

PROBLEM-BASED LEARNING AND THE DEVELOPMENT OF KEY SKILLS IN FOUNDATION MATHEMATICS STUDENTS AT THE BAHRAIN POLYTECHNIC

(Extended Abstract)

Maitham AlMuharraqi (1), George Toworfe (2).

(1) Bahrain Polytechnic, Kingdom of Bahrain, Maitham.AlMuharraqi@polytechnic.bh

(2) Bahrain Polytechnic, Kingdom of Bahrain, George.Toworfe@polytechnic.bh

Abstract

Problem-based learning (PBL) is a student-centered teaching and learning (T&L) approach that has the potential to stimulate students' mathematics and related skills. The T&L of mathematics has always been routine, lacking the capability of developing certain skills in learners. As a result, students learning mathematics are unreceptive and unable to reason mathematically. Very scanty published data are available on the effectiveness of PBL in enhancing students' mathematical skills, problem solving skills, communication skills and teamwork. More specifically, no data has yet been reported on the impact of PBL on Mathematics T&L in a HE institution in the Gulf. This study, therefore evaluates the impact of PBL, as an instructional strategy, in the education and the effective T&L of Mathematics on Foundation students' skills at the Bahrain Polytechnic. The PBL instructional strategy was adopted by the Bahrain Polytechnic in 2011 and has been systematically implemented across the curriculum in the various faculties. It was implemented in Foundation Mathematics in 2013. Its impact, although visible, has not yet been empirically evaluated. Students' assessment data prior to and after implementation of PBL strategies in Mathematics teaching at foundation were collected. In addition, qualitative data comprising students' responses to a questionnaire and their reflections after a PBL research project in Foundation Mathematics (over 6 weeks) as well as tutors' feedback were also obtained. Data was analysed using analysis of variance (ANOVA) and hypotheses (paired t-tests) analyses to ascertain the development of students' mathematical abilities and skills after implementing PBL strategies. Preliminary findings from the study indicated that PBL provided positive impact on Foundation Mathematics students and that it was more efficient, than the conventional teaching strategy, in enhancing students' mathematical skills. Students, as a result, demonstrated enhanced effective problem-solving skills, better mathematical communication skills, independent learning and stronger teamwork, which are key skills in fulfilling the requirement of education in this twenty-first century.

Keywords: Foundation Mathematics, PBL, teaching strategy, skills

1. Introduction:

The study of Mathematics helps to generate creativity by creating an enabling environment as well as learning flexibilities (Brunkalla, 2009). Mathematics are applicable in many fields in the real world (Baki, Çatlıoğlu, Costu, & Birgin, 2009), however, the learning of Mathematics tends to emphasize more on the procedural methods/approach rather than allowing the students to think mathematically. This therefore makes it difficult for the learners to connect mathematical concepts with the real world (Ginsburg & Amit, 2008; Macmath, Wallace, & Chi, 2009). In schools and colleges, students find courses in Mathematics difficult to grasp due to the lack of interesting teaching strategies and methodologies, insufficient quality of Mathematics teachers and limited Mathematics laboratories (Ali, Hukamdad, Akhter, & Khan, 2010). Mathematics as an evolving science requires exploration and the role of teachers is to give students the opportunity to discover mathematics in an exploratory manner (Cazzola, 2008).

Problem-based learning is the instructional approach that requires students to apply theory into practice which will lead to the construction of knowledge and skills through an ill-structured problem (Savery, 2006). In a mathematics teaching environment, PBL focuses on problem-solving and conceptual understanding (Fatade, Mogari, & Arigbabu, 2013), unlike the conventional setting which emphasizes on computational skills and solving the problems without understanding the concepts. Since PBL approach to teaching and learning has been adopted as a practice in school setting, a comprehensive investigation on the impact of learning mathematics in the development of skills, through problem-based learning in schools, has become necessary.

