Physics Education Research Conference, 2010

Uncovering the hidden curriculum:
Research on scientific, critical, and reflective thinking in the physics classroom

July 21-22, 2010
Portland, Oregon

PERLOC

Contents

Conference Overview

Uncovering the hidden curriculum: Research on scientific, critical, and reflective thinking in the physics classroom

An outsider surveying the physics education research literature might understandably conclude that PER studies and PER-based instructional materials are dominated by concerns about conceptual understanding. However, a close look at research-based curricula reveals that helping students develop the ability to "think like a physicist" is in many cases at least as important as helping them develop an understanding of specific concepts and principles. Physics education researchers are examining a broad spectrum of abilities that can be categorized as scientific thinking (*i.e.,* reasoning skills and argumentation practices that feature significantly in physics); critical thinking (*i.e.,* general logical reasoning as applied to, or necessary for, doing physics); and reflective thinking (*i.e.,* thinking about one's own thinking and learning processes). By focusing on research related to instructional goals that transcend specific subject matter, PERC 2010 will provide the field an opportunity to highlight progress in this area and to identify important avenues for continued work.

Conference Organizers:

Paula Heron, MacKenzie Stetzer, Peter Shaffer
University of Washington

Andrew Boudreaux
Western Washington University

The Organizing Committee for the PERC 2010 Conference would like to express gratitude to the following individuals for their invaluable assistance:

Lyle Barbato, Cerena Cantrell, Noah Finkelstein, Tiffany Hayes, Bruce Mason, Mel Sabella, and Rachel Scherr.

The conference program and other information can be found on the web at:
http://www.compadre.org/per/conferences/2010

Schedule

Wednesday, July 21

4:00 – 6:00 pm **Bridging Session**, *Pavilion West*

Uncovering the hidden decisions that shape curriculum, Danielle Harlow, University of California, Santa Barbara

Rethinking our goals: What will our students remember when they forget everything? Eugenia Etkina, Rutgers University

Development of functional understanding in physics: Promoting ability to reason, Lillian C. McDermott, University of Washington

Discussion

6:00 – 8:00 pm **Banquet,** *Grand Ballroom II*

8:00 pm – 10:00 pm **Dessert and Contributed Poster Session,** *Grand Ballroom I*

Thursday, July 22

7:30 – 8:30 am **Breakfast,** *Grand Ballroom I* *(Contributed posters available during breakfast and all day)*

8:30 – 10:00 am **Parallel Sessions 1**

10:00 – 10:30 am **Break,** *Refreshments in Grand Ballroom II*

10:30 – 12:00 pm **Parallel Sessions 2**

12:00 – 1:30 pm **Lunch,** *Grand Ballroom II*

1:30 – 3:00 pm **Parallel Sessions 3**

3:00 – 3:30 pm: **Break,** *Grand Ballroom II*

3:30– 5:30 pm **Plenary Session and Closing,** *Galleria South*

Toward meaning and scientific thinking in the traditional freshman laboratory: Opening the "idea space," Saalih Allie, University of Cape Town, South Africa

Introducing students to the culture of physics: Explicating elements of the hidden curriculum, Edward F. (Joe) Redish, University of Maryland

What we learned by moving beyond content understanding and diversifying our research agenda, Mel Sabella, Chicago State University

Bridging Session

Wednesday, July 21, 2010; 4:00 – 6:00 pm
Pavilion West

Presiding: *Andrew Boudreaux, Western Washington University*

4:00 – 4:30 pm
Uncovering the hidden decisions that shape curriculum

Danielle Harlow, University of California, Santa Barbara,
dharlow@education.ucsb.edu

Developing explanatory models is a central practice to scientific inquiry. When students create and test explanatory models for scientific phenomenon, they develop content knowledge, knowledge of the nature of science, and creative thinking skills. Unfortunately, such instruction rarely occurs in K-12 science. This is, in part, because teachers do not have the opportunity to develop sophisticated understandings of the process of modeling, but also because teaching in this way requires teachers to make real-time instructional decisions that are responsive to students' ideas. This is challenging for new teachers, especially because this decision process is often invisible. In this talk, I will highlight the importance of providing opportunities for sophisticated science thinking for our youngest learners and consider how uncovering the decisions that shape physics courses for teachers may benefit their future students.

