EVALUATING THE EFFECTIVENESS OF A PILOT SEMINAR ON COOPERATIVE LEARNING IN AN ENGINEERING COURSE

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Abstract: Despite the introduction of new technologies in university education, teaching practice is usually based on the stereotype of the classroom and the professor who is teaching the students; as a result, e-learning tools have not been fully integrated. This paper outlines an effort which has started at experimental level by an engineering department, with the aim to optimally use the digital material of an e-learning platform of student self-assessment. In this context, we perform various learning activities, we integrate the material into the activities during class and we use cooperative learning techniques aiming to make an educational intervention to the learning and social outcomes of education. For this reason we set up an 'experiment', which has given the first results, with the participation of undergraduate students who attended a pilot seminar. Diversification from traditional teaching practices/methods, and the variety of activities in the class seemed to enhance the performance of students who attended the seminar compared to those who did not participate. In addition, participants seem to prefer, with regard to the development of their communication and teamworking skills, the technique of 10-minute group exercises in the class without the use of computer yet based on the self-assessment material.

1 INTRODUCTION

Although some academics appreciate team and cooperative work during classes, it is rather an exception to 'normal' classes. The usual teaching practice is indirectly determined by the design of the classroom, the layout of benches, the organizational structures, the curricula, the teaching methods, the general academic culture (Matsaggouras, 1998) and a series of social characteristics and standards. The predominant practice is the lecture given by the professor to the audience composed of a number of students (Neumann, 2001). An exception to this educational model is the integrated approach followed mainly by the universities of Great Britain, USA and Australia, which set standards both for the curricula and the skills development of their students. It is worth mentioning the Problem Based Learning-PBL educational model, which is applied in Aalborg University that focuses on the outcomes and the student. In fact, new technologies and their applications have enhanced teaching although even in the most developed countries they have not managed to change the prevalent feature of academic classroom and teaching methods (Raptis and Rapti, 2006).

The Technical University of Crete runs an e-learning platform (E-Class), since 2005, which is applied to almost all higher Greek education institutions. Almost all tutors upload to E-Class courseware, course notes, exercises and any useful information regarding their course. Despite the encouraging comments and the high degree of satisfaction expressed by students, another research on the development of the platform shows that the system is not fully utilized and is mainly used to download the notes/lectures of courses. This was the conclusion following observation by the researchers

of this paper, in relation to the self-assessment digital material prepared for the Decision Support Systems-DSS course, which is a mandatory course for third-year students at the Department of Production Engineering and Management.

The E-Class has a special service (exercises) for academic staff, which is optionally activated so that the tutor can prepare exercises in the form of questions-answers for the students. With regard to the DSS course, the digital material in the form of self-assessment exercises was divided into groups of thematic modules, according to the detailed curriculum and in the form of multiple-choice or matching or fill-in-blank questions and answers. This effort aims to enhance teaching of the course, familiarize students with the further features of the platform, improve students' knowledge through self-assessment and support digital interaction for educational purposes. However, despite the effort made at the beginning of each semester by the tutors to instruct all students attending the course in using the features of E-Class (2-hour presentation and relevant notes) and despite the effort to develop, improve, and update the self-assessment material on an annual basis it becomes evident that students used it only to download the material of the course and hardly ever used the self-assessment feature. The support team of the course noticed that the self-assessment material is scarcely used, mainly near the date of examinations, as a source of possible questions for the examinations.

In the light of these findings we organized a pilot seminar, in the form of 'experiment' involving a group of twenty-seven volunteer undergraduate students. The main goal was to utilize the digital material. Therefore, we prepared a seminar based on cooperative learning that would use different techniques for the teaching of the same course. This seminar was held on different days and hours than the course, and was attended by 27 volunteers. The idea of the seminar was to integrate the digital material in the form of 10-minute group exercises with the active participation of students. It intended to measure the final performance of participants compared to non-participants and to evaluate their preference in five different activities, one of which was based on the digital material from E-class. In particular, the five activities combined with effective speaking/writing (communication skills) and teamworking skill, were the following: individual written assignments (at home), oral presentation with PowerPoint (prepared at home), group research projects by 2-3 persons (prepared at home during the semester; a very well-known alternative given as a

project in the context of the course, and followed by non-participants in the seminar), active participation in a discussion in class (questions-answers) and E-Class exercises (10-minute written exercises in groups of two in class).

