

The Problem Log is published three times a year by PBLNet, an ASCD member network, to enable dialogue and the sharing of information, methods, and materials for Problem-Based Learning in K-16 classrooms.

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the Problem Log

Network News

In this issue . . .

. . . are two lengthier-than-usual articles describing programs presented at the 3rd Asia Pacific PBL Conference in Rockhampton, Australia. Both are programs that IMSA has helped develop using a PBL format, so I thought they might be of interest to our network members.

Upcoming issue . . .

In the fall we hope to initiate an on-line version of this newsletter rather than a paper version. We welcome your suggestions as to the best format . . . an electronic newsletter three times a year (much like this one) . . . an irregular posting of information and articles as they are submitted . . . other ideas? Let me know what seems to be the most useful for you.

Mark Your Calendar . . .

The 2003 ASCD Conference will be held March 8-10, 2003 in San Francisco, California. The conference theme is "Igniting the Passion for Learning: Innovative Responses to Complex Issues."

The PBLNet Forum will feature a panel of classroom practitioners from K-12. They will share problems and experiences that have ignited their learners' passion. There will be break-out groups so you can learn more in-depth about the problem of most interest to you. Come join us!

Listserv News

Thank you for bearing with us as we limp along with an old system for the listserv. We still plan to change the format as funding allows. Some choices we will make are whether to keep the basic format of a listserv or whether to move toward a threaded message board. We will listen to your input as we explore our options.

The recent postings have described some college programs that incorporate PBL. The most frequently mentioned have been the University of Delaware in Newark, Delaware (www.udel.edu) and Samford University in Birmingham, Alabama (www.samford.edu). Both institutions are well-known for extensive use of PBL.

I am also hearing from and about colleges and universities offering selected courses and programs using PBL. As I continue to get more information, I will compile a list to share with you.

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PBL Alternative Certification Program in Science

Benedictine University (BU), in collaboration with the Illinois Mathematics and Science Academy (IMSA), developed an alternative route to teacher certification to increase the supply of qualified science teachers at the middle and high school levels. This innovative approach uses a problem-based learning methodology where students acquire the competencies of effective teaching by being immersed in problems structured around teaching/learning themes. As the students seek resolution, they make connections between pedagogical theory and knowledge.

The Need for Alternative Certification in Science

Multiple sources cite data that indicate a growing need for qualified science teachers at grades 6-12 in the United States. Particularly noteworthy is the statement by the National Commission on Mathematics and Science Teaching for the 21st Century that the way we educate science and mathematics students must improve. They are disheartened by the fact as they see it that "The basic teaching style in too many mathematics and science classes today remains essentially what it was two generations ago" (Glenn, 2000).

These data indicate a need for certification programs that use a different approach and that tap into a different source of teacher candidates. This new source must supply people already competent in the content of science and experienced in the application of science. BU and IMSA address these needs with an alternative

certification program in a PBL format that targets candidates with a science degree and work experience in a science-related field.

The Use of Problem-Based Learning in the Alternative Certification Program

The BU – IMSA Alternative Certification Program selected problem-based learning (PBL) as the curriculum organizer to address the goals and concerns of science education. The National Science Education Standards (NSES) state that "Good teachers of science create environments in which they and their students work together as active learners" (NSES, 1996). In the program design, the candidates acquire the knowledge and competencies of effective teaching through a PBL methodology that is inquiry-driven and performance-based. Each week the candidates become immersed in a problem structured around a teaching/learning theme, as illustrated below.

You are a new high school science teacher who has been assigned to teach two sections of the freshman level earth science course. The students in each class form two unique learning communities that perform quite differently in identical learning situations. Is it the lecture discussion approach that is not working, or is there something else that might be influencing student learning? What information is available that might help you better understand your students and their learning? What can you do to help your students learn and understand the subject matter that you find so fascinating and relevant in today's world?

