Online Evaluation of Collaborative Learning Platforms

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Abstract. The paper presents a flexible framework for the online evaluation of collaborative project-oriented e-learning platforms. The framework was developed for the evaluation of the COOPER platform [1], but it is flexible enough to be used for the evaluation of other collaborative platforms. The evaluation is based on questionnaires and on logs collected during the platform use. Here we focus on the questionnaire-based evaluation part, which was developed with the same WebRatio model-driven development tool that was used for the COOPER platform. This solution assures a uniform implementation and interface with the whole platform. Statistical analysis of the results is combined with other methods such as social networks evaluation (see [14] for details), thus offering a complex evaluation framework. Some evaluation results obtained in experiments developed in two use cases are presented along with conclusions derived from the experiments

Keywords: Collaborative learning, evaluation, web-modeling

1 Introduction

The paper presents a framework for the online evaluation of collaborative project-oriented e-learning platforms. This research has been done as part of the COOPER project [1].

The evaluation of e-learning systems is extremely important for all the actors involved. However, few of the approaches reported so far in different papers refer to the evaluation of technologies used to support collaborative and cooperative learning in distributed environments. Moreover, even fewer use online tools, such as questionnaires and log analyzers integrated into the platform under evaluation.

Here we focus on the questionnaire-based evaluation part, which was developed with the same WebRatio model-driven development tool that was used for the COOPER platform. This approach assures the uniform implementation and interface

for the whole platform. Statistical analysis of the results is combined with other methods, based on interaction logs and social networks evaluation.

The paper is structured as follows. Section 2 is a presentation of the state of the art in the evaluation of collaborative e-learning systems. Section 3 shortly explains the methodology used in the online evaluation of COOPER. Section 4 describes the development of the questionnaire module using the web modeling tool WebRatio. Some results of experimenting on the evaluation framework in two use cases are presented and analyzed in Sections 5 and 6. Section 7 is reserved to conclusions and future work.

2 Evaluating E-learning

The evaluation of e-learning systems is extremely important for all the actors involved in their development and use. Teachers need to evaluate how effectively the system is adapting to different pedagogical scenarios; students need to evaluate their progress; both, teachers and students need to evaluate the benefits of using e-learning in comparison with the classical methods of learning.

Evaluation studies were commonly concerned with e-learning technical progress and aimed to determine whether learning has been enhanced through the use of technology, how the users interact with each other in the learning environment, how the learners interact with different tools and services, how usable were these tools, what was the content quality, etc. Other studies and papers refer to the evaluation standards and benchmarks [2, 3], evaluation measures [4], evaluation methodologies and strategies [5, 6], and to the results of many evaluation projects [7, 8, 9]. Despite the large number of evaluation studies, few of them refer to the evaluation of technologies used to support collaborative and cooperative learning in distributed environments. The lack in the available evaluation techniques is due to the difficulty of identifying the effect of a particular design feature on learning in such large and complex learning environments [6].

Even fewer studies evaluated the gap between the expectancies of students regarding the e-learning platform they are going to use and the effective quality of the offered services. In addition, knowing what people expect from the e-learning platform is very important as a way to discover what features they prefer and to focus on these features in the teaching process.

3 Evaluation Methodology

According to [10], the evaluation of e-learning systems must consider the following criteria: content, instructional design, interactivity, navigation, motivational components, use of media, evaluation, aesthetics, record keeping. In addition, we want also to evaluate the changes that are brought about by implementing the e-learning platform in terms of process, learning, cooperation, management support and effective use of technology.

Starting from these ideas, we have set up a three- steps evaluation procedure. The first step is the pre-project evaluation, which is the evaluation of students' expectations before using the platform. In this step, users are told about the collaborative platform they are going to use.

Students were told that COOPER scenario of use has three phases: the pre-project phase in which they select the problem to solve and form the teams, the project development phase in which they use he platform to collaboratively develop the project, and the post-project phase in which the results are delivered and exploited to enrich the institutional knowledge base. Students have access to team management tools, to knowledge sharing and recommendation services for teamwork, to pedagogical tools, and to synchronous and asynchronous communication tools such as: chats, videoconferences supported by VoIP, forums, etc.

In the pre-project evaluation, students are questioned about their previous experience with similar platforms. Users are also asked about their expectations that the learning process will be influenced by the use of various tools in the platform. This part of the evaluation uses an online questionnaire. After gathering the responses, a statistical analysis of the answers to the questionnaire is performed.