The learning objective of the seminar was not different from the objective specified in the detailed curriculum of the course. It is noted that at undergraduate level, effective writing/speaking and teamworking are some of the transferable skills suggested by a large number of researchers (Kemp and Seagraves, 1995; Venetsanopoulos, 2004; Baldwin, Cahn, Forman, Lehmann and Wischmeyer, 1979; Caroll, Markauskaite and Calvo, 2008). Both teams of students (seminar/project) had the advantage of a final oral examination. In particular, the second team of students consisted of those who had chosen to prepare a written research project in groups of 2 or 3 persons instead of participating in the seminar. Both teams of students who opted to participate either in the seminar or the project would be given an overall performance grade based on: their performance in the laboratory, their performance at the seminar (27 persons) or their grade for the project (57 persons) and their performance during the oral examination on the course curriculum.

2 SEMINAR DETAILS

The seminar was held in a classroom equipped with a round table, in order to promote equality and familiarity and to avoid the sense of 'superiority' of the tutor, as is the case when teaching from the desk, aiming to encourage participation. The seminar extended over seven sessions of two hours each, covering Information Technology Systems and Decisions Theory, within the educational goals of the course. The tutor assumed also the role of facilitator of knowledge not authenticity, coordinator not transmitter of knowledge, who learns through the students' experiences (Felder, 1996). The role of students changed from a passive receiver to an equal participant in the building of knowledge, a producer of knowledge who draws from previous experiences; they now assumed an active and interactive, not passive role. In brief, an effort was made to perform a more student-centered learning process aiming at the development of students both at knowledge and at skills level, and less focused on the usual one-sided knowledge-based approach which is focused on the principle of transferring knowledge from the tutor to the student. In addition, we took into account

that, as set forth by Yorke and Knight (2004), the learning process is not merely the proof of knowledge proficiency in specific cognitive objects yet a more complex process which informally and tacitly enhances and improves the experiences and competences of students. For example, it develops, strengthens and improves experiences and competences, such as: communication, teamworking, etc. For all these reasons, although the development of students is traditionally linked to their academic progress, the seminar aimed at a more global development.

The techniques used by the coordinator of the seminar included the following:

Brief introduction, usually supported by few slides. Goal: to avoid monologue.

Brainstorming method through words / sentences / questions written on the board or distributed to the participants in printed form. Goal: to connect the previous experiences-knowledge of students to the educational objective and obtain their active participation in the class.

Questions-answers method with relevant material distributed or oral questions made by the coordinator. Goal: to obtain the active participation of students, explore pre-existing knowledge, verify the usefulness of the course, etc.

Students divided in groups of two*,* by draw. Goal: to enhance the cooperation of students, working in groups of two, who do not necessarily know each other or are friends; indirectly support team work with persons not picked by the student himself/herself.

Short (10-minute) group-written exercises in the class*,* derived from the self-assessment material of E-Class. Goal: to enable the cooperation of the groups of two students in order to achieve the objective of the exercise and better learn the material taught.

Presentation of short group-written exercises*.* The exercises were prepared in the class by the groups of two students and then presented to the audience. Goal: to facilitate the oral expression of knowledge obtained by the students and improve their oral skills.

Individual short written assignments to be prepared at home referring to the topics covered during the seminar. The assignments were usually delivered at the next session. Goal: to improve the knowledge of students, enable deeper knowledge and further practice. The coordinator evaluated each individual written assignment in terms of fully elaborated subject, presentation of the paper, syntax, spelling,

punctuation, and returned it to the student for feedback and reflection.