The above scenario opens opportunities for the candidates to explore the relationship between

teaching and learning embedded in a real problem of professional practice. As the candidates seek resolution, they make connections between theory and knowledge, and they develop and enhance content knowledge and skills. The areas for reflection and learning exposed through inquiry include:

- The students' misconceptions about science, background knowledge, perception of relevancy, developmental level, and skill-based deficiencies or difficulties, and
- The teachers' conceptions of learning, pedagogical knowledge base, understanding of individual student needs, and the ability to analyze and understand student scores.

Through a different problematic scenario each week, the candidates in the Alternative Certification Program learn to resolve real school-based problems they may encounter based on sound principles of pedagogy. They gather information related to the week's issue by consulting school professionals, textbooks, professional journals, various local, state, and national standards, and other appropriate resources.

Alternative Certification Program Description

The intensive course of study includes an eight-week summer learning experience and a yearlong mentored internship in a full-time teaching position with school district partners. Six weekend seminars during the internship provide candidates the opportunity to reflect upon and integrate theory with the practical experience of school culture and the process of socialization into the profession. The curriculum for the program embodies the course

content of the traditional certification program and reflects professional teaching standards. Candidates are immersed in reflective learning experiences throughout the Summer program and the internship year that will enable them to transform science teaching and learning for their students.

The program begins with the selection of qualified candidates. Applicants meeting the criteria are interviewed by the Graduate Admissions Committee and participate in a screening process. In addition to usual entrance requirements, alternative certification candidates in this program must hold at least a bachelor's degree and have at least five years of work experience in an area requiring application of the individual's science degree.

Applications of qualified candidates are then distributed to school district personnel for a formal interview for a teaching position for the internship year. The first year's 9 candidates included 2 with master's degrees and 2 with PhDs in fields such as chemistry, biology, biochemistry, laboratory technology, and aerospace, mechanical, civil, and chemical engineering. Their subsequent teaching assignments included physical science, earth science, physics, biology, life science, chemistry, and middle school science.

The BU – IMSA Alternative Certification Program is sequenced and aligned with Interstate New Teacher Assessment and Support Consortium (INTASC) and the Illinois Professional Teaching Standards. But unlike traditional programs that are built upon discrete courses, the alternative program integrates the various

core educational courses in methodology, psychology, philosophy, and pedagogy. Key concepts from the following courses recur throughout the alternative certification program and are integrated into the weekly problematic situations:

- Ethics, Education, and Social Change
- Learning and Development
- Assessment Measures
- Curriculum and Instructional Methods in Science
- Survey of Exceptional Children
- Middle School Curriculum and Instruction
- Classroom Management

In addition to resolving problematic situations, candidates have opportunities to implement PBL methodology in classroom interactions with middle school students. First, the interns conduct classroom observations at IMSA in the Summer Sleuths program, a PBL experience for area middle school students coached by a team of veteran PBL classroom practitioners trained in problem-based learning through IMSA.

Later, the candidates team-teach in IMSA's Summer Sleuths program where they are mentored by their PBL coaches. The teaching experience provides the opportunity for the candidates to take their learning from the theoretical to the practical as they implement their new knowledge, methods, and strategies with learners in a classroom setting. Daily debriefings bring out key teaching and learning issues and the implications for how to manage those issues in their own classrooms.

During the final week of the Summer program, the candidates begin the transition into their own real problem of becoming a first year teacher. They and their

mentors collaboratively participate in experiences designed to integrate pedagogical frameworks and to develop a collegial team. During this time the mentor also orients the candidate to the culture and climate of the accepting school.

Upon completion of the Summer session, an oral presentation/defense of the portfolio determines whether the candidate is prepared for the yearlong internship. Successful candidates are issued a non-renewable, provisional alternative teaching certificate, valid for one year of teaching within a mentored relationship.

Mentored Internship Year

The University and School District enter into an agreement which includes the assignment of a master teacher as the intern's mentor. To enhance their mentoring abilities the mentors participate in a one-week workshop during the eighth week of the summer experience. Participation in the workshop provides the mentors with exposure to problem-based learning, reflective practice, understanding concerns and problems of beginning teachers, and mentoring skills.

