

Project based learning: effects on knowledge and skills acquisition

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Abstract

Project based learning is based on a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks (Buck Institute for Education). The benefits of PBL both for students and teachers are so many and so important and that's why in this literature review is made a great effort to prove those benefits. The results of the literature analysis show that PBL has effects on the students' knowledge as they get high scores on tests and exams and on their skills development, especially on the development of collaboration-cooperation, communication and ICT skills.

Key words:

Project based learning; benefits; knowledge; skills.

1. Literature Review

1.1. Procedure of the literature review

In the specific literature review are concluded theoretical and empirical articles of international journals, scientific books, practices of conferences, relevant to the beneficial effect of PBL on knowledge and skills development, for students. Most of them are published in 20th and 21st decade and that shows the big interest for PBL. The searching of the literature has taken place in the last three months, both in published and on line journals, in relevant published and on line books, in the municipal library of Volos (Greek town) and finally with the help of internet-Web, through a searching machine called " Google Scholar", which drives to academic literature.

1.2. The benefits of PBL

Buck Institute for Education defines project-based learning as "a systematic teaching method that engages students in learning knowledge and skills through an



extended inquiry process structured around complex, authentic questions and carefully designed products and tasks.” This process can last for varying time periods and can extend over multiple content areas (http://www.bie.org/index.php/site/PBL/pbl_handbook_introduction/#history).

Also well known are Thomas’s (2000) five criteria used to define PBL: (a) “Projects are central, not peripheral to the curriculum”; (b) “projects are focused on questions or problems that ‘drive’ students to encounter (and struggle with) the central concepts and principals of the discipline”; (c) “projects involve students in a constructive investigation”; (d) “projects are student-driven to some significant degree”; and (e) “projects are realistic, not school-like” (p. 3-4). Collaboration is also included as a sixth criterion of PBL.

This study aims to find through literature review proofs for the beneficial effects of project based learning, on students’ knowledge and skills acquisition. Especially the question research is: can projects help students learn the curriculum academic content and develop 21st century skills;

According to the Lisbon Council (2007) of the European Union, Students’ 21st Century Skills are: Knowledge Building Problem Solving and Innovation Communication Collaboration SelfRegulation Use of ICT for Learning. An extended body of research demonstrates that PBL is an effective way to teach 21st century skills as well as curriculum content.

Specifically, PBL has been shown: • to help students to remember longer (Dochy, Segers, Van den Bossche, & Gijbels, 2003; Schwartz & Martin, 2004; Strobel & van Barneveld, 2008) • to increase motivation (Boaler, 1997) • to stimulate lower achieving students (Geier

et al., 2008; Hickey et al., 1999; Lynch, Kuipers, Pyke, & Szesze, 2005; Mergendoller et al., 2007; Walker & Leary, 2008) • to help students to learn how to work in groups and communicate (Cognition and Technology Group at Vanderbilt, 1992; Gallagher, Stepien, & Rosenthal, 1992; Hmelo, 1998) • to increase understanding of knowledge (Geier et al., 2008; Hickey, Kindfled, Horwitz, & Christie, 1999; Mergendoller, Maxwell, & Bellisimo, 2007; Walker & Leary, 2008).

More over, many studies have reported positive changes in attitude toward learning, critical thinking, and problem-solving skills as a result from their participation in project-based learning (Bartscher, Gould, & Nutter, 1995; Peck, Peck, Sentz, & Zasa, 1998; Tretten & Zachariou, 1995; Kanter & Konstantopoulos, 2010).

In one British three years study, students were taught using traditional math programs at one school and math with PBL at another school. Three times as many PBL students achieved the highest possible grade on the national exam than the students at a traditional school. Generally research supports that students using PBL perform better on tests than students in traditional instruction programs, because they acquire analytic thinking (Boaler 1999).

In another study, accomplished by Thomas (2000), elementary students in three Dubuque, Iowa schools, that used PBL, raised their IOWA Test of Basic Skills scores from “well below average” to the district average in two schools and to “well above the district average” in another school. Moreover, in three years, reading gains “ranged from 15% in one school to over 90% in the other two schools while the district average remained the same”.

Research also reported that PBL had a positive effect on students with average to low



verbal ability and content knowledge, who learned more in PBL classes than in traditional classes (Mergendoller, et al., 2006; Mioduser & Betzer, 2003; Gultekin 2005; Mioduser & Betzer, 2003; Peck, et al., 1998).

According to elementary teachers, who reported using 37% of their overall instruction time on PBL, students' work ethic improved as well as their confidence and attitudes towards learning as a result of PBL (Tretten & Zachariou, 1995).

