

COLLABORATIVE E-LEARNING BY MEANS OF ASYNCHRONOUS DISCUSSION FORUMS AND GROUP TUTORIALS COMBINATION

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Keywords: Blended learning, Co-evaluation, Collaborative learning, Educational technology, e-Learning, Group tutoring.

Abstract: A combination of teaching techniques including forums and group tutorials combination have been put into practice in Industrial Engineering and Software Engineering degree courses in order to improve students' academical performance and skills in areas including problem-solving, information management and group working by means of a collaborative learning. In addition to implementing the new teaching techniques, a set of assessment tools, including online quizzes, surveys, forum activity analyses and group tutorials co-evaluation have been used. The results presented here are drawn from a six-year experiment and prove to be a useful way of improving the students' general skills and knowledge.

1 INTRODUCTION

Over the last few years, a set of regulatory changes have been introduced in European Higher Education Area (EHEA) in order to overhaul the degrees' structure and the teaching methods, incorporating more active methodologies in which the students responsibility on their learning process has increased notably. In this way, teaching methods involving more fluid and effective interaction between teacher and students, and amongst the students themselves, have acquired particular importance.

The results presented here are drawn from a six-year experiment in Industrial Engineering and Software Engineering courses. The aim of these courses was to enhance the active and responsible participation of students in the learning process by means of replacing traditional teaching methods based on teacher-centred classes and examinations with an alternative based on various techniques such as asynchronous discussion forums, group tutoring, collaborative learning and peer assessment. To attain this objective, the following secondary considerations had to be addressed (Salas-Morera et al. 2009; Lan and Yang, 2009):

- a) Students need to be motivated to work regularly and follow the correct sequence of activities.
- b) Overall student working time needs to be appropriate to the credits assigned for the subject.

- c) The teacher needs to be able to attend, appropriately and at a suitable pace, to all the students in the time available.

- d) The students need to receive prompt and reliable feedback on the results of the assessments.

- e) The members of the group need to interact proactively between themselves and with their teacher.

The results of this experiment were generally highly positive since students rated very highly the exchange of information through the forum, while the role of the teacher as motivator and moderator was regarded as crucial. Similarly it was seen as essential that the general scheduling of the students' work be well coordinated in terms of the course as a whole, and realistic in terms of the amount of effort required.

2 BACKGROUND

e-Learning tools are being widely used in the teaching-learning process as a complement to conventional university classes, as well as in distance-learning institutions (Yau et al. 2009). These tools, among which Blackboard, WebCT and

Moodle, give teachers the possibility to make learning more attractive, dynamic and participatory by virtue of forums, virtual tutorials, wikis, surveys, online quizzes etc. (Kozaris, 2010). In the same way, the students receive information immediately, both in terms of content and activities, as well as the results of assessments (Lahwal et al. 2009). However, using e-learning tools has some difficulties, as for example that they require sufficient resources in terms of hardware and technical staff to guarantee that such tools are available with enough flexibility and efficiency (McPherson and Nunes, 2008); and that teachers and students need to have certain skills that they may not necessarily possess at the outset.

Asynchronous discussion forums are a very useful tool for encouraging the critical dimension of learning; students interactions, both among themselves and with the instructor, yield a synergy in the approach to preparing, sharing and understanding information, which fosters a fuller understanding of the material to be studied (Erlin et al. 2009). Nevertheless, the efficient use of these activities has certain obstacles, due to a lack of students participation, a lack of quality in the contributions, and the use of the forum as a means of exchanging information unrelated to the subject (Lan and Yang, 2009). Other important point to take into account is the role of the teacher as forum director. Mazzolini and Maddison (2003) report that the instructor intervention tends to generate more student satisfaction than peer participation, but increasing instructor participation also helps to shorten discussions, without necessarily impairing their final quality, so it is essential to decide what goals the forum seeks to achieve since these goals should govern the level and style of teacher participation. In this way, According to Rovai (2007), it is essential to pay attention on a number of factors: motivating students participation in forums by awarding them a mark; leaving students clear from the beginning that their participation is expected; giving opportunities for socio-emotional discussions; and ensuring that discussions remain content-oriented and task-oriented. Also, teachers need to avoid becoming the centre of attention and encouraging equality in terms of the culture, gender and status of their students.

