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THE CHALLENGE OF IMPLEMENTING INTERDISCIPLINARY, PROJECT-BASED LEARNING IN ISRAEL

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Abstract

The main goal of education is to prepare students for future job opportunities and civic responsibilities, which are some of the biggest challenges in the 21st century. Project-Based Learning (PBL) prepares students to master their new role as global citizens with greater responsibilities. This paper refers to a unique and pioneering PBL program that is carried out in seven high schools in Israel by the Ministry of Education. This interdisciplinary PBL program involves three disciplines: product design, electronic engineering, and software engineering. The program is designed for students in the 11thto 12th grades who are selected according to specific criteria. It aims to achieve goals such as promoting teaching and learning based on projects and multi-disciplinary learning in technological education; developing students' technological skills; and nurturing the values of collaboration, openness, creativity, innovation, and responsibility. In addition, the program promotes development of pedagogical and environmental methods for teachers and students. This article focuses on the theoretical rationale and principles of PBL, its uniqueness compared to other traditional programs, and the contribution to participants according to previous research. In future, this program will be accompanied by detailed research to explore the contribution of this "PBL Pioneering Program" on teachers' attitudes and perceptions, and the school framework and environment.

Keywords: Project-Based Learning, "Pioneering program", 21stcentury skills.

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1. Introduction

The 'knowledge revolution' era and the needs of modern society demand the development of skills such as initiative, self-regulation, interpersonal communication, creative thought, cooperation, and critical thinking. Thus, new pedagogies are necessary to structure knowledge and develop these skills, both in and out of school. These skills are known in the literature as 21st century skills (Salant, 2006; Project 21, 2014; Science & Technology Directorate, 2014). The PBL is an approach through which students cope with challenges and real-world problems (Kokotsaki, Menzies, & Wiggins, 2016).

This article presents the theoretical rationale behind the PBL approach and its uniqueness in contrast to traditional approaches, and describes an innovative program in Israel integrating interdisciplinary learning using projects.

This program will be the topic of a comprehensive study, examining the effects of the PBL on the personal and professional views of teachers and on the school framework.

2. Main Body

2.1. Defining Characteristics and the Process of Project-Based Learning

PBL is a form of teaching that puts students at the centre. It is based on three constructivist principles: learning in a specific context, actively involving learners in the learning process, and achieving objectives through social interaction, sharing knowledge, and comprehension (Cocco, 2006). This teaching approach presents students with the real world via multi-disciplinary problems (Schwalm & Tylek, 2012) requiring critical thinking, commitment, and partnership (Grant, 2009).

PBL is considered a type of investigative-based learning where the learning context is determined by authentic questions and problems from the real world (Al-Balushi& Al-Aamri, 2014). Students go through a process of exploration in response to a complicated question, problem, or challenge, leading to meaningful learning experiences (Wurdinger, Haar, Hugg, & Bezon, 2007). PBL reinforces the learned academic content and trains the students in 21stcentury skills such as sharing, communication, and critical thinking (Department of Education, U.S.A., 2015).

In comparison to traditional learning, PBL is described as an innovative approach to learning using multiple strategies (Cervantes, Hemmer, & Kouzekanani, 2015), and develops creativity, adventurousness, curiosity, imagination, and challenge (Lou, Chou, Shih, & Chung, 2017). Students motivate their learning through investigation and collaborative work and produce concrete products reflecting their knowledge and comprehension (McGrath, 2004; Bell, 2010; Cervantes, 2013), and gain new perceptions regarding the topic of research (Holubova, 2008).

In the PBL approach, there is a change in the traditional role of teachers as well. They are not at the centre and the emphasis is not on teachers and what they teach, but on students and what they learn. This is a fundamental change, from didactic teachers to teachers who facilitate learning through active learning. Their role is to guide and direct, to ask questions, and to change from being a vessel transferring knowledge to structuring knowledge in the hands of learners by allowing them to consider their experiences and develop insights and theories based on these experiences. This is done by providing feedback that mostly focuses on learners' meta-cognitive developments and social learning skills (Van den Bergh, Ros, &

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Beijaard, 2014). This type of learning requires teachers to be experts not just on the subject, but also experts on how students learn.

2.2. Previous Research in the PBL Field

Most studies in this field have examined the effectiveness of PBL among a range of learning populations, starting with the early stages of education (Habok, 2015), to elementary school years (Karacalli & Korur, 2014; Hsu, Van Dyke, , Chen,& Smith, 2015), high school (Barak &Asad, 2012; Al-Balushi & Al-Aamri, 2014), and higher education, particularly within the framework of engineering studies (Ruikar & Demian, 2013; Fernandes, Mesquita, Flores, & Lima, 2014).

