Fifth Doctoral Consortium

at the

European Conference on Technology Enhanced Learning

September 29, 2010

Barcelona, Spain

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Preface

These proceedings are comprised of the submissions of 18 PhD candidates who are researching in the area of Technology Enhanced Learning (TEL). These students submitted a PhD plan, which was initially reviewed by the organising committee in order to make a decision about whether or not to accept the student for the Doctoral Consortium. Later each submission was reviewed by two senior academics and one peer, and students were required to revise their submissions in the light of these reviews.

The papers provide a window into the current issues of concern in TEL research and range widely from those investigating research in classrooms to those designing and trialling new technological approaches to enhancing learning in both formal and informal settings. Some of the research discussed is in a mature stage and the students are in a position to report on findings and the implications of these findings, and other research is at an early stage and as such, still in the process of clear formulation.

The Doctoral Consortium is a forum within which students at all stages of their PhD study will be supported; for some students this support will aim to prepare the student for a final viva or panel examination, and for others the support will help the student formulate a rigorous and useful study.

The Doctoral Consortium is jointly funded by the European Association of Technology Enhanced Learning (EATEL) (http://www.ea-tel.eu/) and the STELLAR European Network of Excellence (http://stellarnet.eu). Both EATEL and STELLAR aim to build early researcher capacity through doctoral schools and consortia.

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The Impact of Patterns on the Exchange of Practical Knowledge

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Abstract Organizations often face the challenge that practical knowledge cannot easily be transferred between practitioners with different degrees of expertise, as there is no way of directly observing good practice, and practical knowledge often only exists in implicit form. This PhD project focuses on the question of how the exchange of practical knowledge can be supported for becoming adaptive to all practitioners. In this regard, we describe how patterns may be used to support sharing practical knowledge. We present the results of a case study that supports the efficiency of patterns. Patterns facilitate the exchange of good practice by leading to more explicit and understandable descriptions.

Keywords: Knowledge Exchange, Practical Knowledge, Patterns

1 Introduction

Organizations are under pressure to use their financial and staff resources efficiently and to improve their own practices constantly. An exchange and reflection of good practice is crucial for raising the occupational qualification of their personnel to the required level and to work successfully [3,9]. But knowledge of good practice is in most cases implicit and not easy to externalize because it is based on experienced work routines which are often carried out unconsciously [8]. For this reason, it is difficult for practitioners to ensure an efficient exchange of practical knowledge, especially when they are dispersed over many different places. A process of reflecting of one's own practice and of advancing practical knowledge will need to be assisted by the organization itself. So the main question of this PhD Project is: how can practitioners be supported by providing conditions for a web-based exchange of their practical knowledge?

This PhD project takes place within the research project PATONGO (Patterns and Tools for Non-Governmental Organizations). The aim of PATONGO is to investigate

[1] Supervisor: Prof. Dr. Ulrike Cress, see also supporting letter

and optimize the web-based exchange of good practices and to develop a common knowledge base using Web 2.0 technologies[2].

2 Theoretical Background

The known approach storytelling which is used for the exchange of implicit knowledge in the context of narrative knowledge management includes the issues that you need an expert for conducting the interviews and face-to-face contact between the interviewer and the interviewee [12]. Furthermore, it is difficult for practitioners to externalize practical knowledge adhering to very specific situations. They need adequate cues for an efficient externalization. Thus, we assume that so-called patterns are a more qualified method for the exchange of practical knowledge in an online context. Patterns are an established form of templates with solutions for recurrent problems and frequently used in software development. They are, so to speak, a re-usable example of problem-solving in similar contexts. Because of the fact that patterns contain a given structure for guiding the processes of writing and reading, they can make exchange of practical knowledge easier.

Exchange of Practical Knowledge. Generally, the larger part of practical knowledge will consist of implicit knowledge about sequences of action [8]. The *externalization* of such practical knowledge is laborious because practitioners have to be aware of their individual sequences of action. From their own concrete knowledge, they will have to draw general conclusions which can then be presented as abstract knowledge and transfer that to other cases. Moreover, *internalization* processes are also a complex procedure and not easy to perform in the everyday working life of people working in the field. They will have to transfer information from an abstract level to a very specific and concrete situation in order to make it adaptive. Both externalization and internalization are indispensible components of what constitutes collaborative knowledge building. Sharing knowledge and consequential collaborative knowledge building (especially in an online context like the project PATONGO) are complex procedures which can be facilitated and supported by patterns.

Patterns for Sharing Practical Knowledge. When experts are confronted with a problem, they will resort to solutions which have proved in the past that they work under conditions with similar problems. The invariant aspects of this solution structure, abstract fragments of individual cases, can be considered as a mental pattern. This unchangeable structure is based on specific problem situations, and the result of repeatedly applying a procedure of abstracting single experiences. Knowledge of this structure distinguishes an expert from a novice [6]. But often such

[2] The co-operation partners include: FernUniversität Hagen, EKD (Evangelische Kirche in Deutschland, i.e. mainline Lutheran Protestant Church in Germany) and the Knowledge Media Research Center at Tuebingen.

practical knowledge is only available in implicit form. This means that experts may resort to this knowledge but are not aware of the problem-solution pair. The aim of the pattern approach is to reduce these complications by externalizing practical knowledge and allocating this knowledge to others.

Based on examples of good practice, patterns collect the know-how of experienced practitioners, including invariant components of recurring problems and their successful solution within work routines [1]. This means that a pattern describes a frequent problem "and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing the same way twice" [1, p. x]. Thus, patterns of successful solutions are used as samples for solving recurrent problems in similar contexts, and they make it possible to externalize implicit knowledge by providing structures to fill in. They support the co-evolution of a user's practical knowledge and of the common knowledge base as they provide the stage for successful communication between these two systems.

The pattern concept is derived from architecture and based on Christopher Alexander's idea to collect samples of good practice as problem-solving examples for their purpose of designing houses and streets by the respective communities [1]. The concept of a 'good practice collection' has been already implemented, e.g., in the fields of object-oriented software development [5,10]. Assuming that using patterns for describing complex software problems leads to improved externalization of knowledge, it seems to be a good idea to share and reflect practical knowledge by using patterns as well.

The documentation of practical knowledge in terms of patterns has been described in an increasing number of contexts but in many cases only based on some inductive theoretical justification of their potential. Only few, not very systematic studies exist reviewing the practical implementation of patterns in a specific field. Although some practical derivations of a pattern concept exist, and it is plausible that the pattern approach is efficient, there is no theoretical framework so far and no empirical evidence of the mode of operation of patterns. What has been missing so far is an explicitly cognitive point of view at the pattern approach and its practical implementation in different fields.

Patterns from a Cognitive Point of View. During the act of composing their texts, writers are guided by distinctive processes of thinking, like rhetorical considerations, their own long-term memory and individual writing processes. The main difficulty of such a writing process is to become aware of one's own rhetorical situation. Relating to the exchange of practical knowledge, the authors of good practice descriptions will first have to become aware of their own knowledge in order to be able to externalize it effectively. But retrieving information from the implicit part of one's own long-term memory is a difficult process. For this reason there is a need for "finding the cue that will let retrieve a network of useful knowledge" [4, p. 371]. We assume that patterns can support these awareness processes by preparing structures for reflecting and scrutinizing one's own actions and behaviors. But to be able to do that, writers have to reorganize the retrieved information because it contains an individual structure and may in this form not match what readers need. Authors of good practice descriptions have to review and edit their practical knowledge in such a way that this knowledge

may be adapted by other practitioners. In this context, research on representational guidance has shown that people will process represented material in a more intense way if they get it in the form of graphs or matrices, instead of an unstructured text [11,13]. And, in turn, applied to the pattern concept, representational guidance would imply that the inherent structure of patterns will guide and support practitioners when they write down their own good practice.

Flower and Hayes often observed a coherent underlying structure behind the writing process, although the writers themselves believed that their writing processes were disorganized and chaotic [4]. These results seem to be evidence for the existence of "patterns in mind". According to Kohls and Scheiter, patterns may exist in the form of mental representations [6]. Such "patterns in mind" will include a problem-solving schema which activates adequate solution structures when a known problem is recognized. So patterns can serve as a structure for problem-solving. Problem-solving processes are actions aimed at achieving some target state. Individuals who solve a problem will arrive at their destination by passing different sub-goals and recalling the required knowledge from memory in order to solve a current problem by analogy to an example [2,7]. In the same fashion, patterns may support finding the best possible way of solving the problem. They act as an operator to proceed from one sub-goal to the next one, and may be considered as analogies and worked examples [13].

3 Studies

In this PhD project both three studies in the laboratory within the domain first aid and three studies in the field with ecclesiastical practitioners have been intended. Thereof, three (one in the laboratory and two in the field) have already been conducted. The study in the laboratory and one of the two field-studies are finished and the data evaluation will start in the near future. The second field study is analyzed and presented below.

Patterns provide an adequate structure that can improve systematic descriptions of experiences and behavior. From this point of view, we expect that patterns will facilitate the externalization of practical knowledge and lead to a more comprehensible and adaptive description of good practices. To test this hypothesis, we performed a qualitative case study with ten vicars in the middle of their apprenticeship of becoming pastors and compared two conditions (blank sheet of paper and structured pattern in a wiki) of a good practice description.

The participants were asked to describe two different good practices of their ecclesiastical daily work. At the beginning, they were requested to write down the first good practice description in the form of an unstructured pen and paper version. After each participant had described a project, they received a description of some good practice from another vicar and acted as a reviewer. In this second round, the vicars were asked to highlight all those points of the description which they did not understand (requests). After that, in the third and last round, each vicar was confronted with a new, previously unknown description of a good practice and had to criticize constructively and highlight those areas which they thought could be improved by their own ideas and experiences (suggestions for improvement).

The second good practice which each of the vicars was asked to report was meant to be written down in the form of a structured pattern (provided in a wiki). The cycle of writing down the own description and reading descriptions from two other vicars was similar to the first good practice description in the pen and paper condition. On the line of this procedure each vicar wrote two good practice descriptions. So the study realizes a within-subject design with repeated measures (without pattern vs. with pattern).

A good project description has to be complete, understandable and adaptive to other situations. We determined the quality of the written practice descriptions by analyzing the comments of vicars who had read and reviewed the project description. These comments may be understood as a form of feedback from experienced peers and as a valid evaluation of the quality of the respective practices. On average, there were significantly more *requests* concerning the description of good practices if this was written down in blank sheets of paper (M=9.2, SD=4.36) than in the structured patterns (M=2.0, SD=2.33, $t(9)$=4.72, p=.001). This can be seen as evidence for the assumption that practices described by patterns offered a more explicit and more understandable structure to practitioners with some routine than practices described without the support of patterns. The results of *suggestions for improvement* were along the same lines: in contrast to the patterns (M=0.3, SD=0.48), the paper versions received significantly more *suggestions for improvement* by the vicars (M=2.3, SD=1.7, $t(9)$=3.72, p=.005). What was frequently criticized was a missing categorization of information and unavailable recommendations on what should be done. In contrast to that, the patterns seemed to include all the required information in their categories for a good practice description. This indicates that patterns lead to fewer requests and suggestions for improvement because of their inherent structure, which guides both the author and the reader of the good practice description.

4 Conclusion

These results lead to the assumption that an explicit structure, as provided by a pattern, will facilitate an effective description of one's own practical knowledge and, in this way, enable a successful exchange of knowledge between practitioners. Patterns seem to support the difficult process of becoming aware of one's own knowledge and guide authors in writing down their implicit knowledge. This may lead to deeper elaboration and reflection of their own practice which will, in turn, be improved.

The aim of this PhD work is to close the gap between theory and empiricism of the pattern-concept. For this purpose, we apply the pattern-concept to the web-based exchange of practical knowledge and provide a theoretical underpinning of patterns. Consequently, this PhD project focuses on both a theoretical framework for describing how a computer-supported exchange of practical knowledge takes place and the empirical verification of the mode of operation of patterns.

Acknowledgement. This research was founded by the German Federal Ministry of Education and Research, the European Social Fund and the European Union (support code 01PF08005A).

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Crowdsourcing a Personalized Learning Environment for Mathematics

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Abstract. Can we build a semantically adaptive personal learning environment that helps people learn mathematics and that meets reasonable criteria for sustainable growth and development? This is question that applies at the interface between participatory social media and interactive, adaptive, "knowledge media". Ten years ago, no one had heard of Wikipedia. Perhaps in another ten, P2PU will be as popular as my home institution, The Open University. A wide range of stakeholders in education are surely curious to know why, or why not, and what this may mean for their careers. Aside from the possible social significance of the question, I anticipate that the personal learning environment (PLE) approach will provide an interesting stream of use data, including implicit and explicit information about how people learn mathematics. This opportunity to look in detail at learning behaviour in open, online, participatory, educational spaces is quite new. My project will combine socio-cultural analysis, technical development work, and datamining techniques to help support both individualized learning and ongoing system development.

Key words: crowdsourcing, personal learning environments, mathematics

1 Roadmap

How do people learn mathematics? What motivates people to learn in one way or another, given that it's not often easy? Here we recall Euclid's warning: "there is no Royal Road to geometry." Even so, we can imagine a *road to free math* (Figure 1)!

Just what does "free" mean in this context? I think it entails understanding the ambitions of the people involved, as well as their frustrations. Learning math may not be "easy", but perhaps it can be *free of unnecessary frustrations*. My approach aims to foster learner self-awareness and a realistic sense of what's possible. In the words of C. S. Pierce, "To know what we think, to be masters of our own meaning, will make a solid foundation for great and weighty thought."[1]

2 Review of Existing Research

As a sort of mantra, it is helpful to return to the view of personal learning environment put forward by the progenitors of the PLE concept: "Rather than

Fig. 1. The Road to Free Math

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." (Wilson et al., 2006) [2].

The key idea here is that learning takes place in a complex "ecosystem". Rather than building monolithic, or even modular, educational structures, in their fullest development, PLEs will support fully distributed, decentralized, perhaps even "organic", learning activities. With this vision in mind, it is still useful to remember that all activities take place in some context (more on this in Section 4).

Cormac Lawler's research (e.g. [3], [4]) indicates some of the challenges inherent to collaboratively producing a given online space to support learning. In particular, Lawler's attention to the bottom-up nature of Wikiversity provides an important contrast to the top-down nature of systems-engineering (a quality that applies even to systems with significant distributed aspects).

Aaron Krowne's master's thesis [5] details his development of a system for the collaborative production of digital libraries (such as the now-popular PlanetMath.org). In a subsequent collaboration with the present author, these ideas of "commons-based peer production" are connected to various historical developments in hypertext [6]. The system's usefulness in an instructional context is discussed in Milson and Krowne [7], which incidentally also includes numerous citations to earlier literature on collaborative and online learning.

So, what's the hold-up? (If, indeed, there is a hold-up.) My sense is that whether we are talking about engineered, democratic, or distributed solutions (and we're typically always talking about a combination of all of these), what remains in very short supply is the multi-level, multi-scale adaptability that could actually change a learning ecosystem. It is perhaps especially important to overcome the "learner-centric" model that is so popular these days (and is still clearly felt in the quote from Wilson *et al.* above). Or else, putting it another way, to admit once and for all that we're all learning – and that, as they say, we all make mistakes.

Although there have been many academic and commercial projects that successfully solve problems on behalf of learners, uptake or buy-in has often been lacking (ActiveMath makes a particularly good example [8]), or else cost remains prohibitive and major extensions are difficult or impossible to make (e.g. Mathematica). These are the problems I aim to tackle in my work.

3 Research question

Can we build a semantically adaptive personal learning environment that helps people learn mathematics and that meets reasonable criteria for sustainable growth and development?

3.1 Development of the Research Question

Our aim is to build a lens for looking at mathematical learning behaviour in detail. There are several criteria required for "success".

1. It is essential that enough people are motivated to use the system.
2. It is essential that at least some of them learn mathematics while using the system.
3. We will need to document how the semantic adaptivity and personalization features, in specific, help people learn.
4. We will require evidence that the system will grow, not stagnate.

4 Specification of Research Approach

Building educational systems online, in the open, we hope to exploit both high-intensity, high-cost contributions, and a long tail of smaller and less intensive contributions. The process of assimilating many small contributions into resources of high-quality – colloquially known as "crowdsourcing" – forms part of a possible solution to the "sustainability problem". But, like "open source", crowdsourcing is not a panacea. Section 4.1 presents two approaches that I think can be applied to make crowdsourcing work well.

4.1 Situation relative to contemporary theory

In preparation for dealing with the issues I expect to come up in, I've been developing some (interrelated) themes having to do with the ideas of *shared context in motion* and *sensemaking*.

Nishida's idea of shared context in motion, or *basho* [9], as filtered through the the "SECI" framework of Nonaka and Toyama [10], can help us move from stakeholder groups to a clearer picture of the roles of actual participants and on to a detailed understanding of the activities which support these roles (e.g. a student's activities include going to class, collaborating on a class project, building a transcript, and ultimately gaining a skill). Activity theory seems to pick up where SECI leaves off, as it provides another Nishida-like way to "understand the unity of consciousness and activity" ([11], p. 7). These ideas will be used on an ongoing basis to create increasingly detailed sketches of the activities we would like to support.

Sensemaking is a methodology for finding and filling gaps. There is both an extensive research literature (cf. [12]) and room for new and creative ideas connecting to an interesting philosophical tradition (what does it mean for things to "make sense"? cf. [13]). I hope to use sensemaking as a way to move back and forth between high-level picture coming from SECI analysis and detailed development issues, finding ways in which "various data elements fit together in a coherent causal scheme", helping understand how to actually support the activities we're interested in (see Klein *et al.*, [14], [15]).

4.2 Summary of development goals

It is worth noting that the approaches described above work in a context where it is assumed that that much of what happens *happens elsewhere*, i.e., where we do

not presume to be the only show in town. We will not aim to be all things to all people, but to gather enough information to do useful research about what how PLEs can help people learn mathematics. To do this well, we'll want a system should be compatible with various ways of learning and doing mathematics.

Planetary is the name of a system that is currently under development, which meets these needs.[1] Planetary began as a collaboration between myself, Catalin David, Deyan Ginev, and Michael Kohlhase at Jacobs University, with the goal of creating an easy-to-extend clone of PlanetMath's software platform "Noösphere". We chose to base the system on the popular open source Vanilla Forums[2], and the first set of extensions added mathematical writing and rendering capabilities using LaTeXML[3]. Subsequent extensions – all pure plugins to Vanilla – have begun to integrate the "KWARC stack" of software tools for working with mathematics with semantic markup.[4]

My development goals are to

A. finish the clone phase and port the legacy PlanetMath content to the new platform as quickly as possible;
B. add tools for authoring and solving interactive exercises, so as to begin gathering data and generating recommendations based on the learner's performance and prior knowledge;
C. add various other useful plugins that make the site useful and attractive (e.g. integrating the SAGE computer algebra system, the Geogebra diagram-creating system, and a maths-enabled version of Etherpad);
D. move in the direction of increased compatibility with other ways of interacting with mathematics online (e.g. compatibility with Wikipedia, ArXiv, Mizar).

5 Conclusion

The problem I've posed asks how to make large-scale computer-mediated learning system sustainable (something that has arguably not been done before, at least apart from "the free/open source software movement" taken as a whole). This is an ongoing challenge that I hope many people will help solve. A contribution that I feel is more uniquely my own will be an improved understanding of how people learn mathematics, discovered in patterns found via data mining, and embodied in adaptive recommendation algorithms.

Acknowledgments

The author thanks the anonymous reviewers for their helpful comments. The research work described in this paper is partially funded through the ROLE

[1] `http://trac.mathweb.org/planetary`
[2] `http://vanillaforums.org`
[3] `http://dlmf.nist.gov/LaTeXML/`
[4] `http://kwarc.info`

Integrated Project, part of the Seventh Framework Programme for Research and Technological Development (FP7) of the European Union in Information and Communication Technologies.

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Argumentative Interactions in Online Asynchronous Communication

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Abstract. Argumentative interactions in online asynchronous communication are seldom studied by using a qualitative approach as Grounded Theory Methods. The purpose of this paper is about a theory of argumentation based on analysis of teacher-student and learner-learner dialogues. By examining linguistic features of the threads related to the forum of two different academic courses, we consider the structural aspects of argumentative interactions as expressed in term of co-construction of Knowledge.

Keywords: computer supported collaborative learning, social and cognitive processes, communities of learners.

1 Introduction

Researches on development of learning processes and interactions are supported by innovative educational technologies that have caused important changes on the mission of higher educational institutions.

Contexts with the opportunities of networking and collaborating constitute the main features of a learner-centered framework. Inquiry and collaboration are key processes to build argumentative interactions.

This PhD project concerns the structural aspects of argumentative interaction with particular attention to a particular modality of asynchronous communication, forum discussion.

The issue of argumentation has an increasing interest in education, not only because it is an important competence that has to be learned, but also because argumentation can be foster learning in many domains: mathematics, science, history and literature.

The processes of argumentation allow students to emerge new understanding and creative restructuring of problem solving. The learner becomes a co-author in building Knowledge.

2 Research questions

The PhD research is framed by socio-constructivist learning theory. The following general research questions are addressed:

1. Can grounded methods research be useful to understand theory of argumentative interactions in a context of asynchronous communication?
2. How can collaborative learning situations support argumentation?
3. What are the contextual aspects affecting argumentation with a particular attention to the role of student, peer student and tutor.

The aim of PhD project is to understand the nature of interactions, with particular attention to dialogical aspects occurring during processes of elaboration and construction of knowledge in a collaborative environment supported by asynchronous communication.

3 Significant problems in the field of research

Computer Supported Collaborative Learning Environments (CSCLE) affect social and cognitive aspects of construction of knowledge.

Some researchers state that in the contexts that promote process of knowledge-building, explanation is the major constructive activity [1]. This process support collaborative learning in all kind of processes that appear connected with knowledge discourse with the aim to co-construct meaning.

As emerged from a certain number of studies, the learners, working in collaborative environments, are more engaged in argumentative interactions oriented to epistemic tasks as the solution of problem, meta-cognitive reflection and building of consensus [2].

But, the studies tackle the problem of argumentative interaction in learning collaborative environments in a limited way.

The indicators that examine the aspect of argumentative interactions are often focused on quantifying interactions at fine- grained level [3].

Other researches based on user approach, focusing on quantitative methodology for assessing the nature of argumentative interactions, concentrate only about one or two dimensions of collaboration tasks leaving aside a more global picture of complexity arousing from the understanding of cognitive and social aspects that constitute argumentative interaction.

The balance of individual and collective contributions of learners is rarely considered in the researches on investigating the nature of the complementary aspect in the processes of building and sharing Knowledge.

A quantitative research approach doesn’t give indications for understanding how the members of group can collaborate effectively. Ethnographic methods are more sensitive to approach quality of collaboration on the basis of qualitative analysis.

4 State of the art: outline of current knowledge of the problem

Muller and Perret-Clermot [2] state that argumentation is conceived as a particular type of communicative interaction. The action of assessing argumentative interactions in a collaborative learning environment means building of social consensus through negotiation and development of individual and collective level of collaboration.

Baker [4] defines argumentative interactions as contexts in which the use of discursive operations, that is cognitive aspects of knowledge and understanding is particularly intense and frequent. The principal discursive operation in argumentative interactions is negotiation of meaning.

