STUDENT-TUTOR FOR A PBL MODULE: MAKING THE EXPERIENCE RELEVANT FOR A FUTURE ENGINEER

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Abstract

During their first week of engineering studies at the Institut National des Sciences Appliquées Toulouse, France, 300 first year students are introduced to Project/problem Based Learning thanks to an introductory module (PBL0) which is designed to be both technical and fun. In order to recognise and valorise this involvement, INSA has created a "Pedagogy module" which is validated by 3 credits as part of their engineering course. The module adopts an active learning approach. During the module, the student-tutors engage in activities which contribute to the development of transversal competencies required in the engineering profession but also the ability to reflect on one's actions in order to progress in one's learning.

Workshop Topics

Autonomous learning; Beyond active learning

I INTRODUCTION

Since 2006, during their first week of engineering studies at the Institut National des Sciences Appliquées Toulouse, France, 300 first year students are introduced to Project/problem Based Learning thanks to an introductory module (PBL0) which is designed to be both technical and fun. The main objectives of the module are for students to understand what it means to learn in groups (individual responsibility for one's own and the group's learning), understand and apply a number of scientific concepts, and also facilitate their integration into the engineering school. The scientific subjects involved in the project vary: for example, in 2008, students studied concepts in physics (stability, Bernoulli equations…) through building water rockets satisfying a number of conditions.

For this PBL0, the newcomers are guided by student-tutors who are engineering students in the 2nd, 3rd or 4th year. Student tutors have been involved since the module was first introduced but, given the satisfaction felt by the student-tutors, the

first year students and the teaching team involved in the project, their participation has increased each year. In 2006, each team was tutored by a teacher-student tutor dyad. In 2007, all but one dyad consisted of two students. In 2008, all the tutors were students. Moreover, the students have become more involved in the design and organisation of the project before and during the module.

In order to recognise and valorise this involvement, INSA has created a "Pedagogy module" which is validated by 3 credits as part of their engineering course. The module adopts an active learning approach.

The aim of this paper is to show how this experience in the framework of the Pedagogy module is relevant to these students who are preparing to become engineers (and not teachers). We will describe the three stages of the module - before, during and after the PBL0 – in order to give a clear idea of what is required of the students. We will also focus on what we believe to be the key factors of the success of the module. Finally, we will focus on the competences acquired through the experience and which, in our opinion, make it an appropriate part of an engineering degree course.

II PEDAGOGY MODULE

II.1 Stage 1: Pre-PBL0

The module begins by a presentation of the PBL0 project by the Director of Studies and Teaching-Learning Adviser in March. The students who wish to volunteer as tutors send a letter of motivation. There are no specific requirements concerning the year of study or department of specialisation.
Their motivations fall basically into four categories.

- To gain further experience in working with young people for those who have already done so (in holiday camps, sports clubs, private tutoring…),
- To work on a study-related activity for those who are already involved in the running of extra curricula activities at INSA
- Because of a personal interest in the project's content - building the specific product (water rocket, robot…),
- To acquire profession-related skills (engineering, teaching).

Two teams are then formed: an organisation team and a tutor team. Some students ask to belong to both teams.

From March to June, the organisation team meets weekly, sometimes with the teachers involved, sometimes alone. The aim of these meetings is to set up everything that is required for the project and the coordination of the different actors.

The organisation team produces a number of important tools:

- A "student booklet" to guide the first year groups during the three day project, containing a detailed description of the learning objectives, the project and the materials available, each session with or without a tutor, the assessment criteria, the documents which must be filled in by the group during the project and handed in to the tutor. (an example: https://intranet.insa-toulouse.fr/displayContent.do?courseId=541)
- A "tutor booklet" to guide the student-tutors, containing the student booklet plus details concerning the organisation and specific instructions for the different sessions, additional information on the calculations required of the students, the Multiple Choice Test for the final individual assessment.
- A short manual on the technical aspects of the project.

The content of the two booklets are obviously the result of collaboration between the students of the organisation team and the teachers involved. The actual writing is done by the students and validated by the teachers. The technical manual is prepared by the students and validated by the teachers.

Another important task concerns the material required. The students have to calculate and order the quantities required for 48 teams and then prepare a kit for each team before the start of the PBL0 module.

