w. In other words, we treat this case as if the user had added himself the word w to his private base.
2. The private base of the user is updated accordingly.
3. Probably (or optionally) a pair (w, a_i) should be created.

Let's now suppose that the user *deletes* one element w of his private knowledge base. If the user had "published" w in the past, i.e. if a pair (w, a_i) exists, then the system should ask the user if the pair (w, a_i) should be deleted or not. This case suggests that it would be more informative if the UI for each actor a_i were divided into 3 areas: one showing KB_i^p, one KB_i, and one for KB_A, as it is depicted in Figure 2. This would allow monitoring and controlling the contents of KB_i.

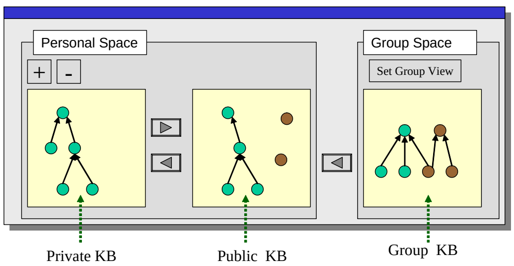

Fig. 2. An indicative UI for trialogical E-learning

Let's now investigate how the "shared" knowledge base might be defined. Let KB_A denote the KB obtained by taking the union of the public bases of all actors, i.e. $KB_A = \bigcup_1^K KB_i$. We can define the *support* of a word w, denoted by $for(w)$, as the set of ids that correspond to actors who have included w in their public KB. So KB_A can also be considered as a set of pairs of the form $(w, for(w))$ where $for(w) = \{ a_i \mid (w, a_i) \in KB_i \}$. Notice that this view is quite generic as it allows defining at run-time the group KB by various methods (by union, intersection or any other) as shown below.

- The UNION case comprises all words w such that $|for(w)| \geq 1$, specifically:

$$KB_{\cup A} = \{ w \mid for(w) \subseteq A \}$$

- The INTERSECTION-case comprises all words w such that $|for(w)| = K$, specifically:

$$KB_{\cap A} = \{ w \mid for(w) \supseteq A \}$$

- The z-PERCENT case comprises all words w such that $|for(w)|/K \geq z$, specifically:

$$KB_{z\%A} = \{ w \mid \frac{|for(w) \cap A|}{|A|} \geq z \}$$

- The case where a user wants to see the group ontology as derived by considering only a subset A' of A can be captured by the above formulas (by replacing A with A').

It has been made evident that by considering a KB as a set of pairs of the form $(w, for(w))$, we can compute "whatever shared knowledge base" we want. So such a representation could be adopted for the physical layer of the repository.

Grading (assessing progress)
Let W and W' be the set of words stored in two knowledge bases KB and KB' respectively. We can define the distance between two knowlebge bases KB and KB' on the basis of W and W'. For instance, we can use the symmetric difference, i.e. $dist(KB, KB') = |W \setminus W'| + |W' \setminus W|$, the Dice coefficient, i.e. $dist(KB, KB') = 1 - \frac{|W \cap W'|}{|W \cup W'|}$, or any other metric.

4.3 KB = A Binary Relation

Now suppose that a KB is a binary relation R over a set of elements T i.e. $R \subseteq T^2$. Let r denote an element of a R, e.g. $r = (t, t')$ where $t, t' \in T$. In our application scenario, this corresponds to the case where the ontology (that the learners have to create) is a graph of keywords.

We can define the personal and group knowledge bases as we did earlier (e.g. $KB_{\cup A} = \{ r \mid for(r) \subseteq A \}$). The only difference is whether the set T is considered to be known by all actors (and thus is not part of the created knowledge), or not. If T is considered part of the created knowledge, then the KB of an actor could be characterized by R_i and T_i (of course $R_i \subseteq T_i^2$). It follows that we can define shared knowledge bases (e.g. $KB_{\cup A}$ and $KB_{\cap A}$) not only for R but also for T.

4.4 KB = A Binary Relation with Second Order Properties

Here we consider the case where a KB is a binary relation R over a set of elements T ($R \subseteq T^2$), with the extra rule or constraint that this relation satisfies a property (e.g. that R is reflexive, symmetric, antisymmetric, transitive, etc). These extra properties can be seen as derivation rules (inferences) or constraints. For instance, note that the case where R is a preorder (i.e. a reflexive and transitive relation) captures the case of taxonomies. So in our application scenario, this corresponds to the case where the ontology (that the learners have to create) has the form of a taxonomy. Supporting this scenario is actually supporting collaborative (and trialogical) taxonomy construction.

We could model inferences (e.g. transitivity) as follows. We can consider a KB as a set of sentences S and we make the assumption that there is a consequence operation $Cons$ that models inference services ($S \subseteq Cons(S)$). Also note that axioms could be modeled by the notion of consistency.

It follows that for each $i = 1..K$ we have KB_i, KB_i^p, $Cons(KB_i)$ and $Cons(KB_i^p)$. A "shared" knowledge base can be defined on the basis of KB_i or on the basis of $Cons(KB_i)$. The resulting shared knowledge base can be different in each case, as shown in the example of Figure 3 where $KB_{\cap\{1*2*\}}$ has been used to denote that $Cons(KB_1)$ and $Cons(KB_2)$ were used for the definition of $KB_{\cap\{1,2\}}$.