Throughout the year of internship, the interns participate in six Saturday seminars that focus on issues of particular importance to first-year teachers. These seminars, too, are conducted in a PBL format in which the learners identify what they know and need to know about the topic. Resources are available for their exploration of the topic.

Discussion and Interpretation

The challenge as this program was conceived and developed was to design an effective alternative

certification program in a PBL framework. As with designing PBL units for other classrooms, the biggest challenge was to cover the required curriculum within the allotted time frame and without compromising the underlying belief structure of PBL that is based in constructivist theory. The challenge was pursued because of the belief that these learners needed to apply their science content knowledge through a process that allowed them to identify and gather information about science pedagogy and to evaluate and interpret its potential implementation.

Although the delivery method for this program is PBL, the course content provides consideration of other effective methods and strategies used in the science classroom. The candidates are steeped in the strategies and skills of PBL, particularly questioning strategies, which are also applicable in other inquiry-based classrooms. One of the strongest skills developed through the use of PBL is the implementation of reflective practice as the candidates compare these various strategies and determine when each is most appropriate.

Summary

Demographic data suggest a growing need for qualified science teachers at grades 6-12 because many lack full certification and an academic major in the field in which they are teaching. There are also concerns that the way we educate science and mathematics students must improve. The PBL Alternative Certification program developed by Benedictine University and the Illinois Mathematics and Science Academy hopes to address both of these concerns by accepting candidates who are highly

qualified in a science field and by providing numerous learning and teaching experiences in problem-based and other constructivist methodologies. We believe this program helps to provide the type of science instructors needed for the 21st century.

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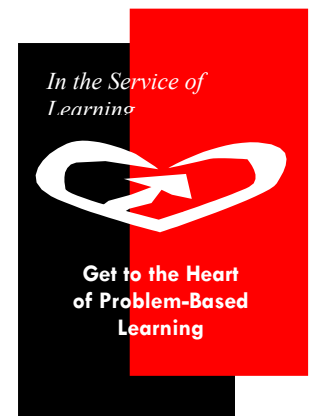
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As Authentic As It Gets!**

This is your year to learn with the best! Nationally known authors, professional developers, and exemplary practitioners of PBL are looking forward to working with you and learning together!

**February 14th & 15th 2003!
Illinois Mathematics and
Science Academy**

- Linda Torp & Sara Sage **Problems as Possibilities: PBL for K-16 Education**
- Ann Lambros **Problem-Based Learning in K-8 Classrooms**
- William Stepien **The Internet and PBL: Developing Solutions**
- Robert DeLisle **How to Use PBL in the Classroom**
- Barbara Levin **Energizing Teacher Education & Professional Development with PBL**
- Shelagh Gallagher **PBL: Where did it come from, What does it do, and Where is it going?**

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PBL Professional Development and a Secondary Program in International Studies

A common belief is that teachers teach the way they were taught. This belief is validated by current research (Stigler & Hiebert, 1999) in which teaching is described as a cultural activity beginning with more than twelve years of indoctrination as students. It becomes difficult to change teaching practice, especially when reform efforts address isolated components of the system.

The implication of the research is that if teaching is to change, professional development experiences must be longer than a typical one-day workshop, and they must be a cultural activity involving collaboration, reflection, and discussion over time. In addition, professional development is most successful if the teaching improvements are developed in the classrooms where the teachers teach and students learn (Stigler & Hiebert, 1999). Also, since students are a part of the system or culture, they must be included in the change process. This paper describes a professional development initiative that incorporates these elements through a three-year program that includes high school students from across the state of Illinois.

In January, 2001, the Illinois Mathematics and Science Academy (IMSA) received a mandate and a grant from Governor George Ryan to develop and implement the Illinois International Career Academy (IICA) with a broad, enriching curriculum that aligns with the interests of education as well as business and industry in Illinois.