In June, four half-day tutor training sessions are organised. One session is devoted to the technical aspects of the project since a certain degree of expertise is essential for a tutor to be able to identify the students' weak points or misunderstandings, to provoke a debate that will lead to alternative directions, to help students towards what is essential [1]. As the student-tutors are all from higher years of study, they all possess the knowledge and skills required for a project designed for students just starting their university course. Nevertheless, those who are not specialising in the field of study related to the project are frequently worried that their technical knowledge is not sufficient.
The tutors carry out the work required during the PBL0 to acquire a full understanding of the problem set. They are supervised by a teacher in the field who replies to their questions, gives advice and validates their expertise. Moreover, we have recently introduced a self assessment grid covering the essential technical elements which must be mastered to help the student-tutors identify their expertise for their role as tutors. By doing the project themselves, they are aware of what they need to know and of the problems their teams may encounter.

During the other sessions, the major activities are role play, observation and the analysis of situations taken from 'CQFD' [2], a tutor training DVD developed by the University of Louvain. CQFD is a well known acronym in French, corresponding to the Latin *Quod Erat Demonstratum*. Here the letters represent the four major tutor roles defined by Kaufman [3] and summarised in Raucent *et al* [4] and Frenay *et al* [5]: Conducting (navigating), guiding the group through the different steps of the

process; Questioning, asking questions for student self-assessment; Facilitating, creating and maintaining a safe learning environment; Diagnosing, assessing student learning.
The role plays and the sequences on the DVD focus on particular situations related to team work in PBL – the group has split into sub-groups, one student plays no part in the group work, the team is way off subject, the effect of a tutor's position on the team… By observing, analysing and discussing what they see and their reactions, students develop an understanding of the tutor's role.

As the tutors are responsible for assessing the team work for each of their groups, they work together on the criteria they consider essential and develop an assessment grid which is validated by the Teaching-Learning Adviser. They also produce the MCQ test on the scientific concepts studied which students take individually at the end of the module.

The tutor training does not stop here. Daily tutor meetings are also planned during the three-day module.

II.2 Stage 2: During the PBL0 module

The PBL0 takes place in the first week of the academic year. The first task of the organisation team is to make sure that the 48 kits are available and easily accessible to all tutors. The tutors work in teams of two and are responsible for two groups, each composed of four teams. The module is organised so that specific sessions are time-tabled for team work with a tutor, team work without a tutor, individual work. The tutors accompany their teams during the planning and construction phases of the project. They are responsible for the assessment – collection of the required documents from each team, administration and correction of the MCQ test. Finally they conduct the feedback session at the end of the module based on the students reflections on the results of their project (e.g. how well their water rocket performed) how their team functioned, and how they could improve both if they were to start the project again.

For the tutors, each day also includes a debriefing session with the Teaching-Learning Adviser. These sessions, 'just in time training', are essential as they give the tutors the opportunity to discuss what has taken place with their teams, to share their problems and to help each other find solutions.

In the following week, a ceremony is organised and the winning teams receive their awards. One indication of success of the PBL0 is the turn-out of first year students on this occasion.

II.3 Stage 3: Post-PBL0

After the PBL0, the student-tutors and organisers continue to work as a group and in pairs during the first semester and are tutored by the Teaching-learning Adviser.

Their first task is to review and assess the PBL0 and to highlight any problems encountered. The reflexion focuses on the tutoring experience, the logistics, the tools developed, the contents of the project… One objective here obviously is to suggest improvements for the next year. Improvements that have been introduced thanks to this analysis include entrusting the tutoring wholly to students, including them in the technical design phase, new assessment procedures for team work…

Through these discussions, the students also reflect on their own contributions and the challenges or problem situations they faced, how they dealt with them, their satisfactions and disappointments. Together they identify a number of areas of interest for in-depth study. Once the list has been made, the students divide up in pairs and choose the topic they want to work on. The topics that have been chosen include: authority, the legitimacy of student-tutors, assessment of group work, success as a factor of motivation, teacher-tutor/student relation compared to student-tutor/student relation.
After studying the theoretical aspects of the chosen topic, each pair leads a discussion with the whole group, thereby giving all the students concerned the opportunity to question and reflect on personal viewpoints. Each pair writes up a report in the form of a research paper. We have imposed this particular format as we believe students will be forced to concentrate more on content than form and that their arguments will be backed up by theory. Finally, the students are required to give an oral presentation on their chosen topic to a panel of INSA teachers as part of their assessment.

III KEY FACTORS FOR THE MODULE'S SUCCESS

Experience has confirmed the relevance and value of students acting as tutors. Nevertheless, certain conditions are necessary to optimise the efficiency and interest for both the PBL0 and the Pedagogy modules.

