From a first cycle PBL environment to a more traditional master's programme: students' impressions.

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Conference Topic: Educational Research Methods

INTRODUCTION

The technological programmes held at the Polytechnic School of Águeda (University of Aveiro, Portugal) have been running in a project based learning (PBL) environment since 2001[1]. The whole curricula have been designed and developed to support such an environment and, reflecting on the past thirteen years, it is now possible to state that an institutional cultural change has effectively taken place [2]. This outcome is in line with the literature on this subject, and the particular development of the Águeda PBL environment has been published elsewhere [1-3]. Over the course of the past years, a few curriculum adjustments have taken place, as a result of the accumulated experience of those involved, but the framework of the curricula and the foundational ideas behind the development have not changed in any substantial way.

Although the Polytechnic School of Águeda (ESTGA) is one of the many departments of the University of Aveiro (UA), it has its own small campus, situated at Águeda, in a highly industrialized region about 25km away from the main university campus. These aspects have all contributed to the development of the school's own dynamics: it has its own campus, it is of polytechnic nature (Portugal has a dual Higher Education system), and a project based learning environment has been soundly established.

As a result of the Bologna process implementation in Portugal, around years 2006 and 2007, the UA redefined its programmes and created the possibility to establish direct links between first cycle programmes, such as the ones offered at ESTGA, and second cycle programmes in scientific areas akin to the former. These second cycle programmes are called "natural continuity master programmes", and allow first cycle graduates direct entry access, without any further selection processes. In the case of ESTGA's Electrical Engineering programme, the natural continuity programme is the Master in Industrial Automation Engineering, a joint programme of the Electronics Engineering Department (EED) and the Mechanical Engineering Department (MED), being offered at the UA's main campus. The ESTGA students who decide to take this path have, therefore, to face a major transition from ESTGA's PBL environment to a

much more traditional learning environment, and to a somewhat different institutional culture. The transition from the polytechnic nature of their background to the university nature of the second cycle also has to be taken into account.

The purpose of the investigation described in this article is to understand the difficulties felt by the students in the transition process, and also the impact (positive and negative) of their PBL background in their continuing education, in a more traditional environment.

Although reports of moves from traditional learning settings to PBL environments are not hard to find in the literature (e.g. [4]), the Author has found no references addressing a similar transition to the one described in this paper, which adds to the originality of the research hereby presented.

1 SETTING THE SCENE

In this section, a very brief description of the main features of ESTGA's PBL environment will be provided, followed by an also very brief description of the second cycle programme organization. This will set the scene for the investigation, and establish a framework for the discussion of the results.

1.1 The 1st Cycle Electrical Engineering Programme

As mentioned earlier, the Electrical Engineering programme offered at ESTGA is a first cycle three-year programme, in which a PBL environment has been established since 2001. The curriculum is organized around aggregate curricular units, each corresponding to an important goal theme addressed by the programme. These aggregate units materialize into Thematic Modules, which consist of a project and a set of supporting courses. The idea behind these modules is to concentrate the delivery for the goal themes in the same semester, instead of spreading them out along the programme, as is usual in traditional engineering degrees. This structure was inspired by the Aalborg model [5] and besides the obvious focus on a particular subject area, allows for closer to reality projects.

Projects are developed in groups of five students, which are assigned a small physical space to meet and work. Students are also granted extended access to laboratories, evenings and weekends included. Each group has a supervisor for every project being carried out. Projects are assessed through a written report and a public presentation before a jury, in which one of the members is the project supervisor. The presentation is followed by a period of discussion, in which students may be individually requested to answer different questions. It is common practice to invite individuals from other HE institutions or from industry to sit as members of the jury, allowing students to gain different perspectives on their work. Complementarily, self and peer assessment strategies are strongly advised and have become common practice for most projects. In the course of three years, students go through ten thematic modules.

Another distinctive feature of the implementation is that all courses are taught in four-hour blocks that can be organized differently according to the course, or the learning needs at any stage of the process, thus enhancing flexibility and allowing for reorganization of the provision for teaching according to students' needs [6].

