

Problem-Based Learning

in Middle and High School Classrooms

A Teacher's Guide to Implementation

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E D U C A T I O N

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Preface

Preparing middle years students for their final years of high school and high school students in their final years for what awaits them after graduation presents a host of challenges long recognized by teachers, parents and administrators. There are issues around academic development, noncognitive skills development and social maturity development. Now add issues of career choice, information bombardment and newly experienced expectations from teachers and parents. It is of little wonder that so much is written about strategies to manage these school and life transitions for these students. The categories seem almost as endless as the issues themselves. There are the transitions from primary to middle years, from middle years to the final years of high school, from high school to university or TAFE, from high school to the world of work or from high school to the widest ever range of tertiary educational opportunities. There are online education, distance education and virtual classrooms, in addition to the more traditional TAFE or university setting.

Students today need a set of skills not only for managing these transitions but for decision making, problem solving and self-direction as they have never needed them before this century. It is a seemingly full-time proposition to prepare students with a skill set just to meet these kinds of demands. Yet, in today's accountability-driven culture, there is hardly time to address the basic issues of content coverage and curricular objectives. How can a teacher feel that the instruction provided

can adequately address content issues, process issues and social development issues?

Let's first consider the dilemmas faced by many high school students as they graduate. Too many students leave high school without the skills to succeed in the workplace or in tertiary institutions. These students will, sadly, find themselves unprepared for the rigours of university courses, the expectations of employers and the need to self-direct a significant portion of their learning, whether on the job or in the classroom.

In an article titled 'Ticket to Nowhere' (Haycock, 1999), the state of unpreparedness among American high school graduates is underscored. Unless the secondary school experience of these young sixth graders differs radically from that of the students who preceded them, many of them will arrive utterly unprepared for college-level work and will spend their first year or more taking high school level courses. This unfortunate prediction may have even more serious implications for students who arrive at colleges and universities with innovative courses and programs such as problem-based learning and who have had no experience with this or similar challenging methodologies.

Likewise, middle years students are nearer to the high school transition often find themselves ill equipped for the new challenges they are facing. Their academic course work is more demanding than their previous experiences in primary school, they are required to work more independently than ever and they are faced with more choices. At the same time, their physical and social development is occurring at its most accelerated rate, and friends have become a significant influence in decision-making processes. Unfortunately, these students are rarely skilled at decision making, determining best choices or working in collaboration with peers who may not be in their circle of friends. Middle years students have usually not developed a process for dealing with so many shifts and demands because it has not been necessary to do so.

What to Do? Why to Do It?

Problem-based learning (PBL) is a teaching and learning style that addresses many of the deficient elements in these kinds of scenarios. In the PBL approach, students are presented with an ill-structured problem and instructed to work in small groups to arrive at some resolution to the problem. The teacher is no longer the focus of all that happens, although the teacher plays a crucial role in selecting the problem and facilitating the student groups. Rather, students start to develop self-directed learning skills as they determine the kind of content learning required to move forward, the resources to use and how new information is synthesized toward resolution. Students must work interdependently, determine multiple possible solutions and test their ideas for viability. As a result, the students are an active part of their own learning, create their own direction as driven by the problem scenario and continuously respond and react to each other as well as to the teacher and to the new content information they encounter.

PBL enlarges the scope of learning opportunities for students at all levels of education. Though PBL originated in medical schools, there are various organized movements nationwide to integrate the methodology in K-12 classrooms. PBL is becoming well established as a valuable addition to traditional teaching methods and has moved beyond the “flavor-of-the-month” trend so often seen in educational reform attempts.

There are currently very active initiatives to implement PBL in K-12 classrooms. These initiatives are largely grounded in the notion that PBL greatly enhances comprehension, social skill development, content retention, student motivation and abilities to self-direct and it engenders positive attitudes toward lifelong learning. The success of these experiences, from the kindergarten level through the high school grades, is promising and exciting.

One example of a plan to use PBL in education reform is in the mission of the Center of Excellence for Research, Teaching, and Learning (CERTL) at Wake Forest University School of Medicine. Its mission includes providing intensive and continuous professional development for K-12 educators in PBL and sponsoring enrichment programs anchored in PBL activities for

K-12 students. The CERTL has also sponsored the development of PBL instructional materials by teachers for teachers and manages the dissemination of those materials for classroom use. Examples of these classroom materials are found throughout this book.

