

Problem-Based Learning in the Student Centered Classroom

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March, 2003

## Abstract

The following paper discusses implementing problem-based learning in the student-centered classroom. The paper focuses on the use of problem-based learning as a tool in the student-centered classroom. It looks at the history of problem-based learning, the implementation of problem-based learning into the classroom, and the role technology plays in a student-centered environment and the opportunities it provides for problem-based learning.

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# Problem-Based Learning in the Student-Centered Classroom

## Introduction

Education today is changing from one of factual based to one of inquiry based. This new approach to learning is bringing about new ways in which students are involved in the learning process. Teachers know that students do not learn at their highest potential when they are in a classroom where the teacher stands at the front of the room and gives them knowledge. Students learn best when they are engaged in the learning process and discover for themselves the meaning of knowledge (Gentry, 2000, pg. 3). Problem-Based Learning (PBL) in the student-centered classroom gives students the chance to discover knowledge in a meaningful and applicable way.

This paper will examine PBL in the student-centered classroom. It will begin by defining student-centered. Secondly, it will look at the history of PBL and the skills that are going to be required by workers in the future. Next, it will define PBL and give a brief explanation of the design, implementation and assessment process of problem-based learning in a student-centered environment. Finally, it will examine how technology plays an important role in both the student-centered environment and PBL.

## A Student-Centered Classroom

A student-centered classroom is defined as a classroom where the students are actively involved in the learning process. This is a classroom where the focus is not on the teacher

teaching, but rather the student learning (unknown, n.d.). Combs (1976) states that three characteristics are needed in creating an effective learning environment:

1. The atmosphere should facilitate the exploration of meaning. Learners must feel safe and accepted. They need to understand both the risks and rewards of seeking new knowledge and understanding. The classroom must provide for involvement, interaction, and socialization, along with a business-like approach to getting the job done.
2. Learners must be given frequent opportunities to confront new information and experiences in the search for meaning. However, these opportunities need to be provided in ways that allow students to do more than just receive information. Students must be allowed to confront new challenges using their past experiences without the dominance of a teacher/giver of information.
3. New meaning should be acquired through a process of personal discovery. The methods used to encourage such personal discovery must be highly individualized and adapted to the learner's own style and pace for learning.

These three characteristics are at the heart of the student-centered classroom. Students need to feel safe in order to take the risk in discovering new knowledge. They must feel secure in facing challenges based on past experiences. They must be given the opportunity to find information on their own in a way that is relevant to them.

In a student-centered environment, students move away from following orders given by a teacher to self-directed learning activities, from memorizing and repeating information to discovering information on their own. Students communicate and take responsibility for their learning instead of listening and reacting to lessons. Student-centered classrooms focus on the understanding of the processes instead of on knowledge of facts, terms and content. Most importantly, student-centered environments focus on lifelong learning and not just learning in youth (Gentry, 2000, pg. 9)

A student-centered classroom is about the students. The teacher takes on a role of facilitator or guide, allowing the students to discover for themselves the knowledge, while the teacher helps or facilitates the learning by guiding the student down the path of knowledge.

When students start to move away from traditional learning to more active learning, the process of learning becomes the focus.

### History of Problem-Based Learning

The modern history of PBL begins at McMaster University's Clinical Medical Department in Ontario, Canada in the early 1970's (Rhem, 1998). McMaster's was concerned that its medical students were able to learn and recall knowledge learned through course work, but when students had to put the knowledge they had learned into application, they fell short. "Learning through lecture did not equate well with application; furthermore, grades, although valued indicators of success, were not good predictors of a students ability to apply that knowledge in clinical situations with real patients" (Albanese & Mitchell, 1993).

To overcome this weakness in their educational system, McMaster designed a program that involved students interacting with simulated patients. Students would have to use the tools at their disposal (i.e.: medical charts, patient interviews, records) to come to a conclusion on how to best help their patient. "A discussion-based approach that faculty tutors facilitated brought students into the inquiry and learning process as full participants rather than as mere receptors (Barrows & Tamblyn, 1976).