The negotiation of meaning is the most generalized of discursive operation by which different meanings of linguistic expressions are compared and refined in verbal interactions. An approach to understanding argumentative interaction in problem solving situation is concerned with the choice of better solution of a problem. This process goes hand in hand with an exploration of dialogical spaces in which negotiation of meanings take form.

Andriessen [5] presents a case of using interactive media for supporting collaborative argumentation in an university context. The author illustrates the principal mechanisms underlying argumentative interaction by using computer tools as chat and forum for generating argumentative essays.

The studies on grounding processes of argumentative interaction contribute to gaining more insight into the mechanisms that can support dialogue in collaborative learning environments. The grounding processes, defined as interactive, are concerned on how mutual understanding of knowledge can be constructed and developed [6]. These processes can occur at linguistic level as well as at cognitive level (searching for concepts and problem-solving strategies) [7].

In collaborative research design, the processes can be classified according to the orientation toward design task procedures, group processes or communication process.

Firstly, collaboration concerns the activities related to evolution of task (design activities, elaboration and enhancements of solution). These content-oriented activities reveal how the group resolves the task by sharing and co-elaborating knowledge concerning the resolution, by confronting participants' different perspectives and by converging toward negotiated solution

Secondly, collaboration concerns group management activities such as project management and coordination activities.

Thirdly, communication processes are highly important to ensure the construction of common ground in collaborative process by which the participants mutually establish what they Know.

Grounding is linked to sharing of information through the representation of the environment and the artifact. These activities ensure inter-comprehension and construction of shared or compatible representations of the current state of problem: solution, plans, design rules.

5 Research design

In PhD research we focus the attention on relation between knowledge construction and argumentation in collaborative learning situations. The purpose of this contribution is to present results pertaining to argumentation and learning in tasks that explicitly stress the importance on negotiation of meaning. We consider as subject of study, two small groups (composed by six or seven participant) of academic students who attend the courses of Didactics and Distance Education delivered by open source software platform Moodle. Synchronous chat and asynchronous forum are used for discussion of project work topics to be presented to tutors, peers and teachers.

The duration of the courses is one semester.

For the Didactics course, the discussion on the forum starts from November 2008 to January 2009.

For Distance Education group the discussion starts from March 2009 to June 2009.

The design of PhD is composed by three different stages.

By the first stage, we select 30 threads of forum on Didactics composed by 420 messages and 17 threads from forum of Distance Education constituted by 459 messages.

In the choice of messages the attention is posed on unity of meaning because in asynchronous forum, the interactions take the form of communicative acts.

A unity of meaning is defined as a coherent sentence distinguished from others adjacent and characterized by comma or point.

Within the approach of Grounded Theory methods, data messages have been analyzed by using three different forms of coding: open, theoretical and constant comparative [6].

The process of coding started by defining some sensitizing concepts [7]. These concepts are useful to indicate what to look for during research fieldwork.

The open coding ends with locating the core categories, while theoretical coding allows to develop relationship between categories and their properties.

Step 1. The first step in the analysis of the data is the coding of selected messages. Open coding techniques, a process of labelling the events and ideas represented in the data, are used. The goal of open coding is to create an initial list of conceptual codes, which are grounded in the data. Most of the data is coded using NVivo, a computer software program for qualitative research. At each paragraph of the transcripts of forum discussion graph is assigned one or more conceptual codes. Within grounded theory approach, the data are analyzed without any particular preconceived notion about descriptive labels.

Step 2. At the end of the first stage we begin looking for connections among conceptual codes through several strategies. A set of emergent models are created based on the codes and categories. In this stage, our intuition is guided by increasing levels of theoretical sensitivity. Narratives and stories of participants are considered as important as their request of information in the forum. These aspects provide a valuable way to engage participants in *member checking* especially because they reflect on their experiences.

Step 3: The collection and analysis of data are repeated by comparing emerging categories with those created from the previous stages. It is “the attribute of having insight, the ability to give meaning to data, the capacity to understand, and capability to separate the pertinent from that which isn't” [8].

The sensitivity can be achieved by a variety of approaches including extensive literature search in related fields of study and a series of reflections on personal and professional experience. Any further data collection and analysis become more selective and guided by the emerging theory in a process known as *theoretical saturation*. At the end of this we reflect about the most recurrent core categories.

6 Sketch of the applied research methodology

In the field of Information System there is an increasing interest toward use of qualitative research methods with an aim to comprehend how ICT issues are context-sensitive. Consequently, the importance is on how the participants are supported by technologies to share meaning.

Most of the researches methods in Information System field include conversation analysis [9] and Grounded Theory approach [10].

Grounded theory approach is driven by the data with the aim to understand and discover patterns. A grounded theory is not built a priori; rather, it emerges during study as data collection, analysis, and theory development occur in parallel.

Research and investigation cannot be undertaken on the assumption that people can simply be questioned, counted and processed; but neither can it be undertaken on the basis that they can simply be observed and recorded.

Grounded Theory method presents an approach that directs the attention of researchers on considering contexts of study as problematic and non obvious. A challenge that can only be met with the contributions of actors involved in the context.

Myers [11] stated that Grounded theory approach is particular useful for developing context-based research oriented to process in an effort to describe argumentative interactions analyzing the messages of different threads.

7 Some results from PhD project

The results of the PhD project leads to the assumption that a substantive theory of argumentative interactions makes sense to understanding the meaning that subject attributed to their action. In according to constructivist interpretation of Theory Grounded Theory [12], Knowledge is a human construct that arises from actions of social beings. The originality assigned to this PhD work is how a theory of argumentation derived from the data can explain the processes of sharing knowledge by using an ethnographic approach.

The results of this study are different by others in the type of software used for elaboration and understanding of data. NVivo 7.0 allows constructing map of argumentative interactions considering from authentic situations.

8 Conclusions and future work: contribution to the problem solution

The results of PhD research indicate that students can be motivated to critically check each other's information through interactive argumentation.

Students construct their own understanding in individual and collective work. This aspect permits them to compare each other's different points of view.

This study, conducted using a qualitative approach, can be considered a point of departure for research on argumentative interaction that taking into account the voice of the participants. It is extremely important give indications to designers of courses.

The design of e-learning course can be done efficiently taking into account the needs, the beliefs and understandings of all learners. This is the most challenging issues of e-learning researches.

Another important aspect that emerges from this PhD project concerns the role of technologies in providing new tools for conducting researches and new means for understanding the way social realities get constructed through discursive behavior.

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Capturing Multi-Perspective Knowledge of Job Activities for Training

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Abstract. Using simulated environments for experiential learning gains a growing popularity in professional training. However, simulated context cannot capture the complexity of real world activities, hindering the adaptation to individual learning needs and real world experiences. On the other hand, there is a vast amount of user contributed content about real world activity which represents different viewpoints and contexts. Although this content can be a useful source for enriching the experiential learning experience in simulated environments, it has not been exploited to date. The main limitations are the poor structure and the lack of approaches to retrieve the knowledge nuggets embedded in the existing digital content (e.g. videos or user stories) and to relate them to the simulated context. The aim of this doctoral project is to develop a novel approach for capturing multi-perspective knowledge of job related activities from existing digital records and personal experiences. The proposed approach aims at extracting an advanced context model which will augment digital records of job activities with semantics, and will provide intelligent search to augment simulated context with real life experiences.

Keywords: Activity, Context, Context-awareness, Activity Modelling

1 Motivation and Description of the Project

This PhD is motivated by two recent trends in professional training. Firstly, research and development in simulated activities and virtual environments is becoming widely used for training and has significant influence on future learning technologies. However, the learning experience in a simulated environment is disconnected from real-world job experience, reducing the effectiveness of learning. Simulated environments embed predefined interactive scenarios which include fixed parameters, whereas real world activities are affected by dynamic conditions and complex situations which are hard to capture in simulated world. Hence, there is limited contextual alignment between the simulated experience and the learner's real job activities. The representation of and adaptation to the real world context in simulated environments is a major challenge, which can play a crucial role in affecting the quality of learning, especially in the area of adult training.

[1] Supervisor: Dr. Vania Dimitrova

On the other hand, there is a remarkable amount of resources available over the web, which offer rich content related to job activities and every day practice that can be used as a source for capturing contextual knowledge. Moreover, people tend to share and search for training material and exchange opinions and personal experiences that mirror their real world job context. This abundance of user generated content offers exciting opportunities to capture contextual knowledge about job activities and use it for training. Such contextual knowledge, however, is currently disconnected from the user interaction in simulated environments where it could offer new means of adaptation to individual needs. The key challenge for making this connection is the lack of effective knowledge elicitation mechanisms to derive a structure that enables intelligent content retrieval for experiential learning.

The key challenge addressed in this project is to find a way to link simulated experiences with real world job-related experience records. *Our main goal is to augment digital content related to job activities with multi-perspective contextual information based on real world experiences in order to improve training and enable context-aware intelligent search.*

The pedagogical underpinning for this PhD is based on the Experiential Learning theory [1] especially applicable to job-based training where people learn from experience, both their own and other peoples'. The research aims at finding a way to capture this experience and use it as a knowledge source for training by relating it to individual experiences and context in simulated environments.

This PhD addresses the following research questions:

RQ1: How to capture multi-perspective contextual knowledge embedded in digital content and personal experience? This includes: deciding how to elicit knowledge from human descriptions and comments related to job-related activities; identifying the main actions of a job-related activity and the important aspects associated with an action; identifying what connections may exist between actions; identifying how these actions are connected with different individual experiences and context, i.e. different perspectives; and how to represent multi-perspective contextual knowledge to augment a reflective digital object.

RQ2: How to use contextual knowledge to retrieve digital content related to a specific situation? This includes discovering structural connections between different pieces of contextual knowledge and finding similarities between context models.

To deal with the above questions, we propose a conceptual framework for contextual knowledge capturing and retrieval, which consists of three layers, as shown in Figure 1. The **Acquisition Layer** deals with the development of a model to capture multi-perspective knowledge of job-related activities**.** This utilizes digital records of a specific **Activity** (e.g. job interview videos) and user input (e.g. comments/stories about interviews) to capture personal experiences and descriptions of the activity presented in the digital content. This will enable us to extract a **Context Rich Activity Model (CRAM)** (see Section 3) in the **Modelling Layer**. The **Application Layer** will provide a retrieval mechanism to map contextual representation of digital content to representation of a specific simulated context and suggest relevant digital content.

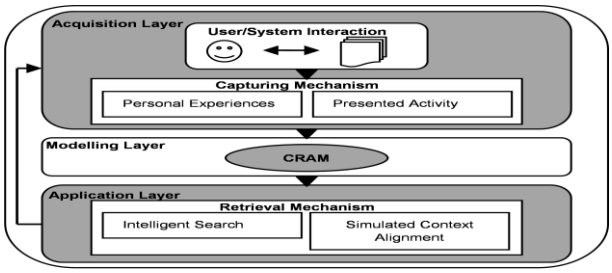

Figure 1 Conceptual framework for capturing multi-perspective knowledge of job-related activities and individual experiences.

2 Background Research and Related Work

This Section outlines the key sources from the background research done so far (this PhD is approaching the end of first year), which built the foundational knowledge for addressing the research questions listed above. The references used here do not intend to give comprehensive description but to show the direction followed to date.

Related to RQ1 an extended literature review on Context, Context-Aware systems [2] and Activity Theory [3-4] has been undertaken to help understand the potential dimensions (aspects) of information that can describe human activity and approaches to model them. To examine knowledge elicitation and representation (i.e. RQ1) the Semantic MediaWiki (SMW) [5] framework was reviewed, which is a technology widely used to facilitate knowledge access and reuse as well as consistency of content. This work will be benefited by semantic technologies to tackle the problem, hoping to conclude with a dynamic ontology to represent Context-Rich Activity. However, the SMW appears to have some technical limitations, which in turn reduce the potential to serve for our purpose. Regarding RQ2 (retrieval of knowledge given particular context), the limitations of SMW include the lack of user profiling mechanisms and the inflexibility of querying algorithms. The potential use of information extraction technologies, e.g. GATE [6], has been examined to derive semantic categories from semi-structured user comments. In addition, Dialogue Agents for knowledge capturing have also been investigated in order to provide structure and guidance for capturing multi-perspective knowledge.

There are several projects that developed approaches which have some similarity with our approach. APOSDLE [7] promotes capturing of job-related experiences into job-related (task) objects, focusing on computer-based tasks. In contrast, our approach considers real world activities which are not performed with a computer (e.g. job interviews, advising students). MATURE [8] aims at capturing organizational knowledge from experiences, considering broad job activities. AWESOME [9] deals with capturing student experiences in academic writing. There is a close similarity of our goal with goals of MATURE and AWESOME. Though, there is a fundamental difference in the methods. Both MATURE and AWESOME consider capturing tags/semantic annotations and accumulating them in a lightweight ontology. Distinctively, we consider more expressive ontologies, look at different activity dimensions (following Activity Theory, see below), and explicitly represent

different individual perspectives. Finally, KP-LAB [10] used records of job-related activities to create pedagogical scenarios for experiential learning where people work in groups and reflect on job activities. The approach of the present project was inspired by the findings in KP-LAB and will take it further by implementing smartness in a system to enable capturing the different aspects of an activity and utilizing this to empower simulated settings. In particular, this work aims to distinguish from KP-LAB in three points: include multi-perceptiveness (i.e. individual knowledge views) in the knowledge base; advance the knowledge elicitation process by implementing methods to provide user-awareness of context and related activities; and provide more expressive models to augment digital content.

3 Research Methodology and Progress to Date

This Section describes the methodology for addressing the research questions and summarizes the progress to date. We will use the term **contextual knowledge** as a holistic description of peoples' job-related experiences. The notion of **experience** refers to the activity that takes place in a real-world job environment. To scope the project we will focus on job interview activities, where a wealth of contextual knowledge can be captured based on peoples' experiences (e.g. university students preparing for jobs or placements; career advisers, interviewers). There is a great amount of digital content about job interviews (e.g. videos with interview examples or personal stories are available in social web sites).

3.1 Capturing Multi-perspective Contextual Knowledge (RQ1)

Contextual knowledge elicitation. Based on a review of existing techniques for contextual knowledge elicitation (such as semantic wikis, information extraction and dialogue agents), we will compose a novel framework for capturing human experiences. To define the type of resources that will be used as records of real job-related activities, we have collected a sample of video files and user comments. Four categories of interview records have been identified: guides (explanations of best practices), interviewees' stories, interviewers' stories and interview examples. We decided to focus on examples and personal stories, as these resources can be closely connected to real world context. For the user input, two interaction dimensions have been identified: users can capture actions in the video; and comment on the actions by providing contextual descriptions and personal experiences. Here we define user as a learner or trainee. Knowledge elicitation mechanism will provide opportunity for reflection and knowledge awareness. A prototype to test the hypothesis of capturing multi-perspective knowledge and start collecting a corpus of resources and user input data has been developed. We will then use information extraction techniques to identify knowledge statements related to key aspects of interview actions and to capture them in an ontology. We also envisage the use of simple dialogue templates to guide the user knowledge acquisition process.

Identifying the main actions of an activity, the important aspects associated with an action and connections that may exist. Due to the complexity of job-related

activities it was decided to exploit Activity Theory to generate the core dimensions related to an activity and the important factors affecting different actions. We utilize Context and relate the activity dimensions to contextual descriptions of actions following the approach in [11]. Another aspect of the problem is to discover relations between activity actions. So far, four types of relations have been considered: time link (e.g. sequence of actions); similarity of actions (e.g. emotional state of the interviewee); connected actions (i.e. derive patterns of annotations from user comments on actions); and connections between different digital content.

Capturing multi-perspectives. We aim to capture the relation between the context presented in a digital resource (i.e. internal descriptions from user comments on the presented activity) and the individuals' perspectives (external descriptions of personal experiences). This will enable us to produce different knowledge views and provide new means of adaption to individual learning needs.

3.2 Representation of multi-perspective contextual Knowledge: The Context Rich Activity Model.

The main constructive component of CRAM is the Context Rich Activity Object (CRAO). A CRAO is a digital object that consists of a semantic multi-perspective knowledge wrapper of a digital record to represent job-related activities and individual experiences. Potential relations between CRAOs will be explored to build a semantic graph of objects and provide a classification framework (Figure 2, left). Figure 2 (right) presents the internal structure of CRAO. We refer to the digital records of real job-related activities as **Activity Resources (AR)**. The Activity is segmented to Actions. Each Action is represented by Engestrom's **Extended Activity Theory** framework [4] and is described by two types of contextual representations: (a) the description of the action as presented in the Activity Resource and (b) the external individual experience representation. Both representations come from the user's comments. The Actions are linked together with various types of relations that we cited in this Section.

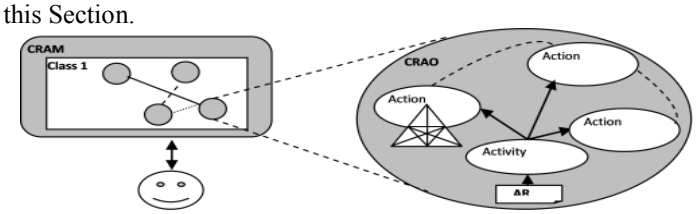

Figure 2 Context Rich Activity Model (CRAM)

3.3 Multi-perspective Contextual Knowledge Retrieval (RQ2) and Evaluation

Example intelligent searches to retrieve knowledge **adapted to particular context** will be conducted. The context dimensions for the queries (i.e. the input fields) will be derived from users-learners and simulated settings. Knowledge retrieval methods will include extensive reasoning on the CRAM ontology and SPARQL queries application.

CRAM will be evaluated in two stages: firstly, the context model to semantically augment the digital record with contextual knowledge; and later, the multi-perspective context model to provide individual knowledge views of the activity. In both stages, CRAM will be evaluated iteratively in collaboration with domain experts, e.g. career advisers. A preliminary evaluation schema for CRAM includes: context dimensions coverage; correctness; and knowledge structure. For the knowledge retrieval process, the functionality of the model will be evaluated not only with individual's context but also with simulated settings to align the simulated experiences with reality aspects.

4 Contribution

The major contribution of this PhD project is the development of a holistic real world activity model that will enable intelligent content search based on personal human-oriented experiences and the adaptation of reality aspects to simulated settings for experiential learning. This process will involve the deployment of a novel system with intelligent services for knowledge elicitation and retrieval and will promote the semantic analysis of real-world activity in ill-defined domains [12], such as interpersonal communications exemplified with job interview activities.

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Experts' & Novices' Concept Map Formation Process: An Eye-Tracking Study

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Abstract: The purpose of this study is to explore how concept map formation process carried out by individuals who are designated experts and novices. As a group of novice participants, 73 prospective teachers and 5 experts were participated to the study. Data collected by using open ended questionnaires, and retrospective review and eye tracking sessions. These data were used to explore the cognitive process of users during concept map development process. The preliminary results showed that participants tended to follow a deductive approach and in terms of concept map building strategy, there is a pattern among participants starting map with writing links after the concepts.

Keywords: Concept map, eye-tracking, expert, novice, cognitive process

1 Introduction

Concept maps defined as graphical tools for organizing and representing knowledge [1]. They are routed from cognitive approach, valued among researchers and practitioners for a long time. It is not a new topic for educators, since the effects and benefits of them were explored and mentioned in many research studies. Especially in science education they have been widely used; especially for evaluating the knowledge organization have been used [2], [3], [4]. The literature on concept maps shows that they have been used widely for five categories; including creativity, hypertext design, communication, learning and assessment [5]. The structure of concept maps as a meta-cognitive tool is considered as beneficial, and enhance the understanding with promoting chances to establish relations between exist structure and new knowledge [6]. It is also supported in the literature while explaining Ausebel's basic idea on cognitive psychology on the learning process "learning takes place by the assimilation of new concepts and propositions into existing concept and propositional frameworks held by the learner" [1]. According to them this knowledge can be seen as the cognitive structure of individuals. For this reason, concept maps as a good way to represent knowledge of participants in order to comprehend the conceptual understanding of participants and they need to be explored with considering

the cognitive processes of the human beings [1]. The importance of concept mapping in terms of the role in the process of demonstrating the individual perceptions on subject, more willingly than copying the memorized facts emphasized [7]. The uniqueness is another key point that every map has its special structure since every individual constructs very different maps because of the comprehension of content and knowledge that they acquired [6]. However, like our views, the tools and their usage were changing with respect to the needs of the learner and teacher, and this affects the learning process and researchers' position and interests directly. In recent years, concept maps are started to be used in many fields and for diverse purposes. The common usages of concept maps were using filling maps [8] using concept maps as assessment tools while considering the issue of reliability and validity [4] using different linking phrases in concept mapping [9] and investigating the feasibility of online concept maps [10]. The frequently explored characteristics of concept maps are the hierarchical structure, cross-links and as well as specific examples related with the maps.

As discussed above, concept maps are beneficial tools as they provide an environment for representing the verbal knowledge visually. As constructivism emphasize the importance of knowledge construction of learner and concentrate on the active participation in this process, concept maps valuable tools for implementing this. Even the emphasis is more on learner than the instructor; the assessment is still a problem. Using concept maps as assessment tools and considering them with scoring the concept, link and cross-link number is a well-known and still being used method. In this process some of the researchers proposed techniques on counting the number of the links, concepts or cross links. Although the process requires an assessment step to gather information on the process in terms of the quality of the maps, counting the content of maps may not be an effective strategy. Concept maps are effective tools with their visual structure also for this purpose. Moreover, exploring the construction process is critical that it centralizes the learner and suits to the constructivism's fundamentals with this respect. Although, many research studies have focused on the practical applications of concept maps [11], there has been limited number of studies dealing with the construction process of the concept maps.

The main purpose of this study is to understand the process of concept map development. With this respect, secondary purposes were emerged as exploring the angles of designated experts' and novices' concept mapping process whether there are patterns among novices and experts' concept map development process regarding their cognitive processes. Specifically, the process will be determined whether there are explicit similarities or differences among the novices and between experts. It is aimed to propose a common model for concept map development. The cognitive dimension will give chance to see the differences between individuals in terms of their expertise and how it affects the map development directly. This study is not interested in scoring because the process includes much more than acquiring an end-product. The construction process itself includes chain of cognitive processes in it, the activities like arranging, constructing, deleting or changing into another relation or concept are also related with construction process and this needs to be explored detailed. As a result, exploring concept map

development process became critical process that it includes visual representation of the existing information by forming relations among concepts. Determining the reasons of ineffective concept map usage and the deficiencies of individuals might be explored easily and effectively. This process is also crucial for determining the reasons of ineffective concept map usage and also the deficiencies of the learners are explored more easily and effectively with considering the reasons lying beneath.

2 Research Method and Procedures

As a research methodology mixed method research was selected including stages following one after another. The process can be considered as a prototyping cycle process and all these sections were presented through this context. With this respect, three research studies were conducted for exploring the cognitive process of the participants with examining their concept map development process.

2.1 Research Questions

1. How does concept map development process actualized?

    - How does concept map development processes differ within designated novices and experts?
    - Is there a relationship between levels of use of different concepts and levels of expertise? How can we improve novices to expert level?
    - What are the factors that affect experts' and novices' concept map construction process?
    - Do novices and experts use specific strategies during the concept map development process?
    - Are there differences among experts' and novices' concept maps in terms of content richness and structure of map? If so, could these differences be used to determine their expertise levels?