Since participation in online forums needs to be evaluated, other important considerations to keep in mind include the evaluation method selected and the teacher effort involved to the effectiveness of the assessment in terms of learning objectives. In this way, Dennen (2008) remarks the importance of

evaluating student participation in forums, but questions the efficacy of the evaluation systems, arguing that the length and the number of messages posted by each student do not necessarily reflect the learning achieved, so he suggests four different methods of assessment:

- a) Participation measures: a relationship between the quantity of messages and learning cannot be assumed, so this is not strictly an evaluation method.
- b) Message content and quality measures: much more reliable, but more difficult to measure and requiring more effort on the part of the teacher (something that must also be borne in mind).
- c) Holistic measurements: simultaneously taking into account both quality and quantity.
- d) Asking for short reports on the students' experiences in the discussion processes.

Furthermore, it is very important that professors to take into account, not only students' performance and knowledge acquisition, but the practical skills needed for the students' professional development too (Barrella et al. 2006). Thus, considerable efforts have been made over recent decades, to define the skills needed by engineering students. In the case of engineering and technology, as well as the relevant local and national regulations, the Accreditation Board for Engineering and Technology [ABET] (2009) Criteria for Accrediting Engineering Programs, must also be taken into account. Among such skills the following stand out:

- a) An ability to apply knowledge of mathematics, science, and engineering.
- b) An ability to design and conduct experiments, as well as to analyse and interpret data.
- c) An ability to design a system, component, or process to meet desired needs within realistic constraints prompted by economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability considerations.
- d) An ability to function in multidisciplinary teams.
- e) An ability to identify, formulate, and solve engineering problems.
- f) An understanding of professional and ethical responsibility.
- g) An ability to communicate effectively.
- h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
- i) A recognition of the need for, and an ability to engage in, life-long learning.
- j) A knowledge of contemporary issues.
- k) An ability to use the techniques, skills and mo-

dern engineering tools necessary for engineering practice.

3 METHODS

The aim was to adapt the teaching methodology used in the modules of the University of Córdoba's Engineering Projects section to the model set out by the European Higher Education Area. In this way, an improvement of students knowledge and skills by means of collaborative reflection on the subject matter, is expected. The modules in question are worth 4.5 ECTS credits (European Commission, 2009) and the contents relate to Project Management. According to the syllabus, the following student skills should be developed:

- a) Adaptation to new situations.
- b) Analysis of client requirements.
- c) Ability to analyse and synthesise.
- d) Ability to apply knowledge in practice.
- e) Ability to manage information.
- f) Ability to organise and plan.
- g) Oral and written communication skills.
- h) Estimating and programming work.
- i) Design methods.
- j) New technologies (ICT).
- k) Strategic organisation and planning .
- l) Problem solving.
- m) Decision taking.

A variety of face-to-face and non face-to-face (using Moodle) teaching tools, were carried out in order to accomplish these abilities. Specifically, activities comprised: online quizzes, asynchronous discussion forums, groups tutorials and practical sessions, as well as theory classes. Each one of this activities is

assigned a percentage of the final marks: reports on practical sessions, 12.5%; online quizzes, 25%; asynchronous discussion forums, 10%; group tutorials, 12.5% and final examination, 40%. The breakdown of anticipated hours of work for each of the scheduled activities, in accordance with the number of credits assigned to the subject matter is shown in Table 1.

3.1 Asynchronous Discussion Forum and Group Tutorials Combination

The asynchronous discussion forum in combination with groups tutorials proved to be the most productive of the tools tested in these courses, in relation to the effort required. The main aim of the forum was to maintain contact and keep the group's attention focused on the themes raised by the subject matter. For their part, teachers were able to take stock of the way knowledge is developing within the group, allowing them to direct their students' work from a distance in a way that was virtually unnoticeable. The teacher's role in regard to student forum postings was twofold: when a student asked a question or put forward a subject for debate, the teachers kept to the sidelines in the hope that the students would come up with an answer between themselves, as freely and spontaneously as possible, intervening to make minor suggestions or encourage others to join in. Secondly, if the teacher noticed any drop-off in forum postings over a certain period, he suggested new subjects for discussion, thus encouraging students to seek information on additional aspects of the subject. Subjects suggested by teachers included: ACM/IEEE Computing Curricula, ethical regulations in the engineering professions, and professional activities in general, among others.

Table 1: Distribution of students' workload.