In the 1970's the University of New Mexico, with support from McMaster, set up a small PBL program that ran side-by-side the existing traditional program. "Mounting comparative evidence showed clearly that the PBL students were learning as much content as the traditional students, thus easing some initial discomfort with coverage issues. Studies also showed that

students in the PBL program were better equipped to be lifelong learners" (Aspy, Aspy & Quinby, 1993).

Though PBL was shown to work in the medical field, educators felt that education as a whole was entirely different. Educators could not assume all of their students would grow up to be doctors, therefore not knowing when or how they would have to apply knowledge learned. "Our students may go on to become teachers, engineers, secretaries, programmers, perhaps even doctors. We may never know, but we are charged, nevertheless, with preparing them to face their future" (Torp & Sage, 2002, pg. 31).

It is the educator's job to encourage students to use the knowledge they have and understand it on a deeper, more meaningful level. David Perkins (1992) states, "If students do not learn to think with the knowledge they are stockpiling, they might as well not have it" (pg. 30). Students must learn to use the information they have to solve-problems and apply it to their life. Greenberg (1990) gives four criteria for good problem-solving situations.

1. Students make a testable prediction.
2. Students can use available or easily accessible materials.
3. The situation itself is complex enough to support varied approaches and generate multiple solutions.
4. The problem-solving process is enhanced, not hindered, by a collaborative approach.

In conclusion, the history of PBL and the theory behind it is one that focuses on student learning. PBL helps students to take the knowledge they have, and apply it in a meaningful way to problems that can occur in real-life situations.

## The Worker of Tomorrow

To understand the power and the need for PBL in our classrooms, we must first understand what skills students will need in the future. With technology advancing very quickly, education does not have the funds necessary to maintain a continually updated technology program. Instead of focusing on the technology, education must focus on skills that we can teach students, enabling them to be successful in this coming age. According to David Thornburg (2002), a leading researcher on the subject, workers of the future will need the following basic skills: comfort with ambiguity, a commitment to lifelong learning, and the ability to be mobile. These basic skills do not focus on technology itself, but more on life skills that people will need if they are going to be successful in the coming age.

Workers of the future will have to be comfortable with ambiguity. With technology increasing and changing so fast, workers will be forced to maintain knowledge of technological advancements as they may have many different jobs in the course of a year. They will have to be able to cope with uncertainty, to focus on projects they are doing at that moment, while thinking about the future (Thornburg, 2002).

We will have to become a society of lifelong learners. To facilitate this change, the current educational system will need to be altered. At this time, only community colleges and specialized technology schools are set up for the lifelong learner (Thornburg, 2002). Major universities, and even our public education system, will have to take a close look at revamping their policies in order to make room for these new learners.

As the world becomes smaller, workers will have to learn to be more mobile. We must start teaching students now that work can be, and must be done in locations other than just school



or home. With the technology that we have today, distance and locality no longer pose a challenge (Thornburg, 1997).

The skills that Thornburg mentions, ambiguity, life long learning, and mobility, are all skills that can be taught through PBL and a student-centered classroom format. These skills need to be the focus of our teachings. PBL teaches ambiguity by not giving students a clear picture of the problem at hand. In PBL, students are faced with many uncertainties that they must resolve before actually answering the question. PBL helps students to become life long learners by requiring them to apply the knowledge they have learned to everyday or real-life problems. PBL teaches students that it is not enough to know information, but that you must be able to use the information you have in a meaningful and productive way. Lastly, PBL allows students to be mobile by offering them opportunities to learn in places besides the classroom or at home. Students might find the answer to a question from an expert on the internet, or get help from someone in a grocery store. Because PBL models real-world problems, it shows students that learning can take place anywhere anytime.

