COLLABORATIVE PROJECT-BASED LEARNING: AN EXPERIENCE

V. González-Ruiz¹, G. Ortega¹, E. Garzón¹, N. Calvo-Cruz¹, J.L. Redondo¹, J. Salmerón¹, L. Casado¹, P. Ortigosa¹, C. Medina-López¹, J.J. Moreno¹, M. Ruiz-Ferrández¹, F. Orts¹, S. Puertas-Martín¹, T. Santamaría-López²

¹University of Almería, ceiA3 (SPAIN)
²University of Guayaquil (ECUADOR)

Abstract

This paper presents, from the point of view of learning, the results obtained in a subject that is taught following the philosophy of project-based learning. Each academic year, all the students of the teaching group of the Multimedia Technologies at the University of Almería develop, in a controlled manner in time and in procedure, a novel project (all students work in parallel on the same project), following a strict protocol based on the resolution of small issues, analysis, and adoption of the best solution achieved, with the idea of continuing to implement the project based on the best found solution until that moment. With this methodology (an iterative process of issues definition, proposals implementation, in-classroom presentation of the proposals, and adoption of the best proposal), the students develop their skills to solve problems, work in groups, increase their critical sense, speak in public, and get an idea of the way of working with which they will find in many companies, especially in those related to technology. In addition, thanks to the continuous evaluation process, the students know their performance in the subject as they are studying it, which significantly increases the percentage of success. The obtained results compare objectively different academic parameters, such as the number of students enrolled and the ratio of students who pass, before and after this new form of learning, showing a positive tendency.

Keywords: Project-based learning, collaborative development.

1 INTRODUCTION

Project-based learning (PBL) [1] is a teaching modality that is characterized by selecting and ordering the theoretical knowledge and skills that students must acquire through the development of a real project. PBL is used especially in technical studies at the intermediate and high levels, and especially in those elective and/or terminal subjects, where students have sufficient basic knowledge acquired in previous years. Among the main reasons why we choose to use PBL, compared to other teaching methods, we can highlight:

1 The students understand and find out the usefulness of many of the theoretical contents that have previously been studied in previous years, as well as the new contents that are introduced in the current subject, in which the PBL is carried out.

2 Students learn to collaborate in the development of a common task (in this case, the project), which develops their interaction and communication skills with their classmates, as well as with the teacher/tutor. This aspect can be essential to successfully develop their work in the company once they have completed their studies.

3 Students learn to solve problems that are not described as a simple sequence of micro-operations or micro-tasks, a situation that in the working world is the most frequent.

4 Students learn that when a project is developed, there are usually no perfect solutions, or simply that there is no single solution. In many cases, and mainly due to time constraints, a simple prototype of the project, which will later be improved (perhaps by other students), may be sufficient.

5 While developing the project, students receive a constant feedback on their performance in the subject, both at the group level and at the individual level. This helps to reduce significantly the failure to pass the course.

6 Students are generally forced to defend their positions and ideas, both in their work groups and in the entire class. Doing that, they are developing their convincing and communication skills.
If the project is sufficiently novel and attractive for the students, they generally work harder than using other types of teaching methods. In addition, face-to-face classes tend to be very dynamic and varied, because there are no predetermined pre-set scripts to solve the problems. Moreover, each student can choose the set of tools that suits him best.

Unlike other forms of teaching based on practices, or solving more theoretical problems, if the project is new for each course, the possibility of copying the solutions from previous years is automatically eliminated. However, this does not mean that in order to solve the project, students usually have to carry out a preliminary search on the Internet, in order to adapt the found partial solutions to their needs.

Finally, each year, the PBL implies some extra effort on the part of the faculty, mainly: (1) to set up a project that can be carried out in a reasonable time and considering the average skills expected of the students, and (2) to monitor continuously the progress of the students during the development of the project.

The paper is organized as follows. First, Section 2 describes the methodology followed in this teaching experience. Then, in order to understand the interaction that students have with the teacher and other students, Section 3 shows one of the issues that were solved in previous years. Next, Section 4 presents some interesting results of the use of the methodology, performing a comparison with other forms of teaching and evaluation in the same subject. Finally, in Section 5 we summarize our main conclusions.

2 METHODOLOGY.

The work methodology used in this teaching experience is summarized in the following steps:

1 Each academic year, before the face-to-face classes begin, the faculty chooses a project related to the competences that the student must acquire in the subject, and defines for such project, a set of issues. An issue is the formal specification of a subproblem, which ordered in time, and address a certain part of the project when it is carried out. Specifically, GitHub [2] is currently being used, a project development tool based on the Git tool [3]. GitHub offers free public (unlimited) and paid private (limited) repositories. Therefore, before the classes begin, a set of issues are available in a GitHub repository.