Face-to-face activities	Assigned time (hours)	Individual and virtual activities	Assigned time (hours)
Whole group activities		Online quizzes and preparation (O.Q.)	12
Theoretical Blocks & Problem Solving (T.B.)	33	Asynchronous Discussion Forums (A.D.F.)	10
Tutorial Sessions (T.)	6	Studying	30
Groups of up to 25 students		Homework	10
Practical Sessions (P.S.)	12	Personal Tutoring	1
Group Tutorial Sessions (G.T.)	9	Total individual and virtual activities estimated time	63
Total face-to-face time assigned	60	Final Examination	5
Students' total working time (60+63+5)			128

Table 2: Discussion forum activity, 2004-2005 to 2009-2010.

YEAR	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Subjects started by the teacher (A)	25	54	26	35	46	55
Total number of replies to subjects started by the teacher (B)	48	136	33	52	193	210
Replies per subject started by the teacher (A/B)	1.92	2.52	1.27	1.49	4.20	3.82
Subjects started by students (C)	56	80	36	57	99	72
Total number of replies to subjects started by students (D)	140	198	91	184	480	409
Replies per subject started by students (C/D)	2.50	2.48	2.53	3.23	4.85	5.68

It was considered important not to base evaluations of forum activity only on the number of contributions from each student, so the evaluation of forum content, although it required more work on the part of the teaching staff, was holistic in nature, awarding a higher score to the most relevant contributions. Although Moodle gives the possibility of evaluating forum contributions individually, an external spreadsheet was used.

Forum activity did not take place in isolation from the rest of the activities in the course, but rather as a reinforcement of all the other activities, in its role as the default communication tool. This role was further enhanced by group tutorials. The aim of these tutorials was to enable students to work together on the subjects discussed in the forum over the previous weeks. Thus, little groups up to five students were given the task to summarize, analyse and present to the rest of the group the debates occurred during the last two weeks in order to have a deeper and consistent face-to-face debate. To do this, students needed to make use of their analytical and synthetical skills, their ability to manage information, their ability to express themselves clearly in speaking and writing, and their planning and organisational skills. The pooling of the subjects discussed in the forum helped to highlight the most important concepts and to address mistakes which might otherwise have been impossible to detect. For the purposes of this activity, the main group was divided into four groups of up to 25 students, and in turn each of these was sub-divided into four subgroups of four to five students. Group and subgroup divisions were made on the basis of affinity between students at the beginning of the year. There were five discussion sessions, organised as follows:

a) At the beginning of the year there was a one-hour session with each group of up to 25 students. In this session students were asked to introduce themselves to other members of the group. There was also an

initial survey in which students were asked about the extent to which they believed they have already acquired the skills targeted by the module, as well as the importance they attached to these skills for their future careers.

b) Four two-hour sessions were held with each of the groups of up to 25 students, distributed uniformly throughout the semester. Prior to each session, one of the four subgroups was asked to monitor the forum and prepare a handout with an outline of the most important themes, which they discussed with the teaching staff. Once the teacher had approved the summary, the subgroup prepared a Microsoft Office or OpenOffice presentation, which was also sent to the teacher for approval. Finally, in the group tutorial session, they gave the presentation, which lasted no more than 40 minutes, to the rest of the group; the remainder of the 2-hour session was devoted to a group discussion of the subjects addressed in the presentation. Assessment of this session was carried out jointly by the teacher (50%) and the other students in the group (50%). The following points were assessed: presentation quality; appropriateness of material (joint ratings for all subgroup members); oral expression during the presentation; and oral expression during the discussion (the last two points were rated individually).

3.2 Other Assessable Activities

The remaining assessable activities comprised six two-hour practical sessions in the laboratory or computer room in small groups up to 25 students and six online quizzes, both regularly distributed along the semester. Prior to each practical session, a handout for the session was published on Moodle, which dealt with problem-solving using specific software (for example Microsoft Project or OpenProject). The global assessment was completed with a final examination.

The main aim of the online quizzes were to encourage students to study on a regular basis, at a rhythm set by teachers and that will allow students to keep up with the progress of the course. When a quiz comes round, the students have four days in which they are free to complete it at any time, on condition that once they open it they have to finish it within 40 minutes. Each quiz comprised up to 10-15 questions varied in difficulty and randomly assigned to students, so each student would have a different quiz. The students needed to study and revise these concepts at least with the same frequency that the teacher scheduled the quizzes, with great benefits for the development of other activities. Once the students had completed two quizzes, the teacher obtained from Moodle a file containing a statistical analysis of student answers, which he then analysed in order to identify the main weaknesses; afterwards, a 2-hour tutorial was held with the whole group, in which the tested material was discussed, paying special attention to those areas in which the poorest results were obtained.

