WESTERN ANATOLIA
JOURNAL OF EDUCATIONAL SCIENCE

http://web.deu.edu.tr/baed
Dokuz Eylul University Institute of Educational Sciences

ISSN 1308 – 8971

Special Issue: Selected papers presented at WCNTSE

OVERVIEWS ON INQUIRY BASED AND PROBLEM BASED LEARNING METHODS

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Abstract
Science instruction has several methods that are classified from direct instruction methods to minimally direct instruction methods. Minimally direct instruction has stood out with Inquiry-Based Learning (IBL) and Problem-Based Learning (PBL). Even though these methods seem pedagogically equivalent approaches, there are some differences due to the nature of methods upon taking account view on education, outcome, origin, and appropriate application field. Therefore, the purpose of this paper is to explain what the main differences and similarities between IBL and PBL are for clarifying many controversies about their application into the instruction. The writers aim to provide a useful document for the educators. The comparison of the methods has followed through in terms of the following aspects which are the criterions of the crosscheck of the study: philosophical bases, pioneers, key elements, what for, principal, teacher role, student role, student's prior knowledge/skills, for which field, for which level, and specific outcomes. At the end of the paper, the writers discuss the answers of the questions which are the best approaches the ones that work for you in your classroom and how you can choose suitable approaches for your students.
Keywords: Inquiry based learning, problem based learning, science education.

INTRODUCTION

IBL and PBL are the minimally direct instructional methods that have been used succesfully more than 30 years and continue to gain acceptance in different disciplines and level of education. There are several review studies have been conducted on IBL and PBL and these demonstrate that students and educators are highly interested in these two methods due to their learner-centered perspectives.As a synthesis of this studies, this paper adds and demonstrates that *"what the main differences and similarities between IBL and PBL are for clarifying many controversies about their application into the instruction".* And also the writers aim to provide a useful comparison document for the educators and students.

METHOD

In this paper, first, some of the available studies on IBL and PBL have been reviewed and debated. Secondly, the comparison of the methods has followed through in terms of the following aspects which are the criteria of the crosscheck of the study: the origin, principle, role of prior knowledge, starting to instruction, need for problem solving skills, explanation source, characteristics of problem, group learning, teacher role, student role, view on education, outcomes, appropriate grade level and field of application.

FINDINGS

Inquiry Based Learning (IBL)

As a learning activity, IBL refers to the activities of students in which they develop knowledge and understanding of scientific ideas as well as an understanding of how scientists study the natural world (Anderson, 2002).

The Origin of IBL

First ideas on science instruction were constructed on laboratory experiments. These ideas included the activities that conducting many firsthand observations, manipulations and knowledge transference. However, In accordance with John Dewey's views on education (in 1910s), these ideas have varied form knowledge transference to processes or methods to learn. With new perspective, Robert Karplus (In 1950s and 1960s) from the University of California-Berkeley proposed and first used IBL as a model of science instruction named *learning cycle*. This new science instruction method was suggested the teachers to present science as inquiry and students work in the laboratory before being introduced to the formal explanation of scientific concepts and principals by Educator Joseph Schwab (In 1960s)(NRC, 2000). This method was again formalized by Marshal Herron (In 1971), which developed the Herron scale to evaluate the amount of inquiry within a particular lab exercise. Today, the method is using in science lesson plans follows Bybee's (In 1997) five steps of Engagement, Exploration, Explanation, Elaboration, and Evaluation

The Main Principal of IBL

The main principle of inquiry is that acquiring knowledge from direct observations by using deductive questions. Therefore, IBL is the art of questioning or the art of raising questions.

