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Learning mathematics in teams: collaborative work using on-line discussion forums*

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Learning mathematics in teams: collaborative work using on-line discussion forums

Abstract

This paper presents the results of a blended learning and collaborative venture in higher education. Although the main objective of this experience was to deepen certain mathematical concepts, we also attempted to develop other skills among the students related to team-work, communication and the use of Information and Communication Technologies (ICT). The study was realized through the teaching of Mathematics to first year students on a Business Degree at the Business School of the University of Basque Country in San Sebastian (Spain). The students were divided into teams and each team was set a collaborative writing task as a course objective. Unlike other previous tasks, the students were asked to conduct their work on-line, using a discussion forum as a means of communicating amongst themselves and with the teacher. Simultaneously, the students had to attend face-to-face sessions in which theoretical aspects of the course were explained to them by the teacher. Before starting work on the course itself we asked the students to fill in a questionnaire in order to discover details related to their habits and level of use of ICTs. Preliminary findings with regard to the success of the on-line methodology are positive with regard to the use of ICTs, cited by the majority of students as being motivational. There is also, however, some evidence of a rejection of the methodology deployed by a percentage of students involved. In relation to writing ability, in most cases the need to collaborate with the other individuals on the team increased the quality of the texts.

Keywords: B-learning, collaborative learning, higher education.
1. INTRODUCTION

Information and Communication Technologies (ICT), and especially the use of communication tools, are playing an increasing role in current teaching methodologies as a means of educational support for boosting, enabling and facilitating team-work between students.

Various acronyms reflect different concepts in the approach to this use: CAI (computer-aided instruction), CSGBL (Computer-supported group-based learning), CSCSL (computer supported co-operative learning), CMD (computer-mediated discussion), CC (Computer Conference) NL (Networked Learning), ALN (Asynchronous Learning Networks), CMC (computer-mediated communication). Within e-learning and parallel to the evolution of learning platforms, the investigation of methodologies oriented towards individual students has increasingly taken steps towards considering learning as a social activity leading to the promotion of collaborative work. In both traditional and distance learning, collaborative learning has been considered an effective teaching method [1].

Bulletin Board Systems (BBS) or discussion forums, as asynchronous means of communication in terms of teamwork, allow for interaction between the students and with tutors. Furthermore, given that the information is written and generally remains in a structured form, content can later be revised and analysed, allowing the student to reflect on his or her own contributions, as well as on the contributions of students on the same course. Students, therefore, actively and thoughtfully participate in the knowledge creation process. The learning platforms which support these types of interaction allow for the post-analysis of all messages exchanged between students via the learning forum.

This aside, ICTs have gradually become incorporated into on-campus university education. As a result, subjects for which it was once necessary to attend class are now incorporating activities, exercises and topics which students can choose to study on-line. As, to a certain extent, the process of the introduction of ICTs has occurred naturally (as opposed to being an artificial imposition), blended learning, or b-learning, now has a strong presence in university education. This form of teaching is characterised, on the one hand, by an endeavour to maximise the best aspects of on-campus teaching and, on the other hand, by the use of technology as a means of implementing such teaching [2]. According to the same authors, blended learning may include any combination of teaching method(s) which combine(s) with the use of ICTs (including traditional classroom methods).

2. THE CONTEXT

The study on which this article is based, belongs within the context of the general teaching of a subject entitled "Business Maths II". This subject is taught in the second term of the first year of a Business Science Diploma, given at the University College of Business Studies in San Sebastian, a centre which forms part of the University of Basque Country.

The authors of the course share the belief that the learning environment created around the student is a key factor which contributes to the success of any attempt to improve a students’ motivation to learn. The authors consider the application of new teaching methods which enable more active learning on the part of the alumni [3] - in an effort to improve motivation, participation and results among the students - to be absolutely necessary.

Previous to embarking upon the current study, the authors had been involved in other studies aimed at fostering teamwork and the development of abilities related to mathematics [4] and of developing a strategy for encouraging voluntary small group working practices, with a view to encouraging teamwork and discussion [5].

However, until now the authors had not considered the possibility of introducing the use of ICT as a tool, not only for working, but also with which to generate communication between the
students and teaching staff via a computer. Certain studies indicate that statistically there is no difference in the levels of satisfaction between students undertaking distance learning courses as compared to those studying on-campus [6]. However, Kitchen and McDougall [7] and more recently Jung, Choi, Lim, and Leem show that students involved in collaborative tasks on-line display a higher level of satisfaction than those for whom the task is designed for use in a direct, face-to-face teaching context.

In these types of environments, in which traditional teaching is fused with non-presential learning, the importance of motivation is even greater since the student spends less time in the classroom and more time working on tasks independently. Interestingly, according to Aycock et al [8], the greatest obstacle facing these students is not their actual use of ICTs but instead their poor time-management skills.

