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Dan Maniu Duse*, Carmen Sonia Duse**

THE IMPACT OF USING PROJECT BASED LEARNING IN NATURAL GAS ENGINEERING

1. 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).

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.

With this method, students develop cognitive and metacognitive abilities and clarify themselves or with the help of the group problems that were previously unclear. Then, presenting in front of the class insures a better understanding of the subject, because in explaining the subject to their colleagues, they must understand what they are talking about and not just memorize senseless phrases (Jaques and Salmon 2007).

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.

* Engineering Faculty, Lucian Blaga University of Sibiu
** Educational Science Department, Lucian Blaga University of Sibiu

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, p.3). 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 use of colleagues as learning resources;
- 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);
- learning to evaluate and self-evaluate;
- developing critical thinking and learning how to give and receive feed-back;
- identifying the area of no knowledge for the individual and the group;
- learning by experience and mistakes.

2. RESEARCH DESIGN

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 *Natural Gas Engineering* program, through their 6^{th}, 7^{th} and 8^{th} semester, because the subject of *Transporting Natural Gas* 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 Engineering Science.

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 (6^{th} 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 (7^{th} 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 (8^{th} 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.

3. 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:

a. If everyone know what they have to do;
b. Proactive behavior of group members;
c. Cooperation flexibility;
d. Team members help and support each other;
e. Group leader shows patience, understanding and support.

The effects of this method on the group are visible in Figure 1. We notice that only 50% of respondents agree that students know what they have to do, but after the plan is done, 80% say that group synergy is visible. We notice that groups 5 and 6 have the best scores, while group 8 has the lowest scores.

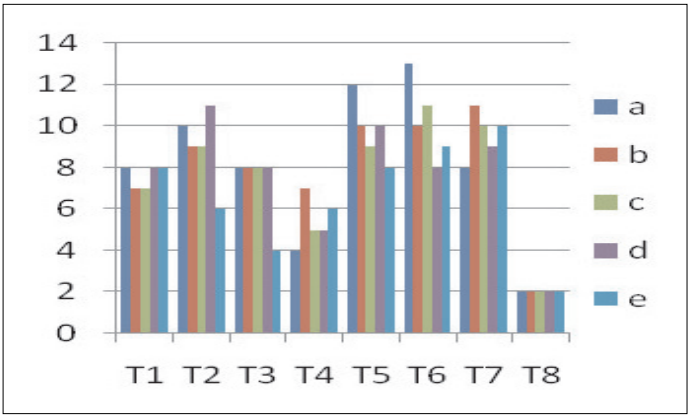

Fig. 1. The effects of the method on the teams

The second item in the group activity self-assessment questionnaire referred to group relations (Fig. 2).

Considered items here were linked to:

- ap – presentation hamony;
- ra – active role of each member in the presentation;
- se – support shown by team for the presenter.

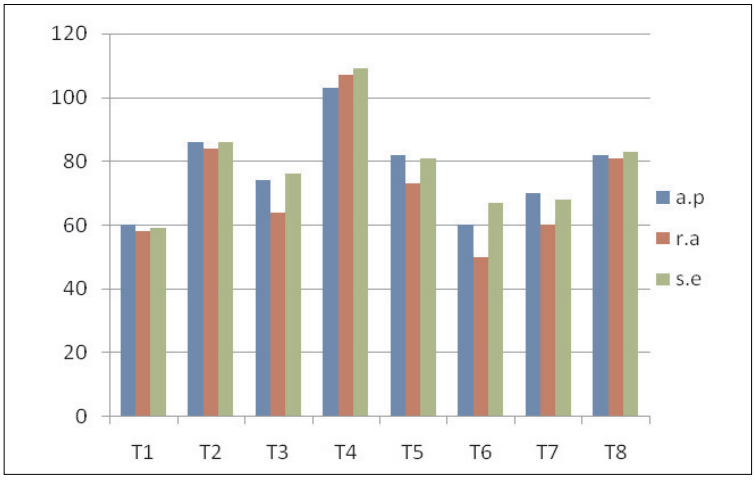

Fig. 2. Gro1up activity self-evaluation

This time, group 4 highlights the advantages of this method, while groups 1 and 6 show lower group scores.

It is interesting to see how groups are seen by their colleagues when presenting. Figures 3, 4 and 5 refer to the presentations.

