

The perception of students on the efficiency of their work by using the projects method in teaching Manufacturing Science

C.S. Duse

Professor PhD

Department for Educational Science, "Lucian Blaga" University
Sibiu, Romania

E-mail: carmen.duse@ulbsibiu.ro

D. M. Duse

Professor Eng. PhD

Faculty of Engineering, "Lucian Blaga" University
Sibiu, Romania

E-mail: dan-maniu.duse@ulbsibiu.ro

R. A. Ari

PhD Student Manufacturing Science, Lucian Blaga University

Email: a13r58i@yahoo.com

Conference Key Areas: curriculum development, engineering education research, new learning concepts for engineering education

Keywords: projects, cooperative work

INTRODUCTION

Project based learning (PBL) started in medical education more than 30 years ago, but has since been used for a large variety of subjects (Savery, 2006) and on all educational levels (Walker, A. , & Leary, H. 2009).

Projects are defined as a set of planned actions within a determined timeframe, focused on achieving certain objectives. According to the European Commission (1986), a project means "a group of activities that must be done in a logical sequence in order to attain a certain set of preset objectives".

Well-designed projects encourage active investigation and the development of superior cognitive abilities (Thomas, 1998). Research on the human brain has highlighted the value of this type of activities in learning. The abilities of students to understand new things are improved when they are tied to "significant problem-solving activities and the students are helped to understand why, when and how these facts and competencies become relevant" (Bransford, Brown, & Conking, 2000).

Using this method, the students work in cooperation groups, assuming active roles that capitalize their personal abilities and qualities. They learn by investigations and

have a certain level of control on the decisions about the way they complete their project tasks. The professor has the role of a facilitator and a coach.

Projects are developed starting from challenging questions that cannot receive answers simply by learning and memorizing. To complete the required activities for solving the projects, the students must conduct a series of own investigations in order to collect relevant information.

In an analysis of research in the field of project based learning, the conclusion rises that these projects that focus on aspects or problems “lead the students to meeting (or confronting) the central concepts and principles of a subject” (Thomas, 2000). More, central activities of a project require an investigation work and the creation of new knowledge by students (Thomas, 2000).

We can enumerate some of the advantages that project based learning has for students:

- the increase in activeness and presence in class, the increase of self-confidence and improvement of attitude towards learning (Thomas, 2000);
- there is a longer retention in memory of knowledge, creating satisfaction both for students and teachers (Buck Institute for Education 2009);
- access to a broader choice of learning opportunities in the classroom, offering a strategy for implicating students from various cultural backgrounds (Buck Institute for Education 2009);
- students often see the university as an organization based on control and competition, where each one tries to outrun the others. Research suggests that students' attitude towards learning, the academic environment and the professors in general increases when they are offered the possibility to work by cooperation and continuous and direct interactions with the academic staff;
- even more, students that benefit the most out of project based learning are those for which traditional teaching methods are not efficient.

1. RESEARCH DESIGN

1.1 Objectives and hypothesis

Introducing project based learning is not a new or revolutionary idea in the field of engineering education. But for Romania, where research highlight personalized learning strategies, this method can bring extra knowledge and the development of the students' interest towards learning. By cooperation based interaction, the members of the group promote each other's success: offering and receiving assistance and support; interchanging resources and information; offering and receiving feedback; requesting their colleagues' opinion; promoting sustained efforts for achieving common objectives; influencing each other for success; using interpersonal abilities; obtaining benefits form the group efficiency.

As a result of these considerations we have done a study on the way in which students see the application of this method, following the way the project is done and its implications on learning. The research has comprised a number of 35 students of the Industrial Engineering program, through their 6th, 7th and 8th semester, because the subject of Manufacturing Science is taught over the course of the last three

semesters of the bachelor level of engineering studies. In Romania, engineering studies have 8 semesters.

The students had the possibility of being tutored by the full professor, a laboratory supervisor with a lecturer title and a PhD student in the field of Manufacturing Science.

Considering that the objectives must describe as precisely as possible what we expect to see in students as a result of their participation in the created learning situation, the operational definition of the objectives must contain:

- a. the identification (name) of the observable behavior;
- b. the description of the conditions in which the desired behavior must manifest itself;
- c. criteria for acceptable performance.

