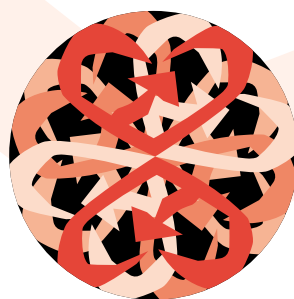


In the service of
learning...

Getting to the
Heart of
Problem-Based Learning

within the kaleidoscope



science enables the art to dance

Illinois Mathematics
and Science Academy®

PBL Symposium 2003

February 13–15

S U M M A R Y R E P O R T

Why a Symposium?



There can be no knowledge without emotion. We may be aware of a truth, yet until we have felt its force, it is not ours. To the cognition of the brain must be added the experience of the soul.

Arnold Bennett. The Journals of Arnold Bennett (1932).

It's about learning. It's always about learning. Learning is at the heart of what we do as educators. It is the source of our passion for teaching. Even when we lose sight of why we are doing what we are doing, we know at our core that, "It's in the service of learning..."

What is Problem-Based Learning?

Problem-based learning (PBL) is an approach to curriculum and teaching that involves students in solution of real-life problems rather than conventional study of terms and information. Developed in leading medical schools, problem-based learning begins with a real problem that connects to the student's world, such as how to upgrade a local waste treatment plant. Student teams organize their methods and procedures around specifics of the problem, not around subject matter as such. Students explore various avenues before arriving

at a solution to present to the class. Teachers report that students using problem-based learning become more interested in their studies, more motivated to explore in-depth, and more likely to see the value of the lesson. Problems are chosen for their appropriateness and power to illuminate core concepts in the curriculum. They must be carefully selected to ensure that students learn the intended content.

Source: ASCD Web Site <http://www.ascd.org/cms/index.cfm?TheViewID=1141>

Why PBL?

PBL engages students in powerful learning situations that capture and sustain motivation. And motivated students remain curious and become persistent, characteristics of successful learners and leaders in all fields of endeavor.

Why PBL Now?

The flood of information and the complexity of today's world demand abilities that equip today's learners not only with the knowledge but also the skills and dispositions to meet life's challenges head-on.

Why the Illinois Mathematics and Science Academy?

Simply stated, IMSA knows PBL. From pioneering early studies of problem-based learning in K–12 settings to the establishment of The Center for Problem-Based Learning to practice, research, and share information about PBL, IMSA has led the way for K–12 educators around the world since 1990. In 2002, planning for this symposium began. It was conceived as an event for learners, novices and experts together, to learn from and with each other about problem-based learning. PBL researchers and authors, exemplary PBL practitioners, recommended educational vendors, and outstanding programs that leverage technology and PBL in the service of learning answered the call.

In a time of drastic change it is the learners who inherit the future. The learned usually find themselves equipped to live in a world that no longer exists.

Eric Hoffer. Reflections on the Human Condition, aph. 32 (1973).

Biographies

Keynote Speaker

Dr. Stephanie Pace Marshall, President

Dr. Stephanie Pace Marshall is the founding President of the Illinois Mathematics and Science Academy in Aurora, Illinois. Dr. Marshall served as President of the Association for Supervision and Curriculum Development International, and was also the founding President of the National Consortium for Specialized Secondary Schools of Mathematics, Science and Technology. Dr. Marshall is a member of numerous corporate, civic and philanthropic Boards and serves as a private consultant, keynote speaker and writer on issues critical to educational transformation.



Author Panel

The Center @ IMSA assembled a panel of distinguished researchers, authors, and practitioners of problem-based learning. These panel members came together to consider several significant questions from their diverse perspectives.

Ann Lambros is the Director of the Center of Excellence for Research,

Teaching, and Learning at Wake Forest University School of Medicine. She conducts professional development seminars in PBL for educators from K–12 through the professional schools levels. Dr. Lambros is the author of the book, *Problem-Based Learning in K–8 Classrooms* and is working on a second book, *PBL in Middle and High School Classrooms: A Teacher's Guide to Implementation*.

Barbara Levin is Associate Professor of Curriculum and Instruction at the University of North Carolina at Greensboro. Prior to moving on to the university setting, she was an elementary school teacher in Wisconsin for seventeen years. Dr. Levin's research interests include the use of case-based and problem-based learning in teacher education. She is the author of *Energizing Teacher Education and Professional Development with PBL*.

Sara Sage is Assistant Professor of Secondary Education at Indiana University South Bend. Prior to moving to Indiana, she served as Professional Development and Research Specialist at the Center for Problem-Based Learning at IMSA, and has collaborated with several classroom teachers in researching PBL in multiple settings. Dr. Sage is the co-author of the book *Problems as Possibilities: PBL for K–16 Education*.

Bill Stepien is the principal of Human Learning Resources and an educator with over thirty years of experience in middle and high school settings, including ten years at IMSA. He has conducted PBL Professional Development across the country and, as an instructional developer, has written PBL curriculum for corporations and government agencies. Mr. Stepien is the author of *Problem-Based Learning with the Internet*.

Linda Torp is the principal of Possibilities, Inc. where she engages in consulting, writing, and researching for both education and business clients. She also coordinates grant submissions for the DuPage Children's Museum in Naperville. She has designed, developed, coached, researched, and written about problem-based learning for many years and is co-author of the book *Problems as Possibilities: PBL for K–16 Education*.



Dr. Stephanie Pace Marshall delivered an inspiring and thoughtful keynote that challenged attendees to become part of a new and emerging story of learning and schooling in America. She took on the challenge of providing:

- A personal view of learning and schooling in America as it is currently practiced that causes us to think about the conditions we as educators create that shape young minds, that perturbs us, and that energizes our leadership so that we give voice to a new story of learning and teaching.
- A rationale for why a profoundly new and radical story of learning and teaching is needed to create a new mind for the new millennium — one that dissolves barriers and creates conditions to build a life-affirming system that liberates the goodness and genius of all children and invites the power and creativity of the human spirit for the world.

Dr. Marshall also put forth the proposition that problem-based learning is a dimension of this new story of learning and teaching in that it nurtures the kind of mind needed to meet the ever-more-complex challenges of today's world. She offered the words of German philosopher Arthur Schopenhauer to illustrate how this kind of mind works:

“...the task is not so much to see what no one has seen, but to think what nobody has yet thought about that which everybody sees.”

Throughout history, we have learned that there are moments during which conditions converge and transformation happens where none was thought possible before. In Dr. Marshall's view that moment is upon us. We are ready for the transformation of the American education system. Do we want to be consumers, conquerors, or stewards of the world's riches? What role do we see for future generations?

Dr. Marshall illustrates the dilemma of educational reform in America with the words of Thich Nhat Hanh:

“...if you want the tree to grow, it won't help to water the leaves, you have to water the roots.”

Over the past few decades, educational reform has been busy watering the leaves; we must start watering the roots to contribute to the development of decidedly different and integrative minds. Our world's problems need connected thinkers: thinkers who can transcend disciplinary boundaries and become part of a growing web of global interdependent thinkers — thinkers who assume, indeed embrace, the responsibility for resolving the problems facing our planet.

Dr. Marshall makes the case that problem-based learning (PBL) creates a generative learning environment that is dynamic, creative, and life-affirming, that fosters deep conceptual understanding and an integrative world-view, and that nurtures truth-seeking and knowledge-producing. PBL contributes to an educational system that enables learners to acquire, assess, and use knowledge for the world.

Now is the time for a new story and PBL is an important part of it.

Author Panel Discussion

Torp: *As researchers, authors, teachers, and professional developers, we work in very different settings. So let me simply ask each panel member to briefly describe the settings in which you are using or have used PBL.*

Panel members clarified their perspectives on PBL, revealing various experiences: at medical school, in graduate and undergraduate teacher education, in elementary, middle, and secondary classrooms, and in professional development, as well as in business applications. The panel's experience and diversity became evident in both the commonality and diversity of their responses.

