The different roles of the tutor in design-based learning

The Different Roles of the Tutor in Design-based Learning

Sonia María Gómez Puente[*], Corinne J. M. Jongeneelen[**], Jacob C. Perrenet[***]

[*] Teacher Training, Education & Training Unit, TU/e Eindhoven University of Technology, The Netherlands
[**] Education Co-ordinator, Mechanical Engineering Department, TU/e Eindhoven University of Technology, The Netherlands
[***] Educational Research, Eindhoven School of Education, The Netherlands

Email: s.m.gomez.puente@tue.nl, c.j.m.jongeneelen@tue.nl, j.c.perrenet@tue.nl

Abstract

Design-based Learning (DBL) is the educational approach within the Eindhoven University of Technology (TU/e) (Wijnen, 2000) in which students work co-operatively and actively on multidisciplinary design projects guided by a tutor. In DBL the role of the tutor is essential as a facilitator of the learning process, as well as a subject matter specialist or as an assessor. However, the involvement of the tutor in supporting students depends not only on the character of the DBL projects but also on the level of competencies to be reached in each specific year of the Bachelor's program. This paper describes the experiences with the role of the tutor in Design-based Learning within the Mechanical Engineering department at TU/e. Throughout the paper the differences in the tutor's role are analyzed according to the nature of the students' group work. Conclusions on the ideal role for the tutor suitable for the Mechanical Engineering education are presented.

Keywords: design-based learning; role of the tutor; project work; collaborative learning.

1 Introduction

1.1 Problem-based Learning/Project-based Learning (PBL) and Design-based Learning (DBL): differences and similarities

PBL started in 1969 at McMaster University in Canada for the study of medicine. (Barrows, 1984). For already longer than four and three decades respectively PBL has been the educational model at Aalborg University in Denmark and Maastricht University in the Netherlands (Kolmos, 2006; Moust, van Berkel & Schmidt, 2005). This model has been successfully integrated in many educational programs i.e. Medicine, Law, Economics, Psychology, Sciences, and Liberal Arts with to certain extend adaptations in each program, such as incorporation of the element of project work in the domain of sciences. The positive experiences of PBL have been the starting point for Eindhoven University of Technology to adapt this concept to fit the engineering education which has a primary function on design.

Since 1997 Design-based Learning has become a crucial element of the educational philosophy within Eindhoven University of Technology. DBL has been introduced with the overall aim of improving quality of education. In order to achieve such a goal DBL is at the front of the curriculum change to provide educational programs with a more competence-based orientation; to strengthen the relation between education and research; to increase the coherence within the TU/e; and ultimately, to modernize the technical systems (Wijnen, 2000).

The underlying educational foundation of problem-based learning (PBL) and project-based learning inspired by the Universities of Aalborg and Maastricht was molded to give a particular flavor to the TU/e context. In doing so, a number of initiatives took place. With the support of experts from Maastricht University and by carrying out field visits to Aalborg University to broaden the scope, the DBL got finally its form. In this sense, the PBL model has gone through a transformation process to serve, therefore, the purposes of the engineering education which has a clear focus on design. The PBL objectives i.e. acquisition of knowledge and skills to be retrieved in the working place and the acquisition of problem-solving skills to be used in a professional setting (Perrenet, Bouhuijs & Smits, 2000) are to be found in the TU/e objectives as well. However, the pure PBL model has been tailor-made to meet the specific academic engineering profile of the Mechanical Engineering department. The PBL original concept was adapted into a DBL strategy to align the curriculum with the innovation trends in higher education towards a more collaborative and self-directed learning educational model. DBL became for the Mechanical Engineering department the educational concept with a strong emphasis on developing technical and scientific knowledge; on acquiring abilities to conceive models and to solve multidisciplinary problems; and, to work in teams as well (Perrenet, Bouhuijs & Smits, 2000).

Although there has been substantial literature written on the similarities and differences between problem-based learning and project-based learning it becomes sometimes difficult to set the line to distinguish among one and another. These models are at times used in a combination and/or can play complementary roles. Differences can be blurred and can only be found in subtle variations based on the focus of the curriculum. Some of the similarities between PBL and the Danish project-based learning concept can be found in that both have similar characteristics i.e. problem orientation and interdisciplinary; open curriculum and experience-based learning; basic year and gradual specialization; and, work in groups (Kolmos, 1996).