Another example of educators' extensive interest in PBL is the participation of nearly 400 college faculty at an international PBL 2002 conference hosted by the University of Delaware. Twenty-four countries and 43 states were represented. Without question, at least several thousand schools and colleges are interested in including PBL in their teaching repertoire. In the past 10 years, several hundred U.S. schools have included PBL in their repertoire and several books on PBL in K-12 education and teacher training have been published (see References).

This book is designed to familiarize educators with the philosophy of PBL, to show its intended benefits and to present many classroom examples. The focus is on the use of PBL in middle and high school classrooms. Examples of PBL problem scenarios and the ways they are used by experienced PBL teachers are provided. The experiences of these PBL teachers will demonstrate the variety of possibilities for integrating PBL into current teaching strategies.

Acknowledgments

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I am constantly grateful to Dr. Patrick Ober for his leadership and support of my endeavors. It is his encouraging guidance, often delivered in the true style and guile of Mark Twain, that reminds me, “Life does not consist mainly, or even largely, of facts and happenings. It consists mainly of the storm of thought that is forever flowing through one’s head.” And although Mark Twain said it, Pat Ober inspires it.

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Problem-Based Learning

What and Why

*You can memorize your way through a labyrinth
if it is simple enough and you have the time and
urge to escape.*

*But the learning is of no use for the next time
when the exit will be differently placed.*

—Unknown

Knowing What

Getting started in any conversation about problem-based learning (PBL) requires knowing exactly what is being called PBL. There are many interpretations of the methodology and just as many descriptions of what it is. For the purposes here, the following working definition is provided to support a framework for better understanding what PBL is and why it enhances traditional teaching approaches.

PBL is a teaching method based on the principle of using problems as the starting point for the acquisition of new knowledge.

Pivotal to its effectiveness is the use of problems that create learning through new experience, new content acquisition, and the reinforcement of existing knowledge. Situations that are in the students' real world or that they can recognize as part of their relevant future are presented as problems and stimulate the need to seek out new information and synthesize it in the context of the problem scenario. To underscore the real-world nature of the problem, students are given a specific role in the problem scenario that enhances their ownership with working toward its resolution.

Here is a simple and familiar real-world illustration of PBL. Consider the last time you required driving directions to somewhere you had never been. You begin the process with what you already know, or your existing knowledge: where you will start driving and where you intend to arrive. You then identify what you need to know to effectively and efficiently reach your destination: names of streets and highways, distinguishing landmarks to look for, and perhaps the number of kilometres you should anticipate travelling. You then integrate this information with your existing knowledge; for example, the amount of time it typically takes you to travel the number of kilometres and the type of road conditions you can expect. Often, after creating the experience of using the new information to travel a new route and successful arrival at the appointed destination, you can later retrieve this new information and apply it to similar situations. It is also likely that you will retain much of the new information and be able to successfully travel the same route again when the need arises.

The real-world frame of reference for you in the example above is that it is likely you have had to acquire and follow driving directions unfamiliar to you before. Each learner has their own real-world frame of reference that should be attended to when PBL problem scenarios are developed and used in the classroom. That frame of reference for a 12-year-old is obviously quite different from that of a 17-year-old, but it is just as significant for the effective use of PBL. It is helpful to understand the learner's real-world frame of reference when determining the role the student will assume within the problem scenario. For example, 12-year-olds still enjoy fantasy as part of their entertainment, and a PBL problem scenario might give

them a futuristic or fantastical role. They might be assigned a role in the problem as a future space explorer or as a member of an undersea research community. Seventeen-year-olds, on the other hand, are beginning to see themselves as adults and are more attracted to realistic roles. They may be assigned the role of engineer or landscape architect. It is important to remember that for PBL problems to be most effective, students should be able to engage or identify with the role they have been assigned.

There are further characteristics that define and determine the quality of how PBL shows up in classroom instruction. It is essential that the learners determine their own learning needs, or learning issues, based on the problem they encounter. This is the student-centered element of PBL. In the earlier driving example, imagine that someone else determined the directions you needed without taking into account your own existing knowledge. The information they decided to provide you could discount your starting point, your familiarity with some of the route, or your own travel preferences. In essence, they would be telling you what they think you need to know, with little regard for what you think you need to know. To get excellent information, you must get answers to the questions that will help you. As the learner, you are the one who should frame these questions and then seek out the information. It is this part of the process that creates higher retention of new content and better recall at a later date.