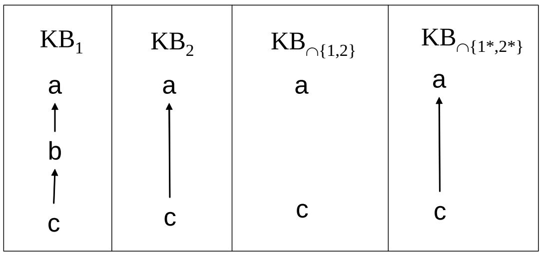

Fig. 3. Local Reasoning and Group KBs

Total Order Consider now the case where R is a total order. For instance, consider the case where learners have to rank a set of available options T in order to come up with some decision. For example, the learners may have to rank a set of keywords or a set of papers according to their significance or importance. In addition, suppose a questionnaire comprising multiple choice questions where more than one choices are correct for each question but the tutor asked from the group to mark only one choice (the most appropriate). Also notice that the case of total orders captures the selection process of peer-reviewed scientific conferences and journals. Here the shared (group) knowledge base can be obtained by aggregating the "rankings" of the learners. For doing an aggregation of this kind, we could adopt various techniques (mainly coming from the area of Social Choice), like plurality ranking, Borda [7] ranking, Condorcet [8] ranking or Kemeny Optimal Aggregation [20], but we shouldn't forget the Arrow's impossibility theorem [2]. A Borda-like technique for aggregating weakly ordered subsets of a set which could be used for our purposes, is described in [33]. Collaborative Selection and Filtering (i.e. the provision of prediction and recommendation services) is also related to this case (and also useful for collaborative knowledge creation and learning). The difference with the Total order case is that now actors do not rank a set of objects but they rate (using a numerical scale) a subset of the objects (e.g. instead of rankings of the form $\langle o_1, o_2, o_3 \rangle$ meaning that o_1 is preferable to o_2 which is preferable to o_3, we may have input of the form $\{score(o_1) = 5, score(o_2) = 3\}$).

In the above scenario the set T is not part of the created knowledge (in other words, it preexists). A scenario where T does not preexist but is rather part of the created knowledge follows. Suppose that a group of persons (e.g. the authors of the current paper) would like to collaborate in order to specify the structure of a research paper to be submitted to TEL-CoPs'06. Each one proposes a structure, i.e. a total order of strings (here a string can be the title of a section or a short paragraph indicating the contents that this section should have). The collaborative system should aid them to come up with some decision, i.e. with one structure either accepted by all of them or by most of them. As it wouldn't be realistic to expect that two persons will propose exactly the same title (or paragraph) for a section, a text similarity function could be employed (meaning that two texts with degree of similarity greater than a certain threshold could be considered to denote the same section). As each participant will be able to see what the others do (using the right area of the UI), they are expected to refine, improve or change the pieces of text they have provided (and their relative order) while interacting with the system. After some interactions the group will hopefully reach to a structure that is probably better than what each one could do by himself (of course aposties may occur). An alternative method to support this scenario follows. Suppose that the paper to be submitted should have exactly 7 sections. Let T be the pieces of texts that all actors have provided (i.e. $T = \cup_1^K T_i$), e.g. if K=3 then $|T| \leq 21$. The group KB (group paper structure) could be the result of applying the K-Means clustering algorithm (here 7-Means) on T, resulting to a set T_A (each element of T_A would be a set of texts). The ordering of the elements of T_A could be derived by first mapping the participant's rankings to rankings of T_A and then applying a rank aggregation method. We have just described a collaborative (or cooperative) document authoring scenario.

4.5 KB = An RDF-based Repository

Suppose now the case that the learners have to create an ontology-based repository (ontology plus ontology-based metadata). A repository of this kind has the form of a conceptual graph. According to RDF [27, 4], this graph can be seen as a set of RDF triples which actually defines a directed graph consisting of 3 kinds of relations (instanceOf, isA and property). So we could write

$KB = (R_{in}, R_{isa}, R_p)$, where R_{in} comprises instanceOf relationships, R_{isa} comprises isa relationships, and R_p comprises property relationships. Note that the *isA* relation (R_{isa}) models a transitive relation so the issues discussed in Section 4.4 apply here as well. It follows that the semantics of the RDF constructs should be taken into account when applying operations (i.e. union and intersection) on various KBs. Such issues for RDF are discussed in [17].

Notions of consistency could arise in such a setting. If inconsistency arises in one individual (personal) KB, then the user is responsible for making what is necessary for reaching a consistent one[5]. However, one can easily see that although each individual personal KB may be "consistent", the group ontology may be not. Who and how should react in that case? Should the system allow such cases and if yes is there anything it could do for aiding actors to overcome this problem? One first remark is that it wouldn't be flexible to forbid inconsistent group KBs. So the system should allow inconsistent group KBs but it should be at least able to detect incosistenscies and indicate them to the actors. If we allow inconsistency also in the personal KBs, then another interesting case may occur: the individual KBs could be incosistent while the group KB is consistent [6].

For tackling inconsistency at the group level, a powerful knowledge manager could try to derive (and present) consistent subsets of the group KB. It could also probably adopt a quantitative notion of consistency (instead of the dichotomy of KBs to consistent and inconsistent). Let's use the notation $\models KB$ to denote that KB is consistent. If a KB is inconsistent ($\not\models KB$), then the system could try computing $KB_{A'}$ (specifically, $KB_{\cup A'}$, or $KB_{\cap A'}$, or $KB_{z\%A'}$) where A' is the maximal subset A' of A such that $\models KB_{A'}$ (resp. $\models KB_{\cup A'}$, or $\models KB_{\cap A'}$, or $\models KB_{z\%A'}$). Notice that if there is no inconsistency, then the above definitions of group KBs coincide with the original ones.

Similarly, we could define a notion of *ranking* (or *priority*) that could be attached to each RDF triple in the repository. This ranking would encode the relative strength (reliability) of each triple in the learner's mental state and could be either qualitative (i.e. encode the ranking through a full or partial order) or quantitative (i.e. encode the ranking through a numerical assignment of a priority to each triple, which implies an ordering). This refinement facilitates the definition of a quantitative notion of inconsistency, as well as the process of aggregation using techniques from Social Choice, as mentioned in Section 4.4. Furthermore, it allows the adaptation of works related to belief merging [21], [23], [22] in our aggregation context, by facilitating the formal description of notions like "weakening", "conceding" and "negotiating" [21], the development of *arbitration* or *majority* merging operators [23] and the definition of distances and aggregation functions [22].

---

[5] The problem of maintaining consistency after updates have been studied in the Database & KR literature (e.g. see [32]) but mainly for the single actor case.

[6] This could be one answer to the *learning paradox*, i.e. to the classical problem of explaining how something new and more complex is created using existing knowledge.

Note that unlike traditional approaches conceiving ontologies as thorough engineering artifacts issued by strict design process and policies, in TL ontology creation and evolution can be seen as a social process where learners collectively improve their individual and shared understanding through social interaction. In this context, the individual interactions of group members would lead to global effects that could be observed as *emerging* knowledge artifacts (related somehow to emergent semantics [1]). Ontologies would thus become an emergent effect of open-ended interactions within or across groups of individuals as opposed to be a firm commitment of a small group of domain experts (for more see [26]).