One of the common elements to be easily recognized in PBL and project work is that they both have a strong accent in self-direction, collaboration and finally, in multi-disciplinary problem orientation. The emphasis lies on the learning process rather than in the teaching process. For both approaches the basic principle is to create authentic scenarios which mirror the real life and market situations aiming at reproducing the production activities by making use of the findings and ideas of the students to achieve the goals (http://pblmm.k12.ca.us/PBLGuide/PBL&PBL.htm). In all cases, the role of the tutor as a supervisor of the group activities is at the centre of this approach and his tasks are modified to respond to the processes, and complexity of demands in content expertise of problems and projects. These similarities can be found as well in DBL. However, the level of self-direction with project work is higher than with PBL since students have to manage their projects in terms of time and resources (Perrenet, Bouhuijs & Smits, 2000).

Essentially, the characteristics of PBL methodology, namely, the 'Seven Jump',(Moust, Bouhuijs & Schmidt, 1998, in Moust 2000), i.e. analyzing unclear terms and concepts; defining, consequently, the problem; brainstorming and carrying out a systematic analysis; formulating and executing, accordingly, own self-study assignments; and finally, reporting (see also next section), form the backbone of the PBL structure. These are also used, in an adapted formula, as the group working methodology of DBL. DBL makes a clear emphasis on the concept of design as a process in engineering education. In the PBL curriculum at Maastricht University, multidisciplinary courses take from six to eight weeks in which both subject-matter and skills are integrated around a central theme (Moust, van Berkel & Schmidt, 2005). Features particularly for design in DBL at the Mechanical Engineering department are analysis and synthesis with contributions from different disciplines, working in teams to create products, materials, processes, and systems.

When it comes to contextualize the DBL concept to Mechanical Engineering the alignment of DBL with the curriculum and the learning outcomes are one of the differences with PBL since DBL focuses on design, and more specifically, on engineering education. Another difference between project work groups and PBL groups is that the project groups (average eight students) are smaller than the PBL groups (average ten students)(Perrenet, Bouhuijs & Smits, 2000). The learning outcomes of DBL are based on a number of competence criteria designed for Bachelor's and Master Curricula by Meijers, van Overveld & Perrenet (2005). They define the features of a university graduate by seven areas of competence, namely: 1.Competent in one or more scientific disciplines; 2. Competent in doing research; 3. Competent in designing; 4. A scientific approach; 5. Basic intellectual skills; 5. Competent in co-operating and communicating; and finally, 6. Takes account of the temporal and social context. Within DBL most of the criteria for the areas of competence three and six and parts of the criteria in the other areas have to be reached. These are for example: the ability to integrate existing knowledge in a design; the ability to produce and execute a design plan; to have creative and synthetic skills with respect to a design problem; the ability to communicate in writing and verbally about the results of learning; the ability to work within an interdisciplinary team. Therefore, the character of the projects must also meet the six underlying educational DBL features: Professionalization; Activation; Co-operation; Creativity; Integration and Multidisciplinarity (Wijnen, 2000)

1.2 Position of DBL in the Mechanical Engineering curriculum

Design-based Learning has been specifically adjusted to meet the needs of the Mechanical Engineering curriculum. Analyzing, modelling, testing and application of project-related skills are the underpinning competencies for the mechanical engineering profile that students acquire in DBL projects.

A DBL project is a case study that takes from four to eight weeks which is often supported by different skills-training. In the first semester, for instance, students follow a training in how to work in a group (Moust, Bouhuijs & Schmidt, 1997), how to make a presentation and how to write a technical/academic report. But besides these process-skills they also get trained in different kinds of technical skills such as the basics of how to work with different computer programs (Matlab, CAD, CAM, FEM) and other tools that they can choose to use to solve problems.

To develop a solid theoretical basis in the curriculum of the bachelors program of the Mechanical Engineering department students work for 60 percent of the time on courses. Parallel to the courses they work in groups of eight students on the DBL-projects for the other 40 percent of the time. Both the first and the second year have a total of 12 courses and eight DBL- projects, the structure of one semester is represented in Table 1. Some of the DBL-projects are programmed together with or directly after a related course, so students learn how to apply the knowledge they gained in the course in the practice of designing. But there are also projects that do not have directly related courses where students have to gain new knowledge to solve a design-problem.

Table 1: DBL in Mechanical Engineering curriculum

Semester			
Block		Block	
Course 1 (3 ECTS)		Course 1 (3 ECTS)	
Course 2 (3 ECTS)		Course 2 (3 ECTS)	
Course 3 (3 ECTS)		Course 3 (3 ECTS)	
DBL (3 ECTS)	DBL (3 ECTS)	DBL (3 ECTS)	DBL (3 ECTS)

The group composition in the first year of DBL remains the same for a whole semester. The students learn as a group how to work together (Belbin group dynamics). In the second year, students have to learn what their natural role is about and how they can balance this in a group. Likewise, they learn how to work in different groups. For example, a student who is a 'natural leader' will feel more comfortable in a group with hard workers only who listen to him rather than in a group where there are more students with the same type of character. The group composition changes in every project. The DBL group meetings take place twice a week. The duration of the meetings varies from two hours in the first year where they learn how to hold a meeting to one hour in the second year. The objective is to help the student to hold more efficient meetings.