1.2 History of PBL at the Bahrain Polytechnic

The PBL T&L strategy was first introduced in the Polytechnic in the first semester in 2011/2012 academic year. During that time, Mathematical-based PBL problems were constructed with help from EDU unit. PBL problems were created for each of the 4 Mathematics modules that existed then. There were challenges encountered which prevented a full implementation of the strategy. In 2013, however, PBL was fully implemented based on recommendations from stakeholders as well as the institution meeting all the requirements for its implementation. The goal of this study is therefore, to evaluate the impact of PBL T&L strategy in building skills in the learners.

2. Materials and Methods:

The school of Foundation offers three Mathematics courses which include Mathematics 1, Mathematics 2 General (M2G) and Mathematics 2 Technical (M2T). Students who did not gain direct entry into their degree programmes of choice are those who are mandated to take these Foundation Mathematics courses. Qualitative and quantitative data was collected and analysed. Preliminary qualitative data comprising of a compilation of students' and tutors' responses and feedback to a questionnaire administered, after undertaking a PBL-based research project in Foundation Mathematics courses, over a period of up to 6 weeks was obtained.

3. Results and Discussion:

The preliminary qualitative data obtained from both tutors and learners are presented and discussed. The data comprises of tutors' feedback on the PBL process and students' responses to a Questionnaire after undertaking PBL-based research projects for 6 weeks. Learners were made to express their opinions based on the experience they have had working on their PBL projects with their colleagues. The administered questionnaire was divided into 3 sections, where section 1 comprises of the 5 main elements of PBL process; section 2 addressed students' overall experience rating and section 3 showed students' general feedback/comments on the overall PBL process.

3.1 Tutors' feedback:

Some of the key feedback/comments from the tutors indicated that the PBL T&L strategy encourages students to become independent and effective learners. The T&L strategy also enables students to be effectively engaged in the process of learning and reflecting. In addition, tutors found PBL T&L in Mathematics more effective than the traditional methods of teaching, while the strategy helped students in raising their levels of confidence in Mathematics and making the learning environment more competitive. Furthermore, it enabled students to acquire more time to practice and to excel in the subject.

3.2 Students' feedback:

Table 1: Section 1 of the questionnaire consisted of 5 main elements related to the PBL process. Table below gives a summary of learners' response ratings to the elements.

| Elements | Activity | Learners' responses |
|----------|------------------------------|---|
| 1 | Initial meeting and tutorial | 84% of students gave a positive affirmation |
| 2 | Independent study within PBL | 85% of respondents were positive |
| 3 | Second meeting / tutorial | 82% of students were positive |
| 4 | Roles within PBL | 74% of learners were positive |
| 5 | Feedback within PBL | 86% of students were positive |

Section 2 indicates learners' overall rating in PBL, in which 85% of the learners were positive. Section 3 is a summary of the general comments and feedback obtained from learners about the entire PBL T&L process and the impact on their learning. Learners indicated that PBL was a great way to learn; that they do not need to always rely on the teacher; that the nature of the PBL process was such that they did not feel like they were studying Mathematics because the concepts were broken down to make it more comprehensible; that PBL projects are very good for students to improve their computer skills among many other employability skills; that it was a new way of learning they have encountered; that what makes it special is that it is not boring and makes learning fun.

Notwithstanding the perceived success PBL implementation in T&L, however, there have been some challenges, which included the problem of designing PBL tasks that are relevant to the Mathematics topics; ensuring consistency across the cohorts; making the PBL process more engaging; extending the implementation process to other topics in Mathematics and the challenge of facilitating larger class sizes during the PBL process.

4. Conclusions and Future Plans

Based on the preliminary data obtained, there is a clear indication that the PBL approach to T&L has significantly impacted our learners. Students' feedback and comments obtained are testament to the fact that this T&L strategy is reshaping students' approach to learning, thereby enabling learners to attain their academic goals.

To evaluate the differences in students' performances based on the teaching approaches: traditional vs PBL, 2 groups of students from each researcher's classes will be selected and classified based on their assessment results (high, mid and low). One group will be taught certain topics using the traditional teaching strategy, while the other will be taught same topics using the PBL approach. Both groups' performances in assessments will be compared to identify any differences in their abilities/skills to solve "abstract" questions and applied problem.

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