Further Issues As we step up the expressive power of the representation framework additional issues arise:

– For instance, knowledge change and evolution raises various issues e.g. the distinction between *update* and *revision* (in the sense defined in [19]), as well as the applicability of belief revision theories to ontology evolution (e.g. see [11]).
– Measuring the distance between two knowledge bases (e.g. for grading as described in Section 2) may not be enough. It will be also important (e.g. for learning purposes) to compute and show the difference, or *delta*, between two knowledge bases. Some approaches for computing deltas of RDF graphs are described in SemVersion [36], PromptDiff [28] and [3].

Furthermore, as the number of actors scales up, additional issues arise, e.g. the need for social network analysis. It is worth mentioning here that the Web is probably a case of collaborative knowledge creation of a very primitive form. The actors of the Web can only create and update their own KB_i's (interlinked web pages) and the only method to combine the KBs of different actors is to add one-way links between them. Despite this simplicity, the growth of the Web was (and remains to be) astonishing, especially because no one ever tried to impose a structure or any form of control on that. It follows that link analysis techniques (either applied on social networks, or on articulated knowledge bases [5, 15], or on large knowledge bases [34]) are also expected to be useful in large-scale collaborative knowledge creation. The provision of personalized services is also very useful in large-sized knowledge bases [31].

As a final remark, note that the need for defining separate knowledge spaces and for combining them has been identified in several contexts also in the Semantic Web as this would be useful for data syndication, for restricting information usage and for access control, among others. Several approaches have been proposed (like [38, 10, 16, 14]), and the more recent one is that of *named graphs* [6, 37]. In this paper we go one step further and we stress the need for synthesizing such knowledge spaces.

At last, we should remark that workflow issues are orthogonal to the issues we discussed so far. The issues we elaborated so far are raised in almost every step of a workflow process if that step should be carried out collaboratively.

5 Epilogue

This paper described a specific scenario for collaborative knowledge creation in the spirit of the trialogical learning paradigm. According to this scenario the group knowledge base is formed by combining the KBs of the participants according to various methods. The provision of flexible methods for defining various aspects of the group knowledge is expected to enhance synergy in the knowledge creation process and could lead to the development of tools that overcome the inelasticities of the current knowledge creation practices. An indicative UI was sketched enabling us to scent the most important issues that are raised for its realization. Subsequently, we focused on knowledge management and we projected this scenario to various knowledge representation frameworks and for each one we outlined related application scenarios, techniques and issues that are worth further research.

Summarizing, trialogical e-learning requires advanced knowledge management services, probably more advanced than those that have emerged in the database and KR area (including the Semantic Web). Database and KR technologies have provided stable solutions mainly for the case where there is a commonly accepted conceptualization and world view. Methodologies and technologies that allow diversification and flexible amalgamation of different world views have not emerged so far. Areas of knowledge management that are related (in principle) to trialogical e-learning include modal logics, quantitative methods for aggregating knowledge and belief revision theories.

We are currently investigating and experimenting with these issues in the context of the Knowledge Practices Laboratory (KP-Lab) project (co-funded by the IST programme of the EU 6). The implementation will be based on Semantic Web technologies specifically on the RDF Suite [12, 18, 25].

Acknowledgements

This research was conducted within the Knowledge Practices Laboratory (KP-Lab) project co-funded by the IST programme of the EU 6 R&D Framework programme.

References

1. K. Aberer, T. Catarci, P. Cudré-Mauroux, T. S. Dillon, S. Grimm, M. Hacid, A. Illarramendi, M. Jarrar, V. Kashyap, M. Mecella, E. Mena, E. J. Neuhold, A. M. Ouksel, T. Risse, M. Scannapieco, F. Saltor, L. De Santis, S. Spaccapietra, S. Staab, R. Studer, and O. De Troyer. "Emergent Semantics Systems". In *Procs. of the 1st Intern. IFIP Conference on Semantics of a Networked World (ICSNW 2004)*, pages 14–43, 2004.
2. Kenneth J. Arrow. *Social Choice and Individual Values.* 1951.
3. Tim Beners-Lee and Connolly. "Delta: An Ontology for the Distribution of Differences Between RDF Graphs", 2004. http://www.w3.org/DesignIssues/Diff (version: 2004-05-01).