Torp: *The title of this Symposium is "In the Service of Learning... Getting at the Heart of PBL." From your perspective, what is at the heart of PBL? What makes PBL work as an engaged learning strategy?*

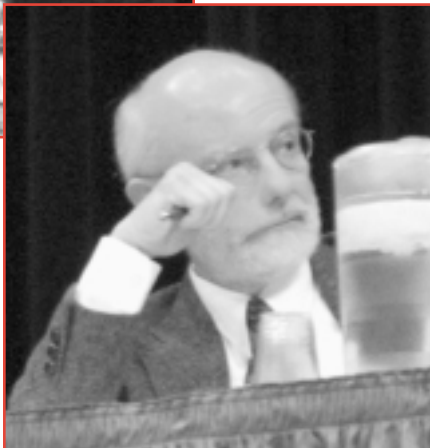
Barbara Levin responded that PBL motivates. No one can reach a child who is disinterested or who has shut down. She added that PBL enables deep engagement and authenticity so that there is a real chance to get at true learning. PBL restores the intrigue and the romance to learning. And — as the prime curriculum integration model — PBL empowers educators to connect with the world in which their students live to seek out and link to those things that capture students' interest and reap learning rewards.

Bill Stepien asserted that PBL pulls it all together as it wraps learning in the fabric of the real world. Read the biographies of innovators: they all talk about the problems that ignited their interest. Problems are magnetic — attracting students' interest and attention. When students are confronted with ill-structured problems, they take on the role of real-world professionals — as architects, historians, archaeologists — and think how the experts think. There is a commitment to reasoning and inquiry where students leave the low road of hunches and travel the high road of rigor.

Ann Lambros affirmed her belief that students don't know what to do when they don't know what to do. Problems provide the opportunities to see the possibilities in the muck of a problem or the blank page or canvas. Problems provide opportunities for students to demonstrate success — not the success of matching the words in column A to those in column B, but real success and that means something to the student.

Sara Sage thoughtfully added that it's okay not to understand something right away. Too often in today's classrooms students don't have the time to muse, to puzzle over, to think about responses before an answer — *the* answer — is expected. PBL teachers demonstrate a respect for students and what they can do when given the time to "cogitate," mentally test hypotheses, and rethink assumptions. In a PBL learning environment, students are able to delve deeply and become thinkers.

Thinking like an expert requires that students analyze a problem to see what pieces are there and what's missing — to view the problem from all sides — to find the real problem buried within extraneous and misleading data.



Author Panel Discussion *cont'd*



Torp: One important issue that always comes up, especially with high school teachers, is content coverage — particularly in light of state and national standards.

Ann Lambros clearly stated that when students know content, they can perform — and PBL students perform well. She elaborated by sharing research findings from varying levels of schooling that confirm that PBL students know and can retrieve information better than traditional students. This is especially true when we look at results over time. PBL students out-perform traditional students when the time period from the initial learning experience increases, demonstrating that knowledge retention is greater among PBL learners than among traditional learners.

Bill Stepien, in his role as a seasoned classroom educator, spoke for all teachers in stating that standards are a political response and, as such, are a reality in today's educational climate. But he firmly asserted that engaged learners perform well — and PBL learners are engaged learners. Recalling a Science, Society, and the Future course he taught with David Workman at the Illinois Mathematics and Science Academy, Stepien recounted how these students outperformed their teachers' wildest expectations on standardized measures of achievement.

Sara Sage agreed that content comes through PBL powerfully. When teachers start with a rich situation with learning potential, there is no question about content. In designing the problem, teachers weave the content and processes of the curriculum into the fabric of the problem. From there it is an easy next step to identify the standards. Students' PBL learning performances can be linked directly to the performance standards of any state's or national organization's learning standards. In fact, this is an easier task and better fit than trying to identify evidence of learning to meet the expectations of standards from a traditional curriculum.

Barbara Levin highlighted the assertion of many PBL educators. This learning strategy has enabled them to trust their learners because the evidence of true learning is so clear—and with this trust of the learner comes a greater trust in the process of PBL. As that trust grows and they employ PBL more, teachers are able to do and “cover” more in more meaningful ways. Content is no longer the issue; learning is first and foremost.



Author Panel Discussion *cont'd*

Torp: *With our current educational climate and its focus on standards and assessment, some colleagues are under pressure to abandon experiential learning strategies like PBL. Standardized tests because of their very nature don't "fit" the PBL model for assessment. How can school leadership help implement PBL in this time of high stakes testing and initiatives that demand immense expenditures of teacher time?*

Sara Sage's response was direct and heartfelt: use PBL daily. It is impossible to lead or to teach by admonition, by telling others what they should do. Instead, lead by example: engage staff in using the PBL process in faculty meetings and in committee meetings when wrestling with the problems of schooling in rural, urban, or suburban settings. Sage's background at The Center for Problem-Based Learning at IMSA came through clearly: "We teach the model by using the model." Using PBL as the strategy of choice in school leadership, professional development, and targeted problem-solving sessions is highly effective. It leads to a grounded recognition that PBL works and that leads to the adoption of a PBL frame of mind.

Ann Lambros added that as educators we need to become aware of the PBL possibilities all around us. It is not that one needs to find a problem, but rather that one needs to choose carefully from the array of problems all around us and match the problem with the curriculum and the interests of the learners. Successful individuals in all walks of life function with a "PBL Frame of Mind" — scanning, questioning, seeking, hypothesizing, probing, analyzing, synthesizing, evaluating, and taking a stand. Education needs proactive leaders to take a stand for PBL.

Bill Stepien proposed that he could tell when conducting a workshop whether PBL would thrive or wither on the vine. A few dedicated "scouts" or "pioneers" can only last so long without the incremental and steady support of administration. "Slow and steady" runs counter to the desire to change the world overnight, so enthusiastic administrators need to curb their enthusiasm and plan for success — not for the implosion of his/her school or district. This plan needs to include the integration of initiatives so that everything isn't piled up and added on, becoming insurmountable for teachers. Just as teacher coaching enables student performance, so does administrator coaching enable teacher performance.

Linda Torp closed the discussion by stating the intent of the discussion, that target "learning issues" would emerge. The conversation and exchange of ideas brought forth in this panel discussion enabled symposium participants to:

- Expand their vision of PBL's applicability for all learners across all areas, and
- Identify the critical elements of PBL in its multiple and varied applications.



Symposium Schedule



Friday Sessions

WELCOME

Linda Schielke, Director of The Center @ IMSA — schielke@imsa.edu

OPENING ADDRESS

Stephanie Pace Marshall, President of the Illinois Mathematics and Science Academy — marshall@imsa.edu
New Minds for the New Millennium

AUTHOR PANEL DISCUSSION

Aiming At the Heart of PBL

Ann Lambros, Barbara Levin, Sara Sage, William J. Stepien, Linda Torp

BREAKOUT SESSIONS

- A1:** *William J. Stepien*, Human Learning Resources, North Carolina — wstepien@email.uncc.edu
Coaching Kids to Become Better Problem Solvers
- A2:** *Lee Anne Burrough*, DuPage Children's Museum, Illinois — laburrough@dupagechildrensmuseum.org
Kids Design Network: An Internet-based Program Providing Focused,
Scaled-down Problem-Based Learning
- A3:** *John Thompson*, Illinois Mathematics and Science Academy, Illinois — jtt@imsa.edu
Teaches With Wolves: PBL in Biology
- A4:** *Colleen Burridge-Collins, Crocker Hollis, Mardie Robinson*,
Star Lane Center, Wyoming — chollis12@attbi.com, mardier2@bresnan.net
Unlearning: The Key to PBL
- A5:** *Kathleen Lee*, Youth-Driven Service Learning Center, Pennsylvania — Klee400@aol.com
Problem-Based Service Learning Project Development
- A6:** *Howard Zeitz, MD*, University of Illinois College of Medicine, Rockford, Illinois — hzeitz@uic.edu
Mark Gilbert, Sandy Clark, Barrington High School, Illinois
The Medical School Model of PBL: Application to High School Students
- B1:** *Dr. Ann Lambros*, Wake Forest University School of Medicine, North Carolina — alambros@wfubmc.edu
Problem-Based Learning: What, Why, How
- B2:** *John Lee*, EBSCO Publishing, Illinois — johnlee@ebSCO.com
Meeting Student Reading Goals Through Expository Content and Technology
- B3:** *Barbara Baber*, Illinois Mathematics and Science Academy, Illinois — bbaber@imsa.edu
Sex, Drugs, and Rock n' Roll Rap!
- B4:** *Katherine L. Hibbard*, Framingham State College, Massachusetts — Khibbard33@hotmail.com
The Inclusion Classroom Problem and Pre-service Teacher Education
- B5:** *Gary Ketterling, Ph.D.*, Benedictine University, Illinois — gketterling@ben.edu
Problem-Based Learning for Non-science Education Majors
- B6:** *Michael DeHaven, Richard Dods, Christian Nokkentved, David Workman*, IMSA — dehaven@imsa.edu,
rdods@imsa.edu — drnok@imsa.edu — workman@imsa.edu
PBL at IMSA: Past, Present, and Future Classroom Use