For the cognitive field, at the end of the instruction period, the expected behavior is: knowledge (acquisition of information); understanding, application, analysis, synthesis and/or evaluation, and (according to newer taxonomies) – creation.

Table 1. Behavior classes for the cognitive field

Cognitive behavior – information acquisition	The evocation/remembering of general and particular facts, methods and processes, or the evocation of a model, a structure or a category. Regarding measuring of knowledge, the evocation behavior only requires to produce the reappearance of data stored in memory.
Cognitive behavior – understanding	It is the elementary level of understanding that allows the one who studies to know what is being communicated, without necessarily creating a connection between this information and some other, or to realize its entire meaning.
Cognitive behavior – application	Using abstract representations in particular and concrete cases. These representations can either have the form of a general idea, certain rules of acting according to a procedure or to form widely spread methods, or that of principles, ideas, theories that we must remember and apply.
Cognitive behavior – analysis	Separating the elements or building blocks of a communication so that a relative hierarchy of ideas and (or) relations between expressed ideas can be determined.
Cognitive behavior – synthesis	Combining elements or parts in order to form a whole. This operation consists of setting and combining fragments, parts, elements etc. in such a manner that they form a plan or a structure that was not clearly visible before.

As a result, the proposed objectives were:

1. The analysis of students' perception regarding the efficiency of team work by applying the projects method, highlighted by the questionnaires of measuring project progress.
2. Determining the influence of the projects method on the motivation for learning measured by the questionnaires for determining the ability for solving problems.

3. Determination of visible results obtained through project based learning expressed in the questionnaires on the advantages and disadvantages of the method.
4. Determining the influence of the method on increasing oral presentation and social abilities, highlighted by the appreciations of the group listening to the presentations.

The starting hypothesis was that students will become aware of an increase in knowledge and learning as a result of personal implication in collecting, analyzing, synthesizing, presenting and then explaining in front of the class the approached theme.

In the first semester (6th study semester), student activity was done by frontal teaching inserting critical thinking methods. This semester was used as a preparation for the students to approach the method. For this, we have taught as a team with the methodist of the Teachers Training Department, using the “know-want to know-learned” technique, the SINELG method, thinking hats, mind-map etc. The idea behind using these methods was for students to know and use them later. The research part consisted of determining some steps, starting from the creation of the team, distributing roles within the teams and choosing the project subjects.

In the second semester of the research (7th study semester), the teams were created based on the results of the students at the previous exam. Thus, 8 teams were created with students from close value groups, so that there is no great difference in value between the team.

The project subjects were then presented to the groups. They contained a theoretical and a practical part, followed by a presentation in front of the other teams. The theoretical part had to be done in an own way, taking the scientific reality into account, while for the practical part, they were asked to present demonstrative didactic materials, starting from drawings and graphs to movies that exemplify the presented subjects.

As stages of the project we considered:

1. Collecting information from primary and secondary sources;
2. Determining variants and opting for the final form;
3. Presenting and defending the chosen variant;
4. Evaluation of the presentation by colleagues (peer-review);
5. Evaluation within the team.

The activity in this semester had as a purpose the preparation and training of the students for the project in the third semester (8th study semester).

For the students used with educational experiences specific to traditional education, this way of working requires a totally different approach. Thus, there is a transition from following orders for achieving activities, to orienting one's own learning activities; from memorizing and reproduction to investigation, integration and presentation; from listening and internalization – learning to discovering, communication and assuming responsibilities; from a theoretical approach to applying theory into practice. And maybe the most important, from the dependence on the professor to the independence in making decisions.

In this last semester, the teams were formed by own preference and they chose their own project themes. These themes, well defined and contoured, had a strong applicative character (the manufacturing technologies of parts families in the

automotive industry were investigated: shafts, bushes, discs and wheels, levers and forks etc.). The project implied going through the design steps (determining the functional role of the parts, analysis of used materials, critical analysis of existing manufacturing technologies, optimizing manufacturing technologies) and presenting some demonstrative films and it was finalized with a presentation in front of the class.