4. Dan Brickley and R. V. Guha. “Resource Description Framework (RDF) Schema specification: Proposed Recommendation, W3C”, March 1999. http://www.w3.org/TR/1999/PR-rdf-schema-19990303.
5. Sergey Brin and Lawrence Page. “The Anatomy of a Large-scale Hypertextual Web Search Engine”. In *Proceedings of the 7th International WWW Conference*, Brisbane, Australia, April 1998.
6. J. Carroll, C. Bizer, P. Hayes, and P. Stickler. Named graphs, provenance and trust. *Proceedings of the 14th international conference on World Wide Web*, pages 613–622, 2005.
7. JeanCharles de Borda. “Memoire sur les Elections au Scrutin”, 1781. Histoire de l’Academie Royale des Sciences, Paris.
8. Marquis de Condorcet. “Essai sur l’application de l’analyse a la probabilite des decisions rendues a la pluralite des voix”, 1785. Paris.
9. John Domingue, Enrico Motta, Simon Buckingham Shum, Maria Vargas-Vera, Yannis Kalfoglou, and Nick Farnes. “Supporting Ontology driven Document Enrichment within Communities of Practice”. In *Procs of the 1st intern. conference on Knowledge Capture, K-CAP’01*, pages 30–37, New York, NY, USA, 2001. ACM Press.
10. J. Euzenat. “Corporate Memory through Cooperative Creation of Knowledge based and Hyper-documents”. In *Proocedings of the 10th Knowledge Acquisition Workshop, KAW’96*, November 1996.
11. Giorgos Flouris. *“On Belief Change and Ontology Evolution”*. PhD thesis, Computer Science Department, University of Crete, Greece, 2006.
12. FORTH-ICS. The ics-forth rdfsuite: High-level scalable tools for the semantic web, 2005. http://139.91.183.30:9090/RDF/.
13. Anuradha A. Gokhale. “Collaborative Learning Enhances Critical Thinking”. *Journal of Technology Education*, 7(1), 1995.
14. R. Guha, R. McCool, and R. Fikes. Contexts for the Semantic Web. *Proceedings of the 3rd International Semantic Web Conference, Hiroshima*, 2004.
15. Lin Guo, Feng Shao, Chavdar Botev, and Jayavel Shanmugasundaram. “XRANK: Ranked Keyword Search over XML Documents”. In *Int. Conf. on Management of Data, SIGMOD’2003*, San Diego, California, June 2003.
16. J. Jannink, S. Pichai, D. Verheijen, and G. Wiederhold. “Encapsulation and composition of ontologies”. In *Proceedings of 1998 AAAI Workshop on AI & Information Integration*, 1998.
17. Zoi Kaoudi, Theodore Dalamagas, and Timos Sellis. “RDFSculpt: Managing RDF Schemas Under Set-Like Semantics”. In *Procs of the 2nd European Semantic Web Conference 2005 (ESWC05)*, Crete, Greece, 2005.
18. G. Karvounarakis, V. Christophides, and D. Plexousakis. “RQL: A Declarative Query Language for RDF. In *Eleventh International World Wide Web Conference (WWW)*, Hawaii, USA, May 2002.
19. H. Katsuno and A. O. Mendelzon. “On the Difference between Updating a Knowledge Base and Revising it”. In *Proceedings KR-91*, pages 380–395, 1991.
20. John Kemeny. “Mathematics without Numbers”. *Daedalus*, 88:571–591, 1959.
21. Sebastien Konieczny. Belief base merging as a game. *Journal of Applied Non-Classical Logics*, 14(3):275–294, 2004.
22. Sebastien Konieczny, Jerome Lang, and Pierre Marquis. Da2 merging operators. *Artificial Intelligence*, 157(1-2):49–79, 2004.
23. Sebastien Konieczny and Ramon Pino Perez. Propositional belief base merging or how to merge beliefs/goals coming from several sources and some links with social choice theory. *European Journal of Operational Research*, 160(3):785–802, 2005.

24. Thorsten Liebig and Olaf Noppens. “OntoTrack: A Semantic Approach for Ontology Authoring”. *Journal of Web Semantics*, 3(2-3):116–131, 2005.
25. M. Magiridou, S. Sahtouris, V. Christophides, and M. Koubarakis. ”RUL: A Declarative Update Language for RDF”. In *Procs. 4th Intern. Conf. on the Semantic Web (ISWC-2005)*, Galway, Ireland, November 2005.
26. Peter Mika. “Ontologies Are Us: A Unified Model of Social Networks and Semantics”. In *Procs of the Intern. Semantic Web Conference, 2005*, pages 522–536, 2005.
27. E. Miller, R. Swick, and D. Brickley (editors). RDF and RDF Schema, W3C, 2003. http://www.w3.org/RDF.
28. Natalya F. Noy, Sandhya Kunnatur, Michel Klein, and Mark A. Musen. ”Tracking Changes During Ontology Evolution”. In *Third International Conference on the Semantic Web (ISWC-2004)*, Hisroshima, Japan, 2004.
29. S. Paavola, L. Lipponen, and K. Hakkarainen. “Models of Innovative Knowledge Communities and Three Metaphors of Learning”. *Review of Educational Research*, 74(4):557–576, 2004.
30. R. E. Slavin. “Research on Cooperative Learning: An International Perspective”. *Scandinavian Journal of Educational Research*, 33(4):231–243, 1989.
31. N. Spyratos and V. Christophides. “Querying with Preferences in a Digital Library”. In *Dagstuhl Seminar (No 05182) Federation over the Web*, May 2005.
32. Ernest Teniente and Antoni Olivie. “Updating Knowledge Bases while Maintaining their Consistency”. *VLDB Journal*, 4(2):193–241, December 1995.
33. Yannis Tzitzikas. “Democratic Data Fusion for Information Retrieval Mediators”. In *ACS/IEEE International Conference on Computer Systems and Applications*, Beirut, Lebanon, June 2001.
34. Yannis Tzitzikas and Jean-Luc Hainaut. ”How to Tame a Very Large ER Diagram (using Link Analysis and Force-Directed Placement Algorithms)”. In *Proceedings of 24th Int. Conf. on Conceptual Modeling, ER'2005*, Klagenfurt, Austria, October 2005.
35. Yannis Tzitzikas and Jean-Luc Hainaut. ”On the Visualization of Ontologies”. In *Proceedings of the X Int. Conf. on Advanced Visual Interfaces, AVI'2006*, Venice, Italy, May 2006.
36. Max Volkel, Wolf Winkler, York Sure, Sebastian Ryszard Kruk, and Marcin Synak. ”SemVersion: A Versioning System for RDF and Ontologies”. Heraklion, Crete, May 29 June 1 2005. Procs. of the 2nd European Semantic Web Conference, ESWC'05.
37. E. R. Watkins and D. A. Nicole. Named graphs as a mechanism for reasoning about provenance. In *Proceedings of the 8th Asia-Pacific Web Conference,APWeb'2006*, pages 943–948, Harbin, China, 2006.
38. Gio Wiederhold. “An Algebra for Ontology Composition”. In *Proceedings of 1994 Monterey Workshop on Formal Methods*, pages 56–61, September 1994.

Community Based Software Development – the Case of Movelex

Kornél Varga and Andrea Kárpáti
Eötvös Loránd University, Faculty of Sciences,
UNESCO Chair for ICT In Education, Budapest, Hungary

Abstract. The paper provides an overview of the elaboration, testing and improvement of Movelex, a complex virtual learning environment (VLE) supporting the establishment of self-regulated learning and shared knowledge building space in the classroom. The development and continuous improvement of the software has the aim to form *communities of practice* of teachers and students to co-operate with software programmers in the creation of new functionalities and widening of the array of pedagogical options. Therefore, the VLE called Movelex is not just a product; it is tool and a digital learning content development platform at the same time – and in both capacities, extremely user-friendly and supports building a community of practice for technology-enhanced learning. The paper refers to the *Knowledge Practice Laboratory Project* (KP-Lab), to elaborate new models for in-service teacher training aimed at assisting future teachers in the *co-evolution process* of technical and pedagogical skills development through a VLE enhancement exercise.