Effective PBL lessons are facilitated for learners to determine what they need to know in order to proceed with resolving the problem. The new content that is intended for learners to pursue is embedded in how students will get to problem resolution. Curriculum standards and content objectives are linked to the problem-resolution component of this process. So, if the content standard in the driving example is “Students will know where Maple Avenue is located,” then finding Maple Avenue will be an integral component of resolving the problem students are given, perhaps as a cab driver who must get from point A to point B in the shortest distance. This allows learners to frame the question, “Where is Maple Avenue?” so it is meaningful to them in relation to what they already know about the location of point A and point B. Now it becomes important to them to know where Maple Avenue is because they have decided they

need this information to fill out their knowledge base regarding this problem.

Unfortunately, as educators we typically spend quite a lot of time telling our learners what they need to know without first determining what they already know or what they think they need to know. Rarely do we ask students to frame the questions that align with the type of information we think is important for them to have. Rather, we provide students with information we have already deemed relevant through lectures, handouts, worksheets, or assigned readings. In PBL, the process is somewhat reversed. Through the problem, students determine what is relevant, make that declaration, and then seek out the information they need. As the teacher using PBL problems, you will be able to accurately anticipate the students' learning needs based on the problem you have selected.

Teachers are often nervous about this notion of allowing students to determine what they need to know or which learning areas they will pursue. These questions are often posed by the inexperienced PBL teacher: How do you know that students will come up with appropriate learning issues, or how can a teacher be certain that the intended content areas will be included? PBL problem scenarios do not stand alone but are designed and facilitated by the teacher. Well-constructed problems coupled with effective facilitation will prompt students into the intended learning areas. In this book you will find examples of effective PBL problem scenarios and instructional units by grade level, the qualities and characteristics of effective PBL problem scenarios and their development, and strategies to ensure effective facilitation of PBL problems.

Collaboration and Differentiation

The PBL approach requires that students work in small groups to attain their learning objectives. Teachers will be further reassured about how learning issues are identified when they observe that within groups, the learning needs tend to be somewhat diversified. The learning needs of one student complement the learning needs of another as the

group works together to address all the learning issues. A host of noncognitive skill development opportunities occur within the context of the small group. Students learn the skills of negotiation, mediation, and cooperation. They learn to organize themselves and their work, to self-direct in their learning, and to determine which resources are credible and reliable. Interpersonal skills in the areas of communication, mutual respect, and mutual consideration are developed in the cooperative nature of the groups. Students learn the art of contribution, they learn how to assist others in contributing, and they learn to distinguish valuable contributions and to acknowledge others for making them.

As these small groups become the focus of the learning situation in classrooms, teachers must assume a different and sometimes unfamiliar role. Rather than being the sole content authority in directing the learning process, the teacher now becomes the facilitator or coach of each small group. Suggestions for effective facilitation skills are offered throughout the book.

Collaboration within the group is an element of PBL that is necessary to accomplish problem resolution. This is a lifelong skill that makes sense to begin developing and practicing as early as kindergarten and certainly needs to be sponsored in the classroom by the middle and high school year levels. The type of intended collaboration in the small group includes resource identification, peer support, acknowledgment and continued reinforcement of existing knowledge, and assistance and assurance in integrating and synthesizing new information. The formation of small groups, their dynamics, and how well they function are all important considerations in the PBL process. Because these elements are dependent on the learner's developmental stage, the principles to consider are presented in later chapters as they relate to year level.

The last essential element of PBL is that in the process, students must take responsibility and be held accountable for their own learning. Once the students have identified their own learning issues, it is fundamental to the success of PBL to make them accountable for that learning in meaningful ways. Students must be able to demonstrate that within the process, they have acquired new content and that they can apply that new information toward problem resolution. Creating the situations that allow

students to acquire new content and demonstrate application constitutes an entire chapter dedicated to authentic assessment strategies.

