Problem Based Learning in a Classroom Environment

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**Abstract:**

This paper will synthesize the processes used to create Problem Based Learning in a classroom environment. I will be discussing what the different parts of the Problem Based Learning method are, and why they are part of the process. Many times Problem based Learning is misunderstood as simply presenting a problem and having students solve the problem. I will attempt to clarify some key points of this method so that it can be successfully implemented. With a greater emphasis on problem solving and critical thinking in state tests, the problem based learning method may be a viable option for instructors looking to create an engaging lesson that students seem to enjoy more than traditional presentation and lecture.

**Introduction**

Research into the subject of Problem Based Learning (PBL) is broad and there are a lot of different studies and research articles that deal with different aspects of the method. There appears to be a lack of research that ties all the different perspectives together. My goal in this research was to blend different research together into a comprehensive synthesis of the various components that are required to effectively implement Problem Based Learning in a high school setting.

With the implementation of the Common Core State Standards, students will be expected to become much more proficient with problem solving, collaboration, and taking the learning into their own hands. Problem Based Learning involves all of these skills and allows the student to practice and perfect them.

Problem Based Learning can be considered a constructivist approach to education where students solve problems for which they do not have the correct knowledge to solve right away. The students must construct mental models of possible solutions, construct ideas with peers, and develop self-directed learning skills in the process (Yew & Schmidt, 2011).

**What is Problem Based Learning**

Problem Based Learning originated in medical schools as an alternative method to help students increase their ability to diagnose unknown medical issues. Traditional methods of lecture only provided specific content knowledge but left a lot to be desired for diagnostics in a clinical application. Diagnosing a patient is a hypothetical-deductive reasoning process that requires a skillset in problem solving. Just knowing content does not necessarily mean that the student will have the ability to solve a problem. In fact, the ability to identify learning deficiencies and then being able to research those deficiencies is the foundation of Problem Based Learning (Hyeon Woo, 2012)

There are six critical characteristics of PBL that have been distinguished. The first characteristic is that student learning needs to be student-centered and carry relevance to the learner. Second, to allow for collaboration, learning has to occur in small student groups which is facilitated by a tutor who can guide the process for students. The third characteristic refers to the teacher as a facilitator or guide of the learning rather than a presenter of information. Fourth, authentic and ill-structured problems are primarily encountered in the learning sequence before any preparation or study has occurred. Fifth, the problems encountered are used as a tool to achieve the required knowledge and the problem-solving skills necessary eventually to solve the problem. Finally, new information needs to be acquired through self-directed learning (Chang, Jong & Huang, 2012).

**Relevance and Problem**

Project Based Learning should start with a problem that is academically relevant to the learning outcomes of the students. It is preferable that the problem be ill conceived to facilitate student discovery of new information (Barrows, 1996). Ill-structured problems are characterized as containing vaguely defined goal states, several unknown problem elements, multiple plausible solutions, and ambiguity about the concepts or principles needed to solve them (Jonassen, 1997).

In contrast, well structured problems contain clear, well defined goals and can be solved using a prescribed set of tools or knowledge. The solution is usually set and there can be only one outcome. A well structured problem can have the effect of not providing the student with the opportunity to identify any learning deficiencies or to research those deficiencies (Hung, 2011).

The quality of the problem is the most critical determining factor on the effectiveness of Problem Based Learning. It is suggested that promoting effective use of prior knowledge, collaboration, and self directed learning all have ties to the development of a quality problem. In fact, ineffective problems can make it difficult for students to discover any learning deficiencies, and consequently, will have problems researching new information (Hyeon Woo, 2012).

**Collaboration**

Students do not prepare for the problems beforehand. Since they do not know about the problem, they have to collaborate as a group to come up with possible solutions for the problem. In this group setting, the students have to share ideas about how the problem can be solved by using their prior knowledge. As a group the students analyze the problem, generate possible explanations, build on their ideas, and identify what needs to be studied further to solve the problem (Yew & Schmidt, 2012).

The effects of the PBL method can be powerful in the classroom. In a study of high school students who were taught science using the PBL method, it was discovered that the students had greater interaction with their peers. Students wrote in their journals about their enjoyment of the increased interaction that they had with their peers (Ferreira & Trudel, 2012).

Web 2.0 tools have allowed a tremendous increase in the ability of students to collaborate without having to be in each other’s immediate presence. There are three basic levels of interaction with these tools: groups, networks, and the collective. Groups are a small cluster of individuals that are mutually engaged in working on a solution to a common problem. The larger collective, that is called a network, is more loosely structured and has a membership that ebbs and flows. Members are not as close knit to each other and have to ability to exit and enter more freely. Groups usually will contribute to a network of more participants. Finally, the collective is a very loose structure that is basically an aggregation of information (Tambouris et al., 2012).