In the first study, the participants were asked to develop a concept map and their eye movements were recorded and analyzed. The second study carried this study one step further with a different group of participants. In addition to the eye movement recording process, participants were asked to fill a form called as "interpretative essay" includes questions regarding concept map formation process. With these questions it was aimed to understand the cognitive process of the individuals by validating the process with the responses coming from themselves. The last study can be considered as a combination of the previous two studies. Since the participants' responses could not provide a detailed picture on their cognitive process, the researcher changed her strategy instead of asking

for subjects to write their acts and concept mapping process, they were requested to talk about their behaviors in this process. This process called as debriefing session or retrospective review. During this process the participants watched their own concept map developing video which was recorded by eye tracking device and they were asked about the specific steps and acts in this video. This process recorded by voice recorder to have a better understanding about subjects' comments and explanations.

The reasons for using different groups and different techniques during the data collection due to the problems occurred in the process. While starting the research study, the researcher decided to use a single case for exploring the cognitive process of the participants. However, after the first data collection she realized that another data collection is necessary by using a narrative way of explaining the cognitive process. In the second phase, the researcher collected data with using different instrument than the first phase; however the participants did not want to write more about the process because the data collection process is frustrating for them. They expressed that they could not explain their feelings in detail. Hence, the researcher asked them to do another concept map with using an easier way as debriefing session from the video, and add another dimension to the study as expertise. These three phases can be seen as extensions of each other, in other words these three studies were independent but associated cases. Each case examined independently and each phase contributed to the other phase like the former step carried to the existing step to one step further.

2.2 Preliminary Results

The preliminary results of the first study showed that, all participants tended to follow a deductive approach. They have started with placing the main concepts and then they established the sub concepts and links with considering the relationships between the main concepts. The main thought lying under beneath is starting with the main concept and going into deeper concepts. In addition to this, it is observer that they had an established pattern of behavior in terms of putting the links and concepts which is a synchronized manner. Moreover, in terms of the concept map building strategy, almost all participants started to construct concept maps with writing the links and after that the concepts were written. Two of the participants used different way that they started by writing the concepts first and after that they wrote the related links. However, these exceptional participants who started with the concepts and continue with the links changed their patterns after average 3 minutes into writing the links before concepts. The average completion time period was 18.72 minutes for all participants. The minimum time period for building concept map is 9.48 minutes and the longest period was 29.39 minutes with SD=6,5801.

In terms of the visual representation of the concept maps almost all participants constructed hierarchically built concept maps. Although some of the participants started to form concept maps which have star structure, they included some branches into the maps and the structure changed into a hierarchic manner. In the concept map formation

process, some specific acts were observed as labeled by researcher. These main acts and the time period spent were analyzed by eye tracking device. This gives opportunity to consider the time frame of the participants while looking at the concepts and links. In addition to this, the reasoning process and arrangement process were analyzed for having an idea on the participants' cognitive structure

3 PhD's project contribution and significance

Although concept mapping is a greatly researched area, many of the studies just focused on the potential of concept maps as in the assessment process and evaluation of the concept maps. Especially, the angles of experts and novices are not a well researched issue for researchers. This study might contribute to the literature, since it has potential to fill the gap on this issues and this study has a combined perspective under the same umbrella while exploring different dimensions related with learning and knowledge structure. Even though every dimension might be explored by researchers particularly, proposing common models for these issues while integrating them under the same umbrella is not an attempted approach. For that reason, this study has a potential to fill this gap while proposing a common model for researchers to be used. This study may help researchers to comprehend their knowledge on expertise and cognitive process with considering the role of concept maps in the learning process.

In addition to this, technological developments effecting field of education like every field. Applications through this also became popular among educators as well as future educators. Since this study includes a technological version of the exist application of concept maps as using paper and pencil. Almost all the students showed an interest to these kinds of applications due to its efficacy and cost-effectiveness than the paper pencil one. This kind of applications and their diffusion among teachers has a significant importance for preventing the resistance to the new technologies and their dissemination. The more teachers and future teacher became aware of the new developments the more they might be willing to use them. Besides, after 2004 the Science and Technology course curriculum structured based on constructivist approach, in Turkey,. This study may offer some practical contributions like helping prospective teachers to use concept maps more effectively in their future teaching life and gaining adequate information about learners. As concept maps are beneficial tools for representing existing knowledge visually and meaningfully rather than memorizing the facts and write down them, this kind of strategies will enable students to analyze and putting through their existing knowledge with new ones while considering their relations. This may provide clues for increasing the quality of the maps and also the perspectives of the learners.

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E-learning and disability:

accessibility as a contribute to inclusion

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Abstract. E-learning can offer great opportunities to students with disabilities, but still few practitioners know exactly how to make it accessible. Although there are many technical standards and specifics to make e-learning platforms accessible, the pedagogical and didactic perspective of accessibility is not enough studied; disabled students can access to the e-learning platform but not to contents, resources, activities, collaboration and interaction tools. Starting from the basic assumption that an e-learning course is really inclusive when accessibility is addressed both technically and pedagogically, this research has the purpose to examine methods, tools and practices to propose a reference model for designing accessible e-learning courses in the higher education context.

Keywords: e-learning, accessibility, e-inclusion, special educational needs, higher education, disabled students, integration.

1 The general issues of the research

As reported by ISTAT, the national Italian statistic institute, in Italy there are 2,600,000 people with disability, equal to 4,8% of the population over 6 years old living in family. 11,407 students with disability in 2006-2007 attended degree courses in public universities, 137% more compared to 2000-2001. The number of Universities that provide online courses and degree programs has been growing dramatically. According to the European and national policies aiming to ensuring access to education for all, e-learning accessibility[1] is recognized as a priority addressed from the technological perspective through standards regarding the access to e-learning platforms, to web services and tools and to educational software [1]. Italian legislation establishes rules against discrimination in access and use of education technology, for instance Law 17/99 (technical and study aids and support

[1] Accessibility can be defined the degree to which a product, service or environment is accessible by as many as possible, including people with disabilities.

by a specialized tutorship for disabled students)[2], White Paper "Technologies for disabilities" [2] (technology must be designed taking into account disabled people and their special needs) and 2008 Ministerial Decree (educational software must be accessible by disabled students)[3]. Students with Special Educational Needs (SEN) can also use assistive technology to access to hardware and software, but this doesn't guarantee the access to all learning activities. Thus, students with SEN can access to the e-learning platform but not to contents, resources and collaborative activities [3].

2 The research question

Several studies state the role of participation and interaction in learning activities to valorize equally all students. Since learning is a social activity and understanding is socially constructed, e-learning should be designed to promote participation, allowing all students to take part in all subjects and activities, enhancing cooperative learning, offering powerful opportunities [4], [5], [6], [7]. An effective learning can be achieved by breaking the isolation that disabled students feel in their life, through their integration into a virtual learning community; they have the right to participate to learning activities such as debates, problem solving, laboratory groups, reflective discussions, assigned questions, projects works, etc. [8], [9]. This means that technical accessibility in e-learning courses should be supported by a pedagogical accessibility (access to contents, resources, learning activities). The work hypothesis of the research is that e-learning courses not addressing a wide accessibility, both technological and pedagogical, limit or impede participation and interaction by students with SEN. The research aims to: define the significance of accessibility in an holistic way (technological and pedagogical); explore and describe the experience of students with SEN in e-learning academic courses; define the guidelines for a reference model to design accessible courses.

3 Significant problems in the field of the research

The research domain can be placed in the field of special education, in a multidisciplinary approach including other research fields: education technology, learning theories, e-learning models and approaches, e-inclusion, universal design, participatory design. At present approaches to accessibility are poorly supported by learning theory and are predominantly based upon learner-resources interaction and focused on providing staff with the technical skills to develop accessible resources rather than inclusive learning [10]. For a long time the problem of accessibility in e-

[2] Legge 17/99: Integrazione e modifica della Legge Quadro 5 febbraio 1992, n. 104, per l'assistenza, l'integrazione sociale e i diritti delle persone handicappate.

[3] Ministero per le Riforme e le Innovazioni nella Pubblica Amministrazione, Ministero dell'Università e della Ricerca, Ministero della Pubblica Istruzione: Decreto Ministeriale 30 aprile 2008, Regole tecniche disciplinanti l'accessibilità agli strumenti didattici e formativi a favore degli alunni disabili.

learning has been handled exclusively from the technical side; during the last few years some authors have faced the e-accessibility topic from a new point of view, overstepping the mere technical accessibility to consider the learning process in all its dimensions. The most relevant contributes in this field have in common the user-centered approach, that means involving the students with SEN in the course design, according to participatory design approach [11], [12], [13], [14], [15]. In this perspective, e-learning courses should be designed to be usable and effective to all users, taking into account the principles of Universal Design, a new paradigm deriving from accessible design, barrier free and assistive technologies to produce buildings, products and environments [16], [17].

4 Current knowledge of the problem domain, existing solutions

The issue of accessible e-learning is treated by two different points of view: (A) technical accessibility (access to e-learning platform); (B) pedagogical accessibility.

(A) Many European documents stress the importance of the access for all to ICT and to e-learning courses and encourage the adoption of Web Accessibility Initiative (WAI) guidelines, technical standards recognized at international level that ensure a wide e-accessibility to disabled persons [18], [19], [20], [21], [22]. Other guidelines have been developed, many of which are more specific for education: for instance, the Chancellor's Office of California Community Colleges access guidelines and the Australian Vice Chancellor's Committee's guidelines. Global Learning Consortium (IMS) proposes technological standards to ensure inclusive e-learning quality experiences [15].

(B) Other researches and studies try to give an answer to the problem of accessible e-learning. Kelly, Phipps and Swift propose an approach that takes into account both technical and pedagogical accessibility. At the centre of the learning process there are the learner's needs, to be satisfied interacting between the different levels made by accessibility and usability, learning outcomes, infrastructure, local context [11]. Bel and Bradburn consider WAI guidelines useful for developers and webmasters, but lacking a pedagogic perspective. They propose a model based on the idea that accessibility is a primary component of every educational design, in every context, for every learner [10]. J. Seale proposes a "contextualized" model for e-learning in higher education, whose planning process involves all stakeholders: disabled students, lecturers, technologists, developers, managers, support staff. Accessibility must be considered a shared responsibility among all these stakeholders [13], [14], [15].

5 A framework for designing accessible e-learning courses: preliminary ideas

A systemic design of accessible e-learning courses should be the result of a participatory design, involving domain experts, pedagogists, technologists, disability experts, support workers, and the final users. Such a reference model should be flexible, adaptable to the different typologies of disability, learner centered, based on

individualized didactic; it should be the result of a participatory design, involving the students with SEN. The whole process can be resumed in a framework with 3 main steps: pre-design, pedagogical design and technological design.

In **pre-design** we refer to learning theories and paradigms to give a theoretical structure to the pedagogical model and to design the learning environment. We pay attention to: constraints (human/economic resources, implementation times, No. of users); aims and objectives; curricula and domain knowledge to develop. We outline the users, the disability typologies and their special educational needs. We can use International Classification of Functioning, Disability and Health (ICF), by the World Health Organization. Pre-design phase is accomplished by the needs analysis and the definition of learners' prerequisites [23]. **Pedagogical design** foresees the choice of didactic methods and strategies; the organization and implementation of didactic contents and resources, that must be planned according to accessibility criteria; the choice of communication and interaction tools; the scheduling and the organization of didactic support by teachers, tutors, special aid staff [24]. **Technological design** is the phase in which the virtual learning environment is designed and planned, by describing the communication architecture and the interface; technical standards for accessibility must be respected.

6 Research context and methodology

The research context is the School of Education (Facoltà di Scienze della formazione) of Roma Tre University, that since 2009-2010 delivers courses on a Moodle platform. In 1997 the University has instituted an Office for disabled students, delivering a support service for studying, attending lessons, using assistive technology, etc. There is also a tutorship service for the online courses: senior students offer guide and support to their peers in the online activities, but this service is not addressed to the students with SEN. The methodology is the qualitative interpretive research based on the constructivist paradigm [25], [26], [27]. The phases of inquiry includes: (1) *On desk inquiry*: literature survey, state of art and on desk data gathering about accessibility in university courses: experiences and good practices. (2) *Collection of empirical data*: description of the actual situation in the School of Education (support services, tutorship, technologies, student's needs). Procedures: (a) case study: how disabled students live their learning experience in technological online environments; (b) interviews with stakeholders: interviews with key actors and stakeholders (disabled students, practitioners, experts, learning technologists, lecturers) to discuss the topics of inclusion and integration in e-learning.

7 Elements of the innovation in the research

The research aims to explore the problem of e-learning accessibility and to develop recommendations for those involved in designing e-learning courses and for the support service for disabled students. In the international context, some authors are

beginning to concern with e-learning accessibility; they prove that there is a lack of knowledge of specific accessibility tools, methods and approaches in a pedagogic and didactic perspective. The previous cited studies and research on this topic propose general frameworks and models but don't explain how learning activities should be designed and planned. At national level there aren't yet researches and studies about the design of accessible e-learning taking into account both technological and pedagogical dimensions; courses aren't customized on the needs of disabled students, and there is no awareness of user-centered approaches such as participatory design and Universal Design. Moreover, e-learning in Italian university is a relatively recent issue: there aren't guidelines to design an accessible course that guarantees equal learning opportunities for all. At present, the e-tutors working in the online courses haven't the necessary competencies about accessibility and about special needs, so they can't efficiently support disabled students in the access to the environment and to the learning activities. This research wants to contribute to the accessibility debate affording the problem in all its educative dimensions, integrating the existing technical rules and guidelines with a new point of view focused on the access to all the learning activities that take place in the virtual environment.

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Assessing Mathematical Problem Solving Behavior in Web-Based Environments Using Data Mining

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Abstract. Over the years, mathematical problem solving research has focused on describing the process, as well as on understanding attributes affecting it, and assessing its outcomes. Most of the research in this field is qualitative, and this is understandable due to the fact that cognitive and meta-cognitive investigation involved in problems solving are complicated to be traced. Nowadays, when many problem solving environments are implemented using the web, innovative research methodologies may be applied for assessing problem solving behavior in large populations. The core of this research entails the development of a correspondence scheme between the logged traces of the students and the observed problem solving behavior. Furthermore, patterns of problem solving behavior and the factors influencing them are to be investigated in large population.

Keywords: web based learning environments, mathematical problem solving, log files, educational data mining

1 Introduction

A great emphasis is being placed on students' mathematical problem solving, and this domain is well represented in the curriculums and in the standards for school mathematics in Israel and worldwide [1]. Many problem solving environments are implemented using the Internet infrastructure which can allow innovative research methodologies to be applied for assessing problem solving behaviors. These innovative research methodologies rely on log file records, which automatically and continuously collected by Internet servers, document (almost) every action taken by three basic parameters: what was the action taken, who took it and when [2]. Following that, the core of this research entails the development of a correspondence scheme between the logged traces and the observed problem solving behavior. Furthermore, patterns of problem solving behavior and the factors influencing them are to be investigated in large population.

2 Background

2.1 Mathematical Problem Solving

Problem solving can be regarded as a situation in which an individual is responding to a problem that he or she does not know how to solve with routine or familiar procedures. Problem solving can be described as composed of three dimensions: the problem, the process and the outcome. These dimensions are detailed in the following sections.

The problem. A problem is only a problem if you don't know how to go about solving it. A problem that has no 'surprises' in store, and can be solved comfortably by routine or familiar procedures is an exercise [3, p.41]. Problems may vary in aspects such as: substance, structure, process to be carried, nature, modes of presentation or representation, and in their components and interactions among them. Jonassen [4] described differences among problems in terms of their structuredness, complexity, and abstractness:
Structuredness: Well-structured problems require the application of a finite number of concepts, rules, and principles being studied to a constrained problem situation. Ill-structured

problems, on the other hand, possess problem elements that are unknown or not known with any degree of confidence have multiple solutions, solution paths, or no solutions at all.
Complexity: The number of issues, functions, or variables involved in the problem; the degree of connectivity among these properties; the type of functional relationships among these properties; and the stability among the properties of the problem over time.
Abstractness: Problem solving activities are situated, embedded, and therefore dependent on the nature of the context or domain, because solving problems within a domain relies on domain-specific cognitive operations.

The process. Polya's [5] seminal work suggested that solving a problem involves 4 phases (or episodes): (a) understanding the problem; (b) developing a plan; (c) carrying out the plan; and (d) looking back. Hence, the problem solving process is described as linear progression from one phase to the other. Schoenfeld (1985) observed that during problem solving, students display distinct categories of behavior, also called episodes. Crucial episodes are: analyzing the problem, selecting appropriate mathematical knowledge, making a plan, carrying it out, and checking the answer with relation to the question asked.
Schoenfeld [6], [7], [8], [9], [10] contributed a framework of different factors (attributes) that affect students' abilities to solve problems. In his framework, four components comprise the major aspects of students' problem solving: (a) Resources: formal and informal knowledge about the content domain, including facts, definitions, algorithmic procedures, routine procedures, intuitive understandings of mathematics, and relevant competencies about rules of discourse; (b) Heuristics: strategies and techniques for approaching a problem; (c) Control: the ways in which students monitor their own problem solving process, use their observations of partial results to guide future problem solving actions, and decide how and when to use available resources and heuristics; and (d) Beliefs: what one believes about mathematics, mathematical tasks, and what it means to do mathematics.

The outcome. This dimension consists of the assessment of the problem solving outcome, which involves the assessment of the outcome creativity. Research on creative thinking identified three key components of a creative product: fluency, flexibility and novelty [11]. Fluency refers to the number of ideas generated in response to a prompt; flexibility refers to apparent shifts in approaches when generating responses to a prompt; and novelty – to the originality of the ideas generated in response to a prompt.

2.2 Web-based Learning Environments for Mathematical Problem Solving

Web based learning environments (WBLE) can enhance students' problem solving by providing an environment to engage in playful exploration, test ideas, receive feedback, and make their understanding public and visible [12]. Underwood et al. [13] also recommend that technological tools should support multiple solution strategies and approaches, employ multiple representations, and link between representations. Web-based tools developed for mathematical problem solving include the dynamic geometry system [14], the PACT cognitive tutors [15], and ActiveMath [16].
Healy and Hoyles [17] found that in the context of a dynamic geometry environment, the presence of particular technological resources (features) can either enable or limit certain actions, hence affecting the available heuristics a student may use during his or her problem solving. As students are solving a problem, not only do they need to implement heuristics and utilize resources, but they also need some mechanism to evaluate their progress so that they are aware of, and are critically examining, their own decision making.

2.3 Educational Data Miming (EDM)

When engaging in Mathematical problem solving in web based learning environments, students leave traces of their activity in the form of log file records, which document every action taken by three basic parameters: what was the action taken, who took it and when [2]. Discovering and extracting educational information from these log files using data mining techniques is called Educational Data Mining (EDM).

The term Data Mining or Knowledge Discovery in Databases (KDD) refers to the automatic extraction of implicit and interesting patterns from large data collections [18]. EDM is the application of data mining techniques to educational settings and is an emerging methodology in education aiming to gain insights on the learners' performance in several levels (e.g., cognitive, meta-cognitive) on large populations [19], [20].
Most research about online learners' activity on the web usually focuses on operational variables, (e.g., time patterns, pace, order of contents viewed), while higher-level cognitive variables, describing the characteristics of the learners' online learning, are less studied. This is of no surprise: traditional research methodologies fail to cope with the complex gathering of information about the online learner.
Building on the existing body of literature, this research will focus on gaining new information about the problem solving process, using an emerging methodology, Educational Data Mining. In doing so, we pursue a better understanding of the cognitive and meta-cognitive processes involved in problem solving, acquiring specific information about major problem solving attributes influencing the problem solving process in large populations.

3 Research Objectives and Expected Significance

The main purpose of the suggested research is to explore cognitive and meta-cognitive processes during problem solving activities in online environments being used in elementary schools. To this end, log files of the learning environments – automatically and continuously being collected – and Data Mining tools and techniques will be used to portray the online learner's behavior. Bridging the gap between the analyzed logged data and the problem solving processes is the core of this research and its main contribution. Three objectives have been defined for this research:

1. Developing a conceptual framework, a computational mechanism and a correspondence scheme between them for assessing mathematical problem solving behavior in Web-based environments by means of logged data.
2. Identifying different patterns of online problem solving behavior using quantitative analysis for large population (N>1,000).
3. Examining the effect of different attributes (e.g., problem type, student pre-achievement level, creativity) on problem solving behavior.

The significance of the proposed research is two-fold. On the practical level, results of this study will enable the automatic assessment of problem solving processes for large populations; this will aid both instructors and researchers to better understand students' behavior. On the theoretical level, association between problem solving attributes and phases will be empirically tested on large population; this will shed light on the nature of problem solving processes and will provide the current body of knowledge on problem solving with empirical evidences.

4 Methodology

Large scale assessment of learners' problem solving has been a challenge for both researchers and instructors for many years. The main reason is the nature of the problem solving process, which involves attributes from cognition and meta-cognition dimensions – and the notion that these dimensions are traditionally examined using qualitative tools and methods with small-scale populations.
The basic assumption of our research is that problem solving behavior is reflected in the student's behavior while interacting with an online problem solving web-based environment; hence, traces of the student's problem solving behavior might be extracted from the log files and may shed light on this behavior for large populations in ways that were not previously possible.

Research Population. Participants in research will include 10 fifth and sixth grade students divided to two equal groups for the construction of the correspondence scheme. Later on, log

files from a large population (N>1,000) of students of the same grade levels will be analyzed for the large-scale assessment of problem solving behavior.

Research Field. An online learning environment in Mathematics (developed by CET - Center for Educational Technology) was chosen, including problems that differ in structuredness, complexity and domain by using a grid on which students can construct geometry objects (e.g., dots, angles, lines, polygons), measure them (length, area, angle), and transform them (move, resize, delete). In addition, student can color squares formed by the grid. This Geometry Applet has many applications within the Israeli elementary school Mathematics curriculum, and it's being used for, e.g., representing fractions, constructing polygons, finding patterns, and measurements. The applet stores the student actions in fine-grained log files.

Research Variables. Independent and dependent variables, based on the literature review, include 3 independent variables and six categories of dependent variables, as detailed in this section. The conceptual framework describing the theoretical relations between these variables is illustrated in Fig. 1.

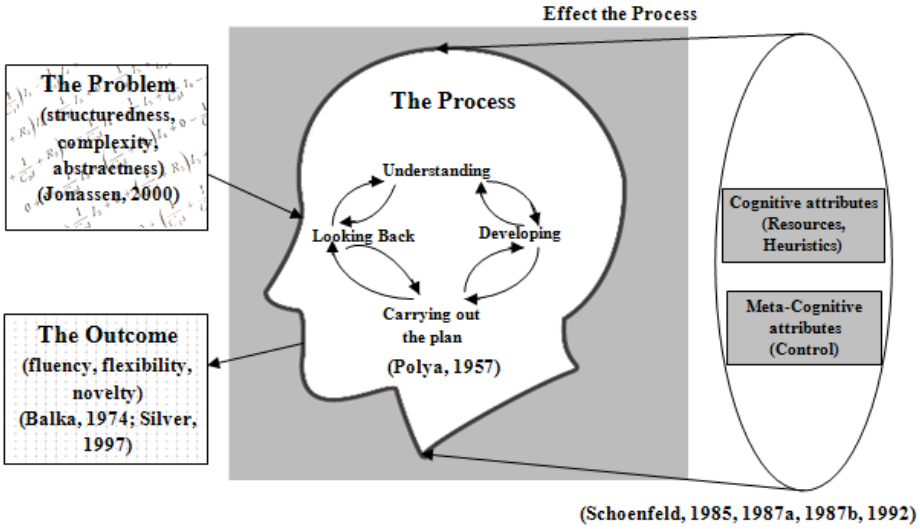

Fig. 1. The conceptual framework of the research.