The Instructional Procedure of IBL

IBL is the most favored and useful instructional model. The main reason for acceptance as large-scale and usefulness in science teaching is that it matches between learning and environment due to the nature of human. In other words, all of our observations, learning necessities, and inquiries instinctively require raising inquiry questions. Therefore, IBL lesson started with questions based on real observations. The characteristic of the questions allow to conclude with the discussions and explanations based on evidences (Cuevas et. al., 2005). These questions have single-step answers on observations, and allow generating new open-ended questions and the process is driven by questions generated by learners (Blumenfeld et al., 1991; Linn et al., 1996). For this reason, most of the questions (driving questions) created by teacher to organize and direct inquiry. The characteristics of these questions seem very complex. However, the process of IBL only needed to use very simple prior knowledge and skills, because the knowledge is constructed by students while carrying out observations and experiments. This process and right use of students' prior knowledge and skills burdens teachers' different roles. These roles vary from leader to facilitator and coach. As a leader, they stimulate interaction, establish inquiry, and guide exploration form operational definition for concept. As a coach, they coach student actions, as a facilitator, they show the learning and the providing knowledge. According to these teacher attitudes, students' roles are forecasting, explaining, hypothesizing, designing and directing their tasks. The students also should be encouraged asking and refining questions, planning and designing how to answer their ideas, share ideas, making sense of data and designing and conducting experimental work. These student/teacher roles have caused some fierce debates among educators. First of all, Kirschner et. al., (2006) has claimed that IBL is the minimally direct instruction, but, Hmelo-Silver et. al., (2007) has proposed that this method is direct instruction. However, they also accepted that controlled experiments of inquiry-based environments are scarce. Another debate on this subject is about its application field and level. IBL seems quite conventional for science instruction and elementary level because of being the first application area and depending on students' prior knowledge.

The Outcomes of IBL

IBL performs several learning outcomes. IBL provokes the intelligence and creativity by processing the mind (Lawson, 2010; p:92) yet it performs the acquisition of scientific literacy, vocabulary knowledge, conceptual understanding, and attitudes toward science (Anderson, 2002; Minner et. al., 2010), critical thinking (Anderson, 2002; Panasan & Nuangchalerm, 2010), science process skills, cognitive achievement (Anderson, 2002; Panasan and Nuangchalerm, 2010; Lawson, 2010), content learning (Minner et. al., 2010) as well as discipline-specific reasoning skills and practices (Hmelo-Silver et. al., 2007). Inquiry helps students to understand how knowledge is generated from different disciplines and promotes development, transformation and representation of ideas (Krajcik, et. al., 1998).

Problem Based Learning (PBL)

The Origin of PBL

The origin of PBL was traced back IBL instruction. Due to the necessities of different types of instruction, researchers (e.g., Anderson et al., 1970; Van Deventer, 1958; Washton, 1967) have discussed a variation on inquiry method called problem based learning (Lawson, 2010; p:86). The first application of this method has designed for medical school students at McMaster University based on the gaps of conventional medical training. Therefore, most of PBL ideas have evolved from these innovative clinical teaching programs (Savery, 2006; Savery and Duffy, 2001). The succeeding of PBL in medical schools has widely spread globally in all forms of undergraduate institutions as well as in elementary and secondary education.

The Main Principal of PBL

The main principle of PBL is based on maximizing learning with investigation, explanation, and resolution by starting from real and meaningful problems. Therefore, PBL is the art of problem solving.

The Instructional Procedure of PBL

PBL instruction is constructed on the ill structured problems. These problems must allow for free inquiry (Savery, 2006). From this point, PBL seems to be started as IBL but not continue and finished as it. PBL process mainly grounded on problem solving. This process is more than raising question, it also includes transferring of knowledge and process of producing a tangible solutions. One important point in PBL is that driving questions and explanations are composed by students to test their hypothesis about problems, not by teacher to control the process and explanation the concepts. Therefore, students need prerequisite skills and knowledge in PBL. Especially, in the initial stages, ability to the identification of the problems and observational skills are identified as having a high priority (Mills and Treagust, 2003). The development problem solving skills also includes the ability to appropriate metacognitive and reasoning strategies (Hmelo-Silver, 2004). Therefore, to cope with PBL tasks demand high level of knowledge and skills. Moreover, the skills of scientific literacy, exploration in greater depth, testing ideas and scientific process draw on skills, group working and knowledge from variables are also important to solve problems. From this point of perspective, PBL broadens the teacher a facilitator or a coach roles rather than leader. Most of the tasks carry out by the students. The tasks are determining whether a problem exists, creating an exact statement of the problem and a working plan, identifying information, data, and learning goals, and finally produces a tangible solution. Upon taking account these; PBL seems quite conventional for medical, law and many other fields fed from different cases and subjects, and high-degree classes because of being the first application areas and depending on students' prior knowledge and skills.