It was found that PBL improves learning achievements, understanding of scientific content, and acquisition of thinking skills. It also hastens self-regulatory abilities in learning and self-awareness through a process of methodical reflective documentation (Barak, 2012). In addition, students learned to rely on themselves by defining objectives, planning, and developing collaborative skills through social learning (Bell, 2010). They also enjoyed and were committed to learning(Lou, Liu, Shih, & Tseng, 2011). Other studies have shown that using the PBL approach for low achieving students improved their achievements, their motivation to learn, and their self-image (Doppelt, 2003; Cuevas, Lee, Hart, & Deaktor, 2005).

2.3. Gap in Knowledge

Most studies examining the PBL approach focused mainly on students: their achievements, the benefits of the approach, and describing its implementation in various educational systems with an emphasis on factors that help its adoption.

Studies dealing with teachers have focused on pre-service teachers who have not yet entered the educational system, and the contribution of the PBL approach to their teacher training (Ljung-Djarf et al., 2014; Mettas & Constantinou, 2008). They did not deal with the views of teachers in the field who cope daily with difficult teaching work, in reference to this teaching approach.

At most schools in Israel and around the world, the traditional method still rules. The current study that deals with teachers can explain why teachers refrain from adopting this approach and how to motivate them to do so.

2.4. “Pioneering (Halutz) Project” in Israel

This is an innovative program exposing students to active and multidisciplinary learning using PBL. The project goals are:

- To advance teaching and learning based on projects, with an emphasis on multi-disciplinary learning in technological education.
- To develop students’ abilities to design a product and produce a working model.
- To develop information and technological literacy using digital tools.
- To develop learning methods and a learning environment for teachers and students learning in teams.
- To deepen values such as collaboration, openness, creativity, innovation, determination/perseverance, and responsibility.

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2.5. "Pioneering (Halutz) Project" Population

The project is intended for 11th to 12th grades students, at a high school in Israel, studying courses in electronics, software engineering and computers, and art design; and for teachers teaching these courses.

The Ministry of Education chose schools in which teachers that are taking part in the program are experts in using a range of methods in teaching and learning processes such as instilling knowledge, structuring knowledge, and problem/dilemma-based learning. These teachers accompanying the teamwork are specialists in the integration of digital tools into teaching, learning, and assessment processes.

2.6. Project Content, Activation, Stages, and Schedule

In this "Pioneering(Halutz) Project", students will experience learning and working in multidisciplinary and interdisciplinary teams to design and produce products to benefit the human race As part of the framework and in the spirit of fabrication laboratories, digital production laboratories will be established, to enable multidisciplinary learning including computer assisted design and production using computerized tools.

In 2016, five schools commenced the project. The target is that during 2018, 15 teams from the five schools will submit their learning projects concerned with the design of a product for the benefit of the human race. In each team are three students from three different technological courses. Students will be examined by three different examiners from matching disciplines. In 2017, seven schools across the country chose to enter the project and the aim is that in 2019, the number of school participating in the process will double to reach ten.

2.7. Uniqueness of the Project

The project's uniqueness is its interdisciplinary teaching using projects. This is the first time that the Israel Ministry of Education has initiated and built a model in which students from the three disciplines will study together, and will be examined for matriculation exams according to this syllabus.

In addition, this project's innovations are:

a. Collaboration between the Ministry of Education and teachers in the field:
   - Identifying teachers' and students' needs alongside determining aims, objectives, and determining policy.
   - Building an infrastructure to assess the process and outcomes.
   - Designing a real and virtual teaching-learning space.
b. Designing a product to benefit the human race with an emphasis on joint research.
c. Learning analytics:
   - Emphasis on the process the team undergoes, which will lead to formative evaluations.
   - Links between teams and examiners created in the virtual space. Examiners will receive a project file, will comment, and will provide direction.

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3. Methodology

The methodology used in this paper is based on analysis of the most recent articles, studies and relevant literature reviews on PBL subject and on published documents by the Israeli Ministry of Education to present an innovative interdisciplinary Project-Based Learning in Israel.

4. Conclusion

In a changing world, education must be flexible and adaptive to its target audience and the environment into which its graduates will integrate. Today, more than ever, there is a need for meaningful and effective learning, in which there is a personal process of structuring relevant knowledge.

PBL pedagogy has the potential to lead towards developing the skills required for the 21stcentury, and successfully create a change from traditional pedagogy to innovative pedagogy. Therefore, this program will be accompanied by an in-depth and comprehensive study, whose uniqueness is focusing on the teachers who operate it, examining their personal and professional views while using the PBL approach in teaching. All this done with the understanding that by listening to teachers' voices it is possible to achieve change.

This research aims:

- To examine how interdisciplinary PBL affects the role and work of the teachers involved.
- To examine teachers' attitudes at three points in time: before, during, and after implementing the "Pioneering (Halutz) Project".
- To investigate how interdisciplinary PBL influences changing the entire teaching framework in a school environment.

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