The student and project guidance in DBL is divided in three stages. Firstly, there is a tutor who guides the group and supervises individually the student's progress against the achievement of the learning outcomes. Secondly, the project co-ordinator, who is the project owner, watches over the learning outcomes of the group. Lastly, there is for every year a year co-ordinator. The mission of the year co-ordinator is to assure that there is a balance between the projects. Among his tasks are to be mentioned: to guarantee the coordination among project co-ordinators, to arrange tutor trainings and tutor meetings and to solve problems with individual students and groups.

Though students go through the seven steps methodology (i.e. analyzing unclear terms and concepts; defining, consequently, the problem; brainstorming and carrying out a systematic analysis; formulating and executing, accordingly, own self-study assignments; and finally, reporting), there are some deviations of that planning steps model. While with PBL the learning activity begins with a problem and follows an inquiry model, the students within DBL follow a production model having in mind, as a starting point, a product. Students need to design the end product for which they also create a plan to manage the development of the project.

2 The role of the tutor in DBL at the Mechanical Engineering Department

There are two primary tasks for a tutor in DBL. Firstly, the responsibility of the tutor is to assure that the learning outcomes of the specific project as subset of the overall learning outcomes are being reached. Secondly, the tutor has a specific task as an assessor. The tutor holds the "assessor hat" for the individual assessment grades. This role is shared with the project co-ordinator who, eventually, grades the final product. The overall grade is composed of 50 percent for the deliverables (the same grade for all of the group members) and 50 percent for the group members individually. The group grades are given by the project co-ordinator and an individual grade is given by the tutor. However, it was identified that it will be almost unfeasible for a tutor to assess a student just by what (s)he shows during the DBL meetings. To solve this assessment problem a digital learning environment was created by which students have to post their self-study outcomes. With this e-tool a tutor is able to judge the input and results of the individual students. In 2001 peer review was introduced within the DBL assessment set-up by which part of the individual grade is given by the students to each other. This was introduced as a respond to students' complaints on 'free-riders' within the group work (Visschers-Pleijers, Mulders & Van der Wouw 2001)

In the first year the students get a peer review training where they learn how to design assessment criteria, how to give constructive feedback and how to come up with an accurate grade. The individual assessment is done by peer review and it counts 25 percent of the individual grade. In the second year, peer review counts for 50 percent of the individual assessment. The three parts of the final grade are assessed by different parties, namely, the project co-ordinator, the tutor and the peer assessment system. In order to pass the DBL-project the grading of all three parties must be successfully passed. It is the task of the tutor to guide the peer review process, to create an open discussion about the collaboration in the group and to give constructive feedback to each of the group members not only after every meeting but also during the assessment procedure.

In addition to the two primary tasks already mentioned, it becomes essential to highlight that the tutor holds different roles in the three years of the Bachelor's program. The following roles can be defined:

- *The facilitator role:* the tutor is responsible for facilitating the learning process and assuring that it flows as expected. The tutor supports the group to reach a goal, to learn to work in teams and to help solve all problems encountered in the process so that the project goals can successfully be achieved. Encouraging communication during the process and creating a learning and reflective culture are some of the tasks of the facilitator.
- *The expert role:* the tutor provides content input where needed by asking motivating and challenging questions and by showing the students where they might find relevant literature.
- *The project manager role:* the tutor guides individual students and provides subject-matter input upon request of the student.

In the first year the role of the tutor takes a more process-oriented character since the complexity and level of difficulties of projects in the first years are less content demanding. The tutor embraces both the facilitator and the mentor role in coaching students in their new academic environment (Figure 1). To learn how to design students work on parts of the design cycle, namely, analyzing, modeling or testing and besides that they learn different basic skills in the skill trainings. The tutor, as a facilitator, supports students in the reflection of the application of knowledge into practical schemes. The tutors for the first year are the experienced (senior) tutors or Ph.D. students who themselves have studied following the DBL methodology. They are, therefore, acquainted with the DBL method, with the "ins-and-outs" of group problems, processes and assessment procedures.

It is also important to clarify that the tutor's role as a mentor must be seen completely separated from the tutor's role since the mentor tasks are related to the supervision and guidance in the study progress of the student. These tasks, therefore, must be regarded outside the boundaries of Design-based Learning. However, because the tutor and mentor in the first semester are the same person it influences the tutors' profile.

