Project Based Learning in Mathematics Context

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Abstract: Project based learning (PBL) is a learner-centered instructional method which supports learning through engaging students in an investigation of a topic worth learning more about. District from traditional models, project based learning has been designed to create opportunities for students to explore, gather information and think critically. Students can reap many benefits from PBL strategy in terms of influencing goal orientation, increasing curiosity to search, augmenting engagement, promoting mastery of new knowledge, fostering problem-solving skills, developing critical thinking, enhancing peer learning and improving communication skills. This paper frames main criteria of PBL and focuses on the influence of PBL on student achievement in mathematics.

Keywords: Project Based Learning, Self-Directed Learning, Motivation, Achievement, Mathematics

1. Introduction

PBL is a learner centered instructional method (Harris & Katz, 2001) for well over three decades. With this in mind, PBL focuses on exploring authentic problems and performing well-designed tasks (Barron & Darling-Hammond, 2008). A project is considered useful if students find it meaningful and they undertake it for an educational purpose (Larmer & Mergendoller, 2012). PBL is a method which helps students develop their skills and knowledge while investigating a challenge for a period of time. Compared with traditional classroom projects, PBL allows learners to deal with self-directed, in-depth investigations to seek for solutions to real world problems (Larmer & Mergendoller, 2012). In other words, distinct from traditional model, students drive their own learning by means of exploration and collaboration (Bell, 2010). Students work on a project by seeking answers to some questions under teacher's supervision. Students are often asked to summarize their discoveries through projects or presentations without in-depth discussions.

Research has found that engaging with PBL increases student achievement (Kaldi, Filippatou, & Govaris, 2011). Students develop their knowledge across a range of subjects through PBL. Moreover, students benefit from PBL in terms of increase in motivation (Grant, 2002). When students deal with real-world problems and seek solutions for them, they develop better attitudes towards learning. As

learners participate in group assignments in PBL, and present their discoveries to their teacher and peers, learning turns into an enjoyable activity.

2. Literature Review

PBL strategy is useful to build an ethos of involvement in learning for the development of motivation, knowledge and thinking skills (Schwartz, Mennin, & Webb, 2001). In addition to its benefits to the enhancement of content knowledge, PBL also helps students with the development of some skills which have become essential to achieve better at the present time. Creative thinking, communication and problem solving are considered as significant skills people need for being successful not only at school but also in community. Thomas (2002) emphasizes five criteria of PBL:

1) Incorporating projects as a part of the curriculum
2) Discovery of answers for problems and questions comes to the fore in PBL to allow students to struggle with concepts.
3) Projects engage students in investigations
4) The focus of instruction in PBL shifts from teachers to students
5) Projects are realistic

PBL strategy is conducive to learning owing to its discernible advantages for integrating theory and practice, creating a meaningful learning environment in which students apply skills and knowledge to deal with real-world problems (Bender, 2012).

Loyens, Magda, and Rikers (2008, p. 413) framed five main goals of PBL:

1) construct an extensive and flexible knowledge base
2) become effective collaborators
3) develop effective problem-solving skills
4) become intrinsically motivated to learn
5) develop self-directed learning skills.

PBL is based on constructivist and sociocultural theories. While the role of teacher is to facilitate the learning process, students endeavor to construct knowledge in a social context. Larmer and Mergendoller (2012) put forward eight features of PBL:

1) Significant content

A topic which is considered by students significant in terms of their own lives and interests encourages them to do a research for an extended period of time. When used effectively, PBL helps students learn about significant amount of content from several subjects. It is not always easy for teachers to cover all materials in the curriculum; for that reason, by means of assigning projects to students PBL helps teachers meet curriculum expectations of students.

2) A need to know

Unless students are motivated to learn, they find it meaningless to work on a project topic. With this in mind, teachers need to spark students' interest by making it clear why they need to know about the relevant information. In traditional learning settings students need to know the information because it will appear on the test. However; when students are aware that the information they need to know is important to complete a project, their desire to know is powerfully activated.

3) A driving question

In order for students to perceive the purpose of a project, a driving question is crucial. Students are more motivated if they understand what they will endeavor to achieve, what they will learn by undertaking the project and why they need to learn about the topic. Open-ended, complex questions are useful to enable students to understand the main point of the project.

4) Student voice and choice

In terms of allowing students to take responsibility for their own learning, it is important to give them more voice and choice in the project. When students can choose their own topic, resources they will use and even driving question, the project becomes more meaningful and enjoyable.

5) 21st century competencies

While working on a project students form teams, work together, exchange ideas, communicate with each other, make presentations, receive questions, think and respond. It is true to say that; PBL has the potential to build 21st century competencies such as communication, collaboration, problem solving, critical thinking and creativity (Bell, 2010).