Independent Variables. Three variables were defined for describing the problem:

1. Structuredness - distinguishes well-structured from ill-structured problems
2. Complexity - defined by the number of issues, functions, or variables involved in the problem. Problem difficulty is a function of problem complexity
3. Abstractness - nature of the context or domain (the battery of tasks include tasks involving fractions, geometry and patterns).

*Dependent Variables***.** Six categories of variables were defined. The first two categories (attributes related) are defined according to Schoenfeld's framework [6], [8], [10], the third category (process related) is defined according to Polya's work [5], and the fourth category (outcome related) is defined according to Belka [21] and Silver [22]; the fifth category consists of log-based variables. Following is a description of these categories:

a. Cognitive attributes – within this category, two sets of variables were defined to describe the conceptual and procedural knowledge of the students: The procedural knowledge is measured by the student's acquaintance with resources (e.g., facts, definitions, procedures, rules, intuitive understandings of mathematics), the conceptual knowledge – by the student's using of heuristics (i.e., strategies and techniques for approaching a problem).
b. Meta-cognitive attributes – this category holds variables describing the control of the student (e.g., the methods in which one monitors the problem solving process, uses

observations of partial results to guide future problem solving behavior, and decides how and when to use available resources and heuristics).

c. Process description – the way the student is progressing from one phase (of the four possible phases) to another.
d. Product assessment – this category holds 3 variables for evaluating the product/solution: *Fluency*, *flexibility*, *novelty*.
e. Log-based variables – the 4 variables to be extracted from the log files are: *Current Tool* ; *Action*; *user; and Time*

Research Instruments. Three main sets of instruments serve this research:

a. Think-aloud protocols – Think-aloud is a method for describing and analyzing thinking processes, during which the student is being asked to verbally describe thoughts and feelings - out loud and in details – simultaneously during a task operation [23].
b. Learnograms – visualization tool for presenting log-based learning variables over time [24]. Learnograms will be used in order to portray the problem solving process by means of episodes, as was done qualitatively by Schoenfeld [10].
c. Battery of tasks – several online tasks using the *Geomtery Applet* were developed, representing different types of complexity, problem space. The tasks will be planned in accordance to the research population syllabus.

Procedure. A Mixed Method [25] involving both qualitative and quantitative analysis, has been chosen for this research. Problem solving behavior will be assessed by means of qualitative research (using think-aloud protocols), as well as actual learning behavior in the online learning environment using Learnograms; patterns of problem solving processes and factors affecting them will be investigated using quantitative methods using log files.

Phase I – Constructing the Correspondence Scheme. During this phase, data from both students and log files are triangulated, aiming to reflect on students' problem solving behavior in log files. The procedure is as follows:

1. Identifying a list of behavioral variables to be extracted from the log files, based on the theoretical framework. Examples of variables include: order of actions, number of solutions, and total time for reaching the solution.
2. Characterizing a list of variables related to the cognitive and meta-cognitive attributes of problem solving, based on qualitative analysis with a sample (N=5) of students representing the discrepancy in the population background (knowledge level, achievements). To this end, observations, interviews and think-aloud protocols will be used. Examples of variables include: creativity, solution strategy.
3. Assessing the means by which attribute-related variables are reflected in the log-based behavioral variables.
4. Validating the scheme by studying a second small set of students (N=5). A second researcher will be given with a description of these students' problem solving behavior, based on their log files, and with think-aloud protocols of them. The second researcher will compare his or her understanding of the think-aloud protocols with the results from the log files analysis.

The expected result of this phase is a validated correspondence scheme for "translating" the qualitative-based outcomes to computable variables based on automatically collected data.

Phase II – Large-scale Problem Solving Characterization. Based on the correspondence scheme constructed in Phase I, the purpose of this phase is to investigate problem solving processes and attributes in large population (N>1,000) by means which were not feasible in previous research.

Distribution of variables describing the problem solving attributes and phases will be investigated, in order to better understand their expression in large population. Furthermore, relations between the variables will be examined using statistical and Data Mining methods, to acquire better understanding and more specific information about major problem solving attributes reported as influencing the problem solving process in large populations.

Phase III – Finding Factors Associated with the Problem Solving Process. A few factors will be investigated in order to associate problem variables (structuredness, complexity, and abstractness) and student variables (achievements level, creativity) with problem solving attributes (cognitive and meta-cognitive) and process. To this end, statistical and Data Mining methods will be used.

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Building Knowledge in Virtual Environments – Influence of Interpersonal Relationships: the outlined research

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Abstract. This article presents a PhD research project that will determine how to enhance learning, at the university level, based on implemented experiences in immersive collaborative virtual environments. Today's students belong to a networked and multitasking generation, and today's teaching strategy does not, in many situations, embrace their needs and perspectives. They need to gather competences in order to become motivated, communicative, knowledge builders. It is our belief that educators can take advantage of virtual environments to develop those competences and transfer them to real-world learning contexts.

Keywords: collaborative virtual environments, technology enhanced learning, Connectivism, knowledge building, interpersonal relationships, Second Life

1 The Outlined Research

We are conducting a research study that is being developed as part of a Doctoral Program in Multimedia in Education, under the name *Knowledge Building in Virtual Environments – Influence of Interpersonal Relationships*. The study is being conducted online using the virtual platform Second Life (SL).

The research project emerged from the need to "observe some of the variables that have been already identified by Bettencourt's study and give it continuity"[1]. These variables are related with three major areas: the person and their motivations; the relationships that exist or are established between avatars (SL users) or between avatars and persons; and finally the social integration in SL (by which we mean sense of community). The three main areas are interconnected, and can't be observed independently since they all influence one another. Our research concerns are more focused on learning relationships that are established in the real-world then flow through a Collaborative Virtual Environment (CVE) and back to the real-world again; we are looking to establish whether this flow is complementary. We will observe in-world educators and learners in formal and informal (natural) contexts of learning. Educators and learners – from Portuguese universities and polytechnics – represent our research sample. This is a no-probabilistic intentional type of sample.

It is qualitative study with an inductive and exploratory character. Qualitative studies are defined as being "an inductive form of inquiry (…) that explores

phenomena in their natural settings and uses multi-methods to interpret, understand and bring meaning to them"[2]. It is also defined as an exploratory study because the main data collecting will be achieved through the observation of some identified key indicators (such as the avatar appearance and how the avatar behaves in a learning group or community). This will help determine the level of growth, motivation or socialization of the avatar/person in the CVE. To complement this, surveys (with closed answers) will be used to inquire about the students experience of entering, using and interacting in the CVE – gathering information such as time spent in-world, activities, difficulties, curiosity and level of social integration (e.g. group membership).

The main goals of this research are: (i) analyze several contexts of educators and learners and identify the reasons for them to engage and grow in SL, and what they experience; (ii) understand the way in which interpersonal knowledge in the real world can combine with the personal development/growth in CVEs; (iii) achieve insights to a better understanding of the way knowledge is constructed in CVEs and then transfer it to real-world contexts of learning – with an impact in traditional teaching strategies. We expect this study to provide some "insights for all educators and researchers interested in using those environments as a teaching medium in real life, and propose new approaches to better prepare the university students for the marketplace that will emerge"[1]. To achieve these goals, the research will question the following themes: (i) what are the main reasons/motivations for educators and learners to join SL; (ii) what are the main factors for them to stay and interact in SL; (iii) what are their personal paths of development/growth in SL; (iv) how does interpersonal knowledge cycle around between the real-world and CVEs.

2 State of the Art

We are no longer simple information collectors (Web 1.0), now we are active and reactive users; we develop and share content and information (Web 2.0). Although some authors believe we are in the Web 3.0 era already, relating to "virtual environments in which we meet as avatars, interact as 3D moving objects that takes sharing, co-creation and communication to the next, predictable level"[3]. SL is the best representation of this idea, its environment is like an "ever growing virtual playground that is limited only by the creativity of its users"[4] that allow us "to build 3-D objects collaboratively and in real time with others in the same world [with major applications at] building, design, and art principles"[5]. SL is also a "rough simulation of the natural world, with meteorological and gravitational systems, the possibilities of experimenting with natural and physical sciences are endless [and all this] in a safe and controlled environment"[5]. The educational potential is that, within an immersive environment, we are walking inside the material, not just viewing it from a distance.

For instance, there are many examples of ancient buildings and cities (some of them have already disappeared at real-worl) that can be visited in SL. The Sistine Chapel has been modelled in great detail so we "can fly up to the top of a wall for a close inspection, look down at the inlaid floor, or even sit on a window ledge"[6]. As

Tailor says the “purpose of this re-creation is to explore the use of virtual reality for teaching and learning about art and architecture, by experiencing the context, the scale, and the social aspects of the original”[6]. Another example is the reconstruction of ancient city of Rome [7] or the city of Lisbon pre-earthquake 1755 [8]. The potential is not limited to anthropology or humanities. One example from the physical sciences on molecular motion illustrates how SL can emulate “the way that hot and cold molecules interact with one another in an environment of uneven heat distribution”[9]. In the medical field, some experiments for training medical students are running [10]. SL is also a good environment for language education, which is justified by the fact that “instructions are context-embedded and therefore the approach treats the second language learner as if he/she was learning his/her first language - which incidentally would correspond to the playful type of language learning present in SL”[11]. Some examples of ongoing research in education can also be found at the SLED (Second Life Educators) list [13]. We have perceived that “Education began, slowly, to realize that many of the attributes of great game playing, from the intellectual challenge to the provision of multiple learning styles, had an immediate part to play in learning”[14].

The advantages of the social web are becoming clear, students “have a lot of practice of e-mailing, blogging, googling, chatting, gaming, and so on!”[1]. Students “entering universities after 2000 (…) were portrayed as needing a more media and IT driven learning environment”[15]. But what do they get when they arrive at University today? For the most part it is the same old strategies from the last century; where students “are asked to sit in rows and listen to lectures, take notes or solve exercises given by teachers. It’s a teaching strategy that doesn’t prepare students to be critical citizens and professional workers on their specialty, nor give them the skills and competences needed to be autonomous and constructors of knowledge”[1]. Our students now live in a multimodal and interconnected world and for them this “way of dealing with information is much more intensive than listening to one source of information at a time”[16].

3 Theoretical Framework

We are conducting the research under the theory of Connectivism; a theory for the digital age. According to Siemens, the theories most often used to describe the learning process (Behaviorism, Cognitivism and Constructivism) do not consider the ways that learning is impacted by technology. More often than not, technology “has reorganized how we live, how we communicate, and how we learn”[17], therefore learning theories of the digital age should be reflective, and with a glance at social environments, since learning (especially in its informal and natural form) often is widely influence by it. Other ways of achieving learning have arisen through social networks and the types of connections that the Web allows. As Vaill said, referred by Siemens, “learning must be a way of being – an ongoing set of attitudes and actions by individuals and groups”[17]. It is important that we perceive learning as a “lifelong process of transforming information and experience into knowledge, skills, behaviors, and attitudes"[18]. To learn is to “acquire certain patterns”[19]. It is also the result of

the interactions and connections that we establish with fellows of our community, peers, personal or social networks. In this way "to know something is to be organized in a certain way, to exhibit patterns of connectivity"[19].

We will be using the Connectivism approach because SL embraces its main assumptions. SL enables a contact and connection with a diversity of opinions, nodes, links and specialized information sources. Because it is digital, virtual and immersive it allows those information links to be more interactive, which enhances the learning and information sharing. It is an endless network of links allowing contacts to flow in between virtual platforms (2D, 3D) and real-world. In our opinion, the motivation and sense of community that are generated among SL users helps to create, develop and maintain connections; it facilitates a process of continuous, natural and lifelong learning. The environment has available a huge number of communities and groups serving a wide range of likes, needs, interests. Inside these groups, or communities, relationships are established and information flows. Members build and share, becoming content providers themselves.

Connections are made and the network of relationships grows and gets reinforced progressively. The bonds that are created between the members quite often jump the borders of the 3D CVE. They continue outside through a 2D platform, or even at real-world. Connections are like a snowball effect. The individual network is made of, or complemented by, friends' networks. As Stephenson said "I store my knowledge in my friends"[20]. In this digital age we have a network of connections that is made of links and nodes with others. It is a "collective knowledge through collecting people"[20]. Therefore "Know-how and know-what is being supplemented with know-where (the understanding of where to find knowledge needed)"[17]. The Internet provides new ways of making those connections and provides an extra dimension of collaborative sharing. Knowledge is "distributed, because it is spread across more than one entity. A property of one entity must lead to or become a property of another entity in order for them to be considered connected; the knowledge that results from such connections is connective knowledge"[21].

In a CVE there are no physical barriers or borders. Information flows, people build and share content, relationships are set up, the net of connections extends and knowledge is built. This acquisition is made in a natural way, by participating in a community, by sharing, interact and collaborate, discussing and launching ideas, contents and information, therefore a "learning activity is (...) a conversation undertaken between the learner and the other members of the community"[19]. It is a natural process of interaction and reflection with the guidance and correction of expertise or peers.

4 Preliminary Findings

The research hasn't been fully implemented yet. We are tracing the theoretical framework, gathering the literature that will underpin the study and preparing the materials to be used for data collecting. Consequently, we don't have data to analyse nor discuss at this time. We have some expectations and a priori assumptions that

arose from the initial literature review and from a small pilot study that was developed. We "have used the experience of a pilot to frame questions, collect background information and adapt a research"[22]. The pilot study was a test to gain experience of the use of CVEs in learning contexts. We seek to learn (i) how students engage with web 2.0 tools and CVEs; (ii) whether the tools and the CVEs show improvement in collaboration; (iii) how well the tools and CVEs promote knowledge building.

In the context of the broader research goal, the pilot study was structured to understand how effective a CVE is as a proxy for face-to-face interaction. Some preliminary findings can be drawn. First we found that the initial set up cost of starting SL (the CVE used at pilot) was high (in tutorial days). The students had no prior experience of SL so the first tutorial became a focus for fixing 'new user' issues. The SL environment has a steep learning curve: how to move, how to interact, how to communicate, how to customize. Predominantly this was navigating the world and helping with avatar appearance. However we felt that this was time well spent as rapid integration into the world is an important prerequisite to collaboration. Two in-world sessions were devoted to students' acquisition of basic skills (+- 6 hours during successive weekends). A number of students engaged in-world beyond teaching hours. In future sessions it was easy to see those who had spent more time learning – avatar appearance is one indicator. Another conclusion from the pilot is related with knowledge building which seemed to be a function of maturity, level of independence as learners and intrinsic motivation. The motivation aspect needs deeper evaluation (where free will is involved). On our broader research question, we can also say that the interpersonal relationship that was established between educator and students is an influential factor on performance. In a mature group, the friendship relationships established seemed to be deeper and stronger between educator and students.

Second Life, as a natural and informal immersive collaborative virtual environment, can be used for the set of e-learning 2.0 contexts. Downes defines e-learning 2.0 as being "an approach to learning that is based on conversation and interaction, on sharing, creation and participation, on learning not as a separate activity, but rather, as embedded in meaningful activities such as games or workflows"[19]. In an immersive environment people can live the experience, live the learning, and thereby may learn better. For us these are alternative methods of presenting content, as an attempt to catch and maintain student's attention and motivation. In fact immersive environments could have a huge potential for education because they can facilitate "collaborations, community and experiential learning"[23]. Our idea will allow educators to create a better learning environment by understanding what makes learning the most successful in a CVE. It seems that informal learning is the best approach as this is already practiced by our students. We think that CVE might provide a better online ambiance for informal and natural learning.

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Exploring how faculties use and rate Web 2.0 for teaching and learning purposes

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Abstract. While some innovative practices have been identified and disseminated, a wider adoption of Web 2.0 tools in Higher Education (HE) teaching practices is not taking place. A study of the drivers and barriers of these technologies in HE outlines that implementing these approaches entails contradictions and conflicts with faculties' and students' beliefs and expectations. Based on a critical perspective of both the adoption of educational technology and Web 2.0 affordances for teaching and learning, this study analyzes the compatibility of Web 2.0 tools to the way that faculties understand learning and teaching.

Keywords: Web 2.0. Higher Education, Collaborative learning, Self regulated learning, Bologna process.

1 Introduction

The pervasive popularity that social networking applications and user generated content have acquired is probably the most important phenomenon in the evolution of the Internet over the past five years. The widespread use of the Web 2.0 tools that shape the "social Web" is significantly affecting the way we relate with others and how we access information and cultural content. In the field of learning, new tools for organizing, sharing resources and building communities are available and have shaped an alternative trend in educational technology [1][2] to the existing Virtual Learning Environment (VLE) model of educational technology in HE institutions. While many researchers have indicated that this model of educational technology has not lead to a substantial pedagogical change [3], a growing number of projects and initiatives inspired by the possibilities of social media seek to reformulate the methods and even the mission of HE [4][5]. According to this trend, Web 2.0 tools will foster collaborative learning, increase motivation and participation, help students to acquire skills for self-regulated learning and weave connections between formal and informal learning. Nevertheless, like other generations of educational technologies before, the adoption of Web 2.0 tools in HE practices need to overcome some tensions and barriers. Based on a critical perspective of the integration and impact of educational technology in HE, this study focuses on the specific drivers and barriers for the adoption of Web 2.0 tools from the point of view of faculties.

1.1 Identification of research questions and related significant problems

Web 2.0 tools and the new social behaviors brought about as a result of their uptake provide the basis for the development of new ways of learning and teaching in the field of HE. However, while some innovative practices have been identified and disseminated, a wider adoption of Web 2.0 tools in HE teaching practices is not being observed [3][7]. A study of the drivers and barriers of these technologies in HE outlines that implementing these approaches entails contradictions and conflicts with faculties' and students' beliefs and expectations [8]. Recent research has also highlighted that we cannot take for granted that the wide majority of young people are fluent in using ICT and interested in online learning [10].

The aforementioned issues allow us to conclude that wider research is needed in order to understand the drivers and barriers for the introduction of Web 2.0 tools in HE practices. Faculties play a very significant role in the adoption of technology enhanced learning (TEL) innovative practices [11] and this fact has motivated this doctoral research to focus on their perspective. Nevertheless, a research on drivers and barriers for the adoption of Web 2.0 in HE practices from the perspective of faculties need to be based on previous work on factors affecting the adoption of educational technology [37][38]

This new trend in educational technology converge in the European HE landscape with the Bologna Process, whose teaching methodologies principles, such as collaborative learning, self-regulated skills development, active learning methodologies and formative assessment, are directly or indirectly aligned with the affordances of the Web 2.0 tools for learning [6]. Self-regulated learning [12] is a core aspect in this topic. On the one side, Web 2.0 tools are critical in the development of digital and informational literacies [13]. On the other hand, the degree of development of these skills can also be critical for the effective integration of Web 2.0 tools in teaching and learning practices.

Thus, this study is focusing on faculties' perception of the benefits of Web 2.0 tools for learning and teaching in the context of HE and more precisely in the context of adaptation to Bologna teaching methodologies, particularly in aspects related to collaborative learning, self-regulated skills development, active learning methodologies and formative assessment. Moreover, based on the assumption that beliefs are crucial in faculties' adoption of innovative practices [14], this study will also explore faculties' utilization and rating of these tools for their personal learning.

To sum up, the objective of this study is to acquire a deeper understanding of the drivers and barriers for the adoption of innovative practices using Web 2.0 in the context of the adaptation to EHEA teaching methodologies from the faculties' perspective. The research question of my work states as follows: How do faculties rate Web 2.0 tools as instruments for self-directed learning and as instruments for teaching in the context of the adaptation to the Bologna teaching methodologies?

With this aim in mind, six secondary research questions have been identified: 1) Do faculties use or have the intention of using Web 2.0 tools in their teaching practices? 2) Do faculties use Web 2.0 tools for the personal learning? 3) How do faculties rate Web 2.0 tools affordances for their personal learning? 4) Do faculties believe that students should learn to use Web 2.0 in order to improve their self-regulated learning

skills? 5) How do faculties rate the affordances of Web 2.0 in their teaching? 6) How do faculties rate the role that Web 2.0 tools can play beyond the classroom scope?

1.2 Related work

The analysis of Web 2.0 adoption needs to take a wider perspective on the drivers and barriers for the adoption of educational technology in HE. Many researchers have outlined that the implementation of online learning environments in the HE institutions has not lead to an educational transformation [3][29][30]. Similarly, some authors have argued that strategies in the early stages of educational technology implementation in HE institutions misunderstood the affordances of online learning environments [31][32]. According to Salmon [32], in a second stage in the implementation of educational technology, HE institutions focus on providing cost effective procedures alternative scenarios or on combining traditional approaches with e-learning. Nevertheless, this author indicates that some weaknesses remain in HE strategies: 1) fragile business cases, 2) lack of best practices models, 3) higher incentives for research outcomes than teaching innovation and 4) weak transfer from research to implementation. As a conclusion of this analysis, Salmon [32] proposes a more complex model of diffusion of innovation than Rogers' [33], which take into account incremental and radical innovation.

Teachers play a key role in the adoption of educational technology based on innovative practices, as indicated by the results of Zhao et al [11]. These authors conclude that, while the aspects related to the context (facilitating conditions and culture) and to the innovation to be adopted (distance to practices, culture and resources) are very important, the aspects related to the teacher (technological skills, compatibility with current teaching practices and awareness of the organizational culture of the institution) remain the most determinant factors of success. Mumtaz [39] revision of factors affecting teachers' adoption of ICT comprises "inhibitors", such as "lack" of experience with ICT, on-site support, ICT specialist teachers, time, access, and financial support; causes of "teachers' resistance" (outside intervention, time management, lack of administrative support or organizational change, and teachers' perceptions linked with "personal and psychological factors"); and drivers, such as obtaining support for adapting their teaching practices to a more student centered approach, making the lessons more interesting, diverse and motivating, improving the presentation of materials, allowing greater access to computers for personal use, acquiring prestige, gaining in efficiency and developing their professional skills. In order to understand the particular position of faculties in the context of HE, other factors need to be taken into account, such as the high degree of autonomy [35], the differences existing in the academic culture of different disciplines [36] and the aforementioned pressure for research outcomes [32].

Web 2.0 specific affordances in education, as an alternative trend to current model of educational technology in HE, can be summarized at four different levels: 1) inquiry, or information literacy, as a result of new ways of searching and organizing resources in the Web, 2) digital literacy, expanding the writing scholar tradition to new modes of representation and expression, 3) collaboration, with different levels of engagement forming a continuum between trivial anonymous aggregation to strong coordination,

and 4) publication, which entails means for creation – read-write Web –, but also the fact of displaying to others, even beyond the scope of the classroom [5]. Therefore, as a sub-ensemble of educational technology with specific characteristics, general and particular drivers and barriers, and also some more specific ones affect the adoption of Web 2.0 tools.

A brief summary of the potential benefits of Web 2.0 tools in education identified by desktop research includes the ability to 1) foster collaboration and peer support [18][19], 2) increase motivation and participation [17][21][22], 3) promote the development of skills for self-regulated learning [19][23] and 4) help to bridge formal and informal learning spheres [18].