The Outcomes of PBL

There is not any study reporting significant negative findings about the outcomes of PBL on knowledge and skills. PBL is challenging, motivating and enjoyable (Norman and Schmidt, 2000), and the process can construct an extensive and flexible knowledge base which is related to the multidisciplinary of PBL. The process enable students to develop effective problem-solving, self-directed, and lifelong learning skills.

DISCUSSION (COMPARISON OF IBL AND PBL)

One may think that all of these methods provide nothing new or claim that this is not a new idea. However, instruction requires different strategies and these are different from each other. Therefore, this paper presents us that the two methods which seem to be very similar and frequently confused with each other are different in many aspects. According to the basic principles mentioned above, the comparison of IBL and PBL are given at the practical and explanatory table below **(Table 1)**.

Tablo 1 *Comparison of IBL and PBL in many aspects*

		IBL	PBL
History	*Philosophical aim*	Driven on raising questions based on real observations.	Focused on the solution of ill-structured problems.
	Main Framework	Inquiry	Inquiry
	Pioneers	*Science and Laboratory Instruction* John Dewey, Madame Curry, Robert Karplus, Joseph Schwab, Marshal Herron, Roger Bybee.	*Medical Schools* John Dewey, Barrows, Savey & Duffy, Williams, Stepien & Gallagher.
Principle	*Principal*	Acquiring knowledge from direct observations by using deductive questions.	Maximizing learning with investigation, explanation, and resolution by starting from real and meaningful problems.
	What for	Best learning approach for human nature.	Best outcomes and learning for problem solution.
Instructional procedure	*Instructional type*	Minimally direct instruction.	Minimally direct instruction.
	Key elements	Exploration, invention, application.	Identifying problems, activating prior knowledge, encoding specificity, elaboration of knowledge.
	Students prior knowledge/skills	Not important-student can produce knowledge from their observation.	Prior knowledge and skills application is important.
	Teacher role	Leader, coach, model, facilitator. *Source of driving questions.*	Facilitator and coach rather than leader.
	Student role	Interprets, explains, hypothesizing designing and directing own tasks, sharing authority for answers.	Determining whether a problem exists, creating an exact statement of the problem, identifying information, data, and learning goals, creating a working plan. *Source of driving questions.*
	For which field	For all fields, but especially for elementary schools.	For all fields, but especially for medical, law and similar fields which includes case studies.
	For which level	For all levels, but especially for early educational levels.	For all levels, but especially for high degree classes.
Outcomes	*Specific Outcomes*	Conceptual understanding of science principals, comprehension of the nature of scientific inquiry and a grasp of applications of science knowledge to societal and personal issues, creativity, intelligence.	Effective problem-solving skills, self-directed, lifelong learning skills, effective collaborations.

CONCLUSION

These overviews present us the ideas that IBL and PBL have suggested new perspectives and have contributed to deal with some limitations of science instruction like the needs of raising question, problem solving, producing a product. However, it is obvious that IBL is the main framework of PBL. The two have to include IBL, yet the opposite of this idea cannot be claimed because IBL performs the function of corresponding learners learning necessities during the knowledge construction. Although IBL includes transference of knowledge into different areas, this process is carried out in later stages. Upon taking account knowledge transference, IBL gives its position to PBL overtime. Mainly, IBL focuses on knowledge construction. The main principles of IBL and PBL derive from different historical context, stress different social and educational needs and have different theoretical considerations. Therefore, in teaching practice, in order to apply these methods effectively and efficiently, practitioners should take these questions in mind: who the learners are, what their current level of proficiency is, and the circumstances in which they will be using science in the future, and so on. Science teachers also could implement all of these teaching methods in organization of activities as appropriate for learners to achieve in the future. In conclusion, no single method could guarantee successful results.

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