IMS A PANEL DISCUSSION

Barbara Baber, Brenda Crosby, Sue Eddins, Mark Horrell, Christian Nokkentved, John Thompson,
Illinois Mathematics and Science Academy — bbaber@imsa.edu — brendac@imsa.edu — eddins@imsa.edu —
horrell@imsa.edu — drnok@imsa.edu — jtt@imsa.edu
The Nature of "Problems" Across the Curriculum

Symposium Schedule *cont'd*

Saturday Sessions

BREAKOUT SESSIONS

- C1:** *Sara Sage*, Indiana University South Bend, Indiana — ssage@iusb.edu
& **D1:** Designing Problems for K–16 Classes and Professional Development
- C2:** *Dr. Robert J. Myers*, Center for Educational Technologies,
Wheeling Jesuit University, West Virginia — bmyers@cet.edu
Problem-Based Learning Across the Curriculum, K–16
- C3:** *Yolanda Willis*, Aurora East High School, Illinois — Smlasp34@yahoo.com
To Kill a Mockingbird: Understanding the Mindset of the South During the Thirties
- C4:** *Margaret Hill*, SCORE, California — Peg_hill@sbcss.k12.ca.us
Problem-Based Learning in an Era of Standards-based Reform
- C5:** *Deb Gerdes* and *Michael DeHaven*,
Illinois Mathematics and Science Academy, Illinois — dgerdes@imsa.edu — dehaven@imsa.edu
PBL at IMSA: External Initiatives
- C6:** *Howard Zeitz, MD*, University of Illinois College of Medicine at Rockford, Illinois — hzeitz@uic.edu
The Medical School Model of PBL: Application to Elementary Students
- D2:** *Shannon Ricles*, NASA Langley Research Center, Virginia — s.sricles@larc.nasa.gov
The NASA SCIENCE Files™
- D3:** *Michael DeHaven*, Illinois Mathematics and Science Academy, Illinois — dehaven@imsa.edu
Cybertribal Economists and the Anarchoprimitivist Response: A Virtual AP Experience
- D5:** *Morteza Shafii-Mousavi* and *Paul Kochanowski*,
Indiana University South Bend, Indiana — mshafii@iusb.edu — pkochano@iusb.edu
Designing and Teaching a Project-based Learning First-year Finite Mathematics Course
- E1:** *Barbara Levin*, University of North Carolina at Greensboro, North Carolina — bblevin@uncg.edu
Applying Research Findings to the Design of PBL Experiences for Teachers
- E2:** *Dave Chiszar*, Scantron Corporation, Illinois — david_chiszar@scantron.com
Adaptive Tools in the PBL Process
- E3:** *Rebecca Jaramillo*, Norwood Elementary School, Illinois — bjara@flink.com
Priming the Pump: Activities to Help Prepare Students for PBL in the Classroom
- E4:** *John Larmer*, Buck Institute for Education, California — johnlarmer@bie.org
PBL in High School Social Science
- E5:** *Sheryl C. Maxsom*, Ysleta Independent School District, Texas — Smaxsom@ysleta.isd.tenet.edu
PBL and 4MAT: Making Connections

CLOSING SESSION

What Is At the Heart of PBL: Synthesis of What We've Learned Together

Analysts: *Stephanie Pace Marshall*, President of Illinois Mathematics and Science Academy
Linda Torp, Author and International PBL Specialist — Linda_Torp@msn.com
Mike Flannery, Political Editor, CBS 2 News, Chicago





It is difficult to imagine that any participant left this conference without feeling heartened and energized to return to their work of making education meaningful for children.

I shared time and conversation with educators dedicated to shifting classrooms to places of greater meaning for children, and to fostering the abilities of children to make their own meaning.

Ann Lambros — Problem-Based Learning: What, Why, How

There are two prevailing scenarios which Problem-Based Learning effectively addresses. The first is the all familiar question often posed by students, “Why do we need to know this?” This student response to learning is indicative of the disconnected ways in which traditional education is delivered. Students are often asked to learn content by rote memorization for some future use which is of little or no meaning at the time of instruction.

The second scenario finds that with alarming frequency students do not know what to do when they do not know what to do. For much of their elementary and secondary education students have been “spoon fed” the information required, followed the assignments made to them, and been bound to handouts, textbooks, and worksheets in order to perform successfully on content examinations. When faced with the situation that does not comprehensively provide needed information, students become immobilized with no fall-back skills for acquiring new information on their own.

Problem-Based Learning addresses the first scenario by placing students in contextual learning situations which contribute to making an education of meaning rather than an education of fact collecting. Because students learn new content in the very context that they will be expected to use it, they are able to retrieve, synthesize, and apply information in multiple situations as needed. Students are also given a real world role in the problem which increases the meaning of the learning. They are able to readily understand why they will need to access the concepts and how they will be expected to apply them.

Regarding the second scenario, students themselves identify their learning needs and then pursue the appropriate resources to address those areas. They develop and consistently practice the skills to identify needed information, effectively and efficiently access that information, and then use it for problem resolution. Students become highly proficient in knowing the next step in any problem solving situation and highly effective at engaging that next step.

Dr. Lambros’s session was designed to provide an understanding of the philosophy of PBL and the rationales for implementing it as an instructional strategy in K–12 classrooms. Lambros began by sharing her experiences with a kindergarten class who were to design a wolf-proof house based on the already



Author Breakout Sessions *cont'd*

It remains my own belief and conviction that the potential to make an education of meaning is the heart and heartbeat of Problem-Based Learning. My conviction was renewed and strengthened by the opportunity to spend time in the presence of the people who make visions become reality.

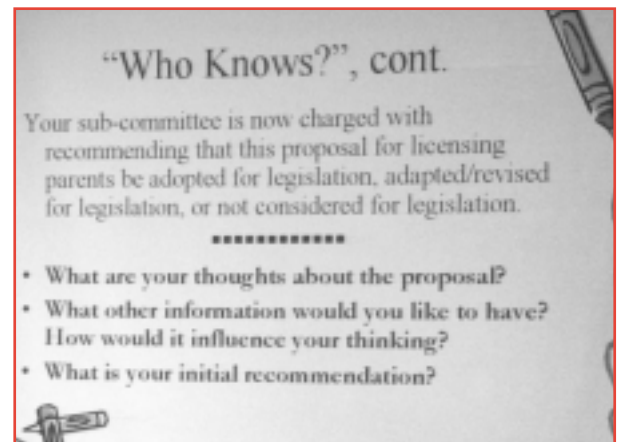
In the current climate of high stakes accountability and its related issues, how refreshing and rejuvenating to find people who are intensely committed to a better vision, a more meaningful vision than just test scores.

familiar story of the three little pigs. Their knowledge places them actively in the story and gives them a reason to expand their thinking based on the knowledge shared through the story. In this assignment, the youngsters were invited to consider what materials they would use to build a wolf-proof house and to provide reasons for their choices.

Lambros then presented a problem for the session attendees to consider: proposed legislation that would require parenting licenses. Teams of three to four people each drafted two lists: 1) the facts given about the proposed legislation, and 2) the list of information they needed to know to make an informed decision about this proposal. Lambros facilitated the discussions of the individual groups, then brought the whole group back together and made a list of the ideas that participants generated. Finally, she shared the “need to know” list she had created prior to the session, which was remarkably consistent with theirs. She emphasized the importance of facilitation to verify that pre-determined learning objectives (her list) are identified on the students’ “need to know” list.