As such, focussing on external aspects that determine the learning processes in mathematics, the present proposal was intended to guide efforts towards collaborative learning among the students, for which discussion forums would serve as a communication tool.

3. THE PLATFORM

Given that the task in question had to be carried out in a completely non-presential way, some form of computing tool was needed. The selected tool was the IT platform Moodle. The principal reasons which led to this choice being: it is a tool which offers all the functions needed for the study; it is easy to use; it has been tested in a wide range of academic circles.

Moodle is considered to be a Virtual Learning Environment. That is, via Moodle, educational platforms can be created and managed. Furthermore, the design and development of the Moodle environment is based on a learning theory known as social constructionist pedagogy [9]. The fact that Moodle was based in the aforementioned theory reinforced the approach taken by the authors of this article with regard to the study in question.

As with almost all learning environments in use today, Moodle offers a wide range of possible uses [10]. As such, and with a view to focusing the students solely on the fundamental, a simple "classroom" was created. Modules were used to introduce theoretical topics (a theoretical topic was introduced in every module) and a forum was created for each group (see Figure 1). This simple classroom design enabled an approach to the objectives the students were expected to achieve, both in terms of learning and in gaining a command of the computer tool. These included: the habit of reading on a daily basis (selected reading based on new topics which the tutor would introduce for each module); the use of the forum to raise doubts with both the tutor and the other members of the group (which entailed sending and receiving messages); the loading and downloading of files, involving learning how to control the size of documents (including how to compress and decompress files) in order to make loading and downloading possible; the management of the various versions of the documents that would be generated by each group.
However, besides from having to be adept at using the Learning Environment, the students also had to use other computing tools. Writing documents implied the use of a text editor. MS Word was chosen primarily because it was the most commonly-used text editor among the students. Given that they were working on a maths text, it was also necessary to write equations using the same application. The students were not permitted to present hand-written or scanned equations, so they were asked to install the MS Word equation editor, which they then used.

4. DEVELOPING THE INVESTIGATION

This section describes the activity which formed the nucleus of the experience presented in the previous section. Firstly, a general approach to the activity is presented, followed by an explanation of the objectives of the activity which is subsequently described in greater detail.

4.1. General approach and objectives

The students had to develop a piece of written work employing a process based on a collaborative focus. The work had to be carried in its entirety as part of a distance-learning task. In other words, group members employed ICTs both in order to communicate and work together in their groups as well as to compare progress and raise any doubts with their tutors.

The aim, on one hand, was to set out an exercise in which group collaboration was obligatory (in order to carry out the exercise in question) and, on the other, to introduce the different uses of ICT (as a tool for communication between the various team members).

The following paragraphs explain in greater detail the principal objectives which the task hoped to cover:

- That the students would consult and analyse the list of reference books relating to the subject and be able to summarize academic texts using appropriate language.
- In terms of group work, reinforce the collaborative participation of each group member. The students both contribute and receive information from each other. They then evaluate each contribution and produce a joint work.
- Reinforce the use of ICT within the subject, with the aim that the students would learn a good command of the proposed tools. These included: Moodle (the Moodle discussion forum); a word processor; an equation editor; a scanner; the sending and exchanging of
4.2. Description of the activity

The following is a more detailed explanation of the proposed exercise.

At the beginning of term, groups, made up of approximately four volunteer students, are formed. In addition, during a class conducted on campus, an explanation of the exercise is given together with instructions on how to use the Moodle platform.

The process of producing the above mentioned exercise includes the following stages:

1. Firstly, via the Moodle forum the tutors assign each group member one mathematical concept (from among those previously presented in the theory class).
2. After consulting the subject's three principal bibliographies, each student goes on to write a first draft of the document in which they explain the assigned concept. For the purposes of the document, the student should appropriately employ the use of a text editor and refer academically to the bibliographical sources they have consulted.
3. Once each group member has written the first draft of their document, they make it available to the rest of the students to read via the forum created for the purpose by the tutors on the Moodle platform.
4. At this point, a deadline is set for each student to read through the work produced by their fellow students and make any contributions or corrections they consider necessary. In this way, each team member benefits from the amendments made by the rest of the team as well as by the tutors.
5. Having taken on board the contributions of other group members and the tutors, each student then writes a final draft of their document which they once again post on the E-learning platform as well as handing in a hard copy to the tutors, thereby bringing the activity to a close.

As may be appreciated from the above description, the aim of the activity is to cover the objectives of acquiring or arriving at: a basic command of ICT; the necessary level of cooperation required to successfully develop the exercise; the skills to consult and reference key bibliographical sources related to the subject.