On the other hand, it is also necessary to acknowledge that there are also significant challenges to Web 2.0 integration in teaching practices. As Crook (2007, p5) [5] has outlined, the "slow educational uptake […] reflects the fact that adoption of Web 2.0 creates a number of practitioner tensions". Very frequently, many of the affordances of Web 2.0 for learning rely on self-motivation, but the driver for participation when such approaches have been applied in formal learning setting is strongly connected with summative assessment [24][19]. Besides, motivation for using these tools can decrease when students are requested to use them for academic purposes [25]. It is also convenient to remember that not all HE students and faculties are equally fluent in using online environments [26][18]. Furthermore, introducing these tools in teaching practices increases faculties' workload, as they need to develop creative approaches in order to face the aforementioned students' lack of motivation and deal with the settings of distributed environments not supported by their institutions [5]. In addition to this, while there is a position arguing that the real potential of Web 2.0 for education relies on working in an open and networked environment [27], other studies highlight that some students are reluctant to publish in open environments [28].

2 Preliminary approach and methodology

The first phase of the research is conducted through an online questionnaire sent to faculties of the University of the Basque Country (UPV / EHU) in order to obtain a minimum of 200 participants filling in the survey correctly . The number of participants by area of knowledge (Arts and Humanities, Social Sciences and Law, Health Sciences, Sciences, Engineering) must also be proportional to the number of faculties in the different areas. This ratio between the sample and the total number of faculties in the university will apply also for different age groups.

The questionnaire consists of 30 questions split into four groups. The first group includes questions on personal data and aspects of knowledge, use and value of Web 2.0 tools by faculties, the second group includes questions about the use of Web 2.0 tools by faculties for personal purposes, the third group includes questions relating to the rating of faculties of the drivers and barriers related to the use of Web 2.0 tools in the classroom, and finally, the fourth group includes questions related to the affordances of Web 2.0 tools for supporting learning networks and communities beyond the classroom.

The results of this questionnaire will be further processed by the researcher and presented to a group of faculties with advanced knowledge on the subject of study for an analysis following the methodology of focus groups.

3 Phd's project contribution

This study proposes a detailed review of specific aspects related to the integration of these tools in the classroom and analyzes how these technologies fit in with the teaching methodologies marked by the convergence process to the EHEA. From this point of view, this research hopes to obtain a complementary perspective to previous related work based on the theory of planned action and the unified theory of acceptance and use of technology (Ajjan et al., 2008; Usluel et al. 2009). The results of this research can also be seen in two different axes: the diagnosis of the skills and attitudes of teachers regarding the educational use of Web 2.0 tools and the reflection and subsequent construction of knowledge. On the one hand, the data obtained through the questionnaire will be used to assess the impact Web 2.0 tools have in the educational community from different perspectives (awareness, rating, utilization, scope of utilization), and to evaluate the relation between these perspectives.
On the other hand, using a focus group methodology for the subsequent analysis of the responses to the questionnaire provide the means for a deeper interpretation because it provides a framework for contextualization and validation of results. Moreover, engaging a group of faculties with extensive experience in innovative practices based on educational technology in the discussion of these data brings the opportunity new relevant aspects related to the research questions.

Acknowledgments: This work has been supported by University of the Basque Country (EHU09/34) under the project "Social Networks for enhancing Life-Long Learning"

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Towards an Adaptive Enterprise Systems Learning Environment for Higher Education

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Abstract. The need of knowledge about well-known Enterprise Systems cannot be ignored by modern higher education institutes. Especially the practical handling and understanding of these systems is not imparted by today's universities in an appropriate way. Thus, we observe an increasing need for adequate teaching methods going along with the demand for a better technological support via adequate software systems. The main objective of this PhD project is to develop a concept for a technologically enriched, integrated, and adaptive environment which supports the individual learner in his learning process. The basis for this adaptive approach is the analysis of information which is stored in trace-files coming from the Enterprise System. Thereby, it is possible to deduce the knowledge level of each individual and optimise further exercises to build the needed competence.

Keywords: Adaptive Learning Cycle, Adaptive Learning Environment, Application Usage Mining, Enterprise Systems, Higher Education.

1 Introduction

In today's education system we are facing various new challenges. Especially the current situation for higher education institutes is affected by major changes coming from different perspectives. Universities and universities of applied sciences, as the major education institutes, complain about high drop-out rates, shoestring resources, and an increasing pressure of competition. From the students' perspective, we can observe a development towards an output-oriented perception, a higher attendance for continuing education, and a rising mobility. Besides the institutional and the students' perspective a third domain perspective is identifiable, which is affected by often changing requirements regarding the content of teaching. Furthermore, different demands coming from the industry and public authorities have to be brought in line with ongoing research topics. Especially in the domain of teaching Enterprise Systems (ES), like ERP systems e.g., this balancing act between industry and research has a very high significance. ES are a good example for the combination of industry and research topics and also allow a very good insight into the illustration, visualisation, and simulation of business and decision-making processes to students

[1]. Therefore knowledge in development and handling ES is highly recommended. This is also underlined by many studies, which show that graduates with experience in ERP systems have better chances on the job market [2], [3], [4]. The industry asks for an adequate knowledge level in handling the most popular ES in order to meet today's market requirements and stay competitive. In summary, ES can be seen as an important component of a modern academic education. Higher education institutes are facing an increasing demand for a sufficient practical education, which has to go along with the communication of the expertise in theoretical knowledge.

Starting from the problem definition in the next subsection (1.1), the objectives of the PhD project will be described. On the basis of these objectives, concrete research questions will be derived (section 1.2). Furthermore, the procedure on how these problems can be solved is explained and a link to the relevant and used research methods is given (section 1.3). In order to meet the requirements for a proposed Enterprise System Learning Environment (ESLE), a conceptual idea for an architecture is introduced in the next section (2). The impact of the PhD project contribution to the problem solution is described in the following section, including a discussion on how the suggested solution is different to existing approaches (section 3). The contribution will close with a summary and final conclusions (section 4).

1.1 Problems

Teaching the handling of software systems, particularly enterprise systems in a practical way, is a relatively new discipline. The development of new software systems is a very fast changing field in comparison to other domains. One occurring problem is the lack of appropriate learning material. The existing material is often realised through case studies (like e.g. the SAP® IDES[1]), which describe a real business scenario and consist of one or more occurring problems resulting in exercises. The students have to work on these practical exercises in order to solve the defined problems. Unfortunately, the success of the case studies lacks for different reasons: Often the students do not understand the underlying business processes with its integration aspects, because the exercises are formulated too specific in order to allow a wide-spread constructivist learning approach [5]. In most cases, the teaching concept does not consider pedagogical aspects in order to support the individual learning process. Furthermore, case studies are presented to a whole classroom, whereby the learning material does not care about individual strengthen and deficits of every single student. Another disadvantage is the lack of a technological support in solving the described problems. How can the learning material be connected to existing Learning Management Systems (LMS) or further supporting systems?

Other practical learning approaches, like ERP simulations (e.g. ERPsim by Léger et al. [6]), do neither cover the integration of a more detailed theoretical insight nor consider the individual state of a learner. In order to solve these problems, the main objectives of the PhD work are described in the next section.

[1] IDES = International Demonstration and Education System

1.2 Objectives

After giving a short insight in the current problem situation for teaching ES in higher education, the main objectives of the PhD project can be formulated. Generally spoken, the main objective of the PhD project is the development, conceptualisation, and prototypical implementation of an adaptive ESLE on the basis of trace-file information in order to improve the overall learning process of the individual learner. Therefore, the learning material, which is presented to the learner, is varying in its specification depending on the prior behaviour of the learner. This information can be deduced from trace-files, which are provided by the most common ERP systems and track nearly each step of the user. This information allows a real-time supervision of each user and gives information about the degree of fulfillment of given exercises. A very important aspect is the integration of the planned learning environment into the familiar working environment. More precisely, the learner will receive hints and exercises, adapted to his individual state, directly from an overlapping interface which corresponds with the regular interface from the ERP system. These objectives lead to the following research questions:

- To what extend can trace-file information allow assumptions about the students learning behaviour, learning styles, and the measurement of learning success?
- How can the learning process, regarding the domain of ES, be improved on the basis of a technology enriched, integrated, adaptive learning environment?

1.3 Scientific Approach

The scientific approach consists of an intensive literature research which also includes a comparison of the main existing solutions and research activities in this field. In parallel, a first conceptional design of the targeted architecture for an ESLE will be developed. The resulting ESLE architecture will build up the basis for a prototypical implementation in the university environment. With this prototype, the theoretical results of the PhD project can be evaluated. Emerging results from the whole PhD work will be summarised in other contributions, which will be submitted to relevant conferences in order to receive feedback from international experts for technology enhanced learning and ES education.

The current state of the doctoral work is the development of the ESLE architecture. More precisely, the actual topic is the comparison of different mining technologies in a technical way for tracking and analysing purposes. Until now, four contributions have been published and presented on international conferences [7], [8], [9], [10].

2 Idea

The main idea of the presented approach is to support the learning process on the basis of trace-file information. Introducing the developed Adaptive Learning Cycle

(ALC) [7] in the next subsection (2.1), the main characteristics of the considered architecture (section 2.2) will be presented.

2.1 Adaptive Learning Cycle

The focus of the idea is primarily on the learner itself. This learner-oriented view assumes that an ESLE is based on the individual and his specific qualification [7]. In order to describe the main idea more general, the ALC is visualised in figure 1. Within the ALC, exercises and tasks are adapted to the individual state of the learner.

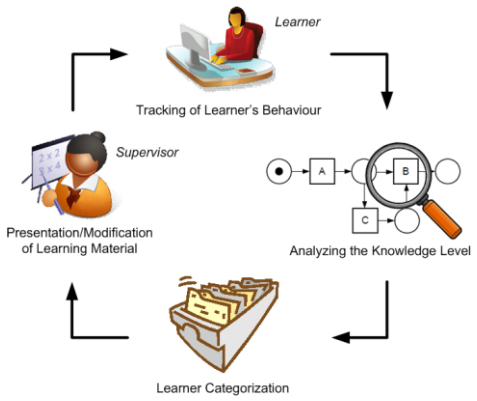

Fig. 1. Adaptive Learning Cycle.

The ALC is subdivided into four areas: Initially, it starts with the tracking of the learner's behaviour, while he is performing a specific task directly in the system. On the basis of this information, it is possible to analyse the learner's behaviour and derive some detailed information about the knowledge level, strengths and weaknesses or general information about the learner and his familiarity with the system. This leads to a categorisation of the learner as a result of the analysing phase. Depending on the assigned category, the learning material can be modified by an advising entity (a lecturer e.g.) and presented to the learner. The effectiveness of this new advisement can also be measured in later cycles. For this case, the success of the new modified learning material, which was presented to the learner, can be analysed via a second run through the ALC. If applicable, are new categorisation of the learner can be made. The concrete functionality will be described within the component description of the architecture of the ELSE in the following section.

2.2 Enterprise System Learning Environment Architecture Approach

At the current state, the development of the ESLE architecture is main task of the PhD work. Therefore the main characteristics of the already defined components will be described. The overall architecture approach is build up on the basis of the ALC.

Later, the resulting architecture will provide a definition for the necessary components and their connections between each other. The architecture will also provide the basis for a later prototypical implementation for evaluation purposes.

Tracking. The ESLE architecture has to include a tracking component, which is responsible for a real-time extraction of trace-file information from the underlying ERP system. The tracking can be carried out during the daily work integrated into a workplace, during a training course, or in a curricular environment. The most ES are logging transaction data via trace-files and protocols. In a SAP® ERP system for example, a huge amount of data is collected during daily operation. In so called user-trace-files detailed information (e.g. name of the performing user, transaction codes, input values, time duration, etc.) about the performed interaction between the user and the system is stored, which can be used for further analysis.

Analysing. The analysing component of the ESLE architecture has to interpret the tracking information in order to find out patterns, which are relevant for the learning aspects like the performed transactions, in- and output data, or the required time. In this component, different existing mining technologies such as Application Usage Mining (AUM) [11] or Educational Data Mining (EDM) [12] come into operation. The derived patterns can be used in order to categorise the learner including a consideration of the current exercise he performs.

Categorisation. The challenge of the learner categorisation is, to evaluate the degree of task fulfillment. Therefore the categorisation component has to compare the intended learning target of the exercise with the concrete transaction, the learner has performed at the system (coming from the analysing phase). On the basis of this result, the new individual learning material can be presented to the learner. Thus, the learner receives an ad hoc response to his performed task, whereby strengths and weaknesses can be handled in an optimal way.

3 Impact

The suggested idea is different in comparison to existing approaches to the problem. It combines the adaptivity and personalisation, which is introduced by Graf and Kinshuk [13] especially for LMS with the practical use of ES realised by case studies (e.g. SAP® IDES). Existing approaches regarding practical exercises such as ERP simulations (e.g. ERPsim by Léger et al. [6]) do not cover this individual support of the learner. Another aspect for practical introductions to ES is the lack of pedagogical issues. The suggested idea will cover methods of competence-building according to the constructivist learning paradigm [5]. Furthermore the involvement of new technologies will be taken into consideration as well. It is possible to connect or integrate the described ESLE into existing learning platforms like LMS or Learning Content Management Systems (LCMS) to provide further adapted learning material to the students.

4 Conclusions

In summary, this contribution introduces a new approach for a technology supported learning environment for the competence-building in the domain of ES. Starting from today's problems in teaching of ES for higher education, this PhD project aims on the improvement of the individual learning process on the basis of historical traces a user leaves in the system. After introducing the ALC, the first components of the planned ESLE architecture are described. In future, the single components will be developed more in detail in order to provide a general architecture. In the end of the PhD work a prototypical implementation will be realised. The results will be evaluated in a university environment in order to measure the success of the suggested approach.

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Self-modeling and Self-reflection of E-learning Communities

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Abstract. Numerous e-learning communities die over the course of time as they do not manage to adapt themselves to the changes of the community environment. We support the communities by providing possible solutions to problems the communities deal with. Firstly, we model communities and their environments and analyse them. As a result, the comparison of communities, environments and their evolution is possible. Afterwards, we propose to identify what solutions of communities were successful and enable communities to survive. These solutions are vital for communities that find themselves in similar situations. We suggest to share the solutions with other communities to keep them fit. To evaluate our approach, we propose to simulate communities and their environment to estimate whether a proposed solution effectively helps communities to survive.

Keywords: community of practice, community patterns, fitness of communities

1 Introduction

Communicating, sharing knowledge and achieving goals are the fundamentals of communities [16]. Humans are social beings. Thus, participating in communities is an unavoidable part of human life. Communities have different participants, different topics of interest and different goals but in general the structure of communities is similar.

Communities mature or die over the course of time. Therefore, we aim to preserve the knowledge of communities by discovering and exploiting patterns of community fitness so as to support them in reacting on changes inside the community and in their environment.

2 Discovering Patterns of Community Fitness

As we require to find the most fit communities, we need to compare them with each other. We need an approach for modeling communities so that we can compare models of communities with each other. Firstly, a modeling approach

must be extendable: as soon as a disturbance, an unexpected event, appear, a community has to adopt to the change. Furthemore the approach has to be able to represent desired situations, i.e. community goals. Goals of communities have potentially positive or negative impacts on a community. Most of the modeling techniques coming from process modeling, business process reengineering and requirements engineering focus on technical systems that support work. Actors of technical system models support functionalities that cover users' needs and, thus, the users are interacting with the systems only for covering the needs. Hovewer, no indication is done on user motivations and goals [17]. Even Learning Process Modeling that includes a reengineering concept and considers learning goals [12] cannot give an appropriate view on a learning community as it consider needs that a learning module cover but not goals that a community / a leaner has. The IMS Learning design can express learning activities that are performed by a learner using a learning object. The activities can be shared and reused. However, as in the case with process modeling the focus of the IMS Learning design is on user actions but not on user goals. We find that i* from Yu covers all requirements we defined.

As soon as an appropriate approach for community modeling is found, components of a community as well as techniques for computing the components should be clarified. Afterwards, a database schema which represents a community model should be created. Using the schema, community parameters are stored in a database. Moreover, the computation of the changes of a community over the course of time and their storage should be solved. We are interested in finding patterns of fitness in the stored data. The patterns are solutions for repeatable events, where a problem doen't mean . Thus, a community is characterized by a set of components and sets of a community on different time intervals may be different. Investigating the sets, we can discover patterns, e.g repeatable events, and solutions, e.g. adoptation, of communities . We support a community to survive as we compare its parameters with parameters of other communities. As soon as we know that the community has a pattern, same that the other communities have, we can suggest the community solutions that the other communities used. It is upon the community if it wants or donnot wants to take suggestions into consideration.

3 The loop of community survival

As it was mentioned in the previous section, we observe life of a community in a changeable environment. Figure 1 depicts a circulation that normally happens if something unexpected appears, i.e. *disturbances*. The *disturbances* are positive, negative or neutral events that are unexpected and appear inside of a community or outside it. The *Self-modeling* phase stands for mining community parameters and changes of those parameters over the course of time. The *Self-reflection* phase stands for analysing parameters of communities within all time periods when parameters where captured. Moreover, patterns of communities are discovered and stored in the phase. Last but not least, the support

of communities is perfomed by finding similar disturbances that other communities met and by proposing solutions the other communities have applied.

In Figure 1 is depicted that Community of Practice (CoP) [16], Activity Theory [4] and Actor Network Theory [11] create a consolation for the theoretical basis for the *Self-modeling* phase. The CoP suits better in our methodology than learning networks as the CoP focuses on communities that are informal and not institutionalised as explained by Cumming and Zee [3]. Wenger claims that a CoP consists of three main components. These are about interactions of community members, same context and possessing a similar knowledge domain. As we consider communities' actual and desired states, we need to extract the goals communities have. A CoP stresses collaborative work of learners while Engeström explains learning through goal-directed activites of learners. As we are interested in both, communities and goals, we find correlating points between both theories and use them for our investigations.

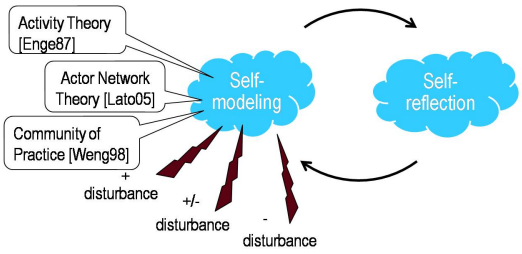

Fig. 1. The loop of self-modeling and self-reflection for e-learning communities

For creating a model of a community, we apply not only the learning theories but Actor Network Theory (ANT) which considers environment as a set of agents. It states that all elements in environment as an actor. Hence, all members of a community are actors as well as Media and Artefacts they use. We need to create a model of a community that is extandable as environment and the community change and we do not know what actor should be added to the model over the course of time. According to the ANT, we can add any event or resource as an actor if it is still not defined in the model.

4 The repository of community fitness patterns

We observe (in the *Self-modeling*) and support (in the *Self-reflection*) the life of learning communities in changeable environment and care about survival of communities.

According to CoP and Activity Theory, learning communities components should be computed. Collaborations between learners can be examined using Social Network Analysis (SNA) [2], users influence measures or measures of collaborations are explicified through SNA parameters. Observing the parameters, we can suggest roles a learner plays and understand a state of a community collaboration in general. Moreover, we can extract patterns based on the parameters. The *example of a pattern*: If 2/3 of community members organizes cliques, isolated groups of learners, and a number of members in the cliques is no more

than 2/10 of all community members than the community needs to refine the structure of its network and increase communication between the cliques. The density will increase, clustering affect will descrease and connections between isolated groups will be established.

Technologies of the Semantic Web [1] allow to get a clear idea about concepts and contexts of knowledge that are mentioned in a community-generated content. This information can be used as a set of community parameters that answer for a community knowledge domain. Using an API like OpenCalais [1], it is possible to clarify main topics of discussions and documents in communities and to discover emergent themes. The *example of a pattern*: A topic cannot be supported by community members involved in the discussion, so that the members are unsatisfied. Members of the community are need to be found that have expertise in the topic.

Moreover, activities performed by learners over the course of time express goals of learners and their communities. Goal mining is required to understand which goals communities have and how do they reach them, e.g., how do they deal with disturbances and what solutions do they have. To define goals, we refer to the phases explained in [5]. During the *Plan*, *Learn* and *Reflect* phases a goal is set, achieved and future goals are set. During the *Self-modeling* phase we collect community parameters over the course of time when a community achieves its goals and during the *Self-reflection* phase we define patterns that were applied for the community as well as we suggest solutions of other communities if the community hasn't still achieve a goal.

Summarizing all, a community model includes community parameters that are computed by techniques expalined in previous 3 paragraphs. So that different states of a community over the course of time are saved in a database. The pattern dicovery should be then performed under community parameters in the database. The challengable task will be to form patterns and combine different community patterns in them as parameters devoted to communication and parameters devoted to concepts are not correlating [14].

As soon as patterns are discovered, they should be evaluated on a test set of communities. Particularly, the simultions of communities implemented as multiagent systems [15] can be used to define changes within communities if a particular pattern is applied.

The results that are achieved so far:

- Modeling of communities with i* and utilizing extracted *parameters* of the communities in models to define the changes over the course of time and adoptations to the changes [8, 13].
- A Community-oriented database, the Mediabase, was reengineered according to Actor Network Theory principles [7]. The Mediabase is a community-oriented knowledge repository. The Web 2.0 interface for the Mediabase, the Mediabase commander [2], allows users to add different Web media to share within their communities. Furthermore, the resources are analyzed with the

[1] `http://www.opencalais.com`

[2] `http://www.prolearn-academy.org/mediabase`

OpenCalais API and important categories and concepts of the resources are defined. Users can see the most popular media that is used within their communities as well as the most popular tags users attach to media. Moreover, media stored in the Mediabase can be visualized with PALADIN II which pictures interactions between community members within media and defines different roles of community members [9] as well as represents link networks of blogs. On the example of the Mediabase and the Mediabase commander, we apply ANT for the Mediabase model and we try out SNA technique and OpenCalais API for extracting community parameters.

- SNA experiments on different Wikipedias extract roles of community members with consideration of the culture of contributors. We conclude about cultural differences in knowledge creation and differences between people of the same culture but physically located at different places in the world. For example, the amount of contributions of Turkish diaspora from Germany is higher than Turkish diaspora living in other countries. We used SNA technique for defining roles of Wikipedia contributors and check the applicability of those roles over different communities.
- Collaborations between teachers of European SchoolNet [3] were simulated with the purpose to find a perfect partner so that the teachers, forming a partnership, benefit from each other. Simulations were based on teacher profiles based on teacher competences. The simulations were performed with a small amount of data and the algorithm should be found to efficiently compute benefits of teachers againt other teachers. We tried simulation techniques for having experience to simulate communities and their behaviour based on pre-defined models.

5 Related work

The *Multi-method approach* considers different aspects of learning in CoPs [10]. Laat et al. concentrate on analysis and definition of roles within learning communites, however they do not consider modeling of learning communities and support communities in their survival. Glahn et al. support learning communities reflection by providing visualizations of learner interactions but they do not consider if learners achieved the goals they set [6].

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Implementing Technology Enhanced Learning to impede the declining interest in Computer Science (CS) studies and careers in Europe

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Abstract. Technology Enhanced Learning (TEL) may have an important role in the strategies for attracting and retaining talent in Computer Science (CS) studies and careers. Contrary to the continuing growth of the informatics industry in Europe the number of CS experts (students, graduates, teachers, etc.) is declining [1]. This decline is producing negative consequences in the technology field that affect other sectors like business and education. The purpose of this PhD study is to determine if the strategic implementation of TEL is an effective means to counteract the declining trend. The research will: Identify the negative consequences of a declining interest in CS studies in Europe; determine the factors which motivate young Europeans to pursue or reject CS studies and careers; analyze CS curricula and how technology can enhance teaching and learning of the unique skills required to become a computer scientist, thus increasing the interest in CS studies and careers amongst young Europeans.

