Assessing Impact of Problem Based Learning (PBL) on Six Sigma Projects Associated with Textile Engineering Education

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ABSTRACT

Structurally, PBL and Six Sigma approaches are similar as their common aim is to solve the problems by executing projects in a systematic way. The purpose of this paper is to highlight a research regarding the impact of implemented PBL methodology on Six Sigma projects, associated with textile engineering education at "Lucian Blaga" University of Sibiu (LBUS). In this research, at first PBL has been introduced in the textile engineering course at LBUS with the aim of enhancing education quality through a collaborative project with a textile factory, where Six Sigma projects have also been executed simultaneously. The PBL activities have been performed in the factory premises associating with Six Sigma projects in order to upgrade the project performance. Finally, the PBL impacts on Six Sigma projects have been assessed by conducting a quantitative survey through structured questionnaires. The survey results revealed that the PBL has a positive impact on executing Six Sigma project successfully and able to shorten the project duration as manufacturing unit trying to achieve now a days. This article has pointed out the necessity of introducing PBL with Six Sigma approach for effective project execution within the organization.

Keywords: *Problem-based learning (PBL), textile engineering, impact, Six Sigma project, LBUS*

PBL AND SIX SIGMA

Problem based and project based learning (PBL) is an instructional teaching method which provides an opportunity for students to explore technical problems from a system level perspective and to develop an appreciation for the inter-connectedness of science and engineering principles (Richard et al., 2003). PBL prepares students to think critically and analytically by using appropriate learning resources (Duch, 2008). More over the PBL-concept representing a learning philosophy of experiential, experimental, contextual, situated, social and team-based learning, which can be modeled in many ways at the curriculum level (Kifor et al., 2007).

As literature evident that like other domains of engineering education, a significant number of academic institutes have been attempting to implement changes in learning and teaching philosophies and methodologies also for textile engineering education, aiming for an important objective which is very clear for engineering teaching and learning process. For instance, in the University of Manchester (Sayer et al., 2006), in the University of Minnesota (Bye, 2011) and, in Illinois State University (Gam and Banning, 2011).

In PBL pedagogical method, students work in a team and learning themselves by solving subject related real life problems. On the other hand Six Sigma, as a quality management approach, systematical and structured improvement procedures provides teams a methodological framework to guide them in the conduct of improvement projects (Pande et al., 2002). A wide number of citations have found regarding the benefits achieved by executing Six Sigma projects such as: customer satisfaction, financial performance and profit generation, reduction in process variability, inventory, maintenance time and cost of poor quality, and also improved service quality (Aboelmaged, 2010). In spite of those benefits, Six Sigma projects are facing various challenges and difficulties during its implementations. The difficulties are mentioned by different researchers such as: acquiring quality data, poor estimation of financial gain, inadequate measurement skills (Martins et al., 2006), data collection process, part-time involvement on Six Sigma projects (Chakrabarty and Chuan, 2009), mismanaging project implementation time (Taner et al., 2007), large project (Kumar et al., 2009). According to Baral et al (2012), PBL can be contributed to enhance the competencies of textile engineering students and also can be influenced on the Six Sigma project execution in the textile manufacturing unit.

The purpose of this paper is to present the outcomes of the PBL impacts on Six Sigma projects which have been executed through collaboration with LBUS and a textile factory. The PBL impact has been assessed by conducting a quantitative survey through structured questionnaires.

PBL IMPLIMENTATION AND SURVEY METHOD

Textile technology department of "Lucian Blaga" University of Sibiu (LBUS) is one of the most important departments under the faculty of engineering. The number of students in this department has increased consistently to cope with the demand form job market. This department is providing 4 years bachelor degree called "B.Sc. in textile engineering" mainly in textile knitting and clothing technology as a specialization. As a part of higher educational quality enhancement initiative, PBL has been introduced through a collaborative pilot project entitled "Problem based and Project based learning in textile engineering education –An effective way of university-industry collaboration" with a textile factory situated in Sibiu, Romania. It has implemented in the summer semester of 2013 only for the "Weaving Technology" course, which is taught in the 2nd year 2nd semester. Due to the limitation of curricula change from Romanian ministry of education, the model of PBL activities has been modified from the traditional Aalborg PBL model (Oprean et al., 2005) for implementation which is shown in Figure 1 and Figure 2.

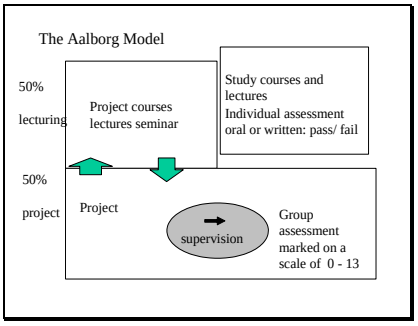

Figure1: The Aalborg PBL model

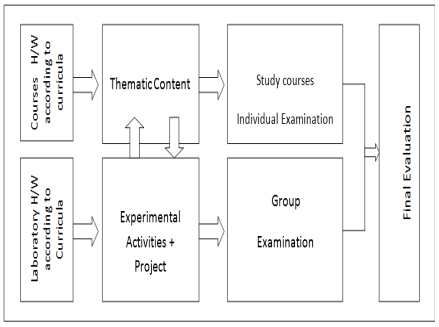

Figure2: Modified PBL model for the Textile Technology Department of "Lucian Blaga" University of Sibiu (LBUS).

