E-learning Strategies to Support Databases Courses: a Case Study

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Abstract. This paper presents a case study where competitive e-learning strategies are used in the teaching of an undergraduate Database course in order to develop, in university students, the capacity to actively research and to lead their own learning process. The experience has been carried out in the spring semester (February-June 2007) and is based on the use of the QUEST system. This tool for active and competitive learning presents both individual and group work environments in which a set of intellectual "challenges" must be solved in a time-constrained way. Important results about the use of competitive e-learning tools in university students have been obtained.

Keywords: Active learning, Competitive learning, Databases course, E-learning, Higher Education**.**

1. Introduction

In the last years, university teachers are trying to adapt the current curriculum to a new educational model, where students are encouraged to construct their own learning, in order to improve both teaching and learning at the technical/engineering degrees [1]. Moreover, several studies [2] [3] have revealed interesting results in terms of student responsiveness and satisfaction, as well as a significant correlation between the use of active learning exercises and final exam scores. In this context, the use of active learning methods can favour the Databases learning since some subjects such as databases design require developing students' creativity and inventiveness. In addition, different studies [4] [5] show that the use of new learning tools for Databases learning provides students with a different and valuable type of learning experience, which traditional methods do not provide.

The aim of this paper is to describe our experience in teaching a Databases course through a new competitive active e-learning tool, the system QUEST (Quest Environment for Self-managed Training), The experience try to show the possibilities of the competitiveness as a pedagogical tool since, although some authors do not recommend competitive learning [6], there are several studies in which good results are obtained when this type of learning is applied [7] [8].

The remaining of this paper is organized as follows: the subsequent section describes the Databases course, its educational context and the methodology used. In this subsection, the QUEST system, a tool for active and competitive learning, is described too. Next, the results of the study are presented. Finally, in the last section, conclusions and future research directions are discussed.

2. The Databases Course

2.1. Educational Context

The case study reported in this paper takes place in an elective undergraduate course on Databases technologies with 15 enrolled students. The experience has been carried out in the spring semester (February-June 2007) of the third and last year of the "Diploma in Telecommunications Engineering (speciality: Telematics)" curriculum at the University of Valladolid, Spain.

The course is about relational database systems and provides an overall view of the processes related to their analysis, design and development. Topics include the database systems and the relational model; normal forms and their benefits; building databases, underlying methodology, database languages; SQL, its use and power, etc.

The whole course spans a 15-week-long semester and comprises 30 lecture hours (one two-hour session per week) and 30 laboratory hours (also one two-hour session per week), and it is given by two teachers. The details on the case study activities and practices are provided in the next subsection.

Regarding the assessment, a process of continuous assessment is established. In this way, the students who reach the minimum required competences during the laboratory exercises will pass the course without having to do an exam.

2.2. Methodology

All the proposed activities and practices can be done both as face-to-face activities during the laboratory sessions and also as distance learning activities. All the necessary documents and tools are available into an e-learning platform Moodle, since the Databases course is delivered through that platform.

The first part of the course involves some exercises about DataBase Management Systems (DBMS) and the Entity-Relationship Model (ERM). These short exercises take place in a competitive context by using QUEST, a telematic tool that is described below. For this activity, the students just need an Internet connection and a web browser. Furthermore, QUEST is integrated into the e-learning platform Moodle, so that students have all the tools available in the course website.

The second part of the course consists of a global project, which is divided into four subprojects about the analysis, design, and manipulation of a database and the implementation of a Web application to interact with the database, in order to get an overview of the whole process of the development of database applications.

QUEST

The QUEST system is an innovative tool for active ICT-based learning, whose aim is the development of cooperative and competitive workshops supported by telematics. QUEST is accessible from any computer with Internet access and, hence, can be used in the classroom, at home or in a cybercafé. Moreover, it has been implemented as a module that can be integrated into the e-learning platform Moodle in order to offer a new type of activity for the courses delivered through that platform.

Fig. 1. Main screen of the QUEST system in which the proposed challenges and their current score are shown, as well as a summarized ranking of the best students.

The QUEST system presents both individual and group work environments in which a set of intellectual "challenges" must be solved in a time-constrained way.

These challenges are proposed to the students by other students and/or by the teachers. The answer to the proposed challenges can be of any type of those most usual within the current assessment tests. Besides, files in different formats can be attached by the students when their answers to the challenges are submitted [9].