2 The issues are designed so that the volume of work requested in an issue keeps the components of the work groups occupied for about a week, considering the total teaching load of the subject and others (students attend simultaneously many other subjects). Most of the student's work is done in class, where the teacher can help to understand what is asked in the issue of that week.

3 The first day of class, after the previous explanations of the teachers, the students form small groups of work of up to 4 members. The composition of the groups can be dynamic throughout the course (some students can be incorporated into small groups or there can be an exchange of students between groups). However, generally, the groups usually remain stable throughout the course.

4 All groups work each week in the same weekly issue. There is no control or restriction on what the group wants to share with the other groups on the part of the faculty.

5 After having finished the issue and when there is still a reasonable amount of time to finish the week, the teacher asks all the groups to publicly present their developments. All the members of the group must participate in this task. The rest of the class, including the teacher, can ask questions to the speakers.

6 The decision on which is the best solution for the current issue is the work of both the students and the teacher. After the exposure of all the groups, all the solutions are weighed and the best is chosen. If the issue has not been solved completely, the process is repeated until (with a cycle of a week) a satisfactory solution for the issue is finally reached. Otherwise, the issue is terminated and the whole class start working in the the next one.

7 The teacher, who maintains the original copy of the repository of the project, accepts a pull-request from the repository of the group that has been chosen as the winner. Therefore, the teacher's repository is updated with the best solution. Next, the teacher advises all the groups that they must synchronize their repositories with the original repository.
The teacher, according to the presented solutions, the oral presentations, the questions proposed by the students, and the given answers, scores each group (all the members of the group receive the same mark) in its current group composition.

While there are issues to resolve, and time to do so, go to Step 4.

3 WORKING WITH GITHUB ISSUES FOR SOLVING PROJECTS

As of June 2018, GitHub is the largest software developing platform with more than 28 million users and 57 million repositories of which, at least 28 million are public [2]. It is based on GitLab [3], an open-source Web-based system based on Git [4], an open-source distributed version-control system for tracking changes in source code during software development, originally developed by Linus Torvalds in 2005 for development of the Linux kernel. GitHub was recently acquired by Microsoft Inc. for $7.5 billion [2], which shows the relevance of the open-source developments currently.

In GitLab (and therefore also in GitHub), an issue is basically the description of a problem or a task to do within a project, whose code is created by one or more programmers. These programmers works remotely, using Git and GitHub as synchronization tools, although this is not compulsory. Typically, an issue describes the work to do an also, provides ideas, links, procedures to address such issue. As an example, we show a solved issue of intercom [5], which is the last (open-source) project that we are developing in Multimedia Techniques, at the University of Almería. intercom is a real-time communication tool for transmitting audio and video between a group of users. It is still under development and this is an example [6] of an issue and the interaction between the teacher (who in this case has defined the issue) and one student:

As can be seen in the figure, two students (Jarh57 and pateleevnikita) and the teacher (vicente-gonzalez-ruiz) discuss (in 14 Oct 2016) how to implement the issue “Averiguar cómo realizar la transformada y comprimir el audio”. This issue (number 5) was closed in that date because it was solved. The next step (not shown in this figure) was that one of the students did a pull-request to incorporate...
the solution to the original repository. This is an useful action, very easy to do using GitHub, that has been one of the reasons of the success of such software developing network.

4 RESULTS

In this section the most significant results of the experiment described previously have been presented.

The following figure shows the statistics for Multimedia Systems from the moment that it began to be taught (2002). As can be seen, in the Y-axes, three different information are displayed: (1) the number of attending students (in red), the number of passed students (in yellow), and the percentage of passed students (blue vertical bars). Academic years, together with a legend that explains the evaluation system used (E=Exam, PBL=Project Based Learning, C-PBL= Collaborative PBL), has been placed in the X-axes.

Based on these results, it can be said that the use of PBL increases the success of the students approximately a 25% respect to the case where the subject is evaluated using a test (E), and that in the case of C-PBL, the success is even higher (always above 90% of success).

5 CONCLUSIONS

After analyzing the results obtained, it is possible to assert that PBL is an interesting and effective methodology in subjects that, like the subject of Multimedia Technologies, lend themselves to this type of teaching. Students are more motivated than in the case of an evaluation using exams and this increases the success rate. On the other hand, the use of collaborative tools that support the use of PBL (C-PBL) can even increase this rate even more, up to values close to 100% success.

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REFERENCES