Students selected by draw to make an individual oral presentation of a topic distributed to them. Usually, presentations were made every 2 weeks. Goal: to elaborate the topic, prepare the oral presentation, structure the presentation in a cohesive and comprehensive manner within the set deadline.

3 RESULTS

In analyzing the results of the pilot initiative we checked the performance of students and we delivered a specially formulated questionnaire at the end of the semester to the participants in the seminar.

In Fig. 1 we present the performance of both teams of students on a scale from 0 to 10 (excellent) [pass grades are from 5 to 10]. We used independent samples, t-tests, to determine if there were significant differences in student performance. Only the performance in the final oral examination was found to be statistically significant [t (66.33) = 2.12, p <0.05)]. The effect size, Cohen's d, was found to be 0.46, which is a moderate effect. Furthermore, we found no statistical differences in performance based on the students' gender.

With regard to the teaching techniques and methods, we examined their effect in enhancing effective writing, effective speaking and teamworking. This research was carried out with a specially formulated questionnaire using the Conjoint Analysis (CA) technique. CA (also known as "trade off analysis") is a multivariate technique used to estimate or determine how respondents develop preferences for products/services. It is widely used in marketing research and is based on the premise that consumers assess the value of a product by combining the separate amounts of value provided by each attribute (or factor) of the particular product or service.

In the CA experiment conducted in this study, the "product" is teaching techniques, which is decomposed into relevant factors that can be combined to fully describe them. From the specified factors and factor levels, hypothetical products (scenarios) were constructed for students to evaluate. The 5 specific factors and factor levels (in parentheses) were as follows: 1. preparation of individual written assignments at home (every week or every two weeks), 2. individual presentation of the assignment using PowerPoint in the class (every week or every two weeks), 3. preparation of a group

research project by 2-3 persons during the semester (yes/no), 4. active participation through questions-answers during the course (yes/no), 5. group written exercises in class based on digital material (yes/no).

The combination of the five factors and two levels per factor gave rise to 32 possible scenarios (2 x 2 x 2 x 2 x 2). To reduce the number of profiles to a manageable size, while at the same time maintaining randomness, a fractional factorial design using SPSS was used. This process reduced the number of profiles to be evaluated to ten (see Table 1), including two holdout profiles. Holdouts are scenarios which are rated by the students but are not used to build the preference model. Instead, they are used as a check on the internal validity of the model. The full-profile approach, whereby students were asked to rate the full descriptions according to preference, was used. A rating scale anchored from one to seven, with 1 being "no improvement" and 7 "great improvement" was selected. The study utilized a verbal description approach. The ten scenarios used in the questionnaire had the following form: (scenario 1) '*Suppose that every week you must deliver an individual short written assignment and every 2 weeks you must prepare an oral presentation on PowerPoint for the purposes of the course. You will not be given any group research projects. In class you will actively participate by answering questions made by the coordinator for discussion, and you will prepare together with your classmates short written exercises that facilitate the learning process. Do you think that the above activities improve your written and oral expression and your ability to work in a team?'* The SPSS conjoint procedure (SPSS, 2004) was used to calculate utility scores (or part-worths) for each individual respondent and for the whole sample. These utility scores are analogous to regression coefficients, and are used to estimate the relative importance of each factor. According to the results of preference expressed by students, the five factors rank as follows in terms of importance: 1. short group exercises in class (E-Class material) (29.37%); 2. active participation through questions-answers during the course (26.12%); 3. group research projects during the semester (21.89%); 4. preparation of individual written assignments at home (14.26%), and 5. individual presentation of the assignment on PowerPoint in class (8.37%).

Our results indicate an adequate level of internal validity in terms of Pearson's product moment correlation coefficient (r = 0.98, p<0.001), and Kendall's tau (τ = 0.997, p< 0.001) for the whole sample. With regard to the means used to improve written-oral expression and cooperation with other students, there seems to be a preference firstly to exercises performed in the classroom, based on E-Class self-assessment digital material, then to discussion through questions made by the coordinator, etc.