The second step of the evaluation considers the logs of students' interactions in the platform, and analyses them from different perspectives, including also the social networks developed around this collaborative platform. The third step is a post-project evaluation that uses a (post-project) questionnaire.

The technical aspects concerning the design and development of the questionnaire tool are presented in the next section.

4 Development of a Questionnaire Module Using WebRatio

The implementation of the Cooper platform is based on the WebRatio modeling tool. WebRatio uses WebML for designing "data-intensive web applications" [11]. One of the innovative aspects of the Cooper platform was related to the integration of the evaluation tools in the actual platform. This way the module that allows building questionnaires and analyzing the responses was developed using WebRatio, similar to the rest of the platform. The main features of this module are presented in this section. They are important for understanding the possibilities offered by the tool and the source of the results that will be presented in the next sections.

The questionnaire module has two main parts: the front-end, where the actors involved in the project can see the questionnaire, and the back-end where the questionnaires can be created and the answers can be analyzed.

The front-end of the questionnaire module is presented in Fig. 1 using the WebRatio representation conventions. The rectangle tagged "Questionnaire user area" represents an area or a website module that contains several pages. These pages (the white rectangles) contain several types of components like data units that show a row from a database entity or index units that show a number of rows from an entity according to a specific selection rule. The arrows that connect the components are used for firing events and for passing data between components. Several other types of units are used to build this module: time units give the occurrence time of an event

and is used in logging the event in the database; selector units are used to implement SQL queries and to filter the results presented in a webpage; switch units are used as controllers that select the page that will be displayed next; and many others.

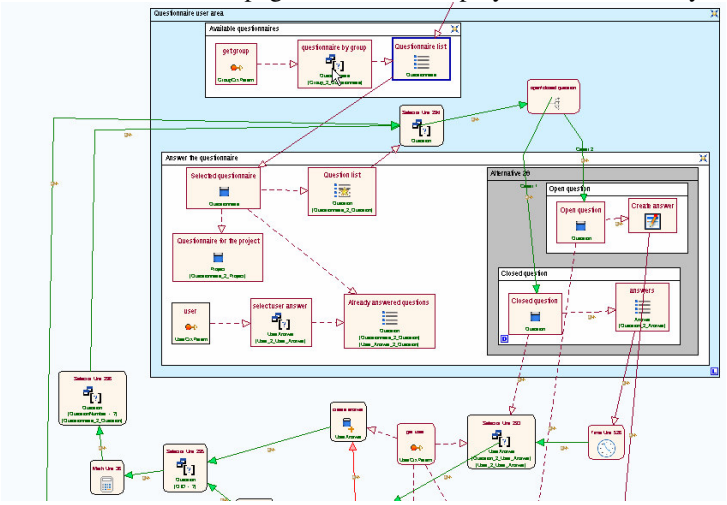


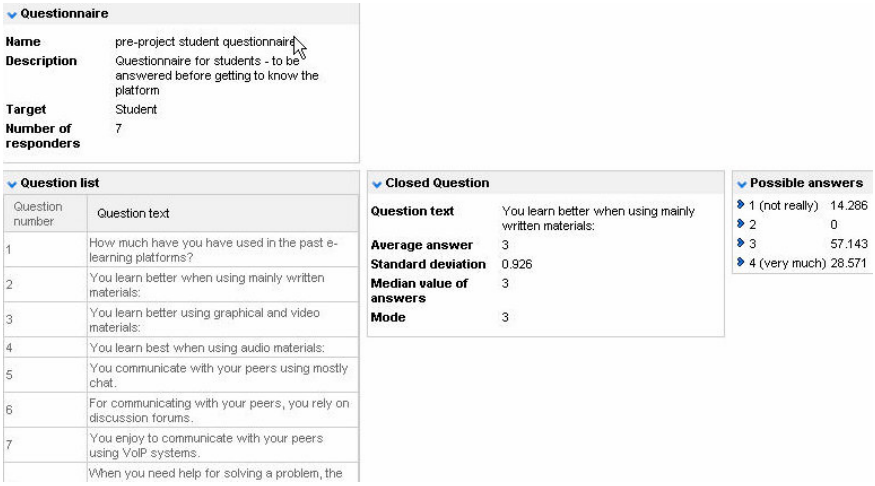
Figure 1 Development of a module in WebRatio

The front-end allows every involved actor (student, tutor or staff) to answer his own targeted questionnaire. The responder is not forced to answer all questions, or answer them in a specific order. He can skip some answers, if he wishes. He may answer in a random order and also can change the answers at any latter time. Figure 1 presents the design of a part of the questionnaire front-end in WebML.