PBL Provides Relevance to Learners

There are philosophical underpinnings to the PBL process that explain why one would choose to make a shift to PBL in the classroom. In *How to Use Problem-Based Learning in the Classroom* (1997), Delisle gives a thorough and informative description of PBL. He describes its historical development and medical school origins. Consideration of learning theories and their alignment with PBL is provided. His book is rich with background that helps anchor the philosophies behind PBL. In this book, however, the focus is a more practical overview of why shifting to PBL practices in the classroom creates advantages for both the learners and the teacher.

PBL creates opportunities in the classroom that traditional approaches simply do not. Perhaps the most significant is that the relevance of the learning is highlighted for students. Because the problem scenarios have a real-world frame of reference, they are centered on an event that the students can imagine in their own life or in their future. The students then determine their own learning needs to understand or resolve the problem. Now, because the students have determined for themselves this “need to know,” the learning that occurs is highly relevant. This contributes to holding the students’ interest, developing a deeper understanding of the content, and increasing the retention of new information. It also contributes to eliminating the ever-present question, “Why do we need to know this?”

The emphasis in PBL is on conceptual understanding rather than the memorization of facts. The intended learning is presented through the problem scenario in a way that compels students to want to know and need to know the new information, much like the driver who needs directions. The problem then requires the students to use the new information to present resolutions to the problem. As the students work in their small

groups toward solutions, they must collaborate and negotiate within the group to rule in and rule out viable solutions. They learn to be in functional relationships with each other to accomplish the group's goals. Students develop communication skills and more sophisticated interpersonal skills. They develop respect for one another's contributions and find ways to acknowledge and encourage each other.

In addition to these benefits, students report that they become excited about resolving the math or science or political problems and about discovering new information that helps in figuring out what is going on in the problem. Discovery, fun, and excitement are all elements that most learners prefer to have as part of instruction. We tend to work harder and longer on the endeavors that we enjoy. When students work longer and harder, they learn more and are more likely to be able to use the new information in similar contexts and situations at a later time. Also, teachers are assured that students have learned when they can apply new content.

Another outcome for students is the development of a process for lifelong learning. Students become aware that they are able to figure out what they need to know, find what they need to know, and use this new information to create solutions in situations that have no obvious answer. They grow more confident in their abilities in these areas and soon are engaging the process even outside the classroom.

A high school student recently shared the story of how she used the process for beginning a search for colleges that would best suit her. She first made a list of what she knew: the major curriculum she intended to study, the size of the college she thought she would enjoy most, the geography/climate that most appealed to her, and the greatest distance from home she wanted to be. She then made a list of what she needed to know: which colleges offered the major she wanted to pursue, which colleges had a strong reputation in that major, what was the tuition, where was the college located, and what were the admissions standards compared to other colleges of similar profile. She used a variety of resources, including her guidance counselor and printed information she obtained from the counselor. She used Internet searches and her local public library. This young lady was using the process of determining what was

known, what additional information was needed, and what resources were available. The significance of this example is that the student applied the process she had become familiar with in her classroom to an issue in her everyday, real-world life.

PBL Teaches Lifelong Problem-Solving Skills

This leads us to yet another significant benefit of using PBL. In this student's example, she was not focused as much on coming up with one right answer or solution to the dilemma of college choice as she was on obtaining the most useful information to expand her consideration of choices. PBL is specifically designed for students to focus on coming up with multiple solutions rather than one "correct" answer. The value of right or correct information as it contributes to problem solving is not negated. The intention here is not to detract from the use of accurate information such as $2 + 2 = 4$. But the value of knowing that $2 + 2 = 4$ is in how that information can be used toward problem resolution rather than in just knowing it to be so.

Focusing on multiple solutions rather than on correct answers allows students to be successful in ways that have not been available to them in traditional approaches. There are limited opportunities to be considered successful in most classrooms. Success tends to be defined by the highest scores, the most right answers, the neatest work, and, often, the most conventional work. While there is value in high scores, correct answers, and neatness, there is also value in creativity, discovery, contribution to a process, and contribution to the development of other people. Students not only are afforded these opportunities in the PBL process but are positively acknowledged as they engage the opportunities. We all have the tendency to return to and continue the things that make us feel successful. Students return to PBL each time feeling more confident, motivated, and excited about what they are able to accomplish.