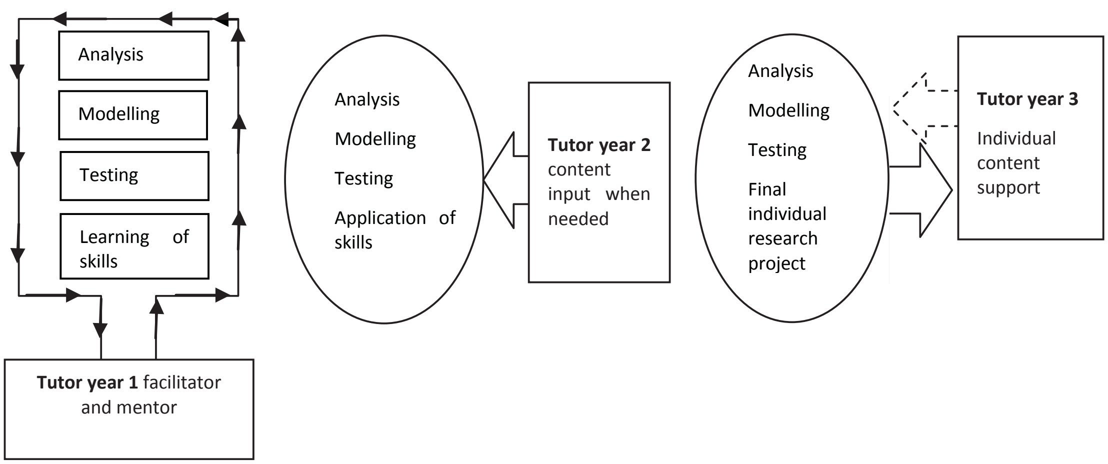

Figure 1: The tutor's role changes from facilitator and mentor to content expert and to project manager

In the second year, however, and due to the high demand in subject matter expertise the tutor holds "an expert hat" (Figure 1). In the project period students have to combine the competencies that they have learned in the first year together with the expected learning outcomes determined for the second year. It requires a high level of application of both knowledge and skills. The different design steps are combined in one project and the skills learned in the first year can be applied. The tutor motivates students by asking questions and giving critical contributions. Furthermore, the tutor provides formative and summative input on the competences of the students related to the subject (i.e. analytical and critical skills; inventiveness; theoretical knowledge and practical skills) as well as to the process competences (i.e. role of group members) according to agreed upon criteria. During the second year the character of the DBL project requires the involvement of more content expertise. Therefore, tutors are those working in the same research group as the project co-ordinator, consequently, the tutors are Ph.D. students, post-docs, research assistants, and Master students who are specialized in the topic of the given DBL project.

On the contrary, in the third year of the Bachelor's program the tutor and the course co-ordinator are the same person and perform essentially the role of a project manager. DBL takes the form of a self-independent research project; the student has to apply in 'real-life' cases the analysis, modelling and testing phases in the design of a product. The student approaches the tutor for guidance whenever it is necessary. The tutor still holds the content expert role when requested but (s)he is not any longer the facilitator of the learning process (Figure 1). The student has already become a self- independent learner.

As it has been stated earlier, the tutor's role changes from facilitator of the learning process to content expert and to project manager. The experiences of DBL project implementation in the three years of the Bachelor's program have brought numerous lessons to be learned. These lessons will be described in section four. One of the aspects of these experiences is that the tutors' role must be accommodated to develop the specific competencies in each year Bachelor's program.

3 The Implicit Metacognitive Role of the Tutor

The DBL methodology applied by the Mechanical Engineering department accompanied by the different roles of the tutor in different moments has a clear objective to stimulate student learning. In this sense, the role of the tutor has another dimension when it comes to supporting students in learning to learn.

One of the primary tasks of the tutor is to guide and facilitate the process of learning to students by supporting them to integrate and apply the findings and information (Moust & Schmidt, 1994). Encouraging communication during the process and creating a learning and reflective culture are some of the tasks of the facilitator. The type of active learning strategies to support metacognitive processes are ample ranging from team working, self-study discussions, oral presentations, group-based concept map building, among others, which promote communication among peers and reflection on own experiences (Pascual & Uribe, 2006). The commonly use of guiding the students in this inquiry process and giving them the opportunity to re-orient themselves is by asking probing questions with the overall goal of challenging the students. Questions or 'nondirective comments' (Barrows, 1985; in Moust, 2000**)** such as "what do you think yourself about it? why do you think that it is fine like this?; or, does anybody have another opinion about it?" ; using suitable examples; or by confronting students with situations by playing the role of a devils advocate (Moust & Schmidt, 1994) are some possibilities used.