Faced with this charge, it was obvious to the program designers at IMSA that problem-based learning was the ideal methodology to fulfill the multi-faceted goals of the IICA. One conclusion from PBL literature (Levin, 2001) is that teachers who plan to use PBL with their students must have guided professional development experiences with PBL themselves. So, an overarching and concurrent professional development program was developed for the teachers of the IICA students to enable them to implement PBL effectively.

Professional Development Program

Current research offers several other recommendations for successful professional development programs which are a part of the IICA program for teachers. One conclusion is that teachers are more likely to use newly-learned strategies in their classrooms if the professional development focuses on specific, higher-order teaching strategies in an innovative rather than traditional format, and involves teachers from the same subject (U.S. Dept. of Ed., 2000). The IICA program incorporates PBL coaching strategies within the two-week summer session and supports the social science teachers as they implement those strategies in their economics problems in their home schools. The teachers form a network with electronic communication and on-site support from program administrators.

Another guideline for good professional development is that it is planned collaboratively by those who will participate and those who will facilitate the sessions (U.S. Dept. of Ed., 2000) and that the participants have opportunities for

intellectual, social, and emotional engagement with ideas, materials, and colleagues (Corcoran, 1995). In the IICA program, the teachers engage in their own study of the problem topics, collaborative planning of the remaining student problems, and online discussions of issues that arise during the implementation of the problems with students.

The IICA is, by design, a Problem-Based Learning experience for the students, so the teachers involved in the program need to have specific skills in PBL design and coaching. In the initial summer program, the teachers were first immersed into the students' Thai baht problem so they would fully understand it before coaching it with the students in the second week. As they explored the issues involved in the problem, they learned the economics content, became familiar with resources for the problem, and experienced PBL as learners. The critical elements of a K-12 PBL model (Torp and Sage, 1998) were clarified during the debriefing as they discussed the PBL process and the learners' perspective, as well as the coaching strategies they would need to implement it with the students. This reflects the belief that good professional development enables teachers to develop expertise in subject knowledge as well as in teaching strategies (U.S. Dept. of Ed., 2000).

The teachers collaboratively engaged in PBL design with the facilitators first by refining the Thai baht problem based on their own experience with it and on their knowledge of their learners. At the next stage of learning about problem design, they were presented with the rough outline for a problem addressing the issues of unemployment and

inflation in Latin American economies. As a group and with the facilitators, they developed this outline into a full design to use with their IICA students in the fall. The final engagement in the design process was for the teachers to begin the design process for a third problem topic. The teachers and facilitators began the design of a problem to be used during the second semester. They gathered information and developed a concept map for issues of sustained growth in China, Russia, and Japan.

Since good professional development provides for sufficient time and follow-up for teachers to master new content and strategies and to integrate them into their practice (Corcoran, 1995), during the second week of the summer experience the teachers coached the students. Each classroom had two teachers under the guidance of a PBL mentor. Daily debriefings with the whole group provided the opportunity for deeper understanding of PBL and for reflection and discussion of coaching issues.

By the end of the two-week summer experience, these teachers had gained knowledge in economic theory and the workings of the global marketplace as well as skills in designing and coaching PBL units. Reinforcement and extension of these skills and knowledge occur throughout the next two years as the teachers collaborate on problem design and implement coaching strategies in their home schools.

Student Summer Program

While the teachers studied PBL, the students were exposed to some complex contemporary regional issues through case

studies in order to flesh out their understanding of geography, world cultures, recent world history, international relations, and economics. This process of investigating structured case studies also served as a bridge between more traditional and familiar classroom experiences and the unfamiliar environment of PBL.

The second week was their first exposure to PBL. The students were placed in the role of reporters for the *New York Times* financial section who are to develop a series of articles related to the Thai baht crisis. This macroeconomics problem focused on the impact of oil prices on cross-currency valuations through examining the Thai baht crisis and its impact on other Southeast Asian economies as well as the interdependencies with the economies of Russia and the United States.