4 CONCLUSIONS

Although the sample was very small, the initial research indicated whether tutors can affect the results of learning by applying a mix of teaching methods and techniques. The performance in the final oral examination of the students who participated in the seminar was higher compared to the performance of non-participants. It is noted that the written comments of participants and the high level of satisfaction expressed by the students encouraged us to repeat the seminar the following year and thus achieve higher reliability of our conclusions. It is worth mentioning that although students did not generally use the self-assessment digital material, in the form of 10-minute long exercises, it was highlighted as the most important tool to improve the two transferable skills, communication and teamworking. McDonald also reached a similar conclusion in 1977 when he noticed that a significant part of learning was taking place in group discussions, away from computers yet regarding computer work.

We do not know whether students would keep the same order of preference if written group exercises in class were diversified in connection with the digital material and had a different content or form. Prima facie we can conclude that students developed a better understanding of the usefulness and *value* of the self-assessment digital material, for the additional reason that it promoted the interaction, exchange and negotiation of ideas both between the groups of two students and at group level in the class. Additional conclusions came to light: it became evident that the theoretical part of an academic course can become more 'exciting' and interesting to students if a mix of teaching techniques is used. In this context, numerous tools, techniques and methods can be applied, and any digital means can, directly or indirectly, become part of everyday practice and be useful.
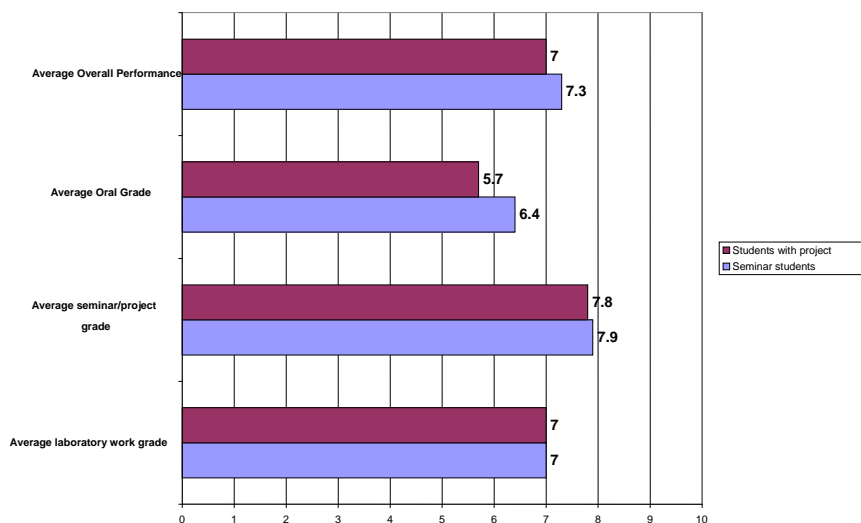
Figure 1: Comparing the performance of student groups.

Table 1: Scenarios through Fractional Factorial Analysis.

s/n	Individual written assignments	Oral presentation using PowerPoint	Group research project during the semester	Discussion through questions-answers	Short exercises in groups of two	Status
1	Every week	Every 2 weeks	No	Yes	Yes	Holdout
2	Every 2 weeks	Every 2 weeks	Yes	Yes	Yes	Design
3	Every week	Every week	No	No	Yes	Design
4	Every 2 weeks	Every 2 weeks	No	No	Yes	Design
5	Every week	Every week	Yes	Yes	Yes	Design
6	Every 2 weeks	Every 2 weeks	Yes	No	No	Holdout
7	Every week	Every 2 weeks	Yes	No	No	Design
8	Every 2 weeks	Every week	No	Yes	No	Design
9	Every week	Every 2 weeks	No	Yes	No	Design
10	Every 2 weeks	Every week	Yes	No	No	Design

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