The students need to be trained as tutors and tutored themselves during the whole process. We cannot just expect their own experience as students in a PBL situation to be enough. Moreover, the training is important since the student-tutors must be efficient to guarantee a successful introduction to the approach for the first-year students.

Associating the students with the design and management of the PBL0 project contributes to their sense of ownership and responsibility for the project itself. We

have found that this has led to a greater commitment on the part of the students; They are also more fully aware of the whole teaching process [6].

If the student-tutors are to fully benefit from their experience in the PBL0 project, it is necessary to go beyond the tutoring practice itself. If one wants to help someone learn it is necessary to put the learner in a situation of double activity: lead him to do, act, practise and at the same time, reflect, question and reason on what he is trying to do [7]. The second part of the module, which brings them to do just this, is essential.

Throughout the project, students have a large degree of autonomy and are also encouraged to work as a group – at times the whole group, at other times, in sub groups. They are tutored but are able to take the initiative in how they get organised for example, or with suggestions for the project (the idea for the final rocket launch to take place at the Cité de l'Espace came from the students who organised the event). They realise that they are recognised contributors to the project and this situation boosts their commitment and participation.

Moreover, their participation in the project and the subsequent theoretical study on the questions raised is further valorised by the Pedagogy module, making it a recognised part of their course.

IV WHAT MAKES THIS ACTIVITY RELEVANT FOR ENGINEERS?

Through their activities as PBL tutors and within the Pedagogy module, students are involved in activities during which they can develop competences which will be useful for them once qualified.

Communication skills, both oral and written, are obviously highlighted. The students interact with people with different statuses (fellow students in their team, younger students, teachers involved in the project, office staff when ordering materials, journalists sometimes…), with different levels of technical expertise. They must adapt their register and language to these different categories. The same is true for writing skills, the wording and style used in the student booklets is very different from that which must be used in the final paper they produce.

Team related skills are developed since the students work together as a large team and in smaller teams (e.g. the organisation team, pairs in the Pedagogy module). They have to be aware of the factors affecting good collaboration – the ability to listen to others, to negotiate, to take on leadership … As engineers they may well be project leaders. This implies being able to build effective teams and allotting specific tasks in accordance to the abilities and skills of the team members. Awareness of this last point can be acquired through the team work during the project. Observation skills are required at various moments – during the tutor

training, tutor practice. It is also acquired through the reflections required during the development of the assessment grids of the PBL0.

The students have to think about assessment in relation to the first year students, on both how they work together and technical knowledge. As engineers, they will be required to assess their work team. They are also called on to reflect on the whole process, on their own contributions, their own questioning and conclusions during the theoretical study. This should make them more aware of the process of self assessment.

Time management is essential. The students start work on the project in March and really must have everything ready (booklets written and duplicated, materials ordered and delivered, kits prepared) for the end of June when vacation begins. The PBL0 takes place in the first week of the academic year leaving little time for last minute problems.

Initiative is encouraged. Suggestions concerning the contents, organisation, tools required for the project are welcomed. A successful example was the suggestion to organise this year's final rocket launch at the Cité de l'Espace, reinforcing the contextualisation of the project and giving it a spectacular element. Another team suggested proposing the whole experience in a competition run by the group L'Etudiant in the Innovation in Teaching category. INSA was awarded first prize – a great satisfaction for the student team but also for INSA.

V CONCLUSIONS

2nd, 3rd and 4th year students have been more and more involved in the development, management and tutoring of an introductory PBL module for first year students. To validate their implication, a Pedagogy Module has been created which consists of practical activities, theoretical study and reflection.

It is possible to identify a number of key principles. Commitment is essential and is encouraged through the degree of autonomy the students enjoy, the cooperative approach adopted, the validation of their work with credits. Tutor training for PBL is also necessary, just as for teachers.

The PBL0 is a large-scale project involving around 300 students over three days, requiring considerable organisation and planning in which the role of the student-tutors has developed. It has been successful each year showing that when students are entrusted with responsibilities, we can be confident in their performance and efficiency.

The students involved as organiser and tutors frequently continue their involvement in similar activities such as the *Dispositif réussite*, a programme designed to help INSA students experiencing difficulties in their studies, and *Egalité des chances*, a programme in which INSA students work with secondary school students in underprivileged areas to help them succeed in their studies.

The activity, in our opinion, has its place in an engineering course since it not only contributes to the development of transversal competencies required in the engineering profession but also the ability to reflect on one's actions in order to progress in one's learning.

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