4:30 – 5:00 pm
Rethinking our goals: What will our students remember when they forget everything?

Eugenia Etkina, Rutgers University, eugenia.etkina@gse.rutgers.edu

The question of the purpose of education is similar to the question about the purpose of life: it is difficult to keep the answer in mind when one is submerged in everyday routines and minor distractions. But if we stop briefly while grading an exam, preparing a lab, or running a review session and ask ourselves what students will remember 20 years form now, the question and its answer might change completely what we do every day. Our PER group has tried to answer this question and as a result is changing our approach to teaching introductory physics. We still want students to understand electromagnetic induction and thin lenses; but a larger goal is to empower them with the understanding of reasoning processes that help them make independent decisions and solve complex problems in their future lives. I will share the successes and challenges of this work.

5:00 – 5:30 pm
Development of functional understanding in physics: Promoting ability to reason

Lillian C. McDermott, University of Washington, lcmcd@phys.washington.edu

A functional understanding of a concept in physics connotes the ability to interpret and apply it appropriately. The need to help students learn how to do the requisite reasoning is often ignored in introductory physics, a neglect that often continues in upper division courses. The emphasis in most recent research at the university level has been on the qualitative understanding of concepts, models of student thinking, and problem solving ability. These are all important, but there is also a need to conduct research to guide the development of instructional materials that promote the development of basic scientific reasoning skills (e.g., interpretation of proportions, construction of proper analogies, control of variables, use of limiting arguments, deductive and inductive logic). Examples will illustrate how the study of physics can cultivate ability in scientific reasoning.

The research and related curriculum development discussed in this presentation have been supported, in part, by a series of NSF grants, of which the most recent are: DUE #0618185 and DR-K12 #0733276.

5:30 – 6:00 pm ***Discussion***

Banquet and Contributed Poster Session

The Banquet will be in Grand Ballroom II, starting at 6:00 pm. Dessert will be served in the poster room (Grand Ballroom I), where a cash bar will be available.

Contributed posters can be set up in Grand Ballroom I starting at about 1:30 pm on Wednesday. The poster session will begin immediately after dinner. The posters will be available during breakfast and throughout the day on Thursday. They must be removed by the end of the PERC on Thursday, at 5:30 pm. The list of contributed posters can be found later in this program. Authors of the odd numbered posters should be available to discuss their poster from 8:00 to 9:00 pm. Authors of even numbered posters should be at their posters from 9:00 to 10:00 pm.

Parallel Sessions

Thursday, July 22, 2010

Session 1: 8:30 – 10:00 am

Title		Primary Organizer	Presenter(s)	Type	Room
1A	Research techniques for uncovering the hidden curriculum in the context of problem solving	Ken Heller	Jennifer Docktor, Ken Heller, Pat Heller, Charles Henderson, Leon Hsu, Andrew Mason, Qing Xu, Edit Yerushalmi	W	Parlor A
1B	Epistemology in the hidden curriculum: Why should anyone care?	David Brookes	Saalih Allie, David Brookes, Eugenia Etkina, David Hammer, Yuhfen Lin, Edward F. (Joe) Redish, David Schuster	RT	Parlor B
1C	Observing scientific reasoning processes in the classroom: Qualitative analysis of video-recorded interaction*	Rachel Scherr	Rachel Scherr	W	Parlor C
1D	Proportional reasoning in physics: What are students thinking? How can we help?	Suzanne White Brahmia	Lei Bao, Andrew Boudreaux, Catherine Chase, Suzanne White Brahmia	TP	Broadway I
1E/3C	Facilitating thinking and learning in the physics classroom	C. Singh / Jose Mestre	Dong-Hai Nguyen, Jose Mestre, Andrew Mason, Shih-Yin Lin, David Maloney	TP	Broadway II
1F/2B	Personal epistemologies as barriers and facilitators to learning by science and engineering undergraduate students	Calvin Kalman	Tetyana Antimirova and Calvin Kalman	RT	Broadway III