A group review (peer review) was then done for the team and another one by the rest of the class that has seen the presentation.

1.2. Obtained results

As we have shown before, the students were evaluated within the team for them to become aware of the way they contributed to knowledge and learning. Thus the students were questioned on several aspects: good group relations (rb); communication between team members (cm); competency of each team member (cf); felt time pressure (pt); pleasure felt during work (dm).

We notice an increased time factor dimension for all groups, which denotes a certain stress for meeting the project deadline. This is due to the fact that the students have a tendency of learning only during exam sessions, spending their time on other activities during the semester. In our case, the deadline for presenting the project acted as a pressure factor.

The good group relations is mainly tied to good communication within the group (62.5%), while the pleasure felt during team work is also present in a 75% proportion. Thus, we notice group 6, where, despite high time pressure, the pleasure of work is great. The lowest scores are in group 8 (Figure 1).

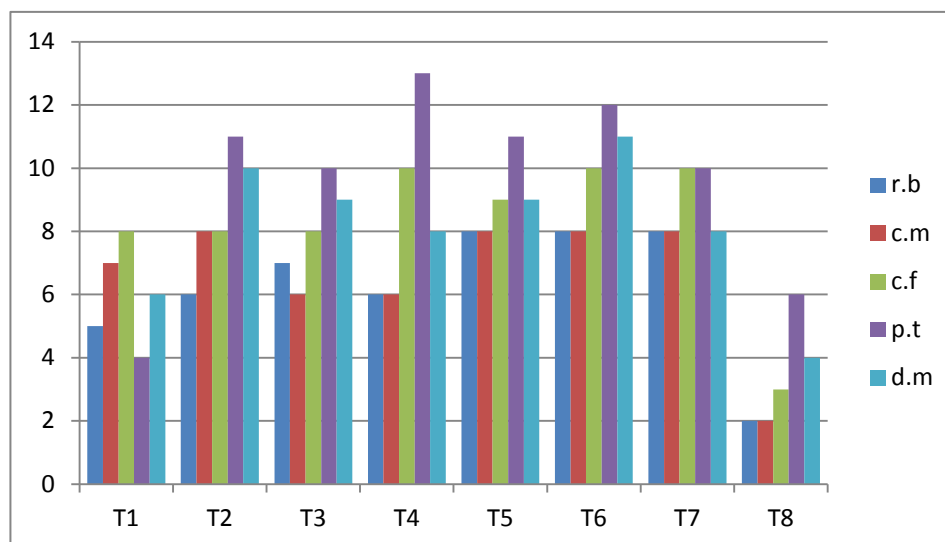


Figure 1. Factors that influenced the project

The second item in the questionnaire for evaluating team activities referred to the interpretation of the students of the advantages of project based learning, respectively their perception on the success of the method (Figure 2). Considered items here were linked to: good group relations (br); improving communication with

colleagues (ic); better understanding of subject (is); better retention of knowledge (rc); developing practical abilities (da).

Again, group 6 shows the best scores and advantages of the method and group 8 shows the lowest performances achieved. Overall there is a high (62.5%) appreciation regarding the advantages of this method.