A critical role of the facilitator is to probe and ask questions that are designed to have students critique the “evidence” they are compiling and to discriminate between fact and opinion. Another element of the role of the facilitator is to let go of the control of the evolving problem. Rather than prescribing the final product of a unit — paper, presentation, audio-visual program — allow the research phase to lead students to choosing their own format for presenting their findings and defending their positions.

Lambros challenged the novices in the group to take the leap of faith to get started.





Barbara Levin — Applying Research Findings to the Design of PBL Experiences for Teachers



If teacher educators are to engage the teachers we are preparing for our nation's schools, we must continually seek better ways to foster the knowledge, skills, and dispositions that they need to be successful in diverse classrooms. Problem-Based Learning (PBL) is one pedagogical tool that fosters the kinds of active learning experiences that prospective teachers should be engaged in during their initial teacher preparation, and that veteran teachers should experience throughout their professional lives. Using PBL for teacher education and professional development offers teachers opportunities to work together to solve complex problems and dilemmas related to students, teaching, learning, curriculum and instruction.

Problem-Based Learning is a good match to what we know about adult learning because it provides teachers with a variety of learning opportunities, acknowledges their personal beliefs and prior experiences, and has the potential to expand their

knowledge base and critical thinking skills as they actively engage in learning more about a problem from a multitude of perspectives. PBL allows adult students to work together, to share their expertise, and to learn from each other. PBL also provides genuine tasks in which teachers can practice their own communication skills in ways that parallel how they would like to engage their students in reading, researching, writing, and speaking.

PBL is also consistent with constructivist theories of learning that are foundational to many teacher education programs. From a constructivist perspective, learning is active and begins with eliciting and acknowledging what learners already know and believe. Teaching from a constructivist perspective includes asking big questions, providing learners with time to think, and guiding them to, but not giving them, the resources needed to answer their questions. PBL includes all of these features.

Teachers are unlikely to try using PBL unless and until they have had personal experience with this powerful and empowering way of learning. Therefore, if we want teachers to use PBL in their own classrooms, they need to participate in PBL in their teacher education programs and through staff development offerings.

During her session, Dr. Levin engaged the participants in just such a personal experience with PBL by having them divide into pairs and practice designing a problem on generating parent involvement in a child's education when the parents do not speak English. This design activity incorporated the research by Schmidt and

The strength of the learning at this conference was due to the expertise of the various speakers, their ability to share their knowledge and experience, and their willingness to engage with all the other participants during the conference through formal and informal conversations in large and small groups.

Author Breakout Sessions *cont'd*

Moust, published in 2000, that describes four types of problems which depend on the different types of knowledge that students are striving to acquire:

Fact-Finding Problems	Use descriptive, objective and public knowledge
Explanation Problems	Use declarative, explanatory or casual knowledge
Strategy Problems	Use procedural or strategic knowledge
Moral Dilemma Resolution Problems	Use personal, subjective normative knowledge

The power of engaging teachers and their students in PBL was obvious in [Mike Flannery's] conversion, and I only hope that he will influence other people in the media to focus on teaching and learning rather than solely on economics and politics when writing about education and schooling.

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The 2003 PBL Conference held at IMSA provided multiple, active learning opportunities for teachers new to and experienced with PBL.

Dr. Levin next shared Chapman's research that references six elements of PBL problem design that are necessary for motivation:

- *Familiarity*
- *Relevance* to students' lives
- *Dramatic Appeal* recognizes the value of a "hook" to engage the students
- *Significance* comes from focusing on a problem that affects others
- *Authenticity* creates a relationship to the actual profession that is associated with the problem
- *Group Collaboration* requires that students work together on some or all of the problem's elements to arrive at one or more possible solutions.

Chapman's work also identifies factors that detract from the work that a problem is supposed to generate. These include an overly complex problem as well as problems that have obvious solutions and are, therefore, too prescriptive. Formal group reports can also detract from the work when the technique is overused. Relying only on group grading can be a problem because that can allow one or more students to leave the work to those who are willing to do it, or it can leave an entire group vulnerable to the poor choices and ineffective work habits of one member of the team.

Dr. Levin's session effectively provided teachers with an experience incorporating the key elements of PBL as described earlier. They learned more about problem design by actively engaging in designing a problem from multiple perspectives. They worked together, shared their expertise, and learned from each other.





As I watched several presenters modeling PBL in their sessions, I observed expert coaching and was reminded of how intricate and complex coaching really is.

Symposia such as this in which people have time to dialogue with other educators from a variety of settings and levels of expertise are so important to increasing our understanding and helping us keep our perspective of what is really important in education.

Sara Sage — Designing Problems for K–16 Classes and Professional Development

The crux of all PBL design, implementation, assessment, and scholarship seems to center on one simple but profound statement: “It all comes down to our views of teaching and learning.”

Learning means coming to a deep, personally constructed meaning through personal and collaborative inquiry, experience and problem solving. To have learned something means not only that you can talk or write about it, do equations or problems with it, or describe it, but also that you can perform it and reflect upon it. To truly learn something also means that you can break down and compare the new concept to other known concepts and understand how it is similar and different, as well as be able to use the concept to perform new tasks, and evaluate the importance of and potential uses for the new concept. This kind of learning parallels the three highest levels of Bloom’s Taxonomy of the Cognitive Domain — analysis, synthesis and evaluation. But beyond the cognitive domain, we must also consider the performance aspect of learning — to be able to do — and the affective aspect of learning something — to value it.

How, then, does this view of learning — of knowing, doing and valuing — relate to PBL experiences? In PBL, we situate learners on the “inside” by immersing them in a problematic situation that gives them an incentive or a stake to learn in order to resolve the problem. We challenge learners not only to know concepts but also to be able to perform skills based on this knowledge and to value the impor-

tance of this information because it affects them personally.

This view of “inside” learning challenges many long-held beliefs in American education. If we use learners’ concerns and problems as the center of a course of study, as distinguished educators such as John Dewey suggest, our curriculum would look decidedly different. While determining a basic set of cognitive, performance and affective outcomes for students may be helpful, the use of PBL inherently goes beyond a pre-structured range of outcomes to deep, integrative learning. Assessment for learning looks different in PBL as well: we not only assess knowledge but also performance, attitudes and values, problem solving skills like critical thinking and self-directed learning, and the ability to work collaboratively. In PBL, instruction moves from the purpose of transmitting knowledge to the purpose of preparing challenging learning experiences and facilitating deep learning during those experiences.

Acknowledging that teachers who are newcomers to using PBL must deal with the fear of taking a first step, Dr. Sage facilitated a step-by-step process that participants could use to construct a problem and to begin facilitating problems in their classrooms. She began by showing her audience how to capture a group’s



As always, talking with other PBL practitioners and researchers is one of the best ways I know to learn more about PBL and rediscover important truths I know but need to remember.

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The more we know about different types of problems that may be used for different purposes, the more effectively we can design our own problems as well as help others with design appropriate for their own settings and students.

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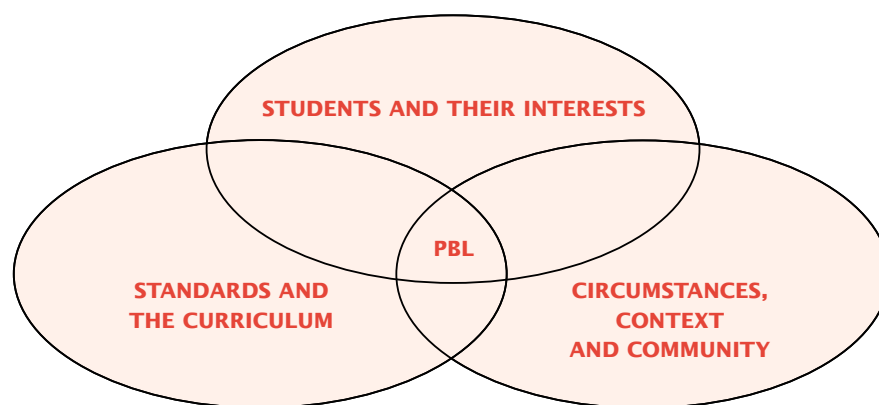
It reinforced for me the need to be politically and publicly active in spreading the word about constructivism, active real-world learning and assessment, and strategies like PBL.

attention and to invest them personally in the problem. Dr. Sage asked the audience what they knew about emergency procedures for the building in which they were sitting. What did learners know to do to insure their personal safety if an emergency announcement alerted the room that weather conditions conducive to forming tornadoes were present? Once she had her learners focused on the general topic, she then orally administered a ten-item quiz, part of her “hook” for this problem, on tornadoes.