Session 2: 10:30 – 12:00 pm

2A	Out of one, many; five researchers analyze the same student video	Brant Hinrichs	Andrew Boudreaux, Dewey Dykstra, Valerie Otero, Rosemary Russ, Rachel Scherr	TP	Parlor A
2B/1F	Personal epistemologies as barriers and facilitators to learning by science and engineering undergraduate students	Calvin Kalman	Tetyana Antimirova and Calvin Kalman	RT	Broadway III
2C	Upper-division activities that foster "Thinking like a physicist"	Corinne Manogue	Dedra Demaree, Elizabeth Gire, Donald Mountcastle, Steve Pollock, Edward Price, Emily van Zee	TP	Parlor B
2D	Taking responsibility for the hidden curriculum: Practices and challenges in addressing the broader goals in physics education	Noah Finkelstein	Eugenia Etkina, Eric Brewe, Sanjoy Mahajan, Hunter Close, Chandra Turpen	TP	Parlor C
2E/3E	The influence of theoretical frameworks on researchers' attitudes towards students	Renee Michelle Goertzen	Noah Podolefsky, Mel Sabella, Renee Michelle Goertzen	TP	Broadway I

Session 3: 1:30 – 3:00 pm

3A	Experimental methods for studying student metacognition and affect*	Brett van de Sande	Brett van de Sande	W	Parlor A
3B	Characterizing participation in and around the physics classroom	Brian Frank	Emily van Zee, Eric Brewe, Valerie Otero, Brian Frank	TP	Parlor B
3C/1E	Facilitating thinking and learning in the physics classroom	C. Singh / Jose Mestre	Dong-Hai Nguyen, Jose Mestre, Andrew Mason, Shih-Yin Lin, David Maloney	TP	Broadway II
3D	How to think and talk like a physicist?	Homeyra Sadaghiani	Vincent Coletta, Homeyra Sadaghiani, Dedra Demaree, Charles De Leone, David Brookes	TP	Parlor C
3E/2E	The influence of theoretical frameworks on researchers' attitudes towards students	Renee Michelle Goertzen	Noah Podolefsky, Mel Sabella, Renee Michelle Goertzen	TP	Broadway I

* Participants should bring a laptop computer to these workshops. For workshop 1C, headphones will also be useful.

Abstracts for Parallel Sessions

Session 1

1A **Research techniques for uncovering the hidden curriculum in the context of problem solving** — **Parlor A** ***Workshop***

Organizer: Ken Heller

Details of a hidden curriculum can be discovered by studying the intentions of the instructors and the actions of the students. This workshop will present research techniques that we use to target and uncover aspects of this curriculum in the context of problem solving. We will introduce the development, use, and analysis of interviews based on authentic artifacts to probe the factors that shape instructors' intentions. We will also introduce the use of an analysis rubric for written problem solutions to determine if student actions reflect these faculty intentions.

Presenters: J. Docktor, K. Heller, P. Heller, C. Henderson, L. Hsu, A. Mason, Q. Xu, and E. Yerushalmi

1B **Epistemology in the hidden curriculum: Why should anyone care?** — **Parlor B** ***Round Table***

Organizer: David Brookes

The evidence is unequivocal: physics courses influence students' epistemological beliefs whether we intend this or not. Unfortunately the influence is often negative in that students seem to move further away from the epistemic perspective of a physicist. We suggest that the physics curriculum, materials, learning activities, learning environment and assessments all send epistemic messages to our students. These are messages about the nature of physics and physics learning, and how physicists have come to know what they know. Such tacit messages form part of the hidden curriculum (Lin, 1982). Science instructors often lament that science is too often presented as a 'rhetoric of conclusions' (Schwab, 1962) – but why should we care? Why should instructors concern themselves about anything beyond students' understanding of physics content and ability to solve problems? The purpose of this round table discussion will be to explore why one should care about students' epistemological development.