### Problem-Based Learning

The familiar model of learning can be described as one in which students learn identified content and process through lecture, direct instruction, and guided discovery, and then apply their knowledge to a well-structured situation or problem (Torp & Sage, 2002 pg. 14). In contrast, PBL lessons model real-world problems. Problem-Based Learning is generally described as "an instructional strategy in which students confront contextualized, ill-structured problems and strive to find meaningful solutions" (Rhem, 1998). PBL confronts students with a

messy, ill-structured situation in which the student assumes a role or owner of the situation (Torp & Sage, 2002 pg. 15). Like the real-world, the problem should not have a clear answer. Instead it should be structured in a way that the learners ask themselves: "What is it I need to know in order to better understand this problem?" When the learner has to first learn information to understand the problem at hand, then the problem is ill-structured enough for inquiry learning to take place.

As students take on the role, the problem becomes their own. This personal connection between the student and the problem at hand drives the learner to discover whatever it is they feel they need in order to arrive at a viable solution or conclusion to the problem. Torp and Sage (2002) list three main characteristics of PBL.

1. Engages students as stakeholders in a problem situation.
2. Organizes curriculum around a given holistic problem, enabling student learning in relevant and connected ways.
3. Creates a learning environment in which teachers coach student thinking and guide student inquiry, facilitating deeper levels of understanding.

As students become more accustomed to the PBL learning environment they start to mature intellectually. Gentry (2000, pg. 13) identifies self confidence, desire to achieve, analytical skills and teamwork abilities, as intellectual skills students learn that might not be prevalent in a traditional classroom format.

Because PBL is self-directed and is based on real-life situations, students gain self confidence in being able to resolve problems that they might face in every day activities. Being able to successfully solve problems in the classroom can correlate to self confidence in solving problems outside the classroom as well.

As students start to realize the connections between their academics and the world around them, they can start to answer the often heard question "When will I ever use this?" PBL helps to show students that there is a direct correlation between school and real-world problems, thus the desire to achieve is heightened by this knowledge that "I can use this in the real-world."

PBL helps students develop deeper analytical skills. Analytical skills such as critical thinking, problem defining and problem solving are at the heart of PBL. Students use these skills by looking at possible solutions to a problem. Students start to develop skills such as research techniques, data analysis and working as a team member as they move through these analytical skills. All of these skills assist students in becoming life long learners.

By working in a team, students learn to be responsible to other learners. They learn to set both long and short term goals as they relate to the problem. Students learn to communicate effectively with other members of a team and learn the importance of effective communication. These skills are what the business world has been telling the educational community that students lack when entering the workplace.

PBL is an approach that does not just allow students to be an active participant in the learning process, but forces them to take an active role by engaging them in a meaningful, thought provoking way. PBL facilitates in giving students tools to become life long learners, tools that can not be taught out of a text book, but only by being an integral part of the learning process.

## Implementing Problem-Based Learning in the Student-Centered Classroom

In designing a PBL lesson, teachers should first identify what standards or outcomes they want their students to know by the time they reach a viable conclusion to the problem. By first knowing what outcomes teachers want from their students, teachers can then choose or develop a problem that allows students to successfully reach those assigned standards or outcomes.

There are many resources teachers can use in developing a problem for a PBL lesson. Knowing that PBL should mirror real-world problems and situations, teachers can turn to their community and colleagues. Torp & Sage (2002 pg. 16) suggest scanning local newspapers, and speaking with community members and colleagues about problems that could be used in the classroom. "When looking for problems teachers should assess the opportunities of 'curriculum payback', including integrating across disciplines and making community connection." (Torp & Sage, 2002, pg 16) Teachers should also look for problems that provide multiple ways in which the content can be displayed or presented (i.e. projects, presentations).

PBL should allow for multiple perspectives. Students need to have the freedom to choose which perspective interests them and allows them to become engaged in the learning process. "We want students to own the problem and the inquiry, and to have a personal investment in the solution" (Torp & Sage, 2002, pg.18).

### *Teachers Role*

The teachers role in PBL changes from one of "all-knowing", to one of helper or guide. The teacher must give the control to the students and allow them to make their own path to the answer, rather than the teacher laying the path out for them. Gentry (2000, pg 11) states

"Teachers are the channel through which the students acquire the skills for learning...not as a supplier for knowledge but as a prod for students to gain that knowledge on his or her own."