The back-end of the questionnaire tool uses web services, which include the module for the primary statistic analysis. The computing requirements for implementing the mean, mode, average, frequency, and standard deviation, which are presented in this module, are not offered by default. To solve this problem we analyzed two approaches.

The first approach was creating stored procedures to compute these indicators. This approach has the advantage of speed, even for large sets of data. The negative side is the lack of portability, as the procedures needed to be rewritten for each new type of database included in different platform instantiations. Another negative side of using stored procedures is the lack of support for generating the graphs representing the social network. The second approach was the use of web services, which are a bit slower, but support all the needed facilities and provide portability as well.

The module also presents the results of processing such a questionnaire and such an example is presented in Figure 2.



Questionnaire

Name	pre-project student questionnaire
Description	Questionnaire for students - to be answered before getting to know the platform
Target	Student
Number of responders	7

Question list

Question number	Question text
1	How much have you have used in the past e-learning platforms?
2	You learn better when using mainly written materials:
3	You learn better using graphical and video materials:
4	You learn best when using audio materials:
5	You communicate with your peers using mostly chat.
6	For communicating with your peers, you rely on discussion forums.
7	You enjoy to communicate with your peers using VoIP systems.
	When you need help for solving a problem, the

Closed Question

Question text	You learn better when using mainly written materials:
Average answer	3
Standard deviation	0.926
Median value of answers	3
Mode	3

Possible answers

1 (not really)	14.286
2	0
3	57.143
4 (very much)	28.571

Figure 2 Results of the primary statistical analysis

Using the answers to questionnaires, experts can perform another statistical analysis to identify correlations between different indicators.

5 Use Cases Considered

The evaluation framework was experimented in two use cases, in which the actual version of COOPER platform was implemented. The first one, ALaRI (www.alari.ch) is an Advanced Learning and Research Institute where the main topic of interest in embedded system design. It belongs to the University of Lugano. The students in ALaRI study electronics and computer science. From the ALaRI's students, around 20 were involved in our study, this number being representative for the number of students in this institution.

The second participant in the evaluation experiment is ASP Italy – Alta Scuola Politecnica (www.asp-poli.it). This was founded by Politecnico di Torino and Politecnico di Milano and offers Master of Science courses in engineering, architecture and design. From the ASP, 15 students were involved in the evaluation study.

In the experiment, students had to answer to 25 questions. Each question had four possible answers from which the user has to select one.

The questions referred to students' previous experiences with the e-learning platforms, their preferred learning materials, their preferred communication tools, what persons they prefer to ask for help, if they prefer to work independently or if they prefer to work in teams, etc. The questions were also about the expected improvements in the time spent to learn, the expected training time, and the tools that were expected to improve users' efficiency like scheduling meetings or tagging documents. In order to validate the results, the questions were not orthogonal (independent of each other). Finding correlations between similar questions had the

role to enforce the trust in the results of the statistical analysis. The results correspond to the two levels of statistical analysis, realized for each case study. The first level means calculating the frequency of each answer and analyzing the semantics of these frequencies. The results are confirmed by examining the average answer, the mode, the median and the standard deviation relative to each question. These indicators show if the answers follow a normal distribution and if these answers can be trusted. The second level is represented by correlations found between different answers. The results for each case study are presented in the next section.

6 Results

ALaRI students used rarely in the past e-learning platforms: 30% answered they did not really used them, and 39% did not use much such platforms. The results are practically identical for the ASP students confirming that the learning platforms aren't very familiar to students of both institutions. The average (2.17) median and mode (both 2) confirm the validity of these answers.