The underlying process factor engaged to the tutor's role in the first year at the Mechanical Engineering department is that the tutor act as catalyst of activating the learning environment in which the students need to produce knowledge. In this sense, their ability to use facilitation skills is a major feature in the quality of problem-based learning (Barrows, 1988, in Moust & Schmidt, 1994). In doing so, the tutor in the first year, as a facilitator, uses the Experiential Learning Cycle by David Kolb (Reese & Walkers, 2006) in an implicit manner. The experiential learning cycle is based on a four-step spiral (Figure 2) to help learners to gain insights in the learning process by reflecting on the four steps: experiencing, reflecting, generalizing and applying. The formula used by the tutor is based on asking questions to help student to go around the learning cycle to motivate their arguments instead of providing themselves the answers. The tutor might not follow the cycle in its original structure, however it uses it in such an adapted manner that allows the tutor to support students to learn. One of the ways to use it is that the tutor might go in several small loops and a number of times around the phases during group meetings so that students are supported to acquire self-directed skills since students learn how to analyze learning processes against learning outcomes, identify missing points to understand better concepts and topics, and, reflect on the processes in solving problems. By asking questions the tutor helps students to walk around the four phases. Likewise, the tutor facilitates the process of thinking about the problem statement, how the students can demonstrate that they have achieved the learning outcomes, but also, how they have learned and what they have learned during this process.

The tutor in the second year supervises that the knowledge of the topic is properly applied throughout the different phases of the project. Using the learning cycle the tutor adapts this model to inquire and assess how progress is being achieved and what results are reached becomes the priority of the tutor. Within the experiential learning cycle students operate more independently in the 'experiencing' and 'applying' parts while the expert tutor provides content support in the 'reflecting' and 'conceptualizing' parts of the cycle.

In the third year, however, the student has already become a self-independent learner, and (s)he is able to use the experiential learning cycle implicitly.

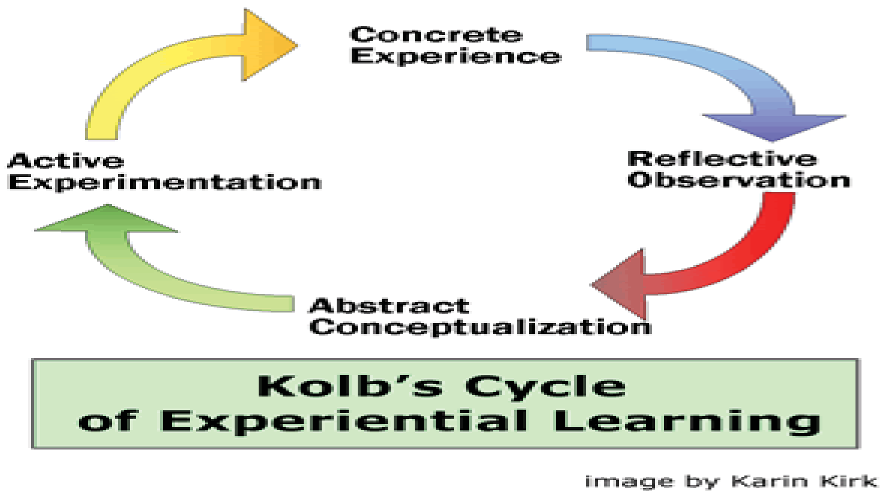

Figure 2: Experiential Learning Cycle (David Kolb)

The Experiential Learning Cycle provides a suitable platform to support learners to go through the experiences while undertaking the different steps of the design-based learning in group work. This model accompanied by the character of the seven step approach helps the student to go implicitly around the process of setting goals, selecting the appropriate strategy among a variety of possible choices; carrying out the planned scheme, and analyzing afterwards how the results of the implemented scheme went.

This brings also consequences for the need to design tailor-made training for the tutors according to the different levels of involvement either as a facilitator of the learning process, as a content expert and/or as an assessor. It is also important that students are aware of the change in the tutors' role.

The tutor training for the first year tutors is consisting of providing the tutor with the necessary skills to coach groups' meetings. In this sense, tutors become aware of their roles, i.e. expert, coach of the learning process, assessor, etc. (Delhoofen, 1996). They also learn strategies to motivate and encourage communication among students in project groups; to learn how to deal with 'critical situations' (i.e. group's problems; lack of progress in project assignments; students not committed to agreements, etc). The tutor's training for second year tutors is a combination of tutor's role and project content, the planning, and the assessment procedures as well.