In further setting the hook, Sage asked for this group’s help with establishing procedures to prepare summer workshop participants who will be at IMSA during tornado season. The assignment of what was to be investigated completed the transition from the quiz to the current problem. For the construction of the Know/Don’t Know lists, she had the room break into groups of three to four people.

In bringing the group back together to discuss the experience she provided, Sage explained the elements of setting the hook, introducing the students to the problem, assigning them a role for the investigation, defining the problem statement, and gathering and sharing information. Sage also covered incorporating curriculum standards into the investigation of a problem. Sage said that to verify that the concepts are getting across at least as well as when content was taught traditionally, “use the same test as pre-PBL.”

She let the activity lead to the development of this diagram that indicates how the elements of student experience should affect the selection of subject matter for a problem.



Using her extensive handout on design in tandem with her six-page PBL template, Sage discussed sources for problems. While there are many problems available on-line, she encouraged people to adapt what they find to the circumstances of their own students and their local communities. For problems that are controversial, assigning students to represent the position that differs from their own personal viewpoint gives these students a reason to do a more thorough investigation because their presentation will not reveal their convictions nor make them vulnerable because of their convictions.

“It all comes back to our views of teaching and learning.” If we fully accept the views of teaching and learning upon which PBL is based, we must also come back to the challenge of creating a whole new system of learning — a new range of knowing, doing and valuing in our educational institutions.



It became clear that a wide variety of styles were being employed in the delivery of PBL. It also became clear that, regardless of the style, effective PBL always seemed to include specific, core elements.

William J. Stepien — Coaching Kids to Become Better Problem Solvers

Huck Finn is rumored to have explained his frequent absences from school this way: “You can learn sixty times as much about cats by pulling their tails as you can by reading about them in books” (Hal Holbrook, *Mark Twain Tonight*). Problem-Based Learning encourages students to “grab the tails of real-world problems,” permitting them to construct new knowledge around issues in the problems while they build experience with the process of inquiry needed to resolve real world problems.

Educators (and parents, too) are interested in helping children become better problem solvers. But explicit attention to this worthy goal is only found in a few places; and in most of these classrooms, well intentioned efforts involve teaching with tidy problems that can be resolved with the

help of fairly simple formulae. One rarely finds complex, messy, real-world problems, the type of problem that provokes learners to use and refine powerful problem solving skills, as the focus of these investigations. Too often in these classrooms, “problem solving” is equated with learning the steps of a model or rubric, under the false assumption that knowing the steps is synonymous with being an effective problem solver.

There is no reliance on tidy, well-structured problems or simple formulae during PBL. At the opening of a PBL unit, children meet a situation with a messy, ill-structured problem at its core. Ill-structured problems provide learners with a genuine problem to resolve and an authentic setting to manage, engaging students because these problems:

- are messy and incapable of being fully understood when first encountered,
- often change their nature as more is discovered about them,
- defy solution by a simple formula,
- require careful consideration of the fit between solution and problem, and
- illustrate the difficulty of being sure one has “the right answer” because data can be missing or in conflict, even after exhaustive investigation.

Genuine, authentic problems create productive learning environments because they demand problem solving the way it is practiced by experts: issues must be identified, hunches and hypotheses investigated, and solutions justified to others by way of their fit to relevant criteria. During investigations, students criss-cross domains of knowledge, making interdisciplinary connections. They move forward, hit dead ends, revisit ideas, revise their thinking and move on. During the process they build substantial knowledge bases, enter into real collaborations with classmates, and, in time, learn to resolve complex problems.



Author Breakout Sessions *cont'd*



Through his presentation, Stepien talked with the audience of teachers about their roles in an effective PBL classroom. Engaging students as problem solvers looks and sounds different: they talk to each other as well as to the teacher; they go to the library and other places where they can gather facts; they work through the transparent structure of a well-constructed problem. In this framework, a teacher is a coach, a mentor, a facilitator, but not the only fount of wisdom.

Stepien guided participants through an analysis of four areas that affect success in coaching and facilitating: *Environment, Structure, Teacher-Coach Behaviors and Student Behaviors*. The optimal *Environment* encourages both reflective thinking and risk-taking when the teacher and students agree to respect one another, giving each other

safety to participate. When arranged for user-friendly comfort, the *Structure* of the room, allows everyone freedom to talk and incorporates visual display of information. *Teacher-Coach Behaviors* embrace a continuum of facilitation techniques. The Teacher-Coach encourages participation by positively engaging quiet students and not allowing extroverted students to dominate (right answers are less important during open discussion than the act of contributing). The teacher's style of probing, challenging, encouraging and guiding sets the tone for the entire class. *Student Behaviors* reflect how students respond to the choices that their Teacher-Coaches make. Students actively receive the problem that the teacher presents by questioning, clarifying responses and asking new questions as they develop information. Students are aware that they are learning and, through involvement, they learn to think critically as they participate in the discussion.

The teacher plans the sequence of questions in advance of the class with the goal of mixing lower-order and higher-order thinking questions. Since the teacher coaches by selecting students to respond, he/she guides the discussion and the timing of probing and clarifying questions. While the discussion will cover content that is not on the priority list of questions that the teacher brings to class, the preparation of this "hit list" will manage the discussion and keep it focused on the key elements of the problem.

Stepien cautioned participants about relying on PBL to the exclusion of other teaching methodologies. "Don't overuse PBL. A couple of well-designed problems will produce profound effects with students. Too many problems, especially poorly conceived ones, will actually blunt PBL's effects." Rather than have one course use PBL as its only strategy, he encouraged audience members to collaborate with their colleagues to embrace PBL across disciplines. While he has not documented the impact, he said he suspects that there is a positive cumulative effect when students have an opportunity to see problem solving through the eyes of teachers in different disciplines.

PBL doesn't end until the newly acquired knowledge is used or applied to resolve the problem students met at the beginning of the unit.

Common Themes from the Breakout Sessions



The Symposium provided a forum for individual presenters to demonstrate how to bring PBL to students of varying ages studying a range of content and working in different environments. As the two days unfolded, a set of core elements emerged that seem to answer the question, “What is at the heart of PBL?”

Use the Model to Teach the Model

In the opening panel discussion, Sara Sage advocated using the model to teach the model. Dr. Robert Myers further clarified the need for this type of professional development in PBL by saying, “Teachers can’t really teach inquiry until they’ve experienced it.” Participants of this symposium were able to gain that PBL experience in several sessions that spanned various grade levels and content areas.

Becky Jaramillo, an elementary special education teacher, focused on activities designed to help students think out of the box. Participants in her session were asked to role play being fifth graders and to write a hypothesis of the problem she presented. She also distributed an article and took the participants through an exercise of reading, hypothesizing, and reflecting that helps students develop critical thinking skills. This session allowed participants to explore various ways to prepare learners for a PBL experience.

Yolanda Willis immersed her participants in a condensed version of a PBL unit for a high school English class. The unit, *To Kill a Mockingbird: Understanding the Mindset of the South During the Thirties*, begins with the scenario that one of the people they are considering honoring through naming of the new high school is a man whose profile includes episodes of racism and criminal activity. The students are then challenged to come up with a recommendation about whether or not to name the educational facility for this person. This session enabled the participants to experience the power of PBL: it engages students through their emotions but requires them to analyze a situation critically.



Giving pre-service teachers the challenge of making a decision about whether or not to accept a principal’s invitation to teach a full-inclusion class of eighteen students formed the basis of Katherine Hibbard’s session. The efforts required to work through this decision-making process show students that they need to develop skills and strategies to approach life — personal and professional — in a problem-based way.

By using the model of PBL to teach the model of PBL, presenters engaged their participants in constructivist learning. Rather than lecturing on the power of PBL, they modeled coaching skills that enabled participants to experience, and thus to understand, the powerful impact of PBL on learners.

Symposium participant – The reinforcement from one speaker to the next confirmed that certain basics are essential to PBL.

