Integrating Problem Based and Project Based Learning for Effective Teaching Learning in Engineering Education - A Case Study of Advanced Database Management Course

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Abstract. Project based learning and problem based learning are perhaps the most widely used instructional methods followed for outcome based education in the present day scenario. Both approaches have their own merits and demerits and have been extensively covered in literature on outcome-based education. The purpose of this paper is to inform the findings of integrating these two approaches. In the blended approach proposed in the paper a single problem specified by the instructor with a specific dataset in the course of advanced databases had to be solved by 16 teams of 3 to 4 members each. The blended approach developed is examined for effectiveness in terms of student learning outcomes. The proposed approach also encourages active engagement among peers as well as with the instructor who acts as the facilitator. The paper also analyses the effect of peer evaluation, self-evaluation done by the students during the continuous internal evaluation. The paper also shows how students could have a say in evaluation process and how faculty assessment could be more transparent and more realistic.

Keywords: Problem based learning, Project based learning, Self Evaluation, Peer Evaluation.

1 Introduction

Both project based and problem based learning approaches appear to have much in common although they are two distinct approaches to learning. In Project-Based...
Learning, students have full control of the project in a sense of how they will work on and what they will do in the project. The project being carried out in majority of the cases may not address a specific problem. John Thomas [1] explains that project-based learning requires “complex tasks that involve students in design, problem-solving, decision making, or investigative activities; give students the opportunity to work relatively autonomously over extended periods of time; and culminate in realistic products or presentations. In order to create effective project-based learning environment in the courses [2]; the instructor should follow the suggested guidelines for project based learning in majority of the literature such as clear goal in mind, clear outcomes, assessment criteria and management of tools and strategies. Problem-based learning is also an instructional methodology. The primary goal here is to enhance learning by requiring learners to solve problems. It is a methodology with the characteristics like problem centric, student centered, self-directed, and self-reflective, which is facilitated by the Instructor.

This paper has proposed in the sections below an approach that blends both of the approaches discussed in the previous paragraphs. Section II discusses the new proposed model. Results and the analysis are discussed in Section III. The paper concludes with section IV.

2 Methodology

The 3C3R model [3] and as shown in Figure 1 has core components and processing components. The content, context, and connection are primarily concerned with the issues of appropriateness and sufficiency of content knowledge, knowledge contextualization, and knowledge integration and are considered as core components. Researching, reasoning, and reflecting are treated as processing component and deal with students’ acquisition of content knowledge and the development of problem-solving skills and self-directed learning skills. Many researchers have worked on this model and this model has been used in the context of problem based learning in the area of effective pedagogy since it was proposed in 2006.

![Fig. 1. The 3C3R problem based learning model](image)

The proposed model as shown in Figure 2 is termed as 3C3R2P model. The enhancement paves the way for achieving the set objectives of the model as shown in Figure 1 by making the students work on a project to solve the same problem using
different approaches. The methods/approaches to solve a problem may be selected by the team with a condition that the solution being proposed is not being undertaken by another set of student.

![Fig. 2. The 3C3R2P Proposed-learning model]

The course instructor in this case had given a project to compare the performance of any of the open source databases in any of the three categories namely object oriented databases, parallel databases and distributed databases which are all included in the ADBMS curriculum with MySQL database. The Databases course had been completed by the students in the previous semester which dealt with MySQL. This was treated as a project to be carried out in groups of 3 or 4 students each. The problem based learning was integrated by giving a specify problem to be solved by taking the same dataset. All the students were supposed to test various database operations in their project namely update, create, delete etc. on a very large real time Airlines database [4]. The dataset used was really very huge and it is considered as a large dataset: there are nearly 120 million records in total, and it takes up 1.6 gigabytes of space compressed and 12 gigabytes when uncompressed. The data consists of flight arrival and departure details for all commercial flights within the USA, from October 1987 to April 2008.

3 Results and Analysis

The students who had undergone the ADBMS course were asked for feedback on the delivery and conduction of the course. The feedback was also not a compulsion and binding on the students but was voluntary. A total of 43 students responded out of the 52 students who attended the course. The data and the results for three very important questions out of the questionnaire are as shown in Table I.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Question</th>
<th>Strongly Agree (%)</th>
<th>Agree (%)</th>
<th>Disagree (%)</th>
<th>Strongly Disagree (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Proposed approach</td>
<td>66.67</td>
<td>33.33</td>
<td>0</td>
<td>0</td>
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is a effective way to teach

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<tr>
<td>2</td>
<td>Choice of opting another course with proposed approach</td>
<td>26.67</td>
<td>66.67</td>
</tr>
<tr>
<td>3</td>
<td>I have learnt more with the proposed approach than the traditional approach</td>
<td>86.67</td>
<td>0</td>
</tr>
</tbody>
</table>

4 Conclusion

The proposed blended approach is an active and engaging pedagogy, which might be used for effective teaching learning at the undergraduate engineering level. The results indicate a variety of positive learning outcomes after the students have had undergone a course with proposed approach. One of the outcomes includes much better papers from undergrad students and those students becoming part of the “scholarly conversation”, and becoming more employable. The proposed approach also encourages active engagement among peers as well as with the instructor who acts as the facilitator.

References

2. Ravitz, J., Mergendoller, J., Markham, T., Thorsen, C., Rice, K., Snelson, C., & Reberry, S. “Online professional development for project based learning: Pathways to systematic improvement.” Association for Educational Communications and Technology Annual Meeting. Chicago, IL, 2004