Key words: Self-regulated learning, collaborative learning, VLE, communities of practice, Movelex

1. Theoretical Foundations

Virtual Learning Environments have decades of developmental history. Still, they fail to yield educational results promised by their developers – an impressive improvement in the quality of teaching and learning that would justify investment in their development. Teachers, irrespective of the quality and quantity of infrastructure and training courses offered, are still reluctant to use them [1]. According to case studies in 21 OECD countries ranging from school cultures of Mexico to Finland, those who make optimal use of ICT technology are innovative teachers who have been equally successful in “non-digital” educational innovation [2].

Teachers complained that learning management systems (LMS) may have a search functions may convey pedagogical message, but the whole environment represents an “HTML logic” – it does not alter the logic of a book. (Many LMS systems actually contain digital versions of textbooks.) Learning Object Repositories offer independent units that may be interrelated in numerous ways, but teachers find it difficult to match them with curricular content and requirements. Collaborative learning environments (CSILE), for example Knowledge Forum involves co-construction of knowledge – however, text and images are imported into the system from outside sources and re-

E. Tomadaki and P. Scott (Eds.): EC-TEL 2006 Workshops, pp. 400-410, 2006.

quire considerable investment in time and effort. These tools may also be quite difficult to handle for teachers who soon develop anxiety and avoid the whole ICT culture [3].

Movelex was developed to offer a solution for Hungarian teachers trained in basic ICT literacy but reluctant to use pre-packaged digital material. Movelex invites teachers to act as co-developers: customize and expand an easy-to-use, flexible, still well-structured learning environment. This feature is considered especially beneficial for matching curricula and VLE-s [4].

This VLE focuses on two main pedagogical goals:

- To support *individualised instruction,* self-regulated and cooperative learning;
- To help teacher communities to produce well understandable learning materials supporting the previous goal.

In order to realise these objectives, educational methodology, information technology and the organisation of the use of the system have to be considered in synergy. Movelex differs from most other VLE-s in the following key features:

- Movelex reflects teachers' teaching methods – may be used flexibly for various teaching and learning styles;
- It does not require technological skills – teachers do not have to deal with technological problems and may learn the usage of the system to its;
- Even basic knowledge about this software results in functional learning solutions that teachers can use at once at school;
- The conceptual framework of the curriculum may be directly translated into a set of Movelex learning objects and their relations.

1.1 A Barrier of Self-regulated Learning

A key problem of self-regulated learning is that students have difficulties in identifying their own learning problems and state that it is the "whole" material that they cannot grasp [5], [6]. Lacking easily applicable diagnostic tools, teachers cannot help localising the knowledge deficit or skill development gap because the ruling paradigm in Hungary, frontal education leaves no room for motivation or detection of individual handicaps. Frontal teaching results in a loss of control over individual learning processes by the teacher while learners also loose motivation.

In order to help students identify problematic parts of a learning material and furnish teachers with identification resources, we built our LE on the mastery learning principle. Bloom's model that was based on principles of Morrison and Carroll aims at a profound acquisition of the learning material. Preliminary knowledge is revealed through a pre-test, the remedial learning process is supported by formative assessment and a post-test proves in-depth acquisition of knowledge [7].

Mastery learning became obsolete as an educational paradigm largely due to the amount of work needed for the elaboration of tasks, exercises and testing tools for each learning unit and skill level. Adaptive teaching and testing was in fact extremely time consuming in the era of hierarchically constructed, paper based learning materials. Before the introduction of ICT solutions in education, it was very difficult to separate information from its pedagogical context. When compiling a textbook, the author had to make a final decision about the sequence of the learning units and also the level of difficulty of the material that ultimately pre-selected prospective audiences for the textbook. A printed teaching aid as an object may not be restructured, and additional materials may not be inserted on its pages. Individual differences in interest or learning problems can only be taken into consideration through typography, the separation of core and additional content through colours or printing styles. If another author intends to offer a different methodology, he / she has to write a whole new book, however the information content of this volume will be not much different from the previous one. The two books, however, will be difficult to compare as methodological differences overshadow content similarities.

An example for hidden knowledge: only a few learners will remember what happened in North America in the times of the French Revolution. Both events are there in the history textbook, but on different pages, chapters apart. A history teacher will have learnt so much about different epochs and nations that he / she is likely to be able to forge that link in his / her head. The relations between these two sets of data are hidden knowledge that never becomes apparent for the learner. Teachers, however, find it difficult to understand why these two knowledge elements remain separate in students' minds. Similarly, teachers of physics will be puzzled to find that mathematical knowledge is very hard to activate. Discipline based learning results in compartmentalized knowledge fragments. *The transfer of knowledge* does not occur spontaneously – it has to be constructed through adequate pedagogical means – or a well-designed VLE.

1.2 Learning Objects versus Structured Materials

Learning objects (LO-s), core elements of e-learning material design aim to solve reusability and variability by not containing references to other LO-s. Even these basic units, however, contain a set of concepts that are not explained but may need further clarification. Even if we omit any hints on previous knowledge, it is still there, inherent in the text and / or image of the LO. Therefore, teachers will always have a decisive role in the design of the learning process – even through the selection of the LO-s to be used in the VLE. Both teachers and learners will be in need of help while constructing their individualised knowledge content from what is seemingly a set of reusable learning objects.

Research on *conceptual maps* or Bruner's theory on the importance of "*structure*" both emphasize "interrelationships" as a key design aspect that provides usable knowledge [8]. Even knowledge transfer depends on the ability of the learner to acquire structures and identify special occurrences of a general phenomenon [9]. Our conclusion is therefore that a real educational software solution cannot neglect handling references and structures. Thus, the challenge for educational software specialists is to provide a *dynamic learning platform* with a wide range of learning paths and content options that, at the same time, provides well-designed learning steps and adequate scaffolding for the learner and constant supervision for the teacher.

It is generally accepted that ICT may play a beneficial role in the realisation of contemporary educational paradigms. However, computer technology can do more than that. It can offer a *model for learning as intelligent information processing* that is not attached exclusively to the computer-supported environment. The traditional role of the textbook developer – gathering, structuring and interpreting information – and the major task of the teacher – facilitation of information retrieval, processing and utilisation for learners are concepts well-known in the world of information technology. All these activities centre around the *arrangement* of information – with emphasis on selection, organisation and structuring. E-learning materials, however, often fail to perform this important task. They provide no more than e-books, digitized versions of traditional, linear, paper based textbooks. Even though these transformed texts contain links and images, they have little to do with conscientious arrangement of information and often result in information overload.