4 The Dilemmas of the Role of the Tutor in DBL

It can be concluded that it is essential that the tutor' tasks are geared to enhance learning processes and content support when needed. However, there are a number of dilemmas that come up from the current practices at Mechanical Engineering department. A number of shortcomings, namely, the motivation of tutors linked to the time they have to spend devoted for group work; the financial constraints; as well as the low quality in students' report writing are some of the drawbacks encountered. These deficiencies can undermine the role the tutor has in group work. The already identified shortcomings and its potential impact on the tutor' role are at stake and, therefore, deserve serious considerations.

Experience shows that it becomes difficult to find suitable tutors for the first year of the Bachelors' program. The supervision of the DBL groups is regarded sometimes as a burden rather than a motivating function. The same counts for the tutors engaged to second year supervision of DBL groups. Therefore, the option of selecting Master students to hold the tutor's role has been introduced with the overall idea of surmounting the motivation problem.

The experience of introducing Master students for the first year tutor's position has been positive according to students' surveys from the Mechanical Engineering department. However, introducing Master students brings about two-fold type of consequences: firstly, there are financial implications of making such a decision. The same counts for the Ph.D. who are not faculty staff members but outside researchers at the service of an external research institution. They are volunteers and don't have education obligations as tutors. The management of the Mechanical Engineering department has to decide whether they are able to get this financial burden on its shoulders while for the faculty staff members the tutor tasks are part of their routine job.

Secondly, the introduction of 'less experienced tutors' can damage the image and credibility of the current tutor position. Consequently, to try to engage Master students as tutors may have a dangerous boomerang effect. The need to introduce a more academic seniority as tutors becomes an issue which demands careful attention at the Mechanical Engineering department. Considerations on selecting tutors who act as well as subject-matter specialist in the first year in combination with their process expertise can give an added value to the tutorship and, consequently, can be regarded as a valuable input to the students' learning process. Likewise, wrong interpretations of whether DBL could be considered a less important subject than a regular course will be avoided.

There are other types of considerations, in addition, in favour of having students as tutor's in DBL groups work. According to Schmidt, van der Arend, Kokx & Boon, (1995) the tutor's contribution depends in a great deal on the type of obstacles that students find while working in groups in problem-solving. However, teachers tend sometimes to avoid another role rather than the traditional one of teaching. Moreover, the traditional teaching in the form of lecturing doesn't respond to the problem-based approach since the emphasis lies on having students actively involved in seeking information to provide answers to the problems. In this sense, the alternative to academic staff having to fulfil the role of the tutor is to use the students who themselves have experienced problem-based learning. They are easily able to adapt themselves to the tutor's role, and are more sensitive to the groups' needs in terms of providing guidance, information and support.

There is substantial literature, likewise, on the impact of having staff tutors or student tutors on students' results in problem-based learning. Results on student's achievement in problem-based learning show benefits of using staff tutors (Schmidt et al, 1993b, in Moust & Schmidt, 1994). However, though the literature shows that problem-based learning is staff-intensive approach (Moust & Schmidt, 1994) there are also arguments to support that group work guided by student tutors can be as valuable as the staff members, i.e. student tutors compensate for the lack of content knowledge by giving more attention to learning difficulties of small-group tutorials. First at all, the learning environment and prior knowledge play a crucial role in the students' learning process. Having circumstances and cases when prior knowledge doesn't meet the needs of the students and the environment doesn't provide the necessary structure to the students, they tend to go back to the tutor looking for clear guidance. In this case, the students who are guided by subject-matter experts may benefit in a greater extend than those students who have a student tutor (Moust & Schmidt, 1994). However, to compensate their lack of content expertise student tutors spend more time in improving processes i.e. giving attention to learning problems, group motivation, a group dynamics.

Looking carefully at PBL experiences from literature, we can conclude that though PBL is a proved model to foster student-directed learning and process competencies. There are likewise a number of arguments which ask for some consideration for adjustment of this approach in the near future. These aspects are, namely, that students don't work following the seven steps method (Moust, Bouhuijs & Schmidt, 1998, in Moust 2000); they spend less time in seeking information, study only the compulsory literature, and report uncarefully (Moust, 2000). Though all above mentioned factors don't represent specifically the situation at the Mechanical Engineering department there are, however, common aspects such as the constraints identified in reporting requirements. This deficiency has been mainly identified in the students' reports of first and second year students.

Since the engineer profile for the XXI century must hold process competencies such as co-operation, communication skills and project management (Du & Kolmos, 2006) and not only content or technological competencies, the Mechanical Engineering department is currently facing a number of challenges that could be addressed by reinforcing the role of the tutor and, more specifically, by providing him with responsibilities to supervise the project reports' before hand.