Symposium participant – This symposium has sharpened my understanding of the essential features not only of PBL but of human learning.

Symposium participant – The various presenters showed both unity of approach and variations.

Michael DeHaven –

PBL is a revolutionary experience which breaks students' emotional dependency on the teacher by empowering students.

•

Symposium participant – Students are viewed as competent learners! They become engaged and see themselves as explorers of their world! They are able to make valid and respected contributions and adults affirm their insights.

•

Symposium participant – I learned that I can work with our at-risk students as well as the gifted! Finally we can ensure that no child will be left behind.

•

Symposium participant – It gives students a choice and gets them more involved. It is different from what kids are used to in most classes.

•

Symposium participant – I will pay closer attention to my learner characteristics and interests. How can I hook them to investigate an idea?

Student-Centered Characteristics

In first coming to PBL, teachers and students alike must unlearn old definitions of their roles by being willing to accept different responsibilities. Despite a decades-long model of teachers as founts of wisdom dispensing facts, students are not empty vessels to be filled or blank slates waiting to be written upon. Unlearning old habits is the biggest barrier and yet the required key to the successful implementation of PBL, according to the team from Star Lane Center in Wyoming: Colleen Burrridge-Collins, Crocker Hollis, and Mardie Robinson. In giving ownership of the learning process to their students, teachers have to confront the risk of letting go of what they perceive is their control of the classroom. Yet, as the adults assume the role of tutors who participate as learners, they gain the opportunity to see genuine growth in their students.

One of Paul Kochanowski's motivations for developing a PBL course is that there is so much information given to the student that much of the learning is

lost. Traditional textbook presentations do not lead students to inquiry or to an understanding of what types of situations call for which techniques. While this change in approach generates anxiety among students, the measure of its power is the amount of work that students are willing to put into it once they have ownership of the problem.

John Thompson, IMSA faculty member, told his audience that PBL engages all students, not just "techie" or those who are academically-talented. The fact that PBL meets the needs of students who focus on learning instead of on grades allows at-risk students who may not read or write as effectively as their peers to achieve success within the model, as emphasized by Becky Jaramillo. PBL values their differing abilities and frees them to contribute to projects in ways that are not limited to memorizing text and reciting it on a testing instrument.

Colleagues Mark Gilbert and Sandy Clark shared the differences in PBL units for a senior-level honors science course and a freshman course. Gilbert allows his senior students to chart their own course through a carefully structured sequence on developing a cleanup plan for an oil spill. Clark modified the sequence so that she could teach study, organizational and research skills to her freshmen who were novices to the PBL process.





Engaging students doesn't just happen; teachers intentionally design PBL units to get the students to invest in their own learning. David Workman names his problems with intriguing titles — *Jane's Baby*, *Murder in the Bathroom*, *Lila* — as one way of engaging students. One of Workman's first problems, exploring the effect of low frequency magnetic field radiation on humans, is an ongoing investigation with no known definitive answer. He identifies this element of uncertainty as a key aspect in keeping students "hooked" in an ongoing study of the problem.

Gary Ketterling uses PBL to teach four science content classes to non-science education majors who bring with them fear, dislike and a corresponding level of high anxiety about math and science and yet they need to be comfortable with both disciplines to teach to standards. The outcome is that these non-science majors are enrolling in more PBL science classes than are required.

In a panel discussion at the end of the day on Friday, IMSA faculty members shared other perspectives on the nature of problems in various curricula using methodologies other than problem-based learning. Examples were given for wellness (Barb Baber), foreign language (Brenda Crosby), mathematics (Sue Eddins), science (Mark Horrell and John Thompson), and social science (Christian Nokkentved). They described multiple ways in which problems can be the focus of learning in any content area.

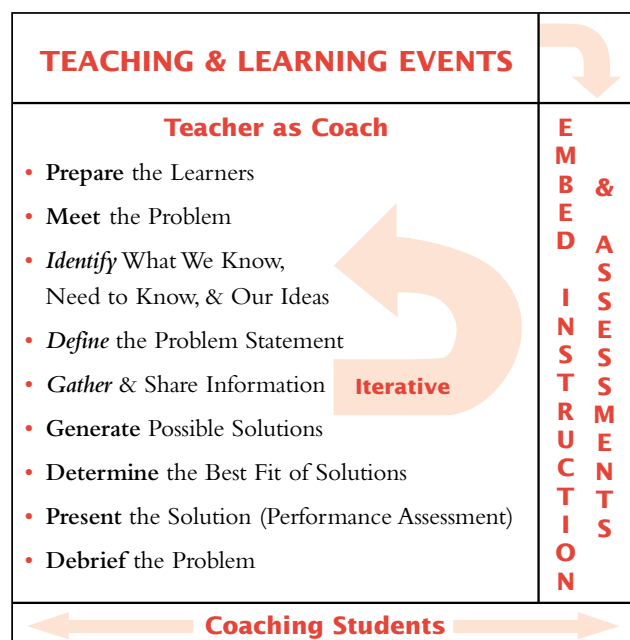
These sessions illustrate PBL is all about the students. In order for students to learn, they must be intellectually engaged. The driving force in problem design is a guiding question: what will engage my learners in the curriculum to be learned?



Problem-Solving Process

Through multiple opportunities to meet, investigate and offer solutions to problems, learners gain a set of skills in one situation that they can then use in a new situation. Presenters used slightly different vocabulary

to describe the process, but all shared elements similar to those in the PBL Instructional Template in this diagram.



Cathy Wright shared her PBL unit for seven- to ten-year-old students. Her process includes the initial scenario, summary of the given facts in a "Knows" list, and a student-generated list of their "Needs to Know," complete with the time frames for conducting each piece of the lesson before the students gather the information needed. Her lesson plan illustrates when the teacher interjects to guide the students to specific concepts or to emphasize certain questions.

Howard Zeitz, Wright's mentor, advocated the scientific method as a strategy for framing the investigation: a) data, b) question, c) hypoth-

Reference: Torp, L. & Sage, S. (2002). *Problems as Possibilities: PBL for K-16 Education*. Alexandria, VA: ASCD, p. 36.

Common Themes from the Breakout Sessions *cont'd*

Symposium participant – The symposium has helped my understanding by teaching me how to go about developing a PBL unit. It has also reinforced the concepts of problem, what is it, how do you solve it, and so forth. It has helped me to organize how to develop the problem.

Symposium participant – The most essential feature I've learned from this conference is that students' problem solving, when engaged with the activity, can bring them to solutions never imagined.

esis, d) test hypothesis, and e) seek new information. This medical school model traces its roots to case studies used in the Harvard Business School during the 1930's. This approach uses progressive disclosure to disseminate chunks of information over time about the key concept of the problem.

Sheryl Maxsom merged 4MAT and PBL as a framework and uses an initial process of KND: Know/Need to Know/Need to Do Lists, which correlates with the Know/Need to Know stage in Barb Baber's work. Baber next gives students time to work independently at gathering data and information. During discussion of their findings, the sharing information phase, she challenges students to identify the sources of their information. Through this process they learn to establish the credibility of their sources as part of the data collection activities.

Morteza Shafii-Mousavi and Paul Kochanowski shared a unit that combines principles of economics and math for university freshmen. In their process, students 1) define the problem, 2) find and organize information, 3) find proper methodology, 4) find and support solutions, and 5) write a report and make presentations of the completed work. They want their students to gain the ability to understand and apply basic tools of mathematics, to enroll in additional mathematics courses, and to seek quantitative approaches to studying other disciplines.

All of these variations share key elements that put students through a problem-solving process and thereby give them skills to be lifelong learners and problem-solvers.



Connection to the Real World

Another theme that emerged from most presenters is PBL's strong connection with the real world. Students are given real problems to solve and real experiences in accessing information from real people and resources beyond the textbook.

John Thompson guided participants through the highlights of his ten-year study of the timber wolf. To gather real data, Thompson's students go into the field, including Yellowstone National Park, to learn the effects of the reintroduction of wolves into that setting. He also described his development of assessments that use real input from real people, such as the questions a real coroner's jury would ask.