Keywords-component: CS studies, learning methods, teaching methods; Technology Enhanced Learning, CS management and economics.

1 Introduction

This paper presents progress in the PhD research "Implementing Technology Enhanced Learning to impede the declining interest in Computer Science (CS) studies and careers in Europe". The investigation will be an economic study, contributing to research in Technology Enhanced Learning which will be considered as a means to prevent the negative impact of fewer CS trained professionals on the economy. The paper is divided into seven parts: First, the formulation of the research question; Second, the identification of current economic factors that justify the timeliness of this research; Third, an overview of the state-of-the-art; Fourth, an overview of the research methodology; Fifth a presentation of the research work underway; Sixth the innovative nature of this study as compared to related research; Seventh, conclusions and future work.

2 Formulation of the Research Question

Can TEL impede the declining number of young Europeans interested in perusing CS studies and careers? Despite a growing demand for work in the Information Technology (IT) sector, the number of students enrolled in courses which prepare future professionals for these careers is decreasing [2]. Many studies have attempted to identify the reasons for this decline, pointing out that the training for skills required to work in information technology is not properly provided for in current educational activities and the poor quality of teaching [3] is to blame. Therefore we intend to investigate how technology might be deployed to enhance CS education and motivate increasing numbers of students to enroll in these studies. The research for this thesis is being conducted within the framework of a broader study underway at the Universitat Politècnica de Catalunya which aims to create strategies to attract and retain students in CS and among them that TEL can represent an effective means. Based on this research, the faculty of economics wishes to identify solutions for attracting students to CS which is primordial for the development of the European economy.

3 Identification of the Significant Problems in the Field of Research

There are several challenges related to the identification of TEL as a method to teach CS classes to motivate young Europeans to study CS thus preventing the risk of losing experts in the field and the negative consequences on the economy.

First, is the lack of scientific information determining the impact that a low number of computer scientists might produce on the economy. Hence the first contribution consists in identifying what would happen if the decline in the number of CS students persists.

Second, although there are a certain number of studies that tackle the problem of attracting talent to engineering in a general way, many of them only focus on gender issues [3]; there is a lack of information showing the reasons why students do not feel attracted to this field of study. Our research will provide a study among young Europeans to clarify these reasons.

Third, some studies illustrate how CS curricula are not perfectly matched to the skills required by practicing computer scientists [8]. Our study will identify the skills that are unique to CS and how TEL is offering opportunities to acquire these competencies.

4 State of the art: Outline of the problem

Technology plays a critical role throughout all industrial sectors in Europe. In France, for example, people spent a total of 7,9 million Euros on technology in 2008 [4]. For this reason, several investigations pointed out their concern about the number of

students enrolled in CS programmes. These studies emphasize the fundamental need to attract students in order to provide the professional talents in information technology required by the European economy [5, 6, 7, 8 and 9].

We suggest that identifying the reasons that prevent students from following CS will contribute to better understanding and controlling this phenomenon [10]. Among reasons identified in the literature: the degree of difficulty in the courses required to become a computer scientist (e.g. Math), the teaching techniques that are not perceived as ideal, and the lack of awareness about the crucial role that CS plays in society and the economy.

On the other hand, previous investigations have demonstrated that TEL can be implemented to enhance teaching and learning of almost any course, even courses like Chinese poetry [11] or music [12]. We can thus assume that CS studies can also benefit from teaching methods and alternatives provided by TEL.

There are already some initiatives to attract and retain talent to CS by sharing technology experiences [13] and by creating teaching and learning methods to support students with the help of information technologies such as effective video clips for learning Web-languages (like HTML) [20]; or using 3D animation environments to teach introductory CS courses [14].

5 Sketch of the Applied Research Methodology

The research is organized in the following way:

First, the context of the research work presents the official statistics revealing a declining interest in CS studies in Europe [15]. Based on these results, a qualitative investigation related to the negative consequences of this decline explains how this rejection is affecting different industries in Europe. This study highlights the necessity of finding solutions to protect CS careers and the benefits it represents for society [5].

Second, identifying the reasons why students reject this career by performing a quantitative study. A survey was conducted by Telecom & Management SudParis, and the Politechnique University of Cataluña with the participation of 26 European countries. This survey makes it possible to draw up a list of the factors that prevent students from choosing CS studies [18].

Third, compare and analyze different curricula in different fields in order to identify the skills that are unique to CS. We plan to support this investigation with qualitative studies organized in form of round tables and interviews among CS students in order better define and identify these skills.

Finally, identify how TEL can contribute to the acquisition of these skills and competencies and reviewing universities which are implementing this TEL successfully in their CS curricula.

6 Research Work and Results Achieved

This section presents the preliminary results achieved in relation to the planned methodology:

6.1 Context of the research work

The research achieved so far, demonstrates that there is a declining interest in CS studies in Europe [15]. The point of departure of our investigation was the key European Statistics published by Eurostat in 2008 which show a decline of CS studies and we propose to take TEL into consideration as a means to attract students [1]. A second analysis shows how this decline may be detrimental to the European economy [5]. This investigation highlights the imbalance in the number of students choosing CS as a domain of study in relation to the demand in industry pointing the impacts this phenomenon is having in the economic, social, political and pedagogical fields. The main results are listed below.

An increase in the price of local (EU) CS development: The economic model on elasticity affirms that the price of a product is determined by its offer in the market [16]. If the number of local technology developers decreases; then their products will become more expensive and scarce while the demand remains constant. Thus, it is crucial to maintain a number of experts in IT in order to keep development costs down.

Migration of CS development: The increase in the price of IT industry and the decrease of professionals to satisfy this demand is related to the initiative of the companies that migrate their labor forces to countries outside Europe where development is not only as efficient as in Europe, but also where there is a greater available production capacity at a lower cost [5]. "The concern is that misplaced pessimism will deter bright young people from pursuing careers in computing, and, in turn, would erode the skills in a field that is crucial to the nation's economic competitiveness" [6].

The need to learn cultures and languages from countries outside Europe: Because of the growing migration, there is an increasing need to learn other cultures and languages to succeed in negotiations with countries outside Europe. [7]. "As access widens, unique educational modules, courses and programs are being designed and evaluated throughout other regions, evidencing issues, challenges, opportunities and initiatives related to this education" [18].

Changes in learning programs and curricula: European curricula need to be strongly adapted in order to integrate the language exchanges and to reinforce the management courses that are being needed by industry [7].

6.2 Identifying the reasons

In order to create strategies to avoid the negative consequences mentioned above, we conducted a study to identify the motivations that both students and professionals

have to reject CS studies. The study is ongoing1. At the time we are writing this paper we have collected 170 responses from participants in 26 European countries [22]. The important results of this research are listed below:

High degree of difficulty: The fact that CS requires a strong background in mathematics and algorithms is a major fear which prevents students from enrolling.

Gender Gap: Women feel that scientific careers related to CS are difficult to accomplish because of the time required, the lack of other women that will accompany them throughout their career, the negative image the career has for many women, etc. [8].

Misconceptions and lack of awareness about careers in CS: Almost 40% of the students have no concept about the kind of jobs that computer scientist can hold in industry and society [10, 19]. Teenagers have incorrectly stereotyped the career or do not have clear models in their lives. Consequently they do not pursue the corresponding degrees (CS and Computing Engineering) because they do not see how it can be relevant for a future career [8].

7 Discussion: How is This Work Different from Others?

Some studies target strategies to attract talent to engineering; a large number of them are directed to attract women to the CS field [18]. This work helps us get some ideas about how to attract and retain people to this field of study. However, there are three areas of research that are missing: First, there is a lack of references to understand the possible consequences of a declining interest in CS and the negative impacts on the economy. Second, the decline in CS is recognized in research, but the reasons for this decline are not clarified. Third, the role of Technology Enhanced Learning as a strategy to reverse the declining interest in CS has not been studied. This Ph.D. investigation will contribute to these three areas.

8 Conclusions & Future Work

This document presented the declining interest in CS studies and its consequences, followed by the reasons that cause this decline. Following the methodology presented in this document, further investigations are needed to complete the work.

The next steps will be to identify the different skills needed to become a computer scientist. As mentioned before, the comparison between curricula in different domains will make this possible, and can be supported by round table interviews with the participation of students.

After this, the investigation will be completed by analyzing what TEL can offer to improve teaching and learning methods to acquire these skills.

[1] http://www.marcelaporta.com/survey

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Supporting the creation and use of Personal Learning Networks of Professionals in Social Work

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Abstract. This paper presents doctoral research work on supporting social work professionals in learning through their personal professional networks and online Personal Learning Networks. In particular, it proposes an empirical investigation into current practice in order to develop appropriate technological support for the networking activities of building, maintaining and activating personal professional networks. It proposes a rethinking of functionality and usability of domain and network analysis technology to put these more in line with the actual needs and requirements of networked learners. The research methodology is presented as well as the current stage of the project.

Key words: Personal Learning Network, expertise identification, user-centred technology design, dialogue and discussion as means of learning, social networks

1 Problem Description

Social work professionals deal with issues of health care, poverty, homelessness, migration and integration in (inter)national environments supported by governmental and non-governmental organisations (NGO). They carry out small-, medium- and large-scale projects to achieve better social conditions for a specific target group, depending highly on their advanced knowledge and competencies. As they work individually or in small teams in well-defined unique environments, they often cannot depend on traditional standardized organisational support structures for professional learning (such as in standard business processes and solutions, courses, etc.). Therefore, they need to develop non-conventional learning strategies to succeed in their goals. Learning in this context is aimed at developing the individuals'skills and abilities to deal with complex problems [1].

As a consequence, these professionals are independently responsible to continuously plan their learning in order to acquire and create new skills and knowledge to fulfil the jobs demands successfully. They develop their individual expertise through the experiences they gain along the way in different projects and through

their own reflection, thereby building up a high level of tacit knowledge [1–3]. They also greatly emphasise the importance of sharing their experiences and reflections with each other [4, 5]. In social interactions, these professionals reflect on experiences gained (individually and collectively), give meaning to them and actively create new knowledge by confronting different perspectives on a same topic [6–8].

Therefore, learning through **experience** and learning through **social interaction** in particular seem to play a prominent role in the social work professional context [9]. Learning in social work seems to take the form of building tacit knowledge through experience and reflection and sharing this knowledge through social interaction with others. In fact, individual (non-formal) learning has been shown to be supported by dialogue and discussion with peers and colleagues [10]. Furthermore, the managing of conversations (i.e. making conversations possible between people when it is needed) has also been recognised as a key enabler of knowledge creation in organisational settings [11]. Dialogue and discussion with colleagues and peers then seem to be the tool supporting and enabling learning in social work.

Such dialogues and discussions have the potential to influence the learning of a social work professional, provided the professional is sufficiently sensitive to this type of learning. Especially the learning theories of socio-constructivism and Connectivism support this, where a learner learns by internalising collaboratively created and constructed knowledge and builds on her personal ability to make connections in a meaningful way [12–14]. In this way, each dialogue partner brings their own unique input to an interaction and takes away whatever has been created in that unique interaction with others that is relevant for their own personal learning. As a consequence, the specific expertise and experience of dialogue partners in these dialogues and discussions have an effect on the quality of these interactive activities.

To create an environment in which effective personal learning can occur, social work professionals need to find the **right and most relevant dialogue partner for a given problem**, i.e. with the expertise and experience that that learner considers most appropriate. The first point of call to find these dialogue partners are their personal professional network, i.e. the network of people set up by an individual specifically in the context of her professional activities. Professionals who consider their personal professional networks as a learning resource may employ particular strategies in building, maintaining and activating that network [15], with the forethought of increasing the effectiveness of this network for learning. In other words, they may design and manage their individual network in such a way that the support offered by this personal professional network for learning increases, to include people with the relevant and required experience and expertise to have at hand when a learning need emerges.

However, little research has been conducted on this aspect of personal professional networks till date, as well as on the network of people an individual creates on and through *online* platforms specifically in the context of her professional activities to support her professional non-formal learning needs, what

we call a '**Personal Learning Network**'. Studying the used strategies on the content of the relation and on the process of finding and interacting with potential dialogue partners will help in understanding better how professionals create and use their personal professional networks for learning. More empirical data from practice is needed to define and develop the concept of Personal Learning Network against the background of the literature on Learning Networks [16] and Personal Learning Environments [17–19].

It can be expected that professionals make considerable investments to conduct these strategies. This investment can be specified and studied with different perspectives, such as a social capital perspective, game-theoretical perspective (return on investment made), cost perspective (time and effort needed to identify and contact relevant others), etc. Naturally, the more effectively and efficiently professionals can build, maintain and activate their Personal Learning Network, the easier it will be to find relevant dialogue partners within this network to support their learning. Professionals use various technologies to support these activities. Particularly, domain and network analysis technology offers various solutions to increase the effectiveness and efficiency in gaining insight into the experience and expertise present in existing networks (recommender systems and social matching systems [20–22], expert systems [23–25], network visualisations [26–29]). However, it is unclear if the extracted information is relevant to professionals and if this information is presented in a suitable way; in other words, does the functionality and usability of this technology effectively match the professionals needs?

2 Research Questions and Hypotheses

The focus of this research project will be on investigating how social work professionals create and use their Personal Learning Networks and how the technology they use for supporting these networks can be optimized to help them in doing this more effectively and efficiently. The research question is 'what is the relationship between the functionality and usability of network analysis technology and its effectiveness and efficiency in optimizing the investment needed (among others costs such as time, effort, etc.) in building, maintaining and activating a Personal Learning Network to find relevant dialogue partners?'The sub-questions are:

- What are the guiding principles in building, maintaining and activating a Personal Learning Network that maximize the quality of such a network as a source for relevant dialogue partners?
- To what extent does existing network analysis technology effectively reduce the investment required (such as transaction costs incurred) for building, maintaining and activating a Personal Learning Network?
- How can the effectiveness and efficiency of existing network analysis technology in reducing the required investment be improved with regards to the relevance of the information provided and the method in which it is provided (functionality and usability of the technology)?

As the quality of dialogues and discussions with dialogue partners is influenced by their specific expertise and experience, a better view on their expertise and experience might enable better and more effective personal learning networks. The hypothesis is that a different approach to functionality and usability in network analysis technology, which offers more relevant information in line with the needs of professionals and presents this information in a more suitable way, will increase the effectiveness and efficiency of this technology by reducing the investment costs incurred in designing and using Personal Learning Networks. In turn, this will enable professionals to create and use Personal Learning Networks of higher quality in less time.

3 Research Methodology

This research project has a conceptual and a technological aim. Conceptually, it aims to define the concept of a Personal Learning Network more closely in relation to the concepts of Learning Networks and Personal Learning Environments, by basing it on data on how these networks are built, maintained and activated in practice. Technologically, it aims to gauge the usability and usefulness of domain and network visualisations of a personal learning network in order to improve the efficiency and effectiveness of these technologies for individual users through the addition of value-adding personalising features. The project consists of three phases:

1. Exploring Phase: in this phase, more insight will be gained into the practice of learning in personal professional networks. The notion of 'quality of personal networks 'and criteria to assess this will be defined in this phase on the basis of exploratory open-ended interviews. Through a structured survey and possibly some selected in-depth interviews, a working framework on Personal Learning Networks will be created and user requirements for technology will be defined.
2. Design and Development Phase: in this phase, the defined user requirements will be translated into the design and implementation of a technical artefact.
3. Experimental Phase: in this phase, experiments will be conducted with the developed artefact to investigate the influence of functionality and usability on learning in professional networks.

4 Current Phase of Research

At the time of writing, the doctoral research is in the first phase. A literature study was taken as a starting point to identify the factors influencing the building, maintaining and activating of personal professional networks. However, as the projected outcome of this literature study is low, 6 exploratory, semi-structured and open-ended interviews with selected interviewees will also be conducted. These interviewees are people in the development sector who have

set up concrete projects from scratch: they have gone through the process of identifying and understanding a complex problem and of devising a solution for this problem. As learning through networks seems to be a skill to be learnt, there will be 3 novices (under 5 years experience in the sector) and 3 experts (more than 5 years experience) in these interviews. A survey will be developed and conducted on 100 participants, who will be a representative sample of professionals working in social work. The criteria to select these participants are to be defined, but will include the extent of their experience in the sector and the level of their proficiency in using their personal networks for learning.

Acknowledgements. This paper presents a doctoral study conducted within the LTfLL project. The LTfLL project is partially supported/co-funded by the European Union under the Information and Communication Technologies (ICT) theme of the 7th Framework Programme for R&D. This document does not represent the opinion of the European Union, and the European Union is not responsible for any use that might be made of its content.

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A Linked-Data-based search system of educational tools for the Web of Data

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Abstract. The number of learning situations that can be carried out in a VLE (Virtual Learning Environment) can be improved by the integration of third-party external tools. Before the integration takes place, it is compulsory to retrieve some information, both to select the most appropriate tool to support an specific situation and to be able to integrate it in the VLE. Current tool registries have some drawbacks that make the data retrieval difficult for the educators; among these drawbacks, the most important one is that search engines are not able to automatically import information from external datasets. To overcome this limitation, this paper introduces an ongoing doctorate research that proposes the creation of a search engine based on the Linked-Data principles.

Keywords: Linked Data, educational tools, Semantic Web, integration.

1 State of the art and problem statement

A Virtual Learning Environment (VLE) is a software system used by teachers and students to support the realization and assessment of learning situations [7]. Some examples of VLEs with a wide adoption are Moodle[1] or LAMS[2]. These VLEs typically include a set of general purpose tools, although educators commonly require to use a particular tool to support specific learning situations [5]. For this reason, ongoing research on the field tries to integrate third-party external tools in VLEs, following different approaches, as shown in [2].

A key step to enabling the integration of external tools in VLEs, or other software environments, is facilitating the discovery of tools, providing useful information for the tool selection and its integration in the environment. When educators are searching tools they need to make queries using educational abstractions. In addition, the integration of tools should be semi-automatic, as educators are not expected to manipulate the data needed to integrate the tool. Finally it is convenient to have a big boundle of tools available and thus allowing educators to choose the most appropriate one.

There are some general-purpose search engines, such as Google, that are commonly used by teachers to discover general information. However, they are

[1] http://moodle.org/
[2] http://www.lamsinternational.com/

designed to retrieve text documents and not data about *software* tools; these documents may contain a text description about software tools, but data must be extracted out of them by a human. In order to facilitate the software tool data retrieval, some other search engines, such as Google Gadgets[3] or Yahoo! Widgets[4], give support for searching tools, providing data about thousands of tools. Moreover, they are commonly used by non-expert users. However, these kind of search engines are not specialized in educational domain, so they do not provide educational information related to the tools; in addition they are keyword-based search systems, which are prone to obtain irrelevant results [8, Pag. 91]. These drawbacks are overcome by OntoolSearch[5], an educational tool search engine based on semantic technologies that use the Ontoolcole [10] ontology to describe *software* tools. Nevertheless, OntoolCole only allows to express the functional properties of the tools, and not their non-functional properties. Therefore, OntoolSearch cannot provide the information for integration of tools.

Another important drawback that is common to all the aforementioned search systems is that they are not able to automatically import information from third-party external repositories. These search systems can only take information from their own internal registry, which behaves as a independent data silo. Thus, each search system is only able to provide the information that has been explicitly described in its internal registry, even if there is more relevant information in another dataset freely accessible through the Web. Moreover, a software tool may be described in a search system internal registry but it may have been updated in another external data source, so a teacher that uses this search system will get out-of-date information.

2 Proposed approach

The most important problem that this doctorate research work is trying to solve is how to create an educational tool search engine able to automatically collect information from third-party external data repositories. Obviously, the problem of integrating external data does not only affect to the educational domain; it is a very important problem to solve related to the information retrievement and data management. The Linked Data [3] approach is a recent proposal that is expected to facilitate the automatic access to the information published in external repositories.

Linked Data is a methodology for publishing data in the Semantic Web [4]. Its key idea is to identify concepts (both data and meta-data) with URIs and reuse URIs defined by external data providers. Following this approach, when two repositories have information referred to the same entity, they will use the same URI to define it and thus a software agent could automatically retrieve the information related to a concept published in different data registries. This proposal has been widely adopted and many data providers are linking their

[3] http://desktop.google.com/plugins/
[4] http://widgets.yahoo.com/
[5] http://gsic.uva.es/ontoolsearch

datasets according to these principles, building the Web of Data, which is motivated by the Linking Open Data Project[6].

In the Web of Data there are several interlinked data repositories with information from multiple domains. Even if none of them provide specific information about educational tools, there are some data repositories where useful information of software tools is registered. One of these datasets is DBpedia[7], where up-to-date structured information extracted from Wikipedia is freely available. A key step to solve the proposed research question is to design a search system able to extract structured data from different sources from the Web of Data, such as Dbpedia, and automatically relate the data to the system internal vocabulary. Note that the data extraction from each dataset will not be ad-hoc implemented because, as different data sources are linked, a single software agent can extract information from several datasets.

However, there is no data registry in the Web of Data that describes software tools contemplating their educational capabilities, nor there is any that give details about how to integrate them in a VLE. So that, the support of searching tools using educational abstractions will be limited. In order to solve this problem a search engine is proposed; this search engine will have a collection of adaptors that will allow to automatically extract data from different sources. Moreover, in order to complete the description of software tools , teachers can publish their educational capabilities and technical users can give details of how to integrate them in a learning environment. This way, a new interlinked dataset will be created, containing information with a specific purpose and reusing information from multiple previously available data repositories.

3 Methodology

In order to design, develop and evaluate an educational tool search system, the doctorate research is being iteratively performed according to the methodology in engineering [1], following the next steps:

1. Research problem definition. The first stage consists on the definition of a relevant research problem after exploring the literature. The problem stated is how to retrieve useful information for the selection of learning tools and their integration in VLEs.
2. Solution proposal. The second stage tries to overcome the problem found with a solution proposal. A software that supports the information retrieval from third-party external data sources, as well as the publication of educational information following the Linked Data principles is the current proposal for the problem.
3. Solution design and development. This stage consists on the design of the solution proposed in the previous stage and also implies the development of a prototype. Therefore, a prototype of the architecture, including the search

[6] http://linkeddata.org
[7] http://dbpedia.org/About

engine and some adaptors will be developed. Moreover, the integration of the prototype in at least a VLE will be carried out.

4. Solution assessment. The last stage shows that the solution overcomes the problems that were detected in the first stage of this methodology. In this context, the system should be able to automatically retrieve and integrate information from different sources and to registry educational information about the tools following the Linked Data principles.

The whole picture of the research proposal is represented in Figure 1.