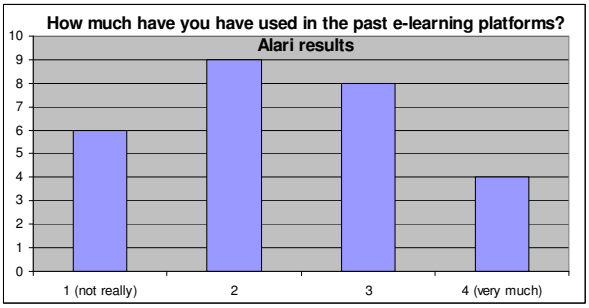


Figure 3 The previous experiences of the students of ALaRI with the e-learning platforms (1 - not much experience, 4 - very strong experience)

Concerning the preference of the learners for specific e-learning material types, most students prefer the written materials (55% show simple preference and 20% strong preference in ALaRI; the figures are 57% respectively 19% in ASP). The preferrence is lower for graphical and video materials (33% simple preference and 33% strong preference in ALaRI, 38% and 31% in ASP). Much less preferred are the audio materials (41% simple preference and 6% strong preference in ALaRI, 35% and 5% in ASP). This set of questions is important for the teachers who need to know what are the materials most liked by students. It's a common perception that students prefer the video materials but this questionnaire shows that the written materials are more valued.

From the point of view of communication tools, the VoIP tools are clearly the winners: 65% of students show preference for VoIP (35% simple preference and 30% strong preference in ALaRI) while 45% (25% simple preference, 20% strong preference) prefer chatting, and only 35% prefer to use the forum. The results for these questions in ASP are practically identical! This is a very important and interesting result because very few learning platforms offer VoIP tools, while most of

them use forums. This shows that the interest of students was ignored in the choice or development of former e-learning platforms. Also the fact that the answers are so close in different universities increases the trust we can have in these results.

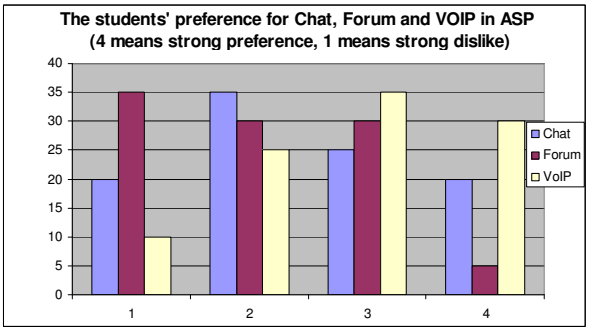


Figure 4 The students preference for Chat, Forum, VoIP - results from ASP (1 - meaning strong dislike, 4 - meaning strong preference)

The next issue is where do students look for help when they have a problem. 40% (10% strong preference, 30% simple preference) of the ALaRI and ASP students ask an expert or a teacher for the solution while 75% (both in ALaRI and ASP) prefer to ask a colleague or a team member for help. All students (100%) agreed, both in ALaRI and ASP, that the Internet is one of the first resources they turn to in order to find help to a specific problem. The only difference between these institutions was that in ASP 75% of the answer were "strongly agree" in comparison to only 70% in ALaRI. Last question in this set intended to check the use of the forums as support for problem solving. 50% agree and 16% strongly agree that they use forums for problem solving in ALaRI, while in ASP 44% agree and 16% strongly agree that they turn to forums for help. This set of questions establishes from whom the students expect help and where do they search in case the answer does not come from a person they know. These results clearly suggest the usefulness of peer recommendation systems for finding the right persons to answer the students' problems and, consequently, to minimize the time students search the forums and the Internet.

The next set of questions is focused on the students' preferences regarding the team work. They have been asked if they prefer to work alone, in teams of 3-4 people or in larger teams (>5 people). This set of questions brings the first big difference between the 2 case studies. In ALaRI no student prefers to work independently while in ASP 55% of the students prefer to work alone. In ALaRI 82% agreed they'd like to work in teams of 3-4 people and 100% would like to work in teams of more than 5 people. 80% of ASP students agree they'd like to work in small teams too, and only 5% would like to work in teams larger than 5 people. This set of questions is also very useful for a pre-project evaluation of the student groups because it can show that students with very similar preferences from the point of view of the learning materials and of the communication tools used can have very different preferences regarding the team work. This kind of questions is useful for every teacher before starting a course where a team project has to be done.

The objective of the next set of questions is to find out if the students expect an improvement of the time spent working on projects, in the effectiveness of the

collaboration with the team or teacher, and also if they expect additional training to be necessary for them to use the platform. 83% of the ALaRI students think they will spend less time on their project due to the platform but only 16% of them strongly believe this; in ASP just 42% expect the platform will save some time. Students don't expect to need training for using the platform (only 16% in ALaRI and 20% in ASP think they might need training) and more than half (54% in ALaRI and 56% in ASP) think the platform will improve the effectiveness of the communication between them and their teams and teachers.