Presenters: S. Allie, D. Brookes, E. Etkina, D. Hammer, Y. Lin, E.F. (Joe) Redish, and D. Schuster

1C **Observing scientific reasoning processes in the classroom: Qualitative analysis of video-recorded interaction*** — **Parlor C** ***Workshop***

Organizer: Rachel Scherr

Scientific, critical, and reflective thinking are processes that unfold as students learn together. Ideally, students collaboratively construct ideas through the use of a wide range of representational resources. At Seattle Pacific University, "embodied learning activities," in which we deliberately arrange for human bodies to symbolize entities in physical phenomena, are playing an increasingly important role in the instruction that we design and study. Students communicate their ideas not only through talk, but also body positions, movements, uses of objects, gestures, looks, and so on. Video documentation of such dynamic multi-modal representations offers the chance to develop our professional vision as well as our understanding of what constitutes scientific reasoning processes. In this workshop, participants will work closely with short episodes of videotaped classroom activity in order to engage with the theoretical and practical issues that are raised by fine-grained qualitative analysis.

* *Please bring a laptop and headphones if it's convenient.*

Presenter: R. Scherr

1D [Proportional reasoning in physics: What are students thinking? How can we help?]

Broadway I
Targeted Poster

Organizer: Suzanne White Brahmia

Despite a significant emphasis on ratio strategies in precollege mathematics, many students have difficulty reasoning about ratio quantities in college physics. Research shows that students who struggle with simple questions that involve proportional reasoning tend to be less successful in introductory physics classes[1]. This should hardly be surprising: the introductory course makes extensive use of proportional relationships between physical quantities in increasingly abstract contexts, and we teach assuming that students understand the algebraic representations and the proportionalities they imply.

This session brings together current work on student thinking and learning about proportions. We'll explore the mismatch between our expectations and how well students actually reason about proportions, some productive and unproductive ways students reason about ratio quantities in physics, an instructional method that promotes proportional reasoning, and its implementation in college physics courses.

1. Cohen, Hillman, and Agee, 1978; Griffith, 1985; Coletta & Phillips, 2005

Posters:

- *Assessment of scientific reasoning: A case in proportional reasoning*, L. Bao, J. Han, and K. Koenig
- *What do students think about when they think about proportions?* A. Boudreaux
- *Inventing-with-contrasting-cases: An instructional method that improves students' uptake of big ideas*, C. Chase and D. Schwartz
- *Inventing physical quantities as an underpinning in physics courses*, S. White Brahmia

1E, 3C [Facilitating thinking and learning in the physics classroom]

Broadway II
Targeted Poster

Organizer: Chandralekha Singh; **Presider:** Jose Mestre

Learning physics is challenging. There are only a few fundamental principles of physics that are condensed in compact mathematical forms. Learning physics requires unpacking these fundamental principles and understanding their applicability in a variety of contexts. Cognitive theory can be employed to design instruction and facilitate thinking and learning in the physics classroom. In this session, we will showcase examples of instructional strategies based upon the principles of learning that have been effective in improving students' learning. These approaches include helping students learn physics via analogical reasoning, helping students reflect upon problem solving with peers, a new use of multimedia learning in introductory physics, "nTIPERs" to help students unpack aspects of Newtonian dynamics and facilitating students' problem solving across multiple representations in introductory mechanics.