Horan's et al (1996) study about PBL showed a positive effect on low-ability students, who increased their use of critical-thinking skills including synthesizing, evaluating, predicting, and reflecting by 46%, while high-ability students improved by 76%.

In addition, PBL has been shown to benefit students in developing collaborative skills. For example, through PBL, elementary students learned to cooperate with passion (ChanLin, 2008); Also they learn how to make new friends through cooperative projects (Belland, et al., 2006; Lightner, et al., 2007; Helle et al., 2006; Lou & MacGregor, 2004; Mitchell, Foulger, Wetzell, & Rathkey, 2009), to tell their own opinions in a free way and to negotiate (Bryson, 1994; Reyes, 1998). An empirical study, also, found that U.S. middle school students who worked on a scientific project gained more collaboration skills than their peers who did not have such an opportunity (Kolodner et al., 2003).

Students, who are given the opportunity to choose their own project, and take part in the organizing procedure, realize that much depends on themselves, not on others and through that they gain self-esteem and personal responsibility (Waks, 1995). Additionally, Tassainari (1996) and Worthy (2000) assert the same, that project-based learning offers students opportunities to guide,

manage and monitor their learning through self-direction and self-regulation.

Project-based learning has the potential to enable pupils to: research, plan, design and reflect on the creation of technological projects raising their competencies (Doppelt, 2000; Barlex, 2002).

Gijbels, Dochy, Van den Bossche, and Segers (2005) reviewed 40 studies that were published between 1976 and 2000. The research question was: What are the effects of PBL? Results indicated that PBL students performed better at understanding the link between concepts and knowledge content.

A growing body of academic research supports the use of project-based learning in school to engage students and cut absenteeism, by the experience, whether they are making a documentary video, designing a travel brochure or developing a multimedia presentation students are engaged in real-world activities (George Lucas Educational Foundation, 2001).

A study of more than 2.100 students in 23 schools found significantly higher achievement on intellectually challenging performance tasks for students who experienced PBL (Newmann, Marks, & Gamoran, 1995).

Shepherd (1998) studied the results of a unit in which a group of fourth and fifth graders completed a nine-week project to find solutions related to housing shortages in several countries. In comparison to the control group, the students engaged in project-based learning demonstrated a significant increase in scores on a critical-thinking test, as well as increased confidence in their learning.

Another study, showed similar gains. In this example, researchers created a task in which students participating in the Challenge 2000 Multimedia Project and a comparison group developed a brochure informing school



officials about problems faced by homeless students (Penuel, Means, & Simkins, 2000). The students in the multimedia program earned higher scores than the comparison group on content, mastery, sensitivity to audience, and coherent design.

Other comparative studies of traditional vs. project-based approaches have demonstrated several benefits from projects, such as an increase in the ability to define problems (Gallagher, Stepien, & Rosenthal, 1992), growth in their ability to support their reasoning with clear arguments (Stepien, Gallagher, & Workman, 1993; Moore, Sherwood, Bateman, Bransford, & Goldman, 1996).

Interestingly, students who may struggle in traditional learning have often been found to excel when they have the opportunity to work in a PBL context, which better matches their learning style (see, e.g., Boaler, 1997; Meyer, Turner, & Spencer, 1997; Rosenfeld & Rosenfeld, 1998).

PBL gives students the opportunity to learn academic content without losing the fun. Many students have a natural desire to move and play. Project-based learning activities can provide experiences and offer opportunities for play (Alexander, 2000: p. 1).

It's also very important that teachers who work with children with various cultural and ethnic background must respond to the needs of these students and Project-based learning helps in this direction. It can enhance children from different cultural backgrounds because children can choose topics that are related to their own experiences, as well as allow them to use cultural learning styles (Katz & Chard, 1989).

Other benefits of project-based instruction, according to researches include: 1. Preparing children for the workplace (Blank, 1997; Dickinson et al., 1998). 2. Raise willingness to

do homework (Bottoms & Webb, 1998; Moursund, Bielefeldt, & Underwood, 1997). 3. Connecting learning at school with reality (Blank, 1997; Bottoms & Webb, 1998; Reyes, 1998). 4. Increasing social and communication skills (Moursund, Bielefeldt, & Underwood, 1997) 5. Providing opportunities to contribute to their school or community 6. Allowing children to use their individual learning approaches (Thomas, 1998). 7. Providing a way to learn to use technology (Kadel, 1999; Moursund, Bielefeldt, & Underwood, 1997).

A teacher in Washington State who has used project-based learning in his math and science classes reports that many students who often struggle in traditional learning find meaning for learning by working on projects (Nadelson, 2000).