5 Conclusions and Discussion

With the introduction of the Bachelor's curricula a more demanding engineering profile is being fostered at the Mechanical Engineering Department. This profile is contributing to model the future engineers from whom it is not only expected to have knowledge but also other type of process competencies such as problem solving, innovation, cooperation and communication among others (Du & Kolmos, 2006). Within this framework, the DBL as an educational concept is supporting the modeling of that profile. The role of the tutor, therefore, plays a crucial role in this scenario.

However, there are still some challenges in the current tutorship system at the Mechanical Engineering department. These challenges are summed up as follows: On one hand, we find 'motivation' as one of the fundamental problems that tutors are confronted with. On the other hand, we encounter that the expected targeted learning outcomes are not reached i.e. students' quality in report writing.

First of all, the unmotivated tutors are to be found more often in the first year than in the second one. Reasons to find unmotivated tutors, especially in the first year, are:

1. First year tutors are less involved in the subject that is given in the courses.

2. There is a lower level in collaboration between the tutors and the project co-ordinator. A consequence is that the learning outcomes of the specific project are not always as clear as expected.

The immediate consequence of having such a problem is that it becomes difficult to find suitable tutors.

It has been already discussed in this paper the positive and the negative aspects of the temporary solution of selecting Master students to hold the tutors' role. The risk of implementing such a solution is that the DBL projects can be regarded as less important parts of the curriculum than other courses.

Furthermore, due to the general character of the projects in the first year there are no research groups specialized in the first-year topics. The tutor's responsibilities are linked to the nature of the project which in this case are to be framed more in the process than in the content. They also have an extra responsibility as a mentor.

With regards to the second mentioned constraint of having unmotivated tutors, the relation between the tutors and the project co-ordinators plays a major role and deserves special attention. A potential solution could be that in the tutors in the first year will need to get their role reinforced. Reinforcement in this sense includes that the tutors get more responsibility in the supervision of the learning outcomes. Both the tutor and the project co-ordinator need to define more clearly the tasks by giving structure to the tutor's profile and criteria.

Another key element is the added value that can be given to the tutor's meetings. The tutorship meetings are aiming at reviewing tutors' experiences and giving answers to potential shortcomings found in the learning process with the students. To strengthen the value of these meetings a more clear agenda can be provided where careful attention is given to the project's learning outcomes. Moreover, to underline this process-orientation task and give an extra value to the relation with the project co-ordinator it would be essential to increase the collaboration between both so that the tutor holds a more relevant and well-defined specific function. In this sense, both the tutor and the project co-ordinator become a team. The latest counts also for the improvement of the relation of these two actors in the second year. Though in the second year the projects are linked to a research group and, therefore, the tutors are automatically more involved in the assessment process.

There are a number of considerations to provide tutorship with a more crucial role to try to undermine some of the above mentioned deficiencies. One of the discussions being held at this moment is that it is necessary to include the tutorship and coaching into the professionalization trajectory of the Ph.D. students. The tutor training can have, therefore, a broader scope and can engage as well the Ph.D. students. Consequently, tutorship as coaching can be included within their Personal Development Plan and curriculum vitae. This would be an ideal solution. However and due to the 'bad image' the tutorship holds at this moment this ideal situation is not included within the personal development.

Likewise, there are a variety of aspects which play a major role when it comes to meeting the standard requirement criteria for the students' reports. One of the main issues is that project co-ordinators find it difficult to give low grades. Reasons are to be found in that the assessment of projects focuses on process and less on content. Besides, and due to that the final grade is a group's grade, the belief is that the good students efforts count for the whole group when it comes to the group mark. Furthermore, experience learns that the requirements for a 'good report' are not always clear for the students.

At this moment, there are, however, some possibilities to make a step forward in the improvement of these shortcomings. The underlying effect is to emphasize collaboration among project co-ordinators to set clear criteria and norms for the definition of the expected quality in the reports as well as to identify the crucial phases in report presentation in the curriculum. There are, likewise, other types of implications. Tutors need to become more strict when it comes to the assessment of the reports just as the project co-ordinators do. To do so, the tutors will have to widen their role and gain more responsibilities within their tasks so that they will be able to provide feedback and advice on the structure to the students on report pitfalls. By doing so, the students gain a chance to improve the assessment.

Another discussion linked to the issue of giving lower marks to the group reports is the possibility of providing students with a chance to pass the learning outcome. The current situation is that the project co-ordinator sometimes spends more time in reviewing the reports than the students do in writing it. By becoming more strict in the report assessment this will be a measure to motivate students to take report writing as a more serious task.

At this moment there are numerous procedures that project co-ordinators use to assess a report. This represents to be an even more unclear aspect for the students to understand the different criteria used by the different teachers. The bottom message is therefore to create a more critical step-by-step set of guidelines which are also known and used by the tutors. Wherever project co-ordinators wish to include new or different rules these are to be stated in the norms and regulations framework and communicated properly with the tutors.