The real solution should integrate texts and visualization with database-like internal structures and thus reduce cognitive load [10]. This is the major technological novelty of Movelex, detailed description of this however doesn't fit into this paper.

2. A Trialogical Model for the Development of Learning Materials

Traditionally, teachers "commission" (express a need for) a digital tool or teaching aid and at best, adapt the finished product – if it is customisable at all [4]. Software developers receive a – transcribed by educational policy makers of marketing specialists – description of the functionalities the product is required to have. Learners are also not entitled to take part in the developmental process – all they can do is to select features and content that seems to suit their learning styles, previous knowledge and interest best. The problem is lack of a common frame of reference. Teachers and learners cannot reflect on a VLE in a meaningful way if they have not seen such before. However, if a prototype is prepared for piloting, a large amount of work has to be invested before the product is testable – and understandable – for future users. Making changes is slow and requires vast financial and human investment [11].

The traditional method of educational software development is based on *parallel monologues* – those of the teacher and learner, expressing their need for a digital learning tool, and those of the software developer and producer, expressing their special viewpoints and interests. Learning materials developed as a result can only be used for traditional, authoritative "*learning dialogues*" [12].

The EU-funded Knowledge Practice Laboratory defines an innovative model for the co-construction of knowledge that educational software development also has to consider: *trialogical learning.* "Those forms of learning where learners are collaboratively developing, transforming, or creating shared objects of activity (such as conceptual artefacts, practices, products) in a systematic fashion. Trialogical learning concentrates on the interaction through these common objects (or artefacts) of activity, not just between people ("dialogical approach"), or within one's mind ("monological" approach)." (from www.kp-lab.org, the official Website of KP-Lab: KP-Lab Wiki / Trialogical Glossary) Consequently, the realisation of this learning model needs *communities of practice*. On the one hand, it involves learning in self-regulated student groups ("knowledge building communities"), on the other hand, teachers' communities that co-develop learning content to support and guide self-regulated student learning also have to be formed [13].

2.1 Movelex: a New Type of VLE

In order to realise the trialogical learning model, a new type of VLE is needed that enables teachers and learners to interact with learning content directly, through an easy-to-use and flexible environment and thus act as developers themselves. In an ongoing effort, the teacher and learner community develops *both a VLE and new content to be used within this VLE*. Movelex is more than handy software – it is the catalyst of a new teaching methodology thanks to its structure to be explained below. It is based on the active partnership of the teacher (and, at times, the learner) as a provider of content, and the developer as a provider of technical framework for the formulation of content types (texts, images, assessments, animations, sound bites etc.)

This co-evolutionary process has involved hundreds of teachers who take part in the testing educational functionalities of the software environment and learning materials produced within this environment as well. Trialogical development means here to harmonise the didactic needs, background knowledge and school culture of *educators* (teaching professionals), *software engineers* (ICT development professionals) and *learners* with a deep understanding of their own motivation and interest. These groups do not normally work together on a learning material design task as their roles never overlap.

The Movelex Virtual Learning Environment was constructed on the principles described in this paper and have already six years of practical experience. (Its name generates from the English words “moving” and “lexicon”.) Below we will describe the basic components of the system:

- *Digital lexicon:* a knowledge repository that makes the implicit structure of the learning content, in the mind of the teacher, explicit. Several innovative features enrich this digital lexicon:
  - Items are not represented as text, but are marked as definitions, remarks, examples and symbols. Teachers may attach categories like age group, school type, target population etc. and the system will filter the items according to the preferences of the teacher.
  - It is also possible to write different interpretations representing levels of difficulty or professional viewpoints for the same concept.
  - *We can differentiate between new and* (supposedly) *known concepts*. This way we can construct a network of concepts that mutually rely on each other. Thus, necessary preliminary knowledge for a certain unit may be defined and the logical hierarchy of learning items may be clearly identified. Therefore, we can avoid the inclusion of non-defined, new concepts on the network.
  - In the lexicon, links not only denote one lexical item, but always refer to the meaning of a word that is needed for the given learning unit. In the lexicon, *every meaning is listed* – with the respective illustration.
  - Among the concepts in the lexicon, *several types of relationships* may be indicated. Apart from subordination (like furniture – table) you can specify syn-

onyms, antonyms, or such intricate sets of relationships like the table of Chemical Elements, a chain of historic events or the origin of species. The material can be arranged according to different structures, for example, make a list of historic events happening in the same period in different parts of the world. (In a printed book, these would be found in different chapters.)
  - The links themselves may also wear tags that associate them with different relationships, therefore even plain text may reflect different relationships. Links are symmetric, which means that their source may also be searched for.
- *Test bank:* several item types make practising and testing more enjoyable (e.g. matching tasks, selection of the right answer, special linguistic and mathematical tasks, inserted images and other multimedia elements). Tasks and tests may contain references to the lexicon, thus facilitating the learner's work with items to be practiced.
- *Image and graph bank:* there is an inbuilt animation software available to produce animated images that may be used both in the lexicon and the test bank.
- *Virtual Communication Environment:* provides a platform for learners' and teachers' dialogues and for the integration of materials developed by users (teachers and learners alike).

2.2 Using Movelex in the Learning Process

In the Movelex VLE exercises (test or practice items) are produced in a word processor, may be corrected at any time, and will be formatted automatically by the VLE. All the user has to do is to save his / her product as a web page and open it with the Movelex Presenter program which can be downloaded from this web-page: www.perfectstudy.org.

The *basic learning unit* may comprise the elements listed below. (These are options provided by the VLE and do not necessarily have to be used in all by the teacher.)