Once submitted, the tasks are rewarded by means of a variable scoring system. The challenges are presented as a contest with the corresponding updated and summarized ranking based on the scores obtained by the students in the different challenges (see Fig. 1).

In order to enrich the learning process by means of collaboration and involvement, the system allows the students to submit challenges and to pre-evaluate the corresponding answers, being rewarded depending on the quality of the task done. Moreover, once a challenge is closed (and no more answers are allowed), the students can read all submissions from all the participants anonymously.

The final result is a dynamic and changing environment in which students generate contents and encourage each other to participate. Since students have the possibility to generate contents which everyone else will be able to access, they tend to aim for a higher level of perfection than if their work were private. This hypothesis, which is supported by the results of the different QUEST experiences [10], has already been presented by some authors [11].

3. Educational Experience

In the Databases course described in this paper, the QUEST system has been used as another basic element for learning and assessment. The score obtained in QUEST counts 20 percent towards the course grade. The teachers of this course have been able to follow this strategy more easily because of the low number of enrolled students; since the revision and assessment of the answers and the design of the challenges involve an important increase of teachers' workload.

Moreover, the activities with QUEST have been carried out during the laboratory hours. The three first laboratory sessions have specifically been based on QUEST. Although each challenge or question has been planned in order to be solved during a single session, they all have been two weeks long. Thus, the challenges can be also resolved once the session has finished. However, because of the QUEST score is variable, the teachers recommend students to answer the questions as soon as possible.

Students are organized in groups of two people so that they collaborate to solve the proposed questions. These can be submitted by the teachers and, as it has been mentioned before, also by the own students. However, in this experience, none of the students has proposed challenges. That is, the students are still reluctant to actively lead their learning process and to be generators of contents.

In relation to the type of challenges, the teachers have included 8 questions about DBMS and 6 conceptual design problems using the Entity-Relationship Model of different levels of difficulty. Therefore, the teachers have defined different assessment instruments according to the competencies to measure (methodological, technical…).

3.1. Results

The students and teachers' suggestions and evaluation results have been collected by means of an on-line questionnaire with a five-score Likert-type scale, which ranges from ''Strongly Disagree'' to ''Strongly Agree''. The survey includes different aspects related to the learning with QUEST, the proposed challenges, the QUEST tool, etc. It was set using the "phpEsp" survey system, which presents each question in a similar format to that normally used on paper questionnaires. Data were collected during June 2007.

Feedback from the students

Several studies [12] [13] suggest that students' satisfaction and motivation are important factors in measuring the success or effectiveness of the e-learning process. Thus, in order to know if the system is successful, the students' satisfaction level is analysed according to the survey data. Here, it is interesting to note that all students enrolled have completed the survey.

In general terms, the experience has been positively evaluated by the students (mean score of 3.4). The main results are summarized in Fig. 2, where the average score assigned to each item (in a scale from 1 to 5) is represented.
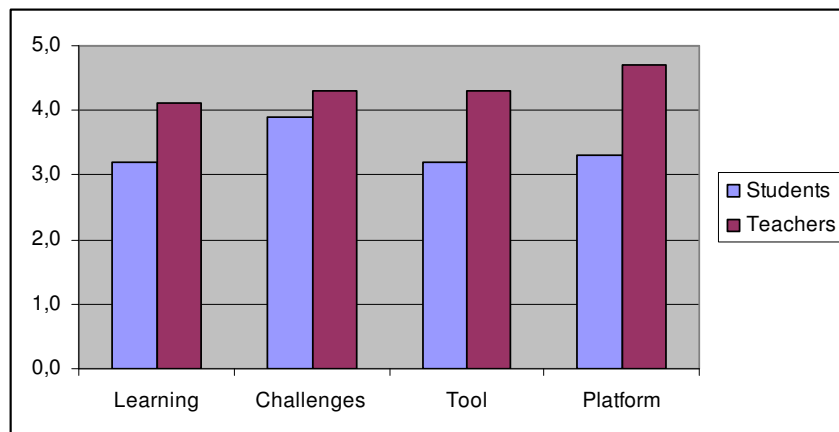
Fig. 2. Level of satisfaction: Students vs. Teachers.

The results indicate that students were satisfied with QUEST; about 53% of the students claimed that they like the QUEST tool. On the other hand, Fig. 3 and Fig. 4 show the responses of the students about two important questions: if they like to learn through the participation in contests and if they would like to take another course using QUEST (respectively). In both cases, the students' response was very favourable. They liked learning through the participation in contests (67%) and would like to use QUEST in other courses (80%).