4.3. Development of the experience

Before beginning the task, students received a series of specific instructions outlining proposed objectives, as well as how to organise their work and manage the drafts of their documents. Each person was asked to choose a colour with which to mark others' work. In this way, a person receiving back various marked versions of their work could easily distinguish one from the other. Furthermore, it was requested that when making changes to a document, the file name should be changed. A code system was also devised so that each person would not have to invent their own arbitrary form of renaming documents.

The authors of this article consider it fundamental for the successful completion of the task as a whole, that the work of each group be clearly and precisely organised. Given that the students in question were in their first year, with no experience of this type of task, and bearing in mind the significance that a good organisation of their work would have with regard to the success of the experience (mentioned above), it was decided that very specific instructions would be given with regard to the organisation of students’ work and that this aspect of the exercise would be closely monitored throughout.

A virtual classroom and discussion forum were then set up for each of the groups on Moodle (see Figure 2). Before beginning the actual task, the students voluntarily agreed to complete a questionnaire regarding their current habits with regard to using ICT. The objective was to determine these habits in advance in order to be able to pre-empt, as far as possible, any
problems that may have arisen.

Figure 2: General view of one group's discussion forum

5. RESULTS
A total of 205 students were enrolled on the course and divided into three groups. Of those 205, 84 (41%) took part in the voluntary experience. A total of 23 groups were formed, each with about 3 or 4 members.

Out of 84 participating students, 83% completed the previous questionnaire. According to the results obtained, 98.6% used a computer at home and practically all (97.1%) had internet connection. 94.3% of the students claimed to use a computer on a daily basis, the main reasons being leisure (79.7%) and for searches, using Google (84%). With regard to whether they had used any kind of discussion forum before, only 7.25% admitted to doing so on a regular basis, 46.38% claiming to have used one once and another 46.38% saying they had never used a discussion forum.

The tutors assigned each member of every group a mathematical concept from those already presented during the face-to-face sessions. After having consulted at least the texts on the course booklist, the students wrote a draft version of the document, summarising and interpreting the concept within an economic framework.

Once the draft document was available to be accessed via the discussion forum, the rest of the group members and the tutors read over the work and, via the forum, sent corrections, contributions and suggestions they considered to be appropriate. It was mandatory for all students to complete this phase for each of the concepts in their group. This element of reinforcement of the interdependence of group members is considered essential to achieving significant results when working as a group.

Once all the suggestions were received, each student would then type up and post a definitive version of their document onto the discussion forum. Note that during the entire writing process, communication between group members and the tutor was conducted exclusively via the discussion forum (see Figure 3).
6. DISCUSSION AND CONCLUSIONS

From the point of view of work content, the mathematical knowledge amassed by the students seemed to be sufficient in order to adequately carry out the assigned task according to directions given by the teachers at the start. In terms of participation, it is worth highlighting the generally high number of messages, from all the students in the forum. 182 debates were counted with more than 900 messages in total.

With regard to using the forum, consistent with the information obtained in the initial questionnaires, the main difficulties occurred when the students had to attach files (the sending of simple messages did not give rise to too many problems). Often the document was sent within the actual message instead of as an attachment.

Another common problem was the size of the files. Very few of the students knew how to compress a file before uploading it onto the forum or knew which image format to use so that the document did not take up too much space (despite the fact that, in the case of the latter, precise instructions had been given in class).

The students also did not know how to use either basic books or other library resources. They lacked, in this sense, any clear criteria for carrying out academic work.
The analysis of messages sent to the forum during the cross revision within the group, shows that most of these messages are merely formal. In those cases, except when the teacher focus the revision to the content of the messages, the goal of motivating a collaborative learning has not been achieved.

As a result of the completion of the experience described above, the principal conclusions reached are as follows.

We consider that the key lesson derived from the nature of this task lies in the development of generic abilities rather than those directly associated with the teaching matter. Among others, it is worth highlighting the general abilities of: the technical composition of documents, skills associated with interchanging documents, the art of non-presential communication and the making of individual contributions within a group.

We think that the feed-back during the work from both, team-mates and teacher, is one of the key points of the innovation. This feed-back, as an element of the continuous assessment, makes the assessment system into a learning tool. Therefore, it changes the traditional way of seeing the examination as an objective itself: obtaining students’ marks.

With regard to the cross assessment among team members mentioned above, we consider that it would be suitable to study in-depth the collaborative part of the task. The teacher would assume a more guiding role in his/her own checking of tasks as well as in promoting this cross revision among team-mates.

Finally, we would also mention that, as expected, the electronic, innovative and individual aspects implied by the task are shown to be elements that strongly motivate quite a number of students (50%). However, there were also a percentage of students who felt alienated (25%). The main reason, in our opinion, for this sense of alienation was the additional difficulty involved in the use of technology to complete the task. In the event that the student does not possess sufficient command over the required tools, the activity means having to dedicate much more time than he or she would normally do in order to complete a task.

References