References

Barrows, H.S. (1984) A specific problem-based, self-directed learning method designed to teach medical problem-solving skills, and enhance knowledge retention and recall, in: H.G. Schmidt & M.L. de Volder (Eds.) Tutorials in problem-based learning. A new direction in teaching the health professions (Maastricht, Van Gorcum).

Delhoofen, P (1996). De student centraal. Handboek zelfgestuurd onderwijs W-N Groningen, HOR

Du, X.Y. & Kolmos, A. (2006). Process Competencies in a Problem and Project-based Learning Environment. Department of Development and Planning. Aalborg University (Denmark).

http://pblmm.k12.ca.us/PBLGuide/PBL&PBL.htm Project-based and Problem-based: The same or different? The Challenge 2000 Multimedia Project. Project-based Learning with Multimedia

Kolmos, A. (1996). Reflections on Project Work and Problem-based Learning. European Journal for Engineering Education, vol. 21, no. 2.

Kolmos, A. (2006), PBL at Aalborg university: contributions to the International PBL Conference in Lima. Technology, Environment and Society: Department of Development and Planning: Aalborg University

Meijers, A.W.M., van Overveld C.W.A.M., Perrenet, J.C. (2005). Criteria for Academic Bachelor's and Master's Curricula. Eindhoven University of Technology. Drukkerij Lecturis

Moust, J.H.C., Bouhuijs, P.A.J., & Schmidt, H.G. (1997). Probleemgestuurd leren. Een wegwijzer voor studenten. Groningen: Wolters-Noordhoff. Derde herziene druk.

Moust, J. (1993). De rol van tutoren in probleemgestuurd onderwijs. Contrasten tussen student- en docent-tutoren. Datawyse/Universitaire Pers Maastricht. Den Haag.

Moust, J.C. & Schmidt, H.G., (1994). Effects of staff and student tutors on student achievement. Higher Education 28: 471-482. Kluwer Academic Publishers. The Netherlands.

Moust, J.C. (2000). Probleemgestuurd onderwijs, bekneld tussen de rekkelijken en de preciezen. Onderzoek van Onderwijs.

Moust, J.H.C., van Berkel H.J.M. & Schmidt H.G. (2005). Signs of erosion: Reflections on three decades of problem-based learning at Maastricht University. Higher Education 50: 665-683.

Notitie: OGO: Onwijs Goed Onderwijs? - Werkgroep OGO & Kwaliteit. Technische Universiteit van Eindhoven (2003)

Pascual, R. & Uribe, R. (2006). Experiential Learning Strategies in a Mechanical Engineering Senior Course. Universidad de Chile. Santiago de Chile. Chile.

Perrenet J.C. & Mulders, W.M. (2002). Collaboration and Design-based learning: Why can't faculties do what students can?. Conference paper at the Improving Learning and Teaching at the University – Vilnius

Perrenet, J.C., Bouhuijs, P.A.J. & Smits, J.G.M.M. (2000). The Suitability of Problem-based learning for Engineering Education: Theory and Practice. Teaching in Higher Education, vol. 5, nr. 3. pp. 345-358

Reese, I., Walker, S. (2006). Teaching, Training and Learning: A Practical Guide. Business Education Publishers. Sixth Edition.

Schmidt H., van der Arend A., Kokx I. & Boon L. (1995). Peer versus staff tutoring in problem-based learning. Instructional Science 22: 279-285. Kluwer Academic Publishers (The Netherlands).

Visschers-Pleijers, Mulders and Van der Wouw (2001). Free riding in collaborative learning [in Dutch]; Onderzoek van Onderwijs, 30 (3), pp. 38-42

Wijnen, W.H.F.W. (2000). Towards Design-based Learning. OGO-brochure, p.8. Educational Service Centre (OSC). Eindhoven University of Technology.

Authors' biographical details

Sonia María Gómez Puente has graduated from University of Twente (The Netherlands), at the Applied Education and Technology Department. She is currently working as a teacher trainer at the Education & Training Unit at Eindhoven University of Technology (TU/e) to support teachers to develop didactical competencies.

Corinne Johanna Maria Jongeneelen has graduated at the Mechanical Engineering Department at the Eindhoven University of Technology. She is currently working as an education co-ordinator at the Mechanical Engineering Department.

Jacob Christiaan Perrenet studied mathematics in Utrecht and psychology in Amsterdam and wrote a dissertation about learning mathematics. He has been involved in various educational innovations in higher education. At the moment he is doing educational research about mathematics and computer science.