Fig. 3. Students' opinion about learning through the participation in contests.

Fig. 4. Students' desire about using QUEST in other courses.

Moreover, most students thought that the challenges are appropriate for the aims of the course (73%) and very useful (67%) but not easy (73%). According to their answers, the students f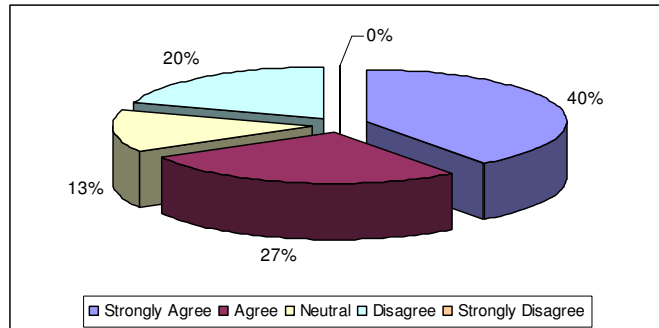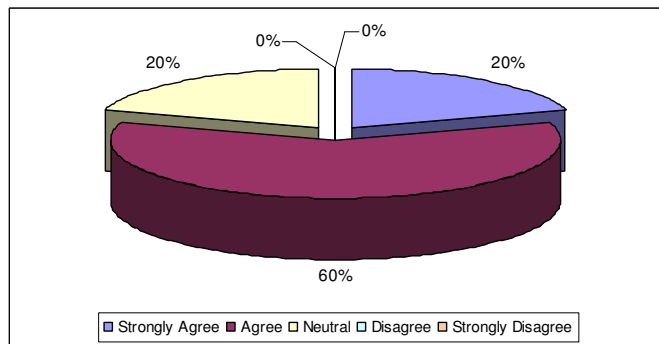ound that the proposed challenges were an effective way to assimilate the course contents and to investigate by searching information on the Internet, books, journals... From these data, it is deduced that the quality of the challenges was satisfactory.

In short, they liked the possibility of competing with their contest partners in order to solve challenges and improve their positions in the ranking. However, they also thought that the competitiveness could cause stress.

Feedback from the teachers
Every learning process is composed of at least two participants: students and teachers. So, in order to complete the evaluation and analysis of the developed methodology, it is necessary to analyse the teachers' opinion too.

If students were satisfied with this new learning method, teachers liked it even more (see Fig. 2). In general terms, the two teachers who gave the course were satisfied with this learning method. They assigned an average score to each item

higher than 4. According to their answers, they thought that the tool QUEST had a very adequate design and a good navigation system and that it was very useful and agile. However, they also thought that the management of the teams should be improved. Besides, it involved an important increase of their workload.

Moreover, the teachers enjoyed using this system in the course since it encouraged the investigation, documentation and critical analysis abilities. They observed that the students were more motivated in order to answer the questions and made better use of the laboratory hours than in traditional classes.

In short, the teachers agreed that the system QUEST has important advantages; since it encourages and facilitates the continuous and feedback-based learning, it integrates the assessment phase into the learning process and it motivates the students to work more.

4. Conclusions

QUEST is an important tool in order to adapt the current university curriculum to the new educational model of the European Higher Education Area, where it is necessary to redefine the role of teachers and students towards a student-centred system. However, we have been able to verify that students are still reluctant to actively lead their learning process and to be not only receivers but also generators of contents. Experiences like the one described in this case study promote the change from this tendency towards a more participative role.

The results show that most participants are satisfied with QUEST. In brief, the QUEST system presents, for both students and teachers, several positive aspects:

- It makes the learning more active and dynamic.
- It provides independence from space and time, since it allows attending the course from outside the classroom.
- It integrates the assessment phase into the learning process (documentation, tutorship…).

On the other hand, QUEST also helps students to learn from their mistakes thanks to other students' responses and teachers' comments. In addition, the possibility of reading answers from other students is very interesting in subjects such as Databases, where the problems usually have multiple open solutions. In this way, students learn a lot from their partners, understanding and reinforcing both basic and advanced concepts. Moreover, the teachers also think that QUEST makes it possible to develop students' abilities in investigation, documentation and critic analysis.

Finally, the future research directions are focused on the improvement of the system and of the used methodology. For example, the new system should offer assessment forms customized for each challenge so that the assessment is perfectly adapted to the competencies to be measured (methodological, technical…) and to the type of challenge (questions about DBMS, conceptual design problems, SQL…).

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