- *Test of necessary preliminary knowledge:* in case of insufficient solution of these items, it is not advisable to start with the new learning material.
- *The learning material.* It consists of three types of units. The definition of their sequence and elaboration is the task of the author:
  - *Background material*: description of the material to be taught in the form of a *lexicon*. Concepts and facts may be illustrated by images and animations.
  - Pages containing *new content* (series of frames that can be viewed in a definite, didactically designed order).
  - *Tasks and exercises*: explanatory and practice items and illustrations (images, animations) attached to them.
- The unit is concluded by a final test. The results of this test help both the teacher and the learner decide if the learning process was successful or more exercises and / or explanations are needed.

A typical Movelex unit consists of the new content as front page material and the lexicon as well as the tasks and exercises are "linked" to its parts. The lexicon helps interpret the concepts of the new learning content, while the tasks and exercises facilitate its elaboration. Practice items offer immediate feedback. Thus, they may be used as formative tests and facilitate knowledge acquisition through repeated testing opportunities with items provided in a random order.

The above elements may be combined in a different fashion: a new knowledge area or theme might be introduced by simulations and problem solving tasks (to be solved in small groups). After these, the learner may go to the new content pages to overview and structure his / her newly gained knowledge [14].

2.3 Integrating Text and Visualization

The central idea of the VLE is, that *visualisation* leads to easier and more profound understanding. If the teacher intends to use a simple illustration, it is enough to mention the file name of the image in the text description of the learning material. However, if we want to connect the text with the images (for example, we intend to insert an inscription on the picture or caption it), then we have to use the Movelex *animator (drawing)* component. This functionality is also suited to the level of the user.

Captioning an image can be learnt in minutes. The simplest form is to insert words on an image, sometimes through arrows pointing at different parts of the image. An image thus captioned, may also be used as a test item with students having to connect concepts and pictures through arrows. More sophisticated drawings can also be applied on images: for example, the borders of a country may be paired with its name. This requires a little more practice. To create an animation needs more advanced skills, but even this function can be mastered within a few hours. The animation technique is very simple but amazingly effective at the same time. A photograph may be animated as easily as you move a Barbie doll. Children may use their favourite images to make an animation based on a thematic unit, and thus approach a set of scientific problems with more motivation (the downloadable sample task sequence also contains such animations).

Even the advanced level of the animator function may be used by a 12-year-old computer fan, and enables young users to realise a set of interesting visual tricks. The optimal use of this function is through pair or group work, where different skills and knowledge backgrounds may create a synergy.

The aim of the advanced-level *editing programme* is to integrate LO-s and images, animations etc. in a unified learning system. The content integrated in the Movelex VLE is a specially structured knowledge repository that has substantial additional functions. To produce such a repository file you generally need a special editing solution the educational relevance and organisational requirements of which we briefly describe here.

Learning content may be structured in a List of Contents page, similar to the File Manager of Windows. This list may be organised into different rank orders and subgroups (and thus be used differently in different classes.) The program is able to list, based on links in the tasks and among the items of the lexicon, those concepts that are misinterpreted or not known by learners. At the end of the test, the software gives an advice to the learner on previous knowledge he / she has to repeat. Thus, Movelex performs a *developmental evaluation* function and can be used as a formative test. Images may easily be turned into test items, because illustrations are linked to concepts of the lexicon.

2.4 Simplicity as a Key Factor of Feasibility

On the basic level of the Movelex VLE adding new tests or practice items does not require more than word processing skills, only discipline based educational knowledge is necessary. On the advanced level, if a teacher intends to integrate his new test with other learning materials he / she developed or identified in the Movelex learning content repository, more advanced user skills are needed, but even this can be acquired in the course of a two-day training sessions. This training, however, includes more professional (educational) activities than software skills development. Members of a new learning material development group have to analyze the teaching content they intend to transform into digital content in order to create a coherent semantic web of concepts and facts that cover the whole area to be taught and / or tested in the VLE. Software developers are offered the role of technical advisors and invited sometimes to solve special technical problems. Besides they refine the framework according to the needs of pedagogical experts.

3. Results

The first development of learning material (databanks for seven disciplines) for Movelex VLE was launched in 1991. By now, its digital content repository contains about 8000 tasks, based in a lexicon of 7000 items. About 300 teachers have been trained, and 100 of them take an active part in the development of the Movelex repository and tools. *One third of those teachers trained became developers and have been involved in this community of practice ever since.* This community building capacity is considered especially important for improving teachers' educational strategies [15]. As a result of assessment of teachers' ICT skills, two levels of Movelex facilities are offered: Beginner and Advanced, as described before.

In-service teacher training courses organised in small village schools with modest infrastructure and unskilled in computer use teaching staff proved that Movelex is user friendly enough to be employed by students and teachers alike [16].

The *inclusion of learners* in the process of digital content development in this project also served the purposes of talent development. Student skills were put to use in the production of visualisations: the production of graphs, charts, still images and animations and their harmonisation with the accompanying explanatory text. This process involves the processing of verbal information and its transformation into visual signs, symbols and text and image combinations. Talented students will arrive at a deeper understanding of the learning material through this complex process.

Working with Movelex means the harmonisation of interests, experiences and skills of different stakeholders of the learning process. The system of digital content production consists of a set of activities that need to be co-ordinated and monitored. Teachers, university staff members or educational researchers may act as moderators of Internet based developer communities. This process is also included in the co-operative educational project of ELTE MULTIPED and Viola Software Ltd. as a pre- and in-service teacher training experiment and is described in some detail below. In order to provide a *learner centred arrangement of the learning material*, we realise the following objectives:

- Separation of the learning content, learning paths and evaluation.
- Collection and grouping of concepts according to higher order categories and thematic units.
- Based on the *concept repository*, creation of concept maps that facilitate the identification of learning gaps and misunderstandings. The role of the concept map is to make sure the learner does not omit important parts and does not ignore the learning sequence designed by the author of the material.
- To facilitate flexible use – besides ensuring the *coherence of the concept map* – alternative explanations are needed that represent different levels of sophistication and may serve the needs of experts and novices. While accessing explanations and tasks at their own level, they will still experience the concept map as a unified whole.
- Organisation of information in a *database* that enables different ways of connecting, arranging and filtering facts, data and concepts.
- *Integration of visual elements* (images, graphs, charts and animations) with textual descriptions and concept maps.
- *Provision of different learning paths* enable the learner to go through them till the end or choose a new path during learning. The concept map ensures logical sequence and prevents the omission of important parts, as described above. Still, the learner is able to spend more time at any given thematic focal point to ensure deeper understanding.
- *Support for cooperative learning* through the coordination of simultaneous access to information.
- Ensure an easy *follow-up of the learning trajectory* by teacher and learner.