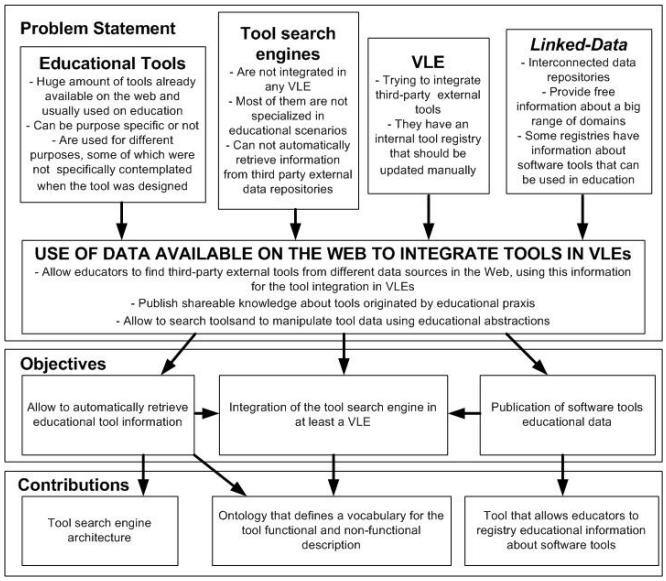

Fig. 1. Doctorate research schema.

4 Results already reached

Doctorate research has been working on some of the partial objectives described in Section 2. Specifically, previous work has focussed on the detection of the information requirements for the tool integration in VLEs and in the design of the search engine architecture.

In order to detect the information that should be provided by the system, some real examples were studied where a tool is published by a tool provider, found and selected by a teacher and later on integrated in a VLE. Furthermore, an analysis of the literature was carried out. Out of this review the tool information requirements were established: the description of the tool should contemplate both functional, technological and administrative parameters of the tool.

Once the information requirements were analyzed, an ontology was design in order to define a vocabulary that can be used by the search system to describe the learning tools. This ontology reuses other conceptualizations that can be found in the literature; for example, Ontoolcole [10] is used to define the educational concepts related to the tools while Dublin Core [6] provides the vocabulary of the administrative domain. Nonetheless, a conceptualization for describing the technical parameters has been specifically defined since there was not found any ontology that defines the needed concepts.

As far as the search engine design concerns, the proposed architecture, which is based on papers such as [9], is shown in Figure 2. The search engine has a central manager that collects the query made by the teacher through its interface and coordinates the data retrievement. The central manager sends the query using a common language, define by the abovementioned ontology, to several adaptors (two in the example of the Figure 2), which mediate in the data exchange between the manager and the external data sources. Finally, there is an educational data registry, which contains educational data about software tools and enriches the information about tools provided by external data repositories.

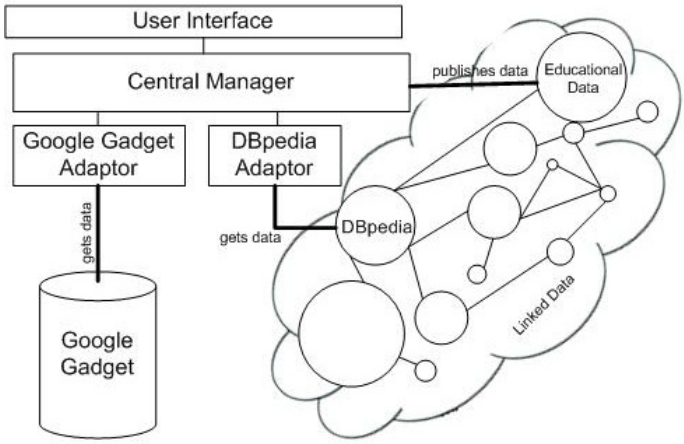

Fig. 2. Current version of the search engine architecture.

5 Conclusions and future work

The present paper shows an ongoing doctorate research work. A research question was detected, which consists on the design of an educational tool search engine able to automatically collect information from external data repositories. The proposed approach to solve this problem is based on the Linked Data prin-

ciples because it is a recent trend that allows software agents to automatically retrieve information from the Web of Data.

This approach overcomes the detected problems in current educational tool search systems, such as OntoolSearch: firstly, it is possible to find educational tools that were not specifically described in the system's data source; secondly, data maintenance will be facilitated, as the system is able to automatically import up-to-date information; finally, the publication of educational tool information will be easier, since it will be possible to reuse the data retrieved from external registries, so it will only be necessary to registry the tools educational aspects. In addition, all the information created by the system will be published and will be freely available on the Web, so it could be reused by other people for some other educational applications.

Future work will focus on the implementation of the search system described in Section 4, taking into account the proposed architecture and the designed ontology. In addition, the integration of the search system in at least a VLE will be an interesting task to be carried out.

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Supporting knowledge construction with mobile learning games

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Abstract. This project researches the potential of mobile learning games to support information access and motivation for educationally disadvantaged learners. Based on the Game Design Patterns for Mobile Games by Davidsson et. al [6] it will analyse existing didactic methods/patterns used within mobile learning games to impart subject related knowledge. The identified patterns will provide the base for developing an exemplary concept prototype application for mobile learning games. The prototype will be used to empirically test how the relevant game design patterns influence learning and teaching and scrutinize the interplay of game design patterns and possible corresponding educational objectives. The test results will lead to recommendations of how mobile learning games should be designed to effectively support motivation and information access for learners difficult to reach.

Keywords: mobile learning games, game design patterns, learners difficlt to reach

1 Introduction

Making education accessible to everyone is a problem: Unterfrauner [21] states that the smaller the income the smaller the penetration rate of PCs and the smaller the possibility for youths to have access the internet (no access point). Also, according to the JIM Study [13] the level of education influences the kind of device that is prevailing. It states that the higher the educational background the more likely youths are equipped with computer, internet or digital camera whereas with game consoles and television it is contrariwise. Hence, social circumstances reinforce prevailing educational disadvantages. With regard to mobile devices, the situation changes though. Nearly all youths (99%) at the age of 13-19 years possess a mobile phone regardless of their social or educational background [13]. By now, the cell phone is the most widely adopted mobile console in the world and cell phone games are most likely to become the biggest platform in the coming years [11] with the rapidly developing mobile technology paving the way. The process power and screen resolution of mobile devices is steadily increasing, they have enhanced memory and the possibilities to access the internet or to communicate with one another are

constantly improving [19, 8, 15] making content portable and conveniently accessible anytime, everywhere and whenever needed [20, 18]. This way mobile technology offers enormous potential for teaching and learning (cf. [5], [19], [12]).

This Phd-work researches the educational potential of mobile learning games for educationally disadvantaged learners i.e. learners that are hard to reach, hard to access or hard to engage (e.g. third chance education). It is related to the German BMBF-funded research project SpITKom that focuses on the acquisition of subject-related (IT-) knowledge for educationally disadvantaged learners.

2 Research question

This PhD-work studies the design, use conditions and effects of mobile learning games that aim at supporting learners difficult to reach. With special regard to the target group's needs it scrutinizes how mobile learning games can effectively contribute to the creation of situative learning scenarios that amongst other things enhance encoding and recall (cf. [18], [11]). In this effort, it resorts to the Game Design Patterns for Mobile Games [6]. It analyses existing learning games according to this categorization and aims at identifying those patterns that effectively support the acquisition of knowledge for learners difficult to reach. It thereby concentrates on the acquisition of knowledge on the levels of knowledge and skills. According to Bloom's taxonomy [3] this relates to the lowest level of educational objectives in the cognitive domain (knowledge, comprehension, application, analysis, synthesis, evaluation). The main objectives of this PhD-work therefore can be summarized as follows:

- What are effective mobile game design patterns to support learners?
- How can Game Design Patterns for Mobile Games be used to deliver new forms of effective and joyful situated learning?
- What are best practices for mobile learning games to support knowledge, comprehension and application?

As a secondary objective this project is (1) to create an exemplary concept prototype for mobile learning games that can be described as an effective and motivating learning scenario and (2) to present instructional design guidelines for the development and application of effective and motivating mobile learning games that address learners difficult to reach.

3 Relevance

This research project deals with the merge of the two different concepts of *learning* and *gaming* and relates them to the increasingly important aspect of mobile technology in the process of learning. It brings together relevant research results and recent developments from the field of mobile technology and game technology that are both paving the way for the growing use of mobile (learning) games and takes into consideration parallel developments in the field of the pattern approach.

3.1 Mobile technology

Findings from research on mobile learning projects frequently indicate the unique opportunities mobile technologies (i.e. PDAs, Smartphone, mobile phones, etc.) provide for educational purposes (e.g., [5], [19], [2]): Learning with mobile devices means using real-world resources that can make education more meaningful [12]. Compared to other technologies, mobile devices tend to be relatively simple to use and learners may be able to provide support to each other [5]. The size of learning material delivered by mobile devices is comparatively small. Learners can proceed at their own pace and access content to improve their basic skills [20]. This way, mobile devices help learners to recognize their existing abilities and to develop and improve confidence, autonomy and engagement [5, 19]).

Up to now, mobile devices are not instantly associated with the learning. They are in use primarily for communication and entertainment purposes [21]. It can therefore be expected that learners are more readily prepared to use mobile devices for the learning because they are a cool thing to use, the learning is not instantly obvious to others and mobile devices are nearly always at hand anyway [16]. Thus, mobile devices offer low-threshold learning opportunities that can help solving the motivational problems third chance education has. Findings of the Mobile Learning NETwork (MoLeNET programme) for example support this assumption [5].

3.2 Game Based Learning

According to the JIM study [13], game based learning approaches seem to be another way of providing the target group with motivating, low-threshold learning offers. Learning by playing has a very long tradition in the theory and practice of pedagogy and psychology (cf. [9]). Also, computer games have been into existence for quite a long time. The combination of both, namely learning by playing a computer game (digital game based learning) has rapidly become subject to research activities [10].

Supporters of using digital game environments for the learning frequently refer to their potential to offer more self-determined and motivating ways to learn which is often missing in traditional computer-based training systems (cf. [14, [1, [17]). Recent research results (cf. [7]) claim that computer games for educational use provide for e.g. increased motivation, more interest in a subject or simulations that present material differently.

Playing games whether they are explicitly designed to foster the acquisition of knowledge or not, may support the development of certain strategies and skills such as problem-solving, decision-making, understanding complex systems, planning or data handling for example [17]. Also, they support the acquisition of factual knowledge [17] according to a predefined set of subject related facts that can be matched against a fixed syllabus or standardised testings.

What is missing though, when considering the use of Game Based Learning approaches for educational purposes is guidance in the sense of *why and how are mobile learning games effective*? Patterns are able to provide this guidance.

3.3 Patterns

When talking about games it is mostly referred to game genres i.e. firstperson shooters, strategy games, etc. (cf. [17]). In the context of educational games, this categorisation is not stable and rather difficult to apply though [6]. This is due to the vital need of tailoring learning offers (i.e. educational games) according to the learners needs and according to the learning target instead of fixed genre features. Björk et. al [4] have therefore proposed a more unified apporach. They have presented a model "… to support the design, analysis, and comparison of games through the use of game design patterns …" Their approach reflects the need for a common structure and language for games to better understand the complex issue.

Davidsson et al. [6] have expanded this already existing set of Game Design Patterns by 75 new patterns that describe the unique characteristics of mobile games [6]. The new collection (Game Design Patterns for Mobile Games) was identified and verified out of existing commercial mobile games and games categorized as "experimental" or "research" mobile games. For this PhD-work, this set of Game Design Patterns for Mobile Games introduced by Davidson et al. [6] serves as starting basis to establish a set of guidelines for the instructional design of mobile learning games (Game Patterns for Mobile Learning Support) that support knowledge construction for learners difficult to reach.

4 Method

The research project has been organised into four studies:

1) *Study 1 (Literature review)* reflects the subject of Mobile Game Based Learning from different perspectives. It comprises a general overview of the literature in the field of mobile learning projects and depicts state of the art design and use of mobile games scrutinizing the prospects of applying them to educational scenarios. The study will be based on the Game Design Patterns for Mobile Games [6]. Their approach will help to identify game elements (mobile game design patterns) that are relevant for the acquisition of subject-related knowledge. The literature review will be the base for further research into the mechanisms of mobile learning game design.
2) *Study 2 (Information access and motivation)* scrutinizes how Game Design Patterns for Mobile Games influence information access and motivation for learners difficult to reach. For this study, an exemplary concept prototype for mobile learning games will be developed that is based on the patterns identified in the analysis of mobile learning games as described above.
3) *Study 3 (Subject-related knowledge)* applies the results from study 2 (patterns that influence motivation and information access). By varying the level of knowledge this study will provide insight into the extent to which mobile learning games might be employed as a tool to support the acquisition of subject-related knowledge.
4) *Study 4 (Conditions of use),* consolidates the experiments and evaluates their outcome. As a result it will extend the Game Design Patterns for Mobile Games to

a set of Game Patterns for Mobile Learning Support. Thus, this study will offer recommendations for educators, instructional designers and teachers as to the design of mobile learning games that support subject-related knowledge construction for learners difficult to reach.

5 Evaluation Design

In a broader sense, the different game design patterns can be taken as different teaching methods or at least as elements of the rather generalizing teaching method *game based learning*. However, this project will not research the "best" method/pattern to acquire subject-related knowledge. It will rather proof that for a given target group (learners difficult to reach) and delivered via mobile devices certain patterns have positive effects on (1) the learning gains (Knowledge, Comprehension), (2) the capacity to retain knowledge, (3) the learners contentment and (4) the learners self-assessment (regarding the achievements). Indicators such as effects on the learning gains and the capacity to retain knowledge (learning performance) will be assessed by guided tests with both the control group and the experimental group. Additionally for the learner's contentment and self-assessment, the participants will be interviewed.

The experiments will be carried out as field or quasi-experiments with a post-test control group and an experimental group. A pre-test will guarantee an effective experimental setting. It will be carried out to have both the experimental and the posttest control group as homogenous as possible thus lessening bias. The experiments for both studies will be carried out with a fixed group of learners recruited from the ongoing research project SpITKom. The mobile devices necessary for the experiments will be provided by the project.

6 Conclusion

Up to now, no experiments have been conducted in the course of this Phd-work to seize the influence of mobile learning games on motivation and information access for learners difficult to reach. However, this approach assumes that mobile learning games provide a promising way to lead these learners back into education because (a) the target group is almost consistently in possession of mobile devices which they (b) use on a daily basis and (c) they are attracted to computer games. Therefore, this project focuses on how mobile learning games should be designed, to meet the target group's needs. So far, no comprehensive research has been conducted on the use and the design of mobile learning games to support learners difficult to reach.

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The Design and Evaluation of Augmented Learning Spaces

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Abstract. The medium of augmented and mixed reality is creating new problem spaces in the fields of learning science. The focus of this research is how to design AR experiences that support learning. These new spaces are inherently social, tangible, and real-time. These factors all point towards key design problems. When technology enters the social space how do we design for it? What is the importance of context as a design principle?
Keywords: Authentic Contexts, Rich Interaction, User Generated Learning, Content Mapping, Learning Design.

1 Formulation of the research questions

One of the many potential dangers of Augmented Reality (AR) without the careful intervention of design is the wholesale replacement of imagination with computer animation. This research will attempt to determine reusable design principles for augmenting learning spaces to ensure the maintenance of critical thinking and knowledge formation.

A central question is what theoretical frameworks can be drawn upon to inform such design principles? The Zone of Proximal Development (ZPD) is "the distance between the actual developmental level as determined by independent problem solving and the level of potential problem solving as determined through problem solving under adult guidance or in collaboration with more capable peers." (Vygotsky, 1978/1930, p. 86). If the ZPD can be thought of as a context in which productive interactivity can take place then what design principles can be used and evaluated to generate such a context? Does keeping the user within their zone of proximal development (ZPD) ensure that constructive learning is maintained?

The meaningful learning context is defined here as the set of circumstances that is deemed relevant for the learner to build his or her knowledge. (Dettori, G, 2008). AR or Mixed Reality is "inherently about who you are, where you are, what you are doing, and what is around you". (Shute, T, 2009) Central to this research is the crucial role of context in accessing and forming knowledge.

"The distributed activity system (Pata & Väljataga, 2007), which forms when learners are realizing their goals in augmented reality, entails software, people and artifacts with different pedagogically usable functions. Mapping the pedagogical functions in case of different combinations of distributed tools and

artifacts is necessary to understand the operationality and pedagogical potential of the augmented environment." (Pata, K. 2007)

AR systems incorporate new ways of interacting with digital media by overlaying meaning onto the real world. Direct 3D manipulation of content is more intuitive in 3D learning and construction environments, because the direct perception of changes may foster the build-up of a mental model. The construction of psychological and physical space is one of the constituent parts in the generation of context. AR systems have been referred to as "intelligence amplifying systems to enhance human cognitive activities, such as attention, planning, analyzing problems, exploring new concepts, and decision making" (Brooks, 1995).

Main research aim: Provide design principles or reusable heuristics for developing augmented learning spaces.
Research questions: What is the best way to present these principles? What evidence will count to show that they work?

In addition the use of mixed or blended reality creates a range of new challenges for the designer and the learner: i) To what extent does the design of the content effect the style of the user interface? ii) To what extent does the design of the user interface affect the range of potential interaction techniques? iii) What are the best methods for reducing the cognitive effort involved in managing interfaces (and the complex systems those interfaces regulate)?

2 An identification of the significant problems in the field of research

The area of AR research is still in its infancy. Very few design guidelines and interaction patterns have been developed. As a result there are many opportunities for research. As AR applications involve virtual information registered in 3D traditional desktop evaluation techniques are not applicable. HCI problems associated with AR are also multiplied due to the vast number of different AR systems, the many types of interfaces (audio and haptic as well as visual) and the types of potential user input.

Another significant problem in the field is that the usability of an AR interface not only depends on objective measurements. The subjective user perception of interacting with the system should also play an important role during the development of an AR environment. However individual differences between users will make this difficult to evaluate.

3 An outline of the current knowledge of the problem domain, as well as the state of existing solutions

Swan and Gabbard (2005) list a comprehensive collection of design principles found in the AR literature. Such guidelines may be used by researchers interested in particular design issues for their AR system but they raise many issues. Other work that has resulted in the development of appropriate interfaces for pervasive and

ubiquitous computing technology; and explored the nature of context and the design of context sensitive technologies includes ([Dey, 2001], [Dourish, 2004], [Lonsdale, 2004] and [Chalmers, 2004].

4 A presentation of any preliminary ideas, the proposed approach, the results achieved so far and contribution to the problem

A preliminary idea for a guiding design principle lies in the difference between declarative and procedural designs. The procedural mode of guidance can be described as a linear sequence of instructions. The more precise we make a procedural representation, the more prescriptive it becomes. A declarative approach is more concerned with the many different ways that something can be achieved. "It describes the structure of a knowledge base (a map for example) rather than specifying a set of instructions for action. The creative activation of this knowledge base is at the disposal of the user because a declarative approach offers alternative options for action." (Boyle, 2002)

The proposed approach will consist of the following 3 phases:

Phase 1) Examine the outcomes of three existing case studies (Palace of Darius Persepolis, Materialising Sheffield and the Theatre of Memory) of virtual reconstruction research projects (where the physical location is not a part of the context). The design of the information environment (content, interface, and interaction) used in each one of these case studies will be examined in order to see the range and type of contexts that was generated from them. How adaptable were these environments? From this analysis the most significant design factors will be captured and identified in order to contribute towards the next design phase. These case studies represent procedural designs because the ability for the learner to interrogate the data set is extremely limited.

Phase 2) Examine a mobile version of the CONTSENS Cistercians in Yorkshire project (where the physical authentic location remains apart of the context). This case study represents an example of more declarative design because the learner has the ability to examine the data set in a more open way.

The archaeological learning environment (consisting of the reconstruction of 5 Cistercian abbeys in Yorkshire) was designed to allow the learner to explore the interaction between the virtual and the physical (the reconstructions and the ruins) and create a rich research context. The core idea behind the creation of the resource was that the user can learn a great deal more about a specific building or style of architecture if they are able to interact with the material in ways that is not possible, either on site, or via traditional print media. A comprehensive database of visualisations contained (but did not prescribe) the entire set of reasoning that led from the design of the 2D plans to the 3D reconstructions. The process of data-mining hierarchies of evidence (intellectual transparency) in the quest for constituent parts, key narratives and evolutions of form can be explored in depth. This declarative design was essential as the total range of knowledge contained within the application could then be utilised, allowing many diverse and wide-ranging opinions to be tested and unified for further analysis. The capacity for users to have this 'active hand' in

the construction of their own ‘take on things’ via visualisations which can be dynamically generated and transformed on the fly, in situ, and ‘saved’ has already been shown to contribute toward the successful augmentation of context (See Cook, 2010)

An example of a successful design principle shows that the way the content is organized directly impacts on the type of interaction which is possible: Inheritance and the innate structural hierarchy of the architectural reconstructions are utilised to allow the disaggregation of a design into its original elements. Users can drill down (an example of an interaction pattern) through the final presentation of the model (the front end to the whole data set) into all the component objects and any architectural element within the model to automatically load any linked information which that element may have attached. These objects can then be extracted from their hierarchical structures, manipulated, measured and reconfigured (interaction patterns) according to the users unique research query. For example each abbey can be represented as a collection of their constituent architectural mouldings. A significant amount of the architectural style is imbedded in the structure of these mouldings along with invaluable information about their origins. The user is able to search and transform (an example of an interaction pattern) these 2D mouldings into their final 3D forms (using mobile devices in situ) in order to examine how (for instance) the Gothic style of architecture compares and potentially relates to the Romanesque style.

In this scenario it is the visualisation database which provides the digital component of the context which in combination with the real ruins allows collaborating learners to augment their rich research contexts for learning. The visual scope made available by the designer provides the ‘action potential’ (context as interaction) for the learner.

Phase 3) From an analysis of phase 1+2 the most significant design factors will be identified in order to create a series of AR prototypes to augment the learning space. The AR environment will map the digital information directly onto the physical world with the intention of eliminating the potential for distraction. A lack of focus on the actual object of study was reported in the feedback of phase two where users had to look away from the real world scene to look at the device.

5 A sketch of the applied research methodology

Design-Based research (Design-Based Research Collective, 2003) will be used to identify and model technology-mediated, social learning and behaviors in order to design tools that support and promote the practices under investigation. For example, Cook (2002) has proposed a Design Research approach which revolves around evolutionary prototyping. This involves repeated cycles of: empirical work, theory/model development and tool/artifact refinement. These particular aspects are typically conceived as overlapping activities and phases (rather than as sequenced ‘steps’); it is thus an evolutionary Design Research approach to analyzing the role of theory/models, empirical work and technology in learning. DBR will be applied to the phases outlined above. Two theoretical frameworks will be used to inform the methodology. The first of these is distributed cognition which highlights the

importance of physical embodiment for cognition. Distributed Cognition involves the embodiment of information that is embedded in representations of interaction between individuals, artifacts and the environment. (Hollan, J. et al 2002). The second framework which will act as a lense and a measure of 'context as interaction' is the previously described Augmented Context for Development (see Cook, 2010).