The final set of questions refers to a set of tools that might be used in the platform. The expected usefulness of a meeting scheduler, of document tagging, of recommendation systems, and of document sharing tools was evaluated by students. A tool for scheduling meetings is considered useful by 75% of the students (same percentage is obtained both in ALaRI and ASP). Recommendation systems are positively appreciated by 67% of ALaRI students (50% very strong) and by only of 45% of the ASP students. The utility of a tagging tool for finding relevant information inside the platform is positively appreciated by 83% of ALaRI students and by 65% of ASP students. Document sharing tools are appreciated by all students in ALaRI (100%) and by 70% of the students in ASP. This set of questions show that the students know and appreciate the existing collaborative tools and want them integrated in the platforms that they are going to use in their universities. The recommendation systems may not be very well received from different reasons, one of them being that people are not very aware of their existence as the recommendation systems simply offer personalization to the web pages most of the time without the user's knowledge.

The analysis of the frequencies of the answers for each question produced useful results. An important issue for this kind of analysis is the level of trust. One of the characteristics of this experiments that makes it more trustworthy is that the students in 2 different environments in 2 different countries have similar answers to similar questions. The biggest differences appear at the questions regarding the size of the teams (questions 14-15) where the explanation lies with the different tasks the students have to perform in the two environments, and also for the questions regarding the tagging and the sharing tools (21&23) where the difference came mostly because the students in ALaRI expressed simple preference while the students in ASP expressed strong preference.

The second type of statistical analysis involves discovering the correlations between the statements that appeared in this questionnaire. The correlations were discovered by calculating the Pearson coefficient for each of the pair of questions. Considering Cohen's interpretations for correlations in psychological research we have considered 2 questions/statements to be positively correlated if the Pearson coefficient was bigger than 0.5 and to be negatively correlated if the Pearson coefficient was smaller than -0.5 [12]. In order to calculate the Pearson coefficient the Apache Commons Math [13] library was used and a web service was developed in order to integrate the calculation module with the WebRatio based questionnaire module.

The most interesting correlations found by our application are going to be presented and analyzed shortly.

The first important correlation was found between the preference for graphical and video materials and the opinion that the students will gain time by using the platform. So, even if students prefer the written materials they associate video and graphical materials with faster learning. Another correlation shows that the gain in time using the platform is associated with recommendation tools, probably because the recommendation tools are expected to reduce the time consumed with searching for relevant data.

Another very interesting correlation appears between the preference to work in teams and the preference to ask an expert or a tutor. This correlation is confirmed by the fact that there is an inverse correlation between working independently and asking for help. This correlation is easy to explain through the fact that the people that prefer to work independently will not rely on other people for information but will prefer to work and search it alone on the internet or on forums, while the others who feel better in a team will have no problem to look for a competent person and ask for help.

An interesting correlation is also the one between the idea that tagging tools is useful for finding relevant information and the idea that recommendation systems and sharing systems are effective. This means that the students understand the connection between these tools which together can improve the collaborative knowledge sharing experience.

A final correlation that was used to validate the experiment was discovered between two questions very similar in meaning that were placed at different positions inside the questionnaire for the purpose of this validation. Agreeing with "you expect that Cooper platform will provide you with a valuable support for learning new skills" correlated with agreeing on "using Cooper platform will be an effective way to consolidate your knowledge." Finding this correlation validates the others as we showed that our method produced valid correlations.

7 Conclusions

The paper presents the design, development and use of a questionnaire evaluation module integrated in an e-learning platform. The pre-project evaluation was performed for two higher education European institutions. The application was developed using a state of the art CASE tool for web modeling. The actual evaluation was performed by analyzing the answers of 35 students in 2 universities to a set of 25 questions. The results were used to draw conclusions about the preferences and expectations of users of the COOPER platform before they start using it for project development. The results can be used as guidelines by the developers of future e-learning platforms but also by teachers who want and need to adapt their courses, their teaching materials, and their didactic scenarios to the profiles of their students.

The results from this phase of the evaluation represent just one step in the evaluation process of a collaborative e-learning platform. They will be used as a reference base for complex evaluation based on the post-project questionnaires, logs collected during the use of collaborative tools provided by the COOPER platform, and the social networks that will be derived from these logs.

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