4 RESULTS AND DISCUSSION

To evaluate the experiment the following tools were used: analysis of forum activity; academic result of group tutorials; surveys on perceived competences before and after the course; and comparison of overall academic performance.

4.1 Analysis of Forum Activity

Changes in forum activity between academic years 2004-2005 and 2009-2010 are charted in Table 2, which shows that student participation in the forum increased from 2007-2008, the first year that this activity was included in the overall mark; a significant increase was noticed not only in the number of threads started by the students but also in the number of responses, indicating that the awarding of a mark greatly encouraged participation.

Comparing the number of threads started with the number of participating students of each year gave averages of 0.47, 1, 1.55 and 1.33 threads started per student in the last four years, which tended to reinforce the claim that the forum generated a growing interest among students over the years. Similarly, comparison of the number of answers with the number of participating students in each year yielded figures of 1.18, 3.23, 7.50 and 7.57, further supporting this hypothesis.

The quality of contributions also improved over time, with the students themselves realising that off-topic or repetitive responses were unlikely to receive good marks. Thus the forum proved a useful tool in focusing students' attention on the topics targeted by the module, leading to contributions that gradually become more and more relevant.

4.2 Academic Results of Groups

The group tutorial activity brought together other activities in the module through the questions emerging on the forum. It also helped to foster the most important skills in the area, such as ability to analyse and synthesise, to manage information, and to organise and plan work, as well as speaking and writing skills. Moreover, all students were given shared responsibility in the evaluation of tutorials. The following were assessed: presentation quality; appropriateness of material (joint ratings for all subgroup members); oral expression during the presentation; and oral expression during the discussion (the last two points are rated individually). Both the teacher and the other students in the group assessed all members of the subgroup on each of the aspects mentioned above, and the overall mark was derived (50%-50%) from the teacher's score and the students' score. Scores awarded by the teacher covered a wider range (practically from 0 to 10), whilst student scores tended to be concentrated in a narrower range between six and nine points. An independent-samples t-test was conducted in order to know whether there are statistically significant differences between scores assigned by teacher and scores assigned by students in 2008-2009 and 2009-2010. In the first year a significant difference was found between scores assigned by teacher ($M_1=7.21$; $SD_1=1.67$) and by students ($M_2=6.73$; $SD_2=0.90$); $t(98)=2.03$, $p=0.045$, so students were more demanding with their classmates than the teacher was. In 2009-2010, however, the hypothesis of equality of means was accepted ($M_1=7.08$; $SD_1=1.29$; $M_2=7.30$; $SD_2=0.55$; $t(83)=-1.25$, $p=0.21$), so the student score not being significantly higher than the teacher-awarded score. Thus no reliable conclusions can be drawn from these findings, suggesting that a further sample needs to be taken in order to reach firmer conclusions.

Similarly, the teacher's score was compared to the mark finally awarded to the students. Here there was no statistically significant difference in the two years being investigated ($M_1=7.21$; $SD_1=1.67$; $M_2=6.97$; $SD_2=1.19$; $t(116)=0.95$, $p=0.35$);

($M_1=7.08$; $SD_1=1.29$; $M_2=7.38$; $SD_2=0.76$; $t(99)=-1.56$, $p=0.12$), indicating that the students' participation did not have a significant influence on the mark.

4.3 Self-assessed Skills Surveys

In order to determine the extent to which the experiment improved students' skills and the importance the students attached to these skills for their professional careers, surveys were carried out in 2008-2009 and 2009-2010, at the beginning and end of the year, using a scale of 1-5. The most striking finding was that in both two years there was an across-the-board increase in students' perceptions of their own skills, indicating that working method achieved its goals to a considerable degree, at least in terms of students' perceptions. At the outset, the competence considered by students as being least important for their professional career was Design Methods; the student grading of this competence by the end of the year had increased more than for any other competence; in the second year, it was the competence recording the second-greatest increase in student grading. Meanwhile, the skill showing least improvement in both years was New Technologies (ICT), possibly because the students considered that they had already developed considerable abilities in this area over the course of their studies and that it was now difficult for them to show further improvement. In both years the subject considered a priori most important by students was Decision-Making, thus reflecting the general approach of the degree, which is strongly oriented towards project performance and management.