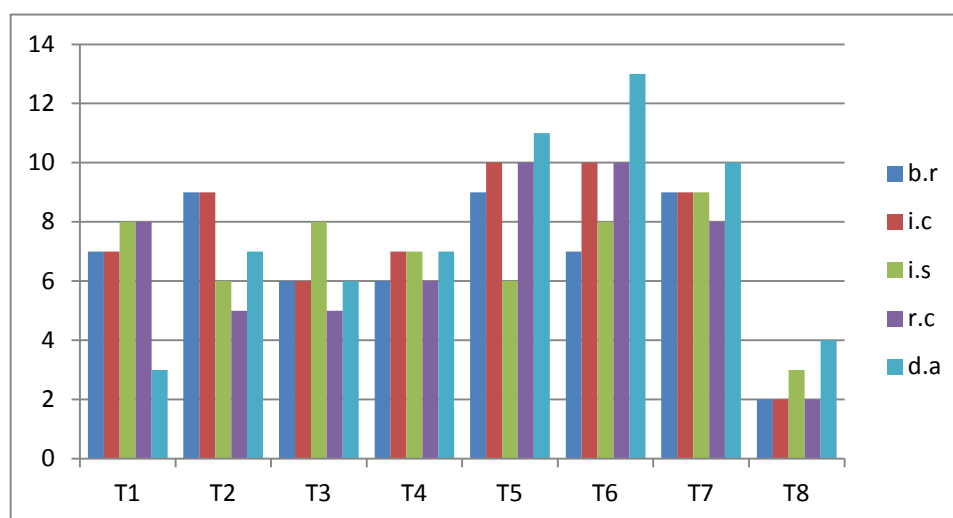


Figure 2. Advantages of project based learning

The disadvantages of using this method are shown in Figure 3. The explanation of the terms is: obligation of team work (om); high time consumption (ct); conflicts (ca); lack of team coordination (lc); lack of competence from other team members (lcm).

From the analysis of responses, we note that 50% of students see team work as unpleasant, as an obligation, and 62.5% talk about conflicts in finishing the project. Also, the lack of competence of others is seen as a problem by the same percentage of respondents.

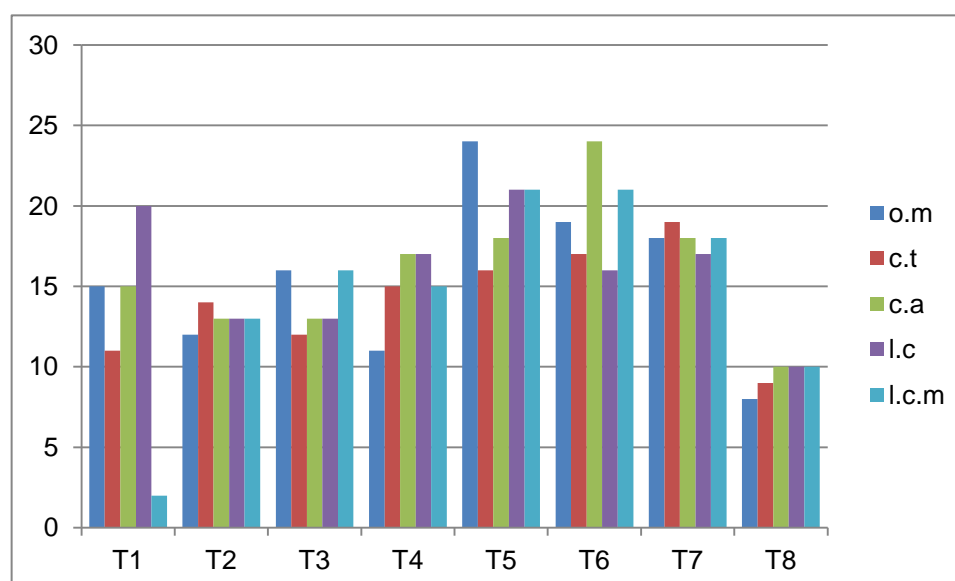


Figure 3. Disadvantages of project based learning

Regarding the effects of this method on learning, results are very conclusive (Figure 4). The items are: it helps me learn more (a); I find new ways of thinking about things I learn (b); I learn more from traditional teaching than from this method (c); I improve my relations with my colleagues (d); I do not appreciate the used method (e).