According to a U.S. teacher whose students worked on a project with peers in Bulgaria: "When we started, most of the students had no idea where Bulgaria was located. In the course of the project, the students learned some basic facts about the country and its history (Gragert, 2000).

Through technology-supported projects, students learn how to use ICT tools. Technology also supports learning by helping students access real-world data, collaborate at a distance and create multimedia presentations (Gragert, 2000; Carver, Lehrer, Connell, & Erickson, 1992; Penuel, Means, & Simkins, 2000; Edelson & Reiser, 2005; Moursund, 2003; Barak, 2005; Carr & Jitendra, 2000).

According to Nikolaeva (2012), the project-based learning in Bulgarian schools provides students opportunities to share and present in public their achievements in learning. Students also think that learning by project helps them to develop useful practical skills such as organizational management (60%). Between 33% and 65% of the students' positive choices support statements



like “projects create opportunities for using research methods in teaching-learning process” (53%), “school projects involve solving real life problems and completing authentic tasks” (49%), “they create authentic products” (39%). Relatively often, students identify as typical features such as “development of high level intellectual skills” (52%), “good chances for field work” (43%), “adults serve as experts” (43%) and “possibilities to help and be helped during learning” (40%).

Hutchinson argues that in traditional lessons very often the brighter students “steal” the teacher’s attention and time for themselves because they are self-confident, more active and faster in answering teacher’s questions. In project work these students can work independently, occasionally asking the teacher to supervise or help, meanwhile the teacher can devote his time to those who need it most, to slower or less confident students (Hutchinson, 1992).

1.3. Possible problems of PBL

In this part of the study we examine possible problems to be aware of the teachers when undertaking project-based lessons. Research shows that beneficial use of project-based learning depends on the teacher having acquired a mastery of the content as well as teaching methods (Hmelo-Silver & Barrows, 2006) and project management skills (Mergendoller, et al, 2006).

Tom Hutchinson (1992:16-17) discusses some of the possible problems with project work. Many teachers expect the project work to be a very noisy activity. Hutchinson argues that what the teachers are mostly afraid of, is not the amount of noise but the lack of their control over the noise. He suggests that this is also part of the learning process. Teacher should teach them to work quietly and

students should accept it as their own responsibility.

During projects the initial motivation can decrease and personal problems between the students can occur (Fried-Booth, 1990: 39-45). The solutions are: Discussion. Doing something different. Inviting other staff and students.

In the book *Learning by Heart*, Roland Barth (2001) discusses the risk that teachers take. Without the support of colleagues and a clear methodology, teachers are “too busy”. To help accomplish effective implementation of PBL in K-12, teachers required a systematic, planning process and implementation and evaluation templates. This reduces the risk and the fear of failure when moving away from the traditional methodology.

Barron et al. Reported problems such as: inadequate material resources, little time to create new curricula, large class sizes, over-controlling administrative structures, that prevented teachers from having the autonomy necessary to implement PBL. However, the biggest problem does not lie on the school equipment, but on the undergraduate preparation of teacher. If teachers do not receive sufficient amount of theoretical and practical information, they won’t be able to practice project-based learning in their class.

Here are some more possible problem to be aware of when undertaking project-based programs (Harwell, 1997; Moursund, Bielefeldt, & Underwood, 1997; Thomas, 1998): Projects can often take longer than expected. Projects often require a lot of preparation time for teachers. Teachers can give students too much independence etc. □ Effective use of PBL requires extensive planning and professional development, a supportive environment, and tools and strategies for effective instruction (e.g., Hmelo-Silver & Barrows, 2006; Strobel & van

Barneveld, 2008). Some of the structures or capacity that may be lacking include a schoolwide emphasis on PBL, teacher mentoring in PBL, a portfolio assessment system, schoolwide performance rubrics, and block scheduling (Ravitz, 2008).

One study found the following barriers to successful implementation of PBL: teachers could not control the flow of information, it was difficult to balance giving students independence, it was difficult to incorporate technology and authentic assessments were hard to design (Marx, et al., 1997). Teachers also may struggle with new beliefs when implement PBL. For example, it may be difficult to let children to explore their interests, to allow students to develop individual answers and empower students to direct their learning (Ladewski, et al., 1991).

2. Conclusion

In summary, research indicates that PBL: (a) has a positive effect on student content knowledge and the development of skills such as collaboration, critical thinking, and problem solving; (b) benefits students by increasing their motivation and engagement (Brush & Saye, 2008; Krajcik, et al., 1998).

Finally reading the above literature review, we come up with the conclusion that the possible problems are relevant to technical and organisational matters and relevant to the teacher being insufficient and inadequate. The benefits are more than the problems, which problems can be easily solved if teachers get scientifically ready when implementing project- based instructions.

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