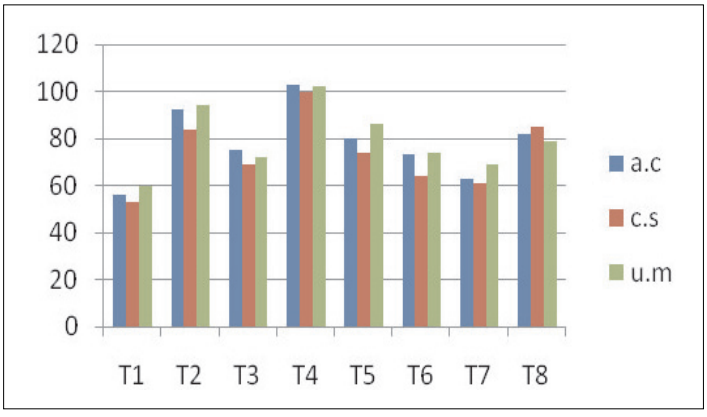

Fig. 3. Verbal expression

The significance of the dimensions is: ac – clear argumentation; cs – connections with other subjects;um – using the models.

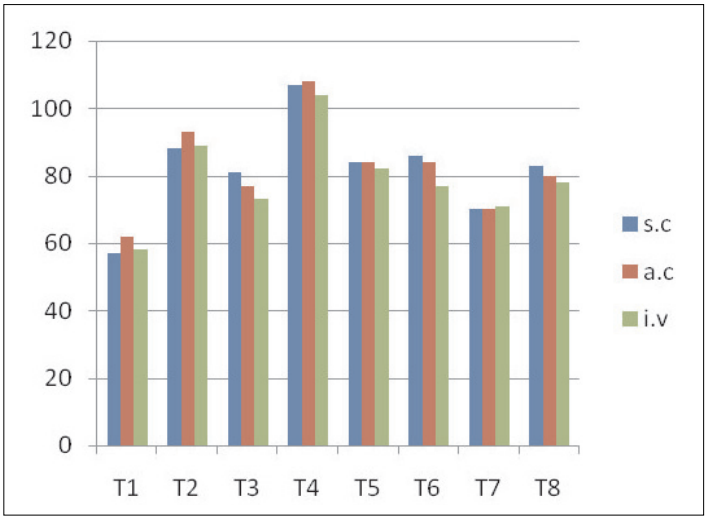

Fig. 4. Presented visual aids

The significance of the dimensions is: sc – clear slides; ac – color harmony; iv – visual impact

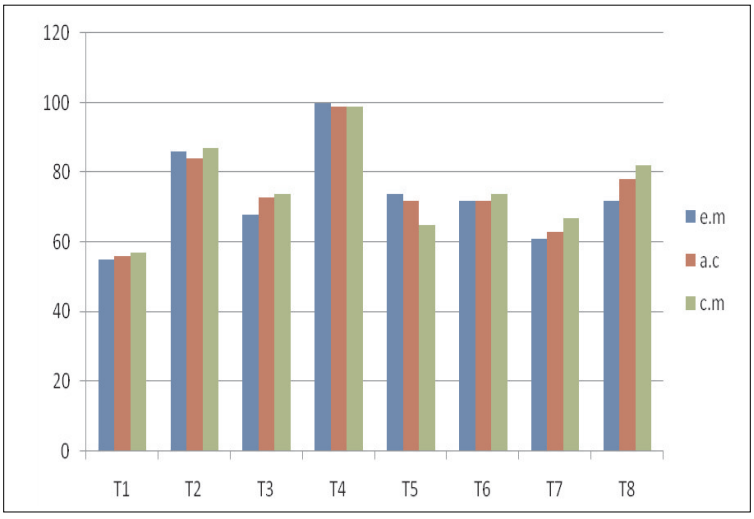

Fig. 5. Existing support materials

The significance of the dimensions is: em – existing support materials; ac – adequate to presentation contents;cm – quality of support materials

It is visible that the peer evaluation has highlighted the superiority of group 4, followed by group 2. It is interesting that students did not perceive the same hierarchy, a clear sign that they have not correctly perceived the implications of this method on gained knowledge.

4. 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;
- Teams where the team leader has had high scores are not amongst the most efficient ones. This means that the leader has low academic performance or that they do not know what to do with the group. Even though they are perceived as a leader, they have weak qualities for this.
- 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.

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