The students were challenged to consider the connections among supply and demand, interest rates, colonization, currency valuations, and the strategic roles of oil, politics, and religion in the post-World War II era. This unit was explicitly designed to meet components of an Advanced Placement Macroeconomics Course:and to address the Illinois Learning Standards for the Social Sciences:

Other opportunities of the summer were attending lectures from Dr. Henry Kissinger, former United States National Security Advisor, and from Lord Robertson of the North Atlantic Treaty Organization. They also spent several hours at the Chicago Mercantile Exchange immersed in the complexities of intermarket trading strategies and pit protocol in the Standard and Poors 500 futures pit.

Follow-up Program, Teachers and Students

The year following the first summer includes the two problems developed during the summer experience and a self-designed macroeconomics problem specific to a multinational business with its headquarters in Illinois. The students work in conjunction with corporate representatives, their IICA teacher, and their fellow IICA students in a virtual learning environment. The resolutions to these problems are presented to the IICA students, teachers, and corporate representatives.

Students in the second summer research and present a problem about microeconomic theory. The focus is on the decision of a privately held partnership to become a publicly traded corporation. In investigating this issue, the students consider the nature and essence of partnerships and corporations with a specific emphasis on the dynamics of fiscal transformation and evaluation.

Throughout the program, students become self-directed learners as the teacher's role gradually decreases, one goal of problem-based learning (Torp & Sage, 1998). The senior year provides an opportunity for students to apply the skills they have learned as they develop and resolve microeconomic problems specific to their international corporation.

The culmination of the Academy experience focuses in several areas. The Academy students will prepare a multimedia presentation of their work with their corporate sponsor. This is followed by a formal, international internship or externship with a corporate or governmental sponsor.

The Virtual Learning Environment

Twice during the year IMSA hosts a convening in which students and teacher sponsors share resources and exchange ideas. The IICA project director and IMSA faculty conduct site visits during which ongoing work is affirmed and new directions are suggested.

Between meetings, the students and teachers work collaboratively throughout the school years via the IICA's web site. This web site provides a chat room where the teacher and student participants share their ideas, comments on posted documents, and investigation results. The web site also serves as the central location to post documents, any documentation of statistics, recent news of the IICA upcoming events and featured speakers. The web site is constantly updated with pictures and video clips of the IICA students in their home schools in order to foster a sense of both virtual and actual community.

Conclusion

The Illinois International Career

Academy presents a unique opportunity to Illinois high school students and teachers. Through PBL experiences and international mentored opportunities, students forge authentic relationships with shapers of the global economy.

The IICA offers a formal course of study that aligns with and complements local districts' curricula and will ultimately influence teaching and learning throughout the state of Illinois.

This program models PBL as the framework for other programs. A key element is that the teachers engage in PBL professional development to become effective coaches for the students. The teachers learn to design PBL units by designing units to use in the IICA program. Finally, this program shows how the virtual learning environment enhances and can be enhanced by the use of PBL and face-to-face meetings.

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UPCOMING PBL EVENTS

Summer Sleuths Institute for PBL Coaching	July 15-19 and 22-26, 2002
The Center @ IMSA (Illinois Mathematics and Science Academy)	http://www.imsa.edu/center/
Harris Institute for PBL Design	July 15-19, 2002
The Center @ IMSA (Illinois Mathematics and Science Academy)	http://www.imsa.edu/center/
2nd International Symposium on Teaching and Learning in Higher Education	September 4-6 2002
National University of Singapore	http://www.cdtl.nus.edu.sg/tlhe/
PBL Symposium	February 14-15, 2003
The Center @ IMSA (Illinois Mathematics and Science Academy)	http://www.imsa.edu/center/
PBL 2003 will be held at Samford University in Birmingham, Alabama	http://www.samford.edu/pbl/
4th Asia Pacific Conference on PBL	December 9-13, 2002
Prince of Songkla University, Thailand	http://www.udel.edu/pbl2002

the Problem Log

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