4. Conclusion: VLE as Organiser of Communities of Practice

Self-regulated learning involves the active participation of students, therefore, the environment should also enable learners to generate new content and adapt existing one for individual needs. *Community based content development and assessment* is inevitable to realise the aim of this VLE: to provide a comprehensive and constantly expanding digital learning content repository [17].

Members of this community are not only educationalists, but also civic associations and companies. The technological framework for the functioning of this community of practice (CoP) is a VLE that offers tools for content development and a sophisticated platform for teaching, learning and assessment. The relatively simple content development component assures that Movelex is used by expert and novice ICT using teachers and students alike. This feature is especially important in Hungary where the level of ICT knowledge and skills of educational stakeholders is extremely diversified.

According to the diversity of ICT skill and interest of stakeholders communities have to be organized as Communities of Practice on multiple levels [6]:

- Basic level development is done in small local groups – as described above – using a word processor. The simplest way – suitable even for novices in ICT – is sending the document to each other by e-mail and writing corrections directly into the text.
- Group work for designers on advanced level may be facilitated by a special *networked mode:* here, the software and database is running on the PC of every group member and all of them are linked through the internet. Modifications done by any of them are synchronised and seen by his / her peers.
- The integrated database of LO-s is offered for testing to the final users (teachers and students) who still have a special technique to give feedback to the designers. They can make remarks on any point of a screen layout as if sticking a ticket on it. Designers get back all these remarks integrated, make necessary corrections and issue a new release of the material.
- At advanced level, this response system works as an integrated shared space, as group members can reflect even on each-other's remarks. These are logged by the system in a searchable database documenting this way the evolution of the trialogical developing process.

The next phase of the project is the testing this trialogical software development model in teacher education. As members of the Knowledge Practice Laboratory (KP-Lab) team, ELTE and Viola Software Ltd. will explore the potentials of this software development model both in in-service and in pre-service teacher education. The course incorporates a combination of knowledge practice models:

- Knowledge creation in small and large peer groups;
- Knowledge creation in an online, "ask the expert" context;
- Micro-teaching;
- Synchronous / asynchronous online forums complete with whiteboard functionality for real time co-operation through drawing.

These features represent collaborative knowledge creation [18] and serve as an example of trialogical learning. Elaborating existing knowledge practices will be an important feature of the course. Design expertise of art education students will be used to form a generally shared knowledge base for learning about the role of visualisation in teaching and learning processes. Missing animation options of Movelex will be highlighted by students and their tutors. Staff of the software development firm invited to discuss online, how these, necessary for teaching features could be included in later versions of the software. Thus, a trialogical approach to software development is realised.

The pre-service group will comprise of art education students in Budapest who will focus on the visualisation potentials of Movelex, while in-service teachers cooperating in Hungary and Romania (Cluj) will represent a wide range of school disciplines and professional interests and will experiment with all features of Movelex.

References

1. Liu, Yuliang, Huang, Carol: Concerns of teachers about technology integration in the USA. European Journal of Teacher Education, 28 (1) (2005) 35-47
2. Venezky, Richard and Kárpáti, Andrea eds.: ICT, Education and Innovation . Special Issue, Education, Communication and Information. Vol. 4, No. 1 (2004)
3. Wood, Allen, Mueller, Judy, Willoughby, Teena, Specht, Jacqueline, Deyoung, Ted: Teachers' perceptions: barriers and supports to using technology in the classroom. Education, Communication, Information, 5 (2) (2005)
4. Leahy, Margaret, Twomey, Denis: Using web design with pre-service teachers as a means of creating a collaborative learning environment. Educational Media International, 42(2) (2005) 143-152
5. Mayer, Richard, Moreno, Roxana: Aids to computer-based multimedia learning. Learning and Instruction, 12 (2002) 107-119
6. Paavola, S., Lipponen, L., & Hakkarainen, K.: Models of Innovative Knowledge Communities and Three Metaphors of Learning. Review of Educational Research 74(4) (2004) 557-576.
7. Bloom, Benjamin S.: All Our Children Learning. New York: McGraw-Hill (1980)
8. Kimber, Kay, Wyatt-Smith, Claire: Using and creating knowledge with new technologies: a case for students-as-designers. Learning, Media and Technology, 31 (1) (2006) 19-34
9. Bruner, J: The Process of Education, Cambridge, Mass.: Harvard University Press (1960)
10. Kirschner, Paul A.: Cognitive load theory: implications of cognitive load theory on design of learning. Learning and Instruction, 12 (2002) 1-10
11. Herrington, Jan – Standen, Peter: Moving from an instructivist to a constructivist learning environment. Journal of Educational Multimedia and Hypermedia, 9 (3) (2000) 195-205
12. Liu, Min, Gibby, Scott, Quiros, Ondrea, Demp, Elaine: Challenges of being an instructional designer for new development: A view from practitioners. Journal of Educational Multimedia and Hypermedia, 11 (3) (2002) 195-219
13. Paavola, S. & Hakkarainen, K.: (2005). The Knowledge Creation Metaphor – An Emergent Epistemological Approach to Learning. Science & Education 14(6), 535-557.
14. Gros, Begona: Knowledge Construction and Technology. Journal of Educational Multimedia and Hypermedia, 11 (4) (2002) 323-343
15. Kerr, Stephen: Why we all want it to work: towards a culturally based model for technology and educational change. British Journal of Educational Technology, 36 (6) (2005) 1005-1016
16. Kárpáti, Andrea: Travellers In Cyberspace: ICT In Hungarian Romani (Gypsy) Schools. In: Kárpáti, Andrea Ed. (2004): Promoting Equity Through ICT in Education. Paris: OECD (2004) 141-156
17. Hakkarainen, K., Palonen, T., Paavola, S. & Lehtinen, E.: Communities of networked expertise: Professional and educational perspectives. Amsterdam: Elsevier (2004)
18. Amory, Alan, McNaught, Carmel: Collaboration, design and technology – themes in the architecture of interactive learning environments. Journal of Interactive Learning Research, 12 (2/3) (2002) 149-153

Author Index