**Facilitation**

A critical component of the problem solving is the facilitation done by the instructor. Instead of disseminating information, the instructor is responsible for modeling problem solving and reasoning. With some guidance from the instructor, the students should be required to solve the problem as a group or team. The students should practice and develop their own self-directed learning skills without needing the advise or guidance of the instructor. (Hung, 2011)

An important part of the facilitation is to help the students identify knowledge shortcomings, known as learning issues. Students must identify these learning issues, and do research on them through self directed learning. The facilitator should be able to guide and tutor the students on this process (Chaparro-Peláez, Iglesias-Pradas, Pascual-Miguel, & Hernández-García, 2013). These skills allow the students to actively develop specific problem solving skills such as identifying what information is known and what needs to be known to solve the problem, generating and testing a hypothesis, critical evaluation of possible solutions, and creating a solution to the problem. The challenge of solving a relevant problem also encourages and motivates students to take the initiative to learn the necessary information to solve the problem.

**Problem**

Developing the problem is very important to the process of Problem Based Learning. The problem is used as the starting point of learning and is the catalyst that allows the student to learn new skills to solve the problem. The problem is usually connected to personal experiences of the student so as to make it relevant and worthwhile to solve (Ferreira & Trudel, 2012).

The problem is often “messy”, meaning it is ill structured, could have several possible solutions, requires the students to learn information that they did not already know, and builds on previous experiences. This messiness allows for deep learning of information so that the student can make an educated solution to the problem. Making the problem authentic also allows for deep buy in from the student. This connection to real world experiences can motivate students to learn the subjects necessary for the solution due to the natural curiosity that we have to take on a challenge and solve it. Through problem solving, students gain a domain of knowledge as well as a structured memory of the information, allowing them to retrieve it easier (Hung, 2011).

When developing a problem, there are three basic levels in which problems can be categorized. Complete Case is where a problem is presented in a complete form that has an organized summary of facts. Most information about the problem is known. Full Problem Simulation has the problem presented with incomplete information. The student is forced to identify what the problems are before they can begin to research solutions. And finally, the Partial Problem Simulation has a mix of the previous two situations where some information about the problem is present, but the student still must identify main issues of the problem (Hung, 2011).

**Problem Solving**

After self-directed learning on the student’s part, they need to use this newly acquired information to critically evaluate a potential solution to the problem. Team members will need to exchange ideas about the solution. A common solution must be decided on and then enacted (Chaparro-Peláez, Iglesias-Pradas, Pascual-Miguel, & Hernández-García, 2013).

In a study summary from several authors, it was concluded that students preferred to simulate the solution rather than to just get the information through lecturing. Simulation improved student engagement in business problems because the correlation to real life problems was similar. Often business problems present themselves with inadequate information that needs to be researched before a solution can be created. The problems are also unclear and ill structured with several possible ways to solve them (Anderson & Lawton, 2004).

In the previously mentioned study by Ferreira and Trudel, it was discovered that students’ problem solving skills were improved. These students were part of a high school chemistry class with a broad range of ethnic diversity. Students were tasked with performing six problem-solving actions. Post Problem Based Learning, students showed the greatest increase in identifying learning issues, suggesting research ideas and resources, and finding initial reasons for the problem and many possible solutions. The students showed an increase from 13 percent to 23 percent. Some actions that did not increase statistically significantly were listing initial known facts, suggesting the best solutions, and adding new solutions after researching the problem (Ferreira & Trudel, 2012). Even though the results for these actions were not significantly increased they do show that the six problem-solving actions can be increased, thus improving a students problem solving ability. This shows that the PBL method would still be a viable learning option for getting students to practice their problem solving skills.

**Conclusion**

In conclusion, Problem Based Learning is a viable way for students to gain new content knowledge and help to retain it. Creating a messy, ill-conceived problem that incorporates real world situations is the base of the method. Students must investigate the presented information and determine what they know and what they do not know. This forms the foundation of their research to solve the problem. With the guidance of a facilitator or tutor, they can gather information from various resources including the Internet, and begin to put the puzzle pieces together to form a solution to the problem. Student interaction and collaboration increases due to the required teamwork involved in solving the problem. Perceived enjoyment of the learning is increased in this method as well. Critical thinking and problem solving is reinforced by using PBL which can help with retaining information for later retrieval by the student.

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