Furthermore, this structure also allows for a better articulation with the thematic projects.

1.2 The 2nd Cycle Master in Automation Engineering Programme

As discussed in the Introduction, the Electronics Engineering Department and the Mechanical Engineering Department, offer the Master in Industrial Automation Engineering (MIAE) programme jointly, at the UA's main campus, in Aveiro. It is a four-semester programme, in which the first two semesters are solely composed of independent courses (a range of which are elective), the third semester includes both courses and 12 ECTS associated with the dissertation work, and the fourth semester is entirely dedicated to the dissertation work.

In Portugal, as a result of the Bologna Process particular implementation, HE institutions are allowed to offer full five-year programmes, named "Integrated Master Programmes", which are organized in a not so different way than the pre-Bologna Portuguese engineering programmes. Both the EED and the MED run such type of programmes, and a majority of the courses of the MIAE are also part of the 4th and 5th years of the integrated master programmes run by each department. Students coming from the ESTGA's PBL first cycle programme will therefore be in the same cohort as students from the Integrated Master in Mechanical Engineering and the Integrated Master in Electronics and Telecommunications Engineering, as well as with students coming from different first cycle programmes and even from different institutions (although the number of these latter types of students is small).

The curriculum organization of the MIAE is traditional, with courses from different scientific disciplines running in parallel and independently along the three semesters, although one of the courses consists of a project, in preparation for the dissertation phase. Most courses have lectures (theory classes, 1-2 hours/week) and laboratory practical classes (2-3 hours long). In a few of the courses, the lectures are replaced by "theoretical-practical" classes, which are similar to tutorials in the sense that, usually, part of the time is dedicated to problem solving activities. Laboratory work is confined to the classes for each course and students are only granted access to other facilities within the context of the dissertation work.

2 DATA COLLECTION AND ANALYSIS METHODOLOGY

Six out of the seventeen students that have chosen to enrol in the second cycle programme over the past three years were interviewed, using a semi structured approach. The interview guide addressed the students' impressions on the transition process, the impact (positive and negative) of their PBL background and their study habits in the new environment.

Of the six students, two had already graduated (respondents A and B), one was in the process of developing his dissertation work (respondent C) and three were still attending courses from each of the three curricular semesters of the MIAE (respondents D, E, and F).

The interviews were transcribed and the data was qualitatively analysed employing Constant comparative method [7] in a systematic way. A simple set of codes was first

established and applied to categorize excerpts of the data. An open coding approach was used, in which codes emerged from the data itself. The codes were then applied to the entire data set, allowing for refinements whenever necessary.

The results of this analysis will be discussed in the next section.

3 RESULTS AND DISCUSSION

The analysis of the interviews regarding the students' impressions on the transition process revealed three major categories: teacher/student relationship, class and curriculum organisation and issues with the prerequisites for some of the courses in the MIAE.

Students report a significant difference in the student/teacher relationship, which all of them find to be more distant in the new environment. The lecture environment, also because of the large number of students, doesn't lend itself too much to student interaction and teachers are

*[…] difficult to get hold of, because they always seem so busy with their projects (**B**)*

outside of timetabled classes. The fact that the other students in the cohort keep a larger distance to the teachers than the students from ESTGA were used to in their previous experience also plays a role in their perception of the student/teacher relationship. Within the context of laboratory classes, the relationship is much closer, but the large number of students prevents the type of interaction that students coming from the PBL background were used to, as one student puts it:

*We were used to the teachers knowing our names and sitting with us in front of the workbench. That doesn't happen often here, due to the limited time of the lab classes and the number of students. (**F**)*

Three of the interviewees refer that, in comparison to other students coming from different backgrounds, they felt that they were usually better documented and prepared when seeking help from the teachers outside timetabled classes, and that they had had positive feedback from the teachers regarding that particular attitude.