The giving up of control is the part of PBL that teachers usually struggle with the most. However, it is not only the teacher who has to change. Students, too, have to learn to view their teacher as a guide, not the person with all the answers. Only after this partnership between student and teacher is formed can true inquiry learning take place. "Teachers have a huge responsibility because they are the first point of contact with their students and have a tremendous influence over the way they learn." (Gentry, 2000, pg. 11)

Many teachers have also stated that PBL has changed their attitudes about teaching and is professionally rewarding in many ways. Gentry (2000, pg. 11) lists several ways teachers have found PBL rewarding:

1. Students are more motivated and enthusiastic about learning
2. Teachers often experience revitalization about teaching and a renewed interest in expanding their own knowledge through additional studies, either on their own or by taking additional classes.
3. Teachers acquire new professional skills in technology.
4. Teachers learn effective and rewarding teaching techniques.
5. Teachers work collaboratively with other teachers to develop interdisciplinary problems or projects, often distant collaborations.
6. Teachers employ a variety of assessment methods.
7. Teachers learn to manage a class where student teams are working independently and at a different pace.

PBL is a new way of teaching that might take some teachers time to grow accustomed to it. However, once teachers have successfully implemented a student-centered classroom and PBL, they find it a rewarding and exciting experience, and hard to change back to a traditional model.

*Students assume the role*

Once the problem has been developed, students need to assume a role in the problem. They need to feel the problem directly affects them, this allows them to take ownership in the problem. Looking at the following example, we see that the students are assuming the role of advisor to NASA.

Second grade students serve as advisors to NASA. A planet much like Earth has experienced massive destruction of the elements in its biosphere. What is causing the destruction of plant life? Can new plants from Earth be successfully introduced to help save the planet's environment? How can we find out?  
(Rawls Byrd elementary School, Williamsburg, VA. Adapted from Torp & Sage 2002, pg. 15)

This example demonstrates how students become a part of the problem. The problem is presented to them in a way that makes the problem theirs. There are many different parts to the question and there is an assortment of unknowns that the students must identify and then research in order to start solving the problem.

*Students immersed in the problem*

After reading and taking a role in the problem, students will presumably have more questions than the problem seems to have at first glance. The students need to become immersed in the problem, to look at what information is given and what information is not given. Students should identify what is needed to solve the problem. Only after information is gathered does the problem seem to take on meaning. Matthew Lipman (1991) talks about ill-structured problems.

Where students have no sense that anything has been left out or is incomplete, they have no need to go beyond the information given. In contrast, the partial, the fragmentary, and the problematic taunt us to complete them or resolve them. (pg. 68)

In comparison to ill-structured problems, well-structured problems "provide the information, the compass, and the clear destination for the problem solver." (Torp & Sage 2002 pg. 20) This does not allow for students to investigate the problem on a deeper, more meaningful level. Instead well-structured problems only allow the learner to comprehend and apply knowledge rather than analyze and synthesize the information gained.

*Students identify knowledge needed.*

Once students understand their role, the problem, and the limited information, they can start to break the problem apart. Students will categorize what information they know, what they need to know, and what ideas they have that might help them solve the problem. Only after students have ideas of what information is needed can they start their investigation into solving the problem.

*Students identify the problem*

During the data/information gathering stage of a PBL lesson, students should have an opportunity to share their data/information with other class members. This sharing gives further ownership to the students, as well as allows for discussion and sharing of information. The teacher as a facilitator helps to keep the students focused on the essential problem, though the problem might change over time, and even become more complex. "Many teachers post evolving problem statements in the classroom to help tighten and target the investigation." (Torp & Sage, 2002, pg. 21)

*Students produce possible solutions*

As students start to produce possible solutions to the problem, they must revisit the original problem to see if there is a solution that is a "best fit." After every student has settled on what they think is the best solution to the problem, they start to prepare to present their solution to the teacher or class.