The first phase of the research methodology is the literature review where the most relevant literature related to the defined problem is classified according to the different areas that are to be covered. During the evaluation phase the proposal will be tested in order to ascertain whether it accomplishes the main objectives of the research. Does the empirical evidence support our theoretically informed ideas about how you structure a context? As the study combines pedagogical and technical aspects it will involve a mixed evaluation that considers qualitative and quantitative analysis. The main aim in the evaluation phase is to understand the use of the technology developed within a context. This will be done through an analysis of various case studies. However, it is crucial for a correct evaluation to have a formal methodology. Since the project is framed in both the physical and digital domains and all technological and learning objectives must be analyzed, it is essential to consider quantitative and qualitative data. For this purpose, the Mixed Method will be implemented. This combines quantitative techniques and sources, such as closed questions or event log files generated automatically by the mobile devices with qualitative techniques, such as open questions, discussion groups or observations. Only by considering both types of information can we gain an in-depth understanding of the whole system within its context

6 A description of the Ph.D. project's contribution to the problem solution

One of the initial contributions to this research area was a proposed set of 'interaction heuristics' based on evaluation data from phase one and two. Heuristics are guidelines or 'rules of thumb' that should in future systems be able to guide the design and development of meaningful learning contexts. The initial set include guidelines such as: i)Vary the form of interaction and provide a more personalised view. ii) Improve indexing (it was deemed essential to give the user full access to all the content that was available in the system at any time) iii) Support for the evolution of practice (students claimed that it would be good to fit this practise into a larger context of their choice. iv) Provide the ability to perform deep customisation including level of detail, preferences and order of presentation (some students were at different conceptual levels and would have benefited from this ability to tailor the content to their individual level of interest) v) Users should be able to accomplish a task with a minimum of interaction steps. It should be easy for the user to learn how to use a system without prior training. vi) Reuse the real worlds (well known) level of interaction - don't make the interaction too different from how people would interact with real environments and problems. Other heuristics included providing the ability to… vii) Use simple designs where all of the interactions and elements of augmented social experiences must add value.

Another area of contribution is the use of declarative design. This is justified primarily as it gives the designer the possibility of an augmented learning context that learners may then choose to activate. In that way it is declarative. Instead of creating a context sensitive system which recommends (in a procedural way) this intervention at this point in time the feature is simply made a part of the context.

The research will further extend the ZPD by incorporating the dynamic use of real time social data into the AR environment. We spread ideas around through dialogue and other forms of interaction. These ideas become 'contagious patterns of cultural information that pass from meme to meme which in turn have the ability to change the actions of a group' (Dawkins, 1976).

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Activating Thinking Skills with Mash-Up Research Environments: A Proposal

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Abstract: Critical thinking skills are seen as one of the most important skills for researchers. Mash-Up Research Environments have the potential to activate these skills. While these environments already have their own value, this work provides a first step in answering the question of whether or not they activate thinking processes, and as a further step, what quality of thinking is activated. Considering the openness of such ensembles, we sketch a method for researching activation of thinking at web scale applying a field experiment approach. We outline an individual and a prototype of a collaborative research space and describe a thinking skill framework we will use to categorize thinking expressed in written accounts.

Keywords: reflection, critical thinking, mash-up research environment

1 Thinking Skills and Mash-Up Research Environments

The ability to reflect and think critically about information, to rate, and to review it, is one of the key abilities of the modern information society. Recently, the Research 2.0 [1] movement tries to leverage the possibilities of the Web 2.0 for researchers, providing tools for research practice in the open space of the Web. We call this research tools Mash-Up Research Environments (MRE).

This work describes the first step of researching the relation between these environments and thinking skills. The question is: How do Mash-up Research Environments support the activation of thinking processes, especially in critical thinking?

Today's researchers use more and more online tools to support their daily work. For example, they use these tools to inform themselves about new publications and other web resources, to engage in social networks with their peers, to use it for online collaboration and communication, and to share resources. Mash-Up Research Environments are able to incorporate these widespread resources and functionalities in a single environment. They use widgets (mini applications), which usually provide a single functionality of a larger web application. A combination of widgets forms the mash-up environment. Due to its flexibility to select several widgets for an environment, it could be used to examine which combination of widgets help to create an environment beneficial for research practice and to activate thinking processes. We will call these widget ensembles an event space and the time-span of people working with this space the event duration. Furthermore we distinguish between three types of widgets. Activation widgets, which are meant to be thought-provoking as the main

component of the mash-up environment. Account widgets to give possibilities to express thinking, and narrative widgets, which can be used to support the thinking process.

While many key pedagogical outcome variables could have been taken into account, like conation (motivation and volition), or affection (emotions), the focus of this work is on cognition and especially its sub-concept critical thinking. To emphasis critical thinking seems to be a good starting point for a further examination of the other mentioned dimensions, which are seen as highly connected. Thinking is topic of manifold research articles (for overviews see [2][3][4][5]). The bottom line is, that thinking can be classified into more or less independent categories of thinking, including dimensions and depth of thinking. Later we will outline how these classifications will be used to assess the thinking process activated by the MRE.

The term activation is chosen to express the characteristic of events, which are usually seen as a period of higher activity of the participants. We see the activation of research activities and thinking skills as essential for a deeper learning experience, compared to a mere facilitation, which tends to be more a supporting process of actors in the background of an environment. This is in line with meta-studies emphasizing the importance of activation on learning outcome [6].

Research Mash-Up environments are usually not embedded in a controlled educational space. For example, if researchers write about nascent theories [7] on their blogs, then these environments, try to incorporate these writings, instead of forcing the authors to use the tool of the platform. This flexibility adds a new complexity for researching them. While in a controlled environment all artefacts produced by the participants are easy retrievable, this is not necessarily true for these open environments. Methodologies, which try to investigate research environments embedded in the real world with large-scale observations [8], seem to be necessary.

We will now outline the main components of the proposed infrastructure in which this research is embedded. Starting with Mash-Up environments, a thinking skill framework and an individual and collaborative event space. Finally, conclusions highlight strengths and discuss limitations of the approach.

2 Mash-Up Research Environments

Mash-ups are “a combination of pre-existing, integrated units of technology, glued together to achieve new functionality, as opposed to creating that functionality from scratch” [11]. They are seen as software applications that merge together separate APIs and data sources [9][10].

Based on the Mash-Up idea we implemented a research infrastructure upon which the STELLAR Mash-Up Research Environment [1][12] is built. It uses Elgg, an open source networking and publishing software, as showcasing platform for bringing together widgets and services and the legacy systems of the STELLAR partners. The Mash-Up Research Environment consists of a set of widgets, which the users select from a directory. The widgets are packaged according to the Widget 1.0 specification and delivered through the Wookie widget engine. A plugin for Elgg enables to embed the widgets into Elgg (Wordpress, Moodle, LAMS are supported out-of-the-box). See figure 2 (right) as example of the working individual event space of the Stellar Mash-Up Environment. These research environments are per se just a collection of artifacts,

with the goal to help researchers with their practice. While these ensembles of artifacts (widget ensembles) have already its own value, the focus of this work is seen how this Mash-Up Research Environments can activate thinking processes, especially reflective or critical thinking. With reflection, we mean a deeper, critical thinking about artifacts or situations/events.

3 Thinking Frameworks

Thinking processes, as outcomes of the researchers participating in the Mash-Up Research Environment are central for this work. Several definitions and frameworks about thinking exist, with different notions and emphasis of thinking [2]. In the following we outline qualities of thinking and describe a framework, which seems useful to describe thinking and its facets.

Within the stream of thoughts, which the human brain consciously and unconsciously processes, some salient thoughts catch the attention and foster a process of critical thinking. This quality of thinking can be described as an "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusion to which it tends" [13]. Thinking in general is seen as a conscious, goal-directed process. Examples are model building, planning of actions, remembering of past events (thinking backward), imagining future events (thinking forward), decision-making, problem solving, reasoning, and so forth. Conscious processes are interrelated with unconscious ones. The latter usually are highly automated processes, which do not involve the consciousness of the actor anymore.

Moseley et al. [14] developed an integrated framework for understanding thinking and learning. They reviewed 35 thinking skill frameworks ranging from all embracing frameworks to specified ones. They conclude, that the current literature on thinking skills can be integrated in a two-factor model, consisting of "cognitive skills" and "strategic and reflective thinking" (see fig. 2).

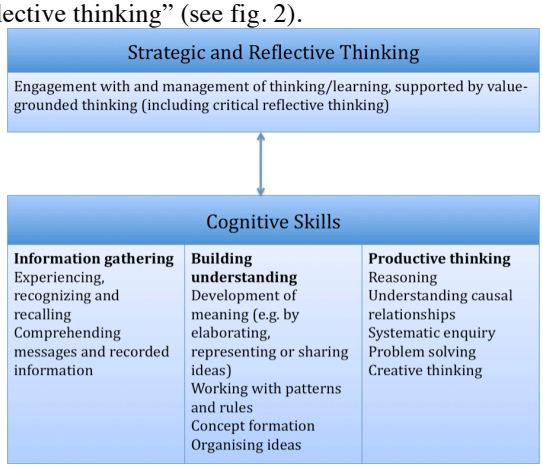

Figure 1: Framework for thinking [14]

These categories of thinking will help to determine which sort of thinking was activated by an event within a Research Mash-Up Environment. The long-term goal

would be to research the correlations between widget ensembles and thinking. Knowing these could help to construct thinking activating environments.

In our research we limit ourselves to manifested representations of thinking processes on the Web. In most cases thoughts are represented in written form, pictures, audios or videos. Because of our usage of an open Mash-Up Research Environment this representations could be basically found everywhere on the Web. Our research will only take into account public available representations. To research the question whether Mash-Up Research Environments can activate thinking skills we propose an iterative research process starting with the following research design and method.

4 Research Design and Method

The basic idea is to set up an event space for researchers supporting by several widgets. An event could be for example a live stream of a keynote, but also other artifacts, like a visualization, text, etc. These widgets follow the above-mentioned categorization of activation, account, and narrative widgets. We will then investigate whether or not the widget ensemble activates thinking processes captured in the account widgets and elsewhere on the Web. The account widgets can provide the functionality either being connected to a tool, which is in control of the observer, like the TELpedia, or being connected for example to the blog of the participating researcher. Furthermore, and even more interesting, we will observe if the participants write about the event outside the Mash-Up Research Environment. For this we have to find methods to detect these writings and the discussions surrounding these. This will lead to a set or graph structure of writings associated with the event. The outlined framework to categorize thinking will then serve as schema to qualify the written accounts.

The goal of the first experiments is to get to know how many participants actually get activated to write about their experiences during and after the event and what type of thinking is involved. Questionnaires before and after the event will support this research activity, helping to figure out what understanding the participants had before the event, what type of tools they use to write about this event, and where to find them. We will then compare the results of the questionnaire with the detection system we will use to find the writings about the event to gain a better understanding to what extent thinking processes about an event could be detected.

While we already developed an individual event space in the above outlined Stellar Mash-Up Research Environments, we are currently working on a collaborative space, called the collaborative event space. See the mockup in the following figure (left).

The collaborative event space shows as main activation widget a video (this could be the live stream of a keynote). This is meant to be the center of attention for all participants of the event. An additional activation widget is shown below – the social network widget. It shows social network activity for example the Twitter posts of this event, Blog posts, associated videos, etc. Next to this widget you can see two account widgets. A feedback widgets, which is meant to give feedback to the keynote speaker or to send him resources. And a collaborative writing widget, which allows all participants to write down their thoughts. On the right side of the presentation widget,

you can see a narrative widget with reflection fostering questions. Next to it is a widget, providing basic information about the event.

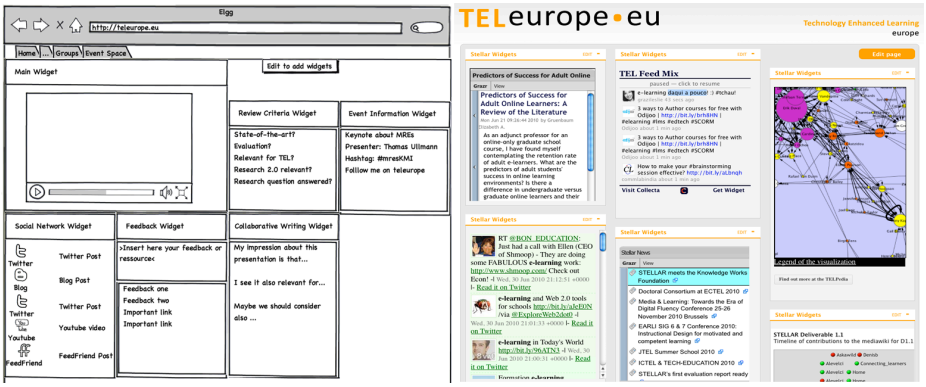

Figure 2: Collaborative Event Space (left) and Individual Event Space (right)

5 Discussion

Thinking, especially critical thinking skills are seen as important, especially for researchers who constantly have to rethink their own work and who need to decide on what work is relevant for their own research. We outlined the Stellar Mash-Up Research Environment, which provides a flexible and open infrastructure for researchers. The Mash-Up approach allows users to use their own tools and arrange them on a space. They can tailor their research space with functionality that is relevant for their own research, while the collaborative research space will allow groups of researchers to work together. One important goal of such environments is to activate the thinking processes of researchers. Considering the variety of tools researchers can use to express them on the Web, a methodology able to detect these seems necessary to study the quality of thinking activated through the events. The first step of this research is to determine if events of the Mash-Up Research environment activate thinking processes. Afterwards, the focus will lie on finding reliable methods to detect thinking accounts associated with an event on the Web. Further examinations will focus on the thinking quality of these accounts. For this we outlined a thinking framework, which will help to categorize manifested thinking processes. In first stance a qualitative research approach will help to categorize the thinking accounts. Using field experiments as approach to observe different widget ensembles, we have to take into account the tradeoff between internal and external validity, weakening internal validity in favor of external one.

We proposed three types of widgets to distinct tasks of widgets. Activations widgets represent the main point of attention for research to think upon. Account widgets will provide an interface to express own thinking. Content generated there could be used by the researcher as a starting point for account writings in the environment of their choice. Narrative widgets can help to initialize the thinking process, providing for example critical questions, standards, or further information. These widgets can be activation points of thinking on their own. For example account widgets could activate to think about ones own account writings or of others,

narrative widgets can activate thinking about the outlined critical questions, etc. The research is drawn on the assumption that the accounts will be publicly available. Researchers publish them on the Web to seek feedback from others or to report about interesting developments. The research data is therefore limited to public accounts.

We see similarities between Mash-Up Learning Environments and Mash-Up Research Environments. Research done in either of the fields could be fruitful for the others. A discussion about the main differences and similarities applying the approach proposed here could encourage new research questions.

Acknowledgment

This work is carried out within the STELLAR Network of Excellence, which is funded by the European Commission under the grant agreement number 231913.

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Using an Online System with Exemplary Teaching Videos to Support the Professional Development of Prospective Faculty Members

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Abstract. The quality of teaching in higher education is an issue which takes the researchers' and policy makers' attention especially after the second half of 1990s. Using online environments is a potential strategy for faculty development on teaching. This project aims to investigate the needs of early career and prospective faculty members' needs on teaching and examine the design, implementation and evaluation of an online environment incorporating discussions and exemplary teaching videos to support prospective faculty members' teaching profession. Findings are expected to provide a framework about using online strategies for faculty development aims.

Keywords: faculty development, teaching in higher education, online support, instructional videos.

1 General Issues about the Problem Domain

In western countries, the universities are under the pressure of change to cope with the increased marketization and managerialism within the broader policy milieux. In this competetive context, the research and other activities of the academics need to be improved [1]. Academics need to demonstrate achievement in many areas of activity in which teaching is one of them.

Boyer [2] identified four distinct but interrelated forms of scholarship for the academics; discovery, integration, implementation, and teaching. He is the one who proposed that the scholarship of teaching is one of four forms of activities associated with university practices. Many models of the scholarship of university teaching have been advocated after his introduction [3].

Teaching initiatives in higher education are becoming more visible, and a new scholarship of teaching and learning forces the faculty to share their thoughts about classroom practice with educational specialists and colleagues [4]. Faculty development programs in higher education institutions are introducing innovative pedagogies to faculty

members from different disciplines. However the efforts on faculty development are usually not meeting the needs of the 21st century by using new technologies [5].

Although teaching could be thought as a very social work, it is usually a private activity for faculty, taking place behind doors [6]. All higher educators share a commitment to knowledge creation in which teaching and research are equally important aspects, however teaching has not been promoted as well as the other activities of the faculty [1], [2], [7].

Since teaching aspects of the higher education is becoming an important issue, different implications have been started for supporting the professional development of faculty members in the area of teaching and learning. The higher education institutions provide either formal qualifications or meetings, symposioms, or inquiry communities in which the faculty with different backgrounds participate [1], [3], [8], [9], [10]. On the other hand, the formal qualification strategies are sometimes critisized by the faculty [1], [10]. So, more flexible and practice-oriented approaches are suggested by the researchers instead of the strict and theory-based applications. Effective professional development should be continuing, active, social, and related to practice [11], [12].

Online technologies can be effective ways of distributing faculty development activities by providing contextualized teaching cases and communication between the faculty members from different disciplines These environments grow collective "knowledge", or "practice" by incorporating the interaction between the members. Moreover, these online environments provide flexibility in access for the members.

2 Research Questions and Purpose of the Study

The purpose of this study is two-dimensional which aims to present the big picture of early career faculty members' needs on teaching at Middle East Technical University (METU) and also evaluate the effectiveness of an online environment designed as a support to a graduate course offered to improve the prospective faculty members' professional development on teaching and learning. The aim is to generate outputs in the forms of knowledge and product. Knowledge is related to the needs analysis and the systematic approach for design and development of a tool for supporting faculty in their teaching. Product refers to the tool itself, which aims to bring about improvement in academics' professional development on teaching. The following research questions guided the study:

- What are the early-career faculty members' opinions, needs, and expectations about their own teaching?
- What are graduate assistants' perceptions about the effects of using an online environment in regards to their teaching profession?

3 Ph.D. Project's Contribution to the Problem Solution

The attention given to the quality of teaching in higher education has been compelling the institutions to focus on faculty development programs. Although many higher education

institutions provide formal meetings or inquiry communities for their faculty, these strategies are sometimes critisized for being not so flexible and practice-oriented. Among different ways of faculty development efforts, the more flexible, context-oriented, and practice-based need to be developed to meet the expectations of higher education in 21st century.

In this study, online technologies have been thought as effective ways of distributing faculty development activities by providing contextualized teaching cases and communication between the faculty members from different disciplines These environments have the potential to grow collective "knowledge", or "practice" by incorporating the interaction between the members. Moreover, the online environments provide flexibile access for the members.

The findings of this study will be valuable in two aspects. First of all, it will contribute to the faculty development efforts on teaching/learning at METU by presenting the needs of the early-career faculty members and examining an online environment as a support to a graduate course on teaching in higher education. Considering the increase on world-wide importance given to teaching and learning in higher education, results would be helpful for the policy makers in designing faculty development programs especially in training the graduate assistants as prospective faculty members.

The second value will be about contributing to the knowledge base. The needs of early-career and prospective faculty members on teaching and learning will provide an example from a Turkish university. Besides being a national case, findings will contribute to the knowledge base on designing faculty development programs on teaching in general. Effects of using an online environment which incorporates exemplary teaching videos of relevant and contextualized cases, and knowledge sharing for improving the teaching profession of prospective faculty members will be examined in the study. Although these strategies are successfully used in preservice teacher education, effective ways for the higher education still needs to be investigated. Opinions of prospective faculty members who didn't have too much concern on teaching will provide insights about developing the most effective strategies for faculty development programs. Finally, evaluation of the online system will provide suggestions for designing online environments for faculty professional development.

4 Research Methodology and Preliminary Findings

The study consists of two phases; while the first phase was done through quantitative methods, second one use mixed methodology approach. For the first phase, a survey design was used to explore the needs of the early-career faculty members about teaching. For the second phase, an online environment was designed as a support to a graduate course on teaching in higher education based on the needs analysis and course instructors' opinions. Then, it was evaluated through the course participants' (namely graduate assistants) point of view. A mixed methodology approach was chosen, so strategies derived from both qualitative and quantitative methods have been incorporated.

4.1 Phase 1: Surveying the Early-Career and Prospective Faculty about Their Needs

Phase 1 of the study is descriptive in nature and aims to explore the opinions, needs and, expectations of the early career faculty about teaching in higher education. Data were collected during the Fall-2008 semester and have been used as a needs analysis for the design of the online environment. A survey was developed to collect data about the teaching and learning related concepts in higher education consisting of three main parts: demographics, perceptions and needs of teaching and learning processes, and background on and preferred strategy for support in improving their teaching.

The survey administered included fifty-three faculty members who had been teaching for not more than six years and 195 graduate teaching assistants. The intended participants of the survey were the graduate assistants and the instructors including assistant professors and lecturers who have less than 12 semesters of teaching experience, but two associate professors have been surveyed too, since their titles reported as assistant professor on the department website. Their data have not been excluded, since they had less than 12 semesters teaching experience. On the other hand, 11 of the assistant professors and lecturers had more than 12 semester experience, but they have not been excluded either and grouped as the fourth group of teaching experience.

4.2 Design and Development of the Online Environment

A graduate course -Teaching in Higher Education- is provided to improve the graduate assistants' teaching profession as prospective faculty members. Based on the aims of the Ph.D. project, the course was redesigned by adding an online environment to the course without making a major change in its content, so the online system was used to support the course objectives. The researcher worked in accordance with the course instructor while deciding on the types and content of the materials for this aim. Findings of the needs analysis survey were also taken into consideration.

The online environment was designed to include three main parts in total; seminar presentations and supportive materials, exemplary teaching and informative videos, and discussion.

4.3 Phase 2: Implementation and Evaluation

Since the evaluation phase was exploratory in nature, the qualitative method was the driven approach for the research study. Participant interviews, responses to the open-ended questions in weekly surveys and discussion logs were the data sources which helped to explore the participants' opinions in-depth. In addition, the research is supported by quantitative data collection and analysis. Weekly surveys provided quantitative data about participants' opinions on each unique online activity.

23 graduate assistants from 11 different departments of 3 colleges (Engineering, Arts & Science, Architecture) at METU have been enrolled to the course at the Spring 2009. All of them participated into data collection for website visits, discussion logs, and weekly surveys. Then, semi-structured interviews have been conducted with 10

participants at the end of the semester. The aim was to collect data about their general impressions on using an online environment for learning in general, and the effects of online materials especially the exemplary teaching and informative videos and online discussions on their teaching profession.

4.4 Preliminary Findings

Analysis of the survey data on phase 1 revealed early career faculty members' and graduate assistants' perceptions on the importance of and needs about the teaching-related concepts. Moreover, their previous participation into faculty development activities and preferences about possible teaching-related faculty development efforts have been examined. See Table 1 for each group's top mean scores.

Table 1. Mean scores on a four-point scale and std. deviations for top three scores of graduate assistants and early career faculty members.

ITEMS		
How important are the following issues in your opinion?	**Grad. Assistants**	
	M	**SD**
6. Course design based on determined goals	3.58	.57
16. Ability to establish communication with students	3.58	.59
11. Facilitating students' active participation into classes	3.56	.56
	Faculty	
	M	**SD**
16. Ability to establish communication with students	3.72	.50
11. Facilitating students' active participation into classes	3.60	.53
14. Ethics in teaching/learning	3.57	.67

In terms of the strategies for faculty development activities, most of the participants preferred workshops. In case of an Internet-based system, most of the participants wanted to see case videos to support their professional development on teaching.

The data analysis of the second phase is still under investigation. A mixed methodology will be used at this phase. The interviews, discussion logs and open-ended answers of the weekly surveys will be examined through content analysis, while the Likert-type questions of the weekly surveys will be analyzed statistically.

5 Conclusion

Findings of the first phase gave us the big picture of early-career and prospective faculty members' needs and expectations about their teaching. This part of the study has been

used in designing the online environment, as well as contributing to the knowledge base on teaching in higher education field.

Although the findings of the second phase are still being examined, it's expected to provide insights about technology-enhanced faculty development programs. The Ph.D. project is aiming to propose a new framework to use online strategies for supporting faculty development on teaching based on the evaluation of the current online system.

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