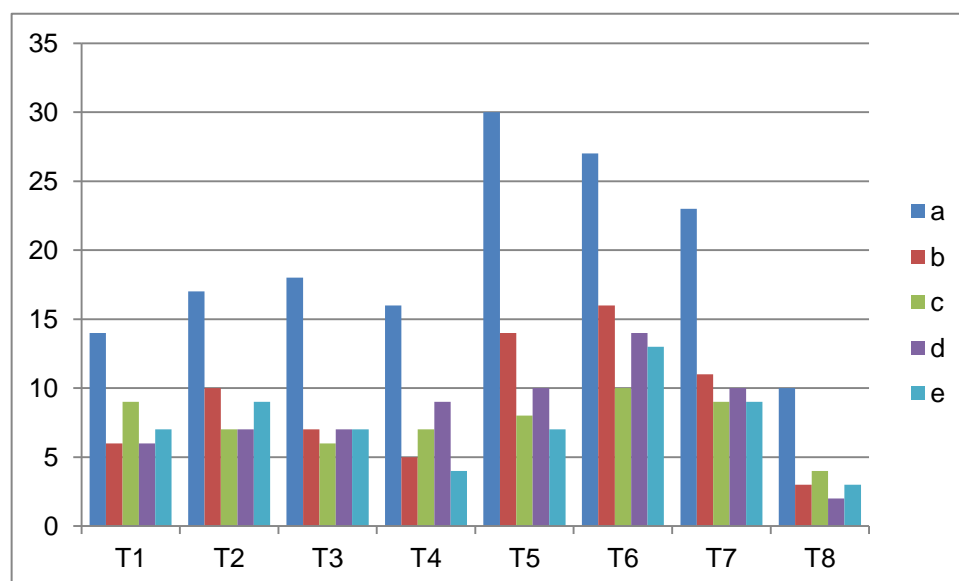


Figure 4. Effects of project based learning

It is visible that students accept an improved learning as a result of using this method, seen in item a, which, with 100%, is the most representative for all teams. We also notice that more than 50% respond positively to the fact that this method helps them view the new from different perspectives. Item c shows that traditional learning is undersized in comparison to project based learning. Even if just slightly, relationships with colleagues seem to improve through this method.

2. CONCLUSIONS

Obtained results highlighted a series of problems that project based learning has. Some conclusions can be drawn:

- Even though they accept the application of this method, students are still attracted to traditional teaching, where their role is simpler, being reduced to just a spectator of knowledge. Their interventions are rare, sporadic and require too little effort;
- Team work requires a series of abilities that will be useful later in active life. These are team work, conflict management, communicating etc. We notice these things are not familiar to students, which speaks of a difficult adaptation to a working environment with multiple tension and conflict points. This must be quickly solved, because it drastically reduces the students' chances of being integrated in the labor market;
- Students are self-aware of their own strengths and weaknesses, resulted from applying the method, but they remain tributary to a certain behavior specific to traditional learning.

To these arguments, we can also add that the psycho-pedagogical training of teachers in the Romanian education system has rather been focused on a traditional approach, towards a classical role of "magister", with few modern inflexions. Thus,

the majority of academic staff have not been prepared to assume the role of moderator or facilitator and to be able to play it.

By using project based learning, the role of the teacher changes. They become mentors and coaches, they are “training” and “modeling” and talking less. They must be prepared to admit and accept “deviations from course” that can happen during a project.

The professor has the mission to stimulate the desire to learn, the final goal being to teach the student how to learn. Learning becomes as such a personal project of the student, seconded by the professor which has a variety of roles: tutor, coach, organizer, animator, manager of efficient learning situations, and the university results as a collection of diversified workshops and systematic tutoring.

References

1. Thomas, J.W. (1998), Project-based learning: Overview. Novato, CA: Buck Institute for Education pp.3.
2. Thomas J. W. A. (2000), Review Of Research On Project-Based learning in www.bobpearlman.org/BestPractices/PBL_Research.pdf pp.3.
3. Bransford, J., Brown, A., & Cocking, R. (2000). How people learn: Brain, Mind, Experience, and School. Washington, DC: National Academy Press. pp.23
4. Walker, A. , & Leary, H. (2009). A Problem Based Learning Meta Analysis: Differences Across Problem Types, Implementation Types, Disciplines, and Assessment Levels. *Interdisciplinary Journal of Problem-based Learning*, 3(1) pp.13.
5. Mergendoller, J.R., Maxwell, N., & Bellisimo, Y. (2006). The effectiveness of problem based instruction: A Comparative Study of Instructional Methods and Student Characteristics. *Interdisciplinary Journal of Problem-based Learning*, 1(2). Retrieved from <http://docs.lib.purdue.edu/ijpbl/vol1/iss2/5/> pp.50.
6. Does PBL Work? Buck Institute for Education (2009) on http://www.bie.org/research/study/does_pbl_work