6) In-Depth inquiry

In in-depth inquiry students seek out answers to a driving question. It is a process in which students endeavor to discover answers by means of research and draw conclusions.

7) Critique and revision

Students need ongoing opportunities which will lead them to high quality. For that reason, when students critique one another's work taking rubrics and other criteria into consideration, they create high quality performances. Furthermore, teachers can bring in experts to provide feedback for the students to help them produce better products.

8) Public audience

It is true to say that when students are given a chance to make a presentation to their teacher classmates, they become more motivated and endeavor to produce better products.

3. PBL in Mathematics

The use of PBL in mathematics teaching is believed to be suitable (Savery, 2006) as it incites students to actively participate in the learning process. PBL has the potential to facilitate learning in mathematics as well. Engagement in learning is a key factor to increase achievement. When students work on projects in mathematics and make them relevant to their own lives, they understand mathematical concepts and

their achievement increases. Learning mathematics is no longer daunting by means of collaborative learning, searching for solutions to real-world problems, discussing their discoveries which are important aspects of PBL (Uyangor, 2012). The authentic nature of projects makes it possible for students to derive their own learning through research, collaborative work and inquiry.

In a study carried out by Boaler (2002) mathematics achievement of students in Britain were compared. While one of the secondary schools provided traditional instruction, the other used PBL. It was seen that after three years the students in the PBL school made huge leaps in the development of mathematical skills and three times as many students passed the national exam. Boaler concluded that the students in the traditional instruction simply drew their attention to remembering the use of mathematical concepts; however, the PBL students acquired more mathematical knowledge as PBL created a strong potential foundation for learning through engaging the students in thought. In another study, Uyangor (2012) found significant differences between pre- and post-test scores of students in mathematics after engaging in PBL. Ali, Hukamdad, Akhter, and Khan (2010) in another study found that the introduction of PBL in the mathematics classroom led to increased student achievement.

It is possible to say that students can reap many benefits from PBL strategy in terms of influencing goal orientation, increasing curiosity to search, augmenting engagement, promoting mastery of new knowledge, fostering problem-solving skills, developing critical thinking, enhancing peer learning and improving communication skills. These are the significant characteristics which enable students make noticeable gains in mathematics learning.

4. Conclusion

Rather than traditional instruction, the implementation of PBL in the learning process allows students to construct knowledge in a social context. The core idea in PBL is providing students opportunities to investigate real world problems which will enable them to gain new knowledge. Benefits of PBF have been identified as increase in student engagement, the provision of more opportunities for the promotion of abilities in terms of critical thinking, problem solving and independent working.

References

Ali, R., Hukamdad, Akhter, A., & Khan, A. (2010). Effect of using problem solving method in teaching mathematics on the achievement of mathematics students. *Asian Social Science*, 6, 67-72.

Barron B., & Darling-Hammond, L., (2008). Teaching for meaningful learning. In D.H. Hammond, B. Barron, P. Pearson, A. Schoenfeld, E. Stage, T. Zimmerman, G. Cervetti, & J. Tilson, *Powerful learning: What we know about teaching for Understanding*, San Francisco: Jossey-Bass.

Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House*, 83, 39-43.

Bender, W. N. (2012). *Project-based learning: Differentiating instruction for the 21st Century.* Moorabbin, Victoria: Hawker Brownlow Education.

Boaler, J. (2002). Learning from teaching: Exploring the relationship between reform curriculum and equity. *Journal for Research in Mathematics Education*, 33(4), 239-258.

Grant, M. M. (2002). Getting a grip on project-based learning: Theory, cases and recommendations. *Meridian: A Middle School Computer Technologies Journal* 5(1).

Harris, J. H., & Katz, L. G. (2001). Young investigators: The project approach in early years.

Kaldi, S., Filippatou, D., & Govaris, C. (2011). Project-based learning in primary schools: Effects on pupils' learning and attitudes. *International Journal of Primary, Elementary, and Early Years Education*, 39(1), 3-13.

Larmer, J., & Mergendoller, J. R. (2010). Main course, not dessert: How are students reaching 21st century goals with 21st century project based learning?

Loyens, S. M., Magda, J., & Rikers, R. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educational Psychology Review*, 20, 411-427. doi: 10.1007/s10648-008-9082-7

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-Based Learning*, 1(1), 9-20.

Schwartz, P., Mennin, S., & Webb, G. (Eds). (2001). Problem-based learning: Case studies, experience and practice. London: Kogan Page.

Uyangor, S. (2012). The effects of project-based learning on teaching of polygon and plane geometry unit. *New Educational Review*, 29(3), 212-223.