When the means at the start and at the end of each year were statistically compared by means of t-test, significant differences were found in almost all cases what clearly remarks the success of the experience in this aspect.

4.4 Academic Performance

Final student marks were analysed for the last ten academic years. In the first period, 2000-2001 to 2003-2004, traditional teaching methods were used, with theoretical-practical classes and final examinations as the only method of evaluation. During this period there was a marked drop in the number of students passing the study subjects. This led to an overhaul of teaching methods in 2004-2005, taking advantage of the implementation of the ECTS. For the first time, all the activities to be carried out by students (rather than just attendance at

lectures) were scheduled in detail; the programme was fine-tuned by weekly feedback as the course progressed. At the same time, a discussion forum was included on Moodle, although this forum did not initially contribute to the final mark; finally, online quizzes were scheduled. In the first year of implementation of the ECTS, there was a notable increase in pass rate as a positive consequence of the detailed scheduling. However, over the next two years (2004-2005 and 2005-2006) the number of failures again rose, perhaps because more teachers changed their teaching methods, leading students to complain about the large number of tasks they were expected to perform simultaneously. Given this situation, and with the aim of encouraging even greater participation in the forum, from 2007-2008 10% of the overall mark was allotted to assessment of participation in the forum. The forum came to be one of the most useful and valued activities, both for the students, who appreciated its immediacy and ease of use, and for the teachers, who valued it as a way of answering questions and clarifying grey areas. As soon as forum activity was included in the final mark, all the activities required of the students were incorporated into the assessment, allowing teachers to calculate the students' workload more accurately, and enabling students to adapt their efforts to reflect the percentage of the final mark represented by each activity. The result was a substantial increase in forum participation, as well as an enhancement of its value, thanks to an improvement in the quality of student postings. There was again an increase in the number of passes in that academic year, confirming that the changes had been appropriate. Finally, in 2008-2009 and 2009-2010 the group tutorial activity was added, in which groups of up to 25 students discussed topics raised in the forum in preceding weeks. The aim of this activity was to foster the basic skills required by graduates, as well as linking with other course activities; the introduction of this activity prompted a new increase in pass levels.

5 CONCLUSIONS

In recent years a combination of teaching strategies, including asynchronous discussion forums and group tutorials, has been implemented in Industrial Engineering and Software Engineering degree courses with the aim of improving some students' skills needed in Engineering. These strategies have prompted greater skills acquisition, as well as enabling students to regulate their workload.

Participation in the forum, and also the quality of postings, rose substantially from the moment that assessment of this activity started to contribute to the overall mark for the course. Perhaps as a result of greater use of the forum, there was also an improvement in the way students perceived the accessibility of their teachers, even if such accessibility was only online.

Teacher participation in the forum is important and needs to fulfil a dual role: first motivating students to participate and exchange information and secondly starting new discussion topics when forum activity abates. Students are seen to be more diffident about participating when it is the teacher who starts a discussion; it is therefore advisable for the teacher to keep to the sidelines, intervening only to correct mistakes and encourage participation rather than leading discussions.

Group tutorials are a core activity in the new teaching methodology. They enable the work of the group to focus on the topics discussed in the forum, and they actively contribute to the development of skills such as the ability to manage information, to analyse and synthesise, as well as enhancing oral and written expression and other competences. Peer assessment of this activity consolidates the responsibility students feel towards themselves as well as towards their colleagues. However, in the two study years, peer scores was not decisive for the final marks obtained, given that there were no significant differences between the final marks and those awarded by the teachers alone, which indicates that the assessment system needs to be revised in the future.

According to students, skills improved in each study year. The skills showing most improvement were Design Methods and Organisation and Planning Ability; this is consistent with the general philosophy of the content of the Projects module and the way the activities were planned.

Future prospects of research deal with improving activity planning, making it more realistic with the students' workload, analysing the real effect of co-evaluation, not only on the final marks but also on the students' attitude in facing the academic activities, and finally, searching for new ways of evaluating skill acquisition.

ACKNOWLEDGEMENTS

The authors thank Córdoba University Quality Vice Chancellor for the support given to the Educational Improvement and Innovation Project 08C4005.

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