Common Themes from the Breakout Sessions *cont'd*



Kathleen Lee, a language arts and social studies teacher, directly involves her students in their community as they explore problems in a service learning context. Service learning is a constructivist teaching methodology that incorporates various aspects:

- Authentic Needs
- Academic Rigor
- Adult Connections
- Applied Learning
 - *Active Exploration*
 - *Assessment*

Stressing that service learning is not community service, Lee explained, “The key difference between service learning and traditional PBL is the role of advocacy in the project. Students work to achieve a change.” Her students participate in the research and selection of a problem that is inherently controversial in her LaSalle, Pennsylvania community. Recently her students won a grant to install a bio-retention drain.

The Star Lane Center highlighted their evolving story as a learning community that takes risks and challenges the status quo with the belief that students must acquire information that is relevant to their lives. The availability of community resources is crucial to their implementation of PBL. Students go out into the community to gather data, and they present their solutions to real stakeholders in the community who ask probing questions to ensure that the students have considered all aspects of the problem.

The Kids Design Network, presented by Lee Anne Burrough, provides opportunities for children from five to ten years of age to learn about engineering and to become invested in engineering by designing and building a simple machine. They can have their design and their ideas about how it works critiqued by an engineer in real time. Children draw a schematic of their design using drawing tools that are provided and type notes back and forth in an on-line dialogue with an engineer whose time they reserve in advance based on an on-line schedule of open time slots.

The real world is not limited to the local community. Michael DeHaven is convinced that “PBL is not contingent on face-to-face interaction; it can and does work in virtual space.” Michael has overcome his own resistance to integrating PBL into his classroom and now works actively to convert colleagues not only to using PBL but to doing so in a virtual environment.

Dr. Robert Myers introduced participants to the Exploring the Environment portion of The Center for Educational Technologies website that offers PBL science modules for grades 5–12. It is also the gateway to the Challenger Learning Centers, an outreach opportunity through which students take on roles and become part of missions into space.

In PBL, students learn curricular content through authentic context. No longer do they ask, “When will I ever use this?” Instead, they explicitly state their need to know the information. Whether they solve a community problem or use community resources, or go on-line for national/international resources, PBL students connect their learning to the real world.



Symposium participant –

I will be more aware of real-world situations that may be used to support concepts in my classroom.

•

Symposium participant –

I am trying to improve my use of community resources when executing a PBL unit. This symposium has given me more ideas on how to do that.

•

Symposium participant –

My students came up with a problem in our community dealing with invasion of privacy and personal rights by snow-mobiles invading private property. I encouraged them to be proactive and do something about it. I now have a model to follow.

*Symposium participant –
I am beginning to see PBL as
a “living organism” in the
world of learning. Problematic
learning tends to stay with us.*

Competency Driven Approach

Since PBL is often criticized by non-practitioners as “fluff,” several presenters emphasized PBL’s effectiveness in preparing students to meet academic standards. Although problems appear ill-structured to students, they are developed around learning objectives and standards that allow teachers to coach students to the discovery of the content that is fundamental for the unit of learning.

Michael DeHaven reviewed his process for creating an on-line course in economics and cited the advanced placement concepts that each problem covers as well as their alignment with the State of Illinois Learning Standards. DeHaven prepares a concept map of the problem identifying the learning experiences that he intends the

problem to cover. The concept map becomes an assessment tool to determine what students are learning.

The website SCORE (Schools of California Online Resources for Education) presented by Margaret Hill highlights the history and social science standards embedded in each problem. Hill presented the interactive, web-based, six-step process that guides teachers from the standard to determining the assessment to preparing the lesson.

Using IMSA-authored PBL design tools, Barb Baber, in collaboration with John Martin and Nancy Todnem, began the development of a PBL unit for a wellness course by identifying learner characteristics as a way to guide the selection of curricular outcomes and both intrapersonal and interpersonal learning outcomes. Baber used the construction of a Genogram by each student for a self-assessment of personal risks as a means of keeping their engagement at a high level. She also challenges students to identify the sources of their information. Through this coaching process, students learn to establish the credibility of their sources and to differentiate between facts and opinions.

Katherine Hibbard demonstrated how the generation of a *Need to Know* list covered specified pre-service curriculum objectives required for licensure. The use of a problem structure also allowed her to introduce the cooperative learning technique, Jigsaw. Jigsaw gives each child an essential role to perform on which all other students are dependent to complete the assignment and/or perform successfully on a test.

Two on-line resources, the NASA SCIfiles for younger students and NASA CONNECT for middle school students, offer PBL units. Shannon Ricles said the SCIfiles storyline follows the exploits of six ethnically diverse “tree house detectives” who use mathematics, science, technology and NASA to solve problems in their world. The program’s foundation is the federal mathematics and science standards.

Middle school teachers and administrators found grade-level applications for their students in the EBSCO Publishing session where John Lee presented examples of assignments from the EBSCO*learn* series. These applications are designed to supplement classroom content, provide opportunities to improve reading comprehension, and increase the amount of practice students receive in taking standardized tests.



Common Themes from the Breakout Sessions *cont'd*

Richard Dods presented the findings of his 1997 study comparing the effectiveness of PBL to that of a lecture format in promoting the acquisition and retention of knowledge. His conclusion from this study is that PBL promotes in-depth understanding, but content coverage is more comprehensive in the lecture format. He discussed the current debate in science that is attempting to define how much content is sufficient for students to acquire and the parallel debate to promote higher order thinking skills. He cautioned that his own research needs to be replicated by others in different settings.

John Larmer shared the rigorous process Buck Institute for Education uses in their development of PBL units. BIE invests two years in developing, testing and publishing five to six units. Dave Chiszar of Scantron brought sample products, The Classroom Wizard and Skills Connection, of computer-adaptive and real time assessment tools that provide one option for collecting evidence that responds to the demands of the data-driven decision making world that currently sets the tone in much of education. One of the ways for PBL to achieve wide acceptance is to be the subject of many research models that produce data demonstrating that it is effective.

Well-designed PBL units create a rigorous learning environment. Students not only learn curriculum specified by local, state, and national standards, they learn to validate their sources and to synthesize information from various resources.

Summary of Common Themes

Symposium participants, whether novice or experienced PBL practitioners, chose among many sessions to meet their own learning needs, yet the core message was similar, regardless of the specific session attended. Through using problem-based learning in their sessions, the presenters modeled the key elements at the heart of PBL. Students, first and foremost, are at the heart of PBL. Their interests and their characteristics guide the teachers in the design of PBL curriculum. Specific problem-solving strategies are also key elements of PBL. These strategies may not be explicitly given to the students but instead may emerge as they go through the process.

A third common element at the heart of PBL is an authentic connection between the curriculum and the real-world experience of the students. Learning happens in context rather than in isolation. A fourth key element is an emphasis on competency. PBL units are designed to meet specific curricular standards at a deep level of understanding, rather than just knowing.

PBL sets high goals for students to direct the process of their own learning, engages students in content that holds their interest, and allows students to achieve and frequently exceed the standards assessing their performance. At this symposium, experienced PBL teachers eagerly shared their personal, powerful experiences about how possible it is to change the traditional classroom through PBL.



*Symposium participant –
And now it is clear to me that PBL is not like a “cooking recipe,” but a way of thinking about teaching and learning that can be applied at any level and in any subject.*

•

*Symposium participant –
I will examine what I need to do in order to create/construct problems that can capture my audience, while covering the critical content that is to be covered. I will try to figure out how to connect the disconnected.*

Symposium Closing Panel

During the opening of the Symposium, we asked everyone to step inside the problem and learn. In particular, we charged everyone to take note of the variations on the PBL theme presented and to identify the elements each had in common.

Our hope was that you would be able to both see and appreciate two things:

- PBL can be and indeed is applied within and across disciplines at all levels of education, and from short-span to multi-week investigations to the full-scale adoption of a PBL frame-of-mind.
- The essential elements of PBL shine through each variation — the problem focuses all learning, learners own the investigation and the resolution, and the relevance or context of the problematic situation motivates and grounds authentic learning.

That's the beauty of a model. It's not a script or a road map or a blueprint. It's a model—one that allows for stylistic differences and adaptation while enabling deeper levels of learning and application.

Linda Schielke reconvened presenters and practitioners for a final reflective debrief in the spirit of problem-based learning.

