Problem-Based Learning (PBL) in Schools: A meta-analysis

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ABSTRACT

PBL is a pedagogical and instructional approach towards holistic learning that demands thinking and intentional connections by using relevant and meaningful real life situations. PBL promotes problems as a process of learning and it consists of reinforcement of existing knowledge integrated with new content acquisition and new information towards problem resolution. Originally, PBL was implemented in medical schools and since then it has widely spread to other higher institutions. Is PBL appropriate to be implemented in primary and secondary schools? This meta-analysis will study on the impact of implementation of PBL in schools. Initial analysis shows that PBL played a significant role in preparing teamwork and problem solving among schools students at the primary and secondary level.

Key words: PBL, schools, teamwork, problem solving

1. Introduction

PBL is a process of meaningful and experiential learning that helps students to become active learners by providing them with real world problems to resolve (E.Hmelo-Silver, 2004). Not only PBL aims at promoting student-centered learning and enhancing the development of students’ higher-order thinking and fostering students’ social skills (Azer, 2009), it can also help in developing thinking skills through solving problems (Cotton, 2011). As an instructional strategy, PBL engages students in thinking skills, problem solving, communications, group works and sharing information with others (Ak&Özkarde, 2007). This instructional approach leads students to learn by themselves through their experience(Hmelo-silver & Barrows, 2006). Originally, PBL was implemented in medical schools and accepted in North America and Europe (Savery, 2006). PBL has been applied in various studies such as science, chemistry, biology and marine studies (Sulaiman&Baco, 2012). This shows that PBL can be applied in many fields including education. PBL had a big impact in educational practices in higher education, especially in professional education (Dolmans et al.,2005). What about the impact of its implementation in primary and secondary schools? Are the students ready for PBL approach in schools’ learning process?

2. Research questions

This small scaled meta-analysis aims to answer the following research questions:

2.1 What is the impact towards cognitive dimensions in learning through PBL?
2.2 What is the impact towards affective dimensions in learning through PBL?

3. Methodology

Abstracts were retrieved and papers were selected based on the presence of the phrase PBL in the title, abstract or keywords. This meta-analysis only focuses on primary and secondary schools, thus only published papers that provide original and empirical meta-analysis which focused its implementation on students were selected. The procedure of doing this meta-analysis was based on the review of (Dochy et al., 2003). The terms [PBL], [PBL Secondary], [PBL Primary] and [PBL] were used to conduct the search in EBSCOHost, IEEEXplore Digital Library, JSTOR, SAGE Journal, ScienceDirect, Taylor & Francis Online, Web Of Science and Interdisciplinary Journal Of PBL. Only papers which were published from 2009 until early 2014 were selected.

However, to reduce the likelihood of introducing bias at this stage, the electronic search was not narrowed down, and the subsequent iterations were done manually. One difficulty arises as the participants’ age group was often not or insufficiently reflected in titles, keywords or abstracts. The electronic search produced a total of 55 papers by using titles as the basis. Majority of the papers were classified under the implementation of PBL in higher institutions in various fields especially in medical education. Since the focus of this study is to analyze the implementation of PBL in schools only, the initial output from the electronic search was further screened. Finally, eighteen papers that match our requirements were selected for meta-analysis.

In this meta-analysis, the author reviewed the literature based on the narrative review. A narrative review synthesizes non-numeric data in a systematic way to identify what we want to meta-analyze (Jerzembek & Murphy, 2013). This meta-analysis reviews the impact of implementing PBL in schools towards students’ affective and cognitive domains as presented in Table 1.

<table>
<thead>
<tr>
<th>Author</th>
<th>Affective</th>
<th>Cognitive</th>
<th>Discipline</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li, H. C. (2011)</td>
<td>Cooperative</td>
<td>Problem solving</td>
<td>Mathematics</td>
<td>Primary</td>
</tr>
<tr>
<td>Fatade, A. D., Mogari, D., &amp; Arghabat, A. A. (2013)</td>
<td>Not applicable</td>
<td>Achievement</td>
<td>Mathematics</td>
<td>Secondary</td>
</tr>
</tbody>
</table>
Obviously, most studies resulted in positive impact on cognitive and affective dimensions in schools. In most cases, PBL had an impact on problem solving and teamwork. Other cognitive and affective dimensions were also affected by PBL’s implementation.

4. Results and Discussions

**Impact of PBL in Primary Schools**

From the meta-analysis, it was found that PBL was implemented in Mathematics (Li, 2011; Tillman, 2013) and Sciences (N.Drake & Long, 2009). Only three out of the eighteen articles had discussed the subject of PBL’s implementation in primary schools. At this level, PBL generated multiple impacts as it played a significant role in developing teamwork and problem solving among the young students (Li, 2011; Tillman, 2013). In this learning strategy, students have to solve ill-structured problem in groups (Belland et al., 2009) through teamwork and discussions. The real world problems to be solved require learners to formulate solutions that drive them to work together. Moreover, students search and share information under teacher’s guidance to resolve the problem. The requirement of teamwork and problem-solving is based on real life in challenging careers.

**Impact of PBL in Secondary Schools**

From the meta-analysis on papers classified under secondary schools, fifteen papers revealed that PBL was implemented in various disciplines: Chemistry (Peen & Arshad, 2014), Mathematics (Ali et al., 2011; Fatade et al., 2014; Fatade et al., 2013; Hatsaru & Küçükturan, 2009a, 2009b; Kohlhaas, 2011), Science (İnel & Balım, 2013; Liu et al., 2014; Shahbodin et al., 2009; Wong & Day, 2009), Electrical and Electronic (Mustapha & Laila, 2011), Geography (Ratinen & Keinonen, 2011) and Physics (Saka & Kumaş, 2009). The reviews identified that students can solve problems collaboratively (Abdullah et al., 2010; Liu et al., 2014; Mustapha & Laila, 2011; Saka & Kumaş, 2009), develop analytical thinking skills (Hatsaru & Küçükturan, 2009b; Ratinen & Keinonen, 2011) and students’ questioning (Peen & Arshad, 2014). In PBL, students have fun while engaging in active learning (Hatsaru & Küçükturan, 2009b; İnel & Balım, 2013; Peen & Arshad, 2014) that could lead to prolonging attention and achieving meaningful learning (Hatsaru & Küçükturan, 2009a; İnel & Balım, 2013). Students can connect the problems with real world situations by applying what they learnt or derived from the problems. The rich learning
environment motivates students to learn. In short, PBL provides impact to both cognitive and affective domain.

5. Conclusion

A number of researches have shown that PBL is effective in secondary schools, as well as in primary schools. Young children at the concrete operational stage could benefit from PBL through teamwork and problem solving. Meanwhile, students who are supposed to have reached the formal operational stage at the secondary school level not only benefit in those two competencies but also in self-esteem, analytical thinking and retention. However, the researchers are more comfortable conducting PBL among older students than younger ones. In summary, the significant role of PBL in the development of various cognitive and affective dimensions should be harnessed in both primary and secondary schools. In this twenty first century, the challenge is to nurture students with multiple competencies so that they will be better equipped to face and solve authentic real life problems of today and the future.

Acknowledgement

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6. References


Tillman, D. (2013). Implications of Problem Based Learning ( PBL ) in Elementary Schools Upon the K-12 Engineering Education Pipeline Implications of Problem Based Learning ( PBL ) in Elementary Schools Upon the K-12 Engineering Education Pipeline. In 120th ASEE Annual Conference & Exposition.