As might be expected, the curricular organization and class format were key aspects that came up in the interviews. All students mentioned, in one way or another, initial difficulties in adjusting to the lecture format, due to the lack of interaction and the length of the presentations. Four out of the five students also stated that they had initial difficulties with keeping up with the rhythm, since they were not used to so much content coverage in just one hour.

The format of the laboratory sessions was also extensively mentioned, since they had never been exposed to that kind of setting. Students estranged the restricted access to the laboratories to the timetabled sessions, which they viewed as a stress factor, due to the time limit on developing the required experiments. On the other hand, they were all quite surprised by the fact that in most courses they were given a guide to the lab work, which as one student comments (when mentioning an Electronics course)

*[…] makes it so easy for us. We just have to build the given circuit and follow the guidelines. They even give us the datasheets!! At ESTGA, we had to do all that by ourselves. (**C**)*

When it comes to the actual lab work, report writing and presentation skills, all students felt that they were much better prepared than their colleagues coming from different backgrounds, and report that they felt respected for it, both by their colleagues and the teachers. Three of the interviewees were among the best students in their cohorts, when considering the marks obtained in several of the courses. The three students who had already gone through the dissertation work proudly stated that they had no major difficulties in completing their projects and that their PBL background played an important role in their capability to succeed with such confidence.

While four of the students noticed a lack of integration between courses running in parallel and the strict boundaries of each course, two of them also mentioned that that fact allowed for a more in-depth exploration of each subject or, in the lab work, of the systems being developed. Naturally, one has to consider the fact that in a second cycle, the demand has to be higher in that regard.

As far as prerequisites are concerned, all students reported difficulties with their lack of experience in computer programming, when compared to their other colleagues, namely the ones from the integrated master programmes. This has to do with the scope and overall learning outcomes of their first cycle programme, which doesn't include a strong focus on that particular discipline area. Nevertheless, all students reported that with an extra autonomous effort, they were able to complete the corresponding courses. As for their Mathematics background, all five students felt initial difficulties with a more formal approach in the new programme, but these difficulties faded rapidly and all of them stated that they felt adequately prepared.

One important result that emerged from the analysis of the interviews has to do with the students' study habits. Although there is no emphasis on group work in the 2nd cycle programme, apart from the lab sessions in which groups of two were established for logistical reasons, students coming from ESTGA continued to work in small groups in their out of class time, exchanging materials and resources, and even dividing tasks whenever possible. The interviewees all mentioned that this behaviour contrasted with that of their other colleagues, which three of them considered to be

*[…] too competitive and self-centred. (**F**)*

In fact, even when developing their dissertation projects, students often relied on their colleagues' opinions and discussed ideas with them. These findings hint at the fact that the work habits acquired during the PBL experience leave a durable imprint in the students' behaviour and their attitude towards collaboration and group work.

As a final question, all five students were asked whether they would consider choosing a different 1st cycle learning environment, now that they had had the opportunity to experience a different, more conventional setting. All of them declared that they would choose the PBL environment again, without any doubt.

4 FINAL REMARKS

In this paper, a group of students who chose to continue their education by enrolling in a traditionally organized master programme after completing their first cycle in a project based learning environment, were interviewed in order to investigate the characteristics of the transition process and the impact of their background training in the new setting.

Results show that students struggle with the difference in the teacher/student relationship and with the way classes are organised, in the new environment. On the other hand, students feel better prepared for the practical activities of the master's programme than their colleagues coming from different backgrounds, and proudly report that they feel better equipped to solve problems on their own. It is also important to note that students coming from the PBL environment keep working in groups and find ways to keep their previous work and study habits in the new environment.

Overall, the transition process was not too hard for the interviewees and they even felt their PBL background to be an advantage in the new setting. As one of the students declared:

At ESTGA we learned to work autonomously and to adapt. So, we adapted!

Naturally, more research is needed, involving a larger number of students, and also the impressions of the teachers involved in the master's programme. Hopefully, this work will proceed to be described in future publications.

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