Stephanie Pace Marshall, Michael Flannery, and Linda Torp were invited to comment on the impact of the symposium during a brief closing session on Saturday, February 15, 2003. The three conversed freely, sparked by quotes captured during the symposium.

Linda Torp spoke of the substantial body of research that points to the fact that our educational system produces dependent learners. In Ann Lambros' words, "They don't know what to do when they don't know what to do." If dependency should not be the goal, what is and why?

Dr. Marshall underscored the demands of our current and future world, one that is rife with problems, predicaments, and puzzles. Complexity is the norm and it is critical that we grow minds that can reframe and solve problems. Future citizens must be fearless learners who are not afraid to venture into the unknown seeking data, analyzing conditions, evaluating effects, and drawing appropriate conclusions.

To become fearless learners and problem-solvers, our students must experience learning in dynamic situations where

information is the energy that fuels inquiry—not simply a commodity to be obtained and stored. This view fits what we are learning about cognition.

If information is the fuel, the combustion chamber is context. Context provides the container into which learning connects and interconnects. Without context, we collect disembodied information with nothing to connect it to — and little meaning for the learner.

Marshall supported her comment with an example. "Physics First, an innovative curriculum model for the sequence of secondary school science, provides clear connections to the larger whole. Conceptually, Physics First provides the foundation and the connective tissue for chemistry and biology."



Symposium Closing Panel *cont'd*

Torp highlighted Bill Stepien's comments about the issue of relevancy. He urged that we must "wrap learning in the fabric of the real world." Contextualizing learning emerged in each presentation over the two days of the Symposium.



Mike Flannery took the opportunity to place his learning into the context of his world—that of journalism and policy. He confessed that after nearly thirty years as a journalist, only during this Symposium did he become aware of the political nature of textbook development and sales. Using this one issue as an example, Flannery emphasized a need for clear communication regarding education. Sometimes the words, or the jargon, of the education profession get in the way. But the need for educators to communicate forcefully and clearly is more urgent than ever, especially in the policy arena.

Flannery urged educators to "raise the level of their game" by being informed, being knowledgeable, and being involved. Teachers need to be better educated about their profession. They need to know at deeper levels about learning and cognition and to be able to engage parents, community members, politicians and policy makers professionally at deeper levels. He went on to advise us not to get stuck in the issues at the margins that become sideshows, but rather to concentrate on what matters most—the quality of learning and the ability of our children to learn. The teachers' voices are missing from the debate and this cannot continue.

Linda Torp brought the Symposium to a close. Symposium attendees believe wholeheartedly in the power and potential of PBL to support authentic learning, learning that is demonstrated by significant and meaningful achievement as opposed to learning that is trivial and inert (1993, Newmann & Wehlage). This kind of achievement is characterized by (1) students constructing meaning and producing knowledge, (2) students using disciplined inquiry to construct meaning, and (3) students aiming their work toward production of discourse, products, and performances that have value or meaning beyond success in school. PBL is as authentic as it gets.

Problem-based learning allows students to apply their minds to work that is of value to them for reasons beyond success in school. They employ higher order thinking skills, develop a depth of knowledge, connect this learning to their world, engage in focused, substantive conversation, and receive feedback from peers, teachers, and others in their community. PBL serves learning well.

We know PBL works; because of that, we have a responsibility to spread the word. But we need to understand that the conversation needs to be engaged philosophically—at the level of beliefs. What do we believe about the role of the teacher, the role of the student, curriculum, what it means to teach, what it means to learn, and the nature of knowledge?

Think of it as a conversion experience because it is—one must believe to be able to practice PBL.

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Resources

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Publicly-Accessible Resources

Center for Educational Technologies. The CET website, www.cet.edu, is the gateway to the Classroom of the Future project, the NASA Educator Resource Center and the Challenger Learning Centers.

Kids Design Network. The Network found at www.dupagechildrensmuseum.org/kdn combines hands-on building with computer time, including real-time, secure communication with engineers via the KDN website.

NASA SCIENCE Files™. This series includes nine instructional programs designed to introduce students in grades 3–5 to the excitement of NASA, mathematics, science and technology. The web address is scifiles.larc.nasa.gov/treehouse.html.

Schools of California Online Resources for Education. At score.rims.k12.ca.us educators will find a web site offering California's online resources for educators categorized by grade level and topic.

Vendor Resources

Adopt-A-Watershed. Contact Kim@Adopt-A-Watershed.org
Provides K–12 Environment-based curriculum.

Buck Institute. Contact Johnlarmer@bie.org
Develops problem-based economics curriculum units for high schools.

EBSCOlearn™ is an online tool for educators to use for the purpose of improving reading comprehension. The non-fiction, lexiled articles can also be used to supplement textbook instruction at individual reading levels.

NCREL. Contact doug.obert@ncrel.org
The North Central Regional Educational Lab offers a wide variety of educational resources.

Scantron. Providing education testing and assessment tools for thirty-one years, this firm's website, www.scantron.com, profiles products and services.

The Center @ IMSA features 3 Classrooms in Action PBL video and Inquiry and Problem Solving video and booklet. www.imsa.edu/center

Ventures Education Systems Corporation. Contact info@ventures.org
Provides professional staff development in classroom management and test preparation.



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A Final Word...

It is with great pride and gratitude that we share this summary report of our Problem-Based Learning (PBL) Symposium at the Illinois Mathematics and Science Academy (IMSA) on February 14–15, 2003. We hope this event was another important step in sharing the power of PBL with the world. From Stephanie Marshall's inspirational invitation to help create a new system of teaching and learning to Mike Flannery's emotional tribute to the power of teachers to change the world, this convening was truly a remarkable journey to the heart of PBL!

We were honored and moved by the phenomenal contributions made by all of our authors and presenters, and we thank them for coming to teach and learn with us. We have tried to capture the essence of what they said and how they perturbed our thinking and furthered our knowledge in the pages of this booklet. We couldn't include everything, but we hope we've captured enough to make you want to check the references cited in the final pages. We hope you'll keep and use this resource in your own journey to better understanding and applying the powerful components of problem-based learning.

Please check our web site for further information about upcoming learning opportunities in PBL (www.imsa.edu/center/pbl).

Sincerely,

Linda Schielke
Director, The Center @ IMSA

Deb Gerdes
Professional Development Leader for PBL, The Center @ IMSA

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The Illinois Mathematics and Science Academy®

Located in Aurora, Illinois, the Illinois Mathematics and Science Academy is an internationally-recognized pioneering educational institution created by the State to develop talent and stimulate excellence in teaching and learning in mathematics, science and technology. IMSA's advanced residential college preparatory program enrolls 650 academically talented Illinois students in grades 10–12. More than 16,000 teachers and 23,000 students in Illinois and beyond have benefited from IMSA's professional development and enrichment programs. IMSA serves the people of Illinois through innovative instructional programs, public and private partnerships, policy leadership and action research.

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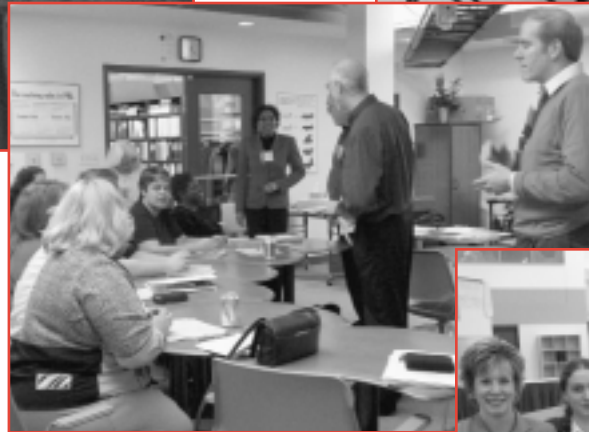
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The Center @ IMSA provides professional development programs for teachers and enrichment programs for elementary, middle and high school students. The Center also provides extensive professional development in problem-based learning to teachers in numerous states and countries.

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Over the years, IMSA has envisioned and enacted exemplary programs fueled by the passions and skills of the IMSA community—students, faculty, and staff alike. These efforts have served the Academy well and positioned IMSA to extend its reach throughout Illinois, the nation, and the world.

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