Allowing for diversity in the way in which students are allowed to present their solution is another way of giving students ownership in the process. "They may choose to share their solution by using concept maps, charts, graphs, proposals, position papers, memos, maps, models, videos, or a web site." (Torp & Sage 2002, pg. 22) This allows the student to present their solution in a way that makes sense to them.

*Assessing*

When it comes to assessing PBL, traditional methods are not always appropriate measures of the learning taking place. While traditional assessments (ie. True False, multiple choice, short answer recall, etc) measure students' knowledge, it fails to make the connection to how students might use this knowledge in a real-world setting. Moreover, these traditional assessments can not measure such skills as working in a team, performing research or describing a problem and a reasonable solution. Gentry (2000, pg. 15) states "In an environment where students are encouraged to articulate questions of interest to them and 'take the plunge' for discovery, assessment techniques should be planned that will support this type of learning. We want to assess whether or not they can apply what they have learned to their everyday life."

There are many different ways one can assess a PBL lesson or project. The assessment technique will ultimately be decided by the type of project or the teacher's preference. The most



commonly used assessment for PBL is a scoring rubric or a checklist, in which students are scored on criteria set out by the teacher before the project begins. This criteria focuses on the outcomes or standards the teacher wants to assess. Although rubrics and checklists are becoming more commonly used, they are not the only forms of assessment. Other assessment techniques might include portfolios of completed assignments, journals containing reflections, summaries, or notes, peer reviews, team and self evaluations, teacher observation, presentations or projects. (Gentry 2000, pg. 15)

The PBL format believes "it is better for students to be able to apply knowledge to a new situation than to know the answers to 'old' questions (Gentry, 2000, pg. 6). PBL focuses on the processing and applying of information to a situation rather than knowing actual facts about a topic (Gentry, 2000, pg. 7). Overall, the steps in the PBL format all focus on the students being the center of the learning process, and the teacher being the guide helping the student reach their goal of solving the problem.

### The Use of Technology

Technology has allowed for the advancement of student-centered teaching as well as PBL. Technology is a tool that gives students access to an almost unlimited amount of information. In the student-centered classroom, students can become active learners by looking for information quickly and efficiently on the World Wide Web or by using research software. "When technology is thought of as a support tool or creation of student projects, the classroom starts becoming learner-centered and takes on a different feeling" (unknown, n.d.).

Technology can also help students in a PBL lesson. The computer can be a powerful tool for solving realistic problems. Students could use the technology for such things as e-mailing experts who would have information on the topic, finding other sources of information using the World Wide Web, or students might set up a message board where they can easily keep track and share ideas with other class members.

When it comes to presenting the final solution to a problem, again technology can play a major role. Students are no longer limited to writing a report or making a poster to show their thoughts and share information. With technology, students have multiple ways they can present the information to an audience. One student might choose to create a video, while another might choose to build a website to inform others. Yet another student might feel it best to present a solution using presentation software such as PowerPoint or Hyper Studio.

Technology has opened up numerous possibilities to both teachers and students. Using technology as a tool to solve problems, is a skill students are going to need to be successful in the coming age. PBL and technology gives both students and teachers a wide range of options when looking for answers to real-world problems. Technology is a tool that students will need to become comfortable with and know how to use. PBL and student-centered classrooms offer the opportunity to become comfortable with these tools now rather than later.

### Conclusion

In conclusion, problem-based learning in the student-centered classroom maximizes the student's involvement in the learning process. Within a PBL student-centered classroom, students are able to use the knowledge they have and apply it towards a meaningful problem.

Students start to see how the knowledge they learn helps them to solve problems in life, therefore giving them a love for learning and turning them into life long learners. As education learns to embrace this new type of teaching, teachers will have to learn to give the control of the problem and the classroom to the students. Teachers need to take on a new role in the classroom; they themselves need to become part of the learning process, acting as a guide and a resource for the students. Once a teacher learns to become part of the learning process, and students are immersed in the problem, knowledge flows freely and students learn to apply their knowledge in meaningful and productive ways.

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