The PBL activities were executed within the 14 weeks of semester duration by full filing the following key elements of PBL (Richard et al., 2003).

i. Team building with students by an Instructor/Facilitator (Course Teacher).
ii. Identify the course related problem from industry.
iii. Detail the parameters necessary to solve the problem.
iv. Encourage students to brainstorm with teammates.
v. Develop an action plan to achieve the time-line for the project.
vi. Implement the action plan.
vii. Summarizing the result both in written and oral reports.

The PBL activities were performed both in factory and university premises with active participation of students, sponsor, coordinators and mentors. During these activities PBL students' team and mentors were involved with the Six Sigma projects which were executed in the factory. Then the effectiveness of the project-based learning experience was assessed through an empirical survey looking at changes in factory participants. The main objective of the evaluation process was to know the influence of PBL activities to the Six Sigma projects through the survey. In order to achieve this goal, information was collected, by supplying survey questionnaires, from factory stakeholders; those participated in the PBL activities and Six Sigma projects.

ASSESSMENT OF PBL IMPACT ON SIX SIGMA PROJECTS

A set of survey questionnaire were sent directly to all the industry (factory) stakeholders, those who participated in both, the PBL activities and the Six Sigma projects. The questionnaires were formulated relating to their experience during Six Sigma project execution regarding influence of PBL activities such as:

i. Have they seen the similarities between PBL and Six Sigma projects?
i. Has PBL raised awareness of continuous improvement like Six Sigma?
ii. Has PBL contributed on data collection procedure for Six Sigma?
iii. Was there any influence of PBL to decrease the Six Sigma project duration?
iv. How PBL helped them to contribute Six Sigma project effectively?

The survey result and the responses regarding the influence of PBL activities on Six Sigma projects execution are presented in the Figure 3.

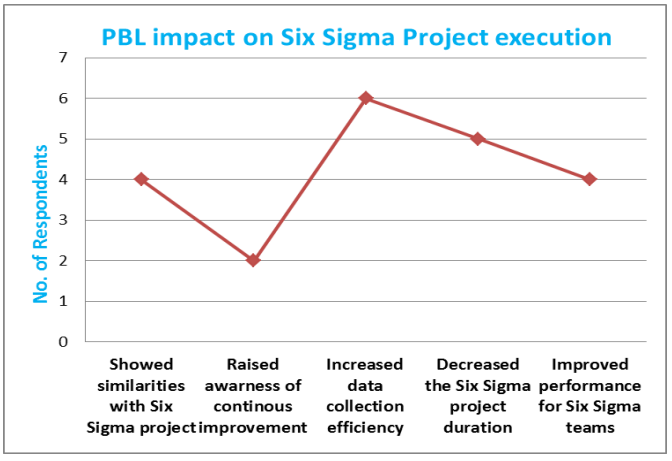

Figure 3: Impact of PBL on Six Sigma project execution.

- According to survey results, all respondents (100%) agreed that PBL activities have increased the data collection efficiency for Six Sigma projects. This is because PBL problem solving methodology was performed using the Six Sigma tools.
- Just over eighty percent (83.33%) of respondents gave their opinion that the PBL activities have the capability to decrease the Six Sigma project duration, which has been considered as another important impact.
- Two thirds (66.66%) of respondents agreed that the PBL has similarities with the activities of Six Sigma project execution and the respondents also believed that PBL activities have improved their performance as a Six Sigma team member.
- A few respondents also mentioned that they believe PBL has raised the awareness of continuous improvement around the factory people to some extent.

CONCLUSION

This paper has highlighted the unification of PBL with Six Sigma approach for effective project execution within the organization. The Survey results revealed that the PBL showed positive impact on Six Sigma project implementation by increasing data collection efficiency, decreasing the project duration and enhancing the performance of project team members. This research has some limitations due to the fact that the survey in this project has been carried out within a small number of participants. This implies that this research could be conducted in collaboration with other institutes so that large number of participants can be included to generalize the results. This study will offer some guidance to other institutes looking into utilizing the PBL for executing the effective Six Sigma projects in their own field. As a further study, we are recommending to involve more number of participants and also investigate the effect of PBL implementation in other domain of engineering education. Many academic institutes around the world are currently introducing PBL to enhance the quality of higher education. On the other hand manufacturing units trying to shorten their Six Sigma project duration, but interconnection between both issues is not always evident or addressed. Therefore this study offers direction toward a more effective utilization of PBL for Six Sigma projects implementation.

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