Posters:

- *Facilitating students' problem solving across multiple representations in introductory mechanics*, D.H. Nguyen, E. Gire, and N.S. Rebello
- *A new use for multimedia learning in introductory physics*, J. Mestre, G. Gladding, and T. Stelzer
- *Helping students learn effective problem solving strategies by reflection with peers*, A. Mason and C. Singh
- *Using analogy to help students learn introductory physics*, S.Y. Lin and C. Singh
- *nTIPERs: Tasks to help students "unpack" aspects of Newtonian dynamics*, D. Maloney and C. Hieggelke

1F, 2B **Personal epistemologies as barriers and facilitators to learning by science and engineering undergraduate students** — **Broadway III** ***Round Table***

Organizers: Calvin Kalman and Tetyana Antimirova

I am the principal investigator of a SSHRC grant with the above title. I have developed a suite of activities that seem to get students to evaluate their understanding in terms of two alternative frameworks; Aristotle, and Galileo & Newton. Students become aware that the frameworks relate concepts from different parts of the course and learn to evaluate the frameworks. We plan to develop and deploy instruments that can measure changes in students' learning before and after using the array of activities.

Data will be collected in several post-secondary institutions. Interviews will be conducted by research assistants under the supervision of professors on the team. The first year of the program (2010-11) is to involve development and testing of the instruments to be used to examine changes in student epistemologies. In this roundtable, I and one of my co-applicants, Tetyana Antimirova would like to discuss what instruments should be used.

Presenters: T. Antimirova and C. Kalman

Session 2

2A **Out of one, many; five researchers analyze the same student video** — **Parlor A** ***Targeted Poster****

Organizers: Brant Hinrichs and Dewey Dykstra

This session brings together five experts with different theoretical perspectives for an in-depth conversation centered on a single classroom video. Focused discussion will highlight how the experts' analyses compare, contrast, and compliment one another, and enable participants to see some of the strengths and limitations of these different perspectives in a specific context.

Want to know more? Go to http://public.me.com/ddykstra and open the "Different Perspectives" folder to watch the actual classroom video, read its transcript, and view what each researcher will present. Come prepared to contribute to the discussion!

* *This session involves presentations, rather than posters.*

Presentations:

- *Cultivating multiple sensitivities to student thinking*, A. Boudreaux
- *"Seeing" the development of physical theory in students' minds*, D. Dykstra
- *Physics Learning as the Objectification of Discourse*, V. Otero
- *Who says what and when: How rules of discourse impact learning interactions*, R. Russ
- *Thinking about energy with bodies and objects: Cognition as a sensorimotor and material activity*, R. Scherr, H. Close, and S. McKagan

2B, 1F **Personal epistemologies as barriers and facilitators to learning by science and engineering undergraduate students** — **Broadway III** ***Round Table***

Organizer: Calvin Kalman**; Presenters:** T. Antimirova and C. Kalman

See Session 1F.

2C [Upper-division activities that foster "Thinking like a Physicist"] **Parlor B** *Targeted Poster*

Organizers: Corinne Manogue, Elizabeth Gire, and Emily van Zee

In this targeted poster session cum research working group, curriculum developers will each present their favorite upper-division activity to small groups of session participants. The participants will be asked to identify aspects of the activity that engage students in "thinking like a physicist", the in-class actions of the instructor that foster this skill, and the types of resources that students must employ when working with the materials. Then we will compare the activities, looking for common curricular structures and hidden curriculum goals, the differing affordances of different activities, and hopefully, at the end, a rich description of what "thinking like a physicist" might mean and how we can foster this capability in our students. A research paper summarizing the session's conclusions will be written for the proceedings. (Yep, expect videotaping and IRB forms!) This material is based upon work supported by the National Science Foundation under Grant No. DUE 0618877.

Posters:

- *Applying ISLE ideas to active engagement in the Spins Paradigm*, D. Demaree
- *Kinesthetic activities in upper-division physics courses*, E. Gire
- *Exploring the transition between quantum and classical physics using compelling graphical representations*, D. Mountcastle
- *The use of concept tests and peer instruction in upper-division physics*, S. Pollock, K. Perkins, S. Chasteen, and M. Dubson
- *Physics thinking in complex analytical calculations*, E. Price

2D [Taking Responsibility for the hidden curriculum: Practices and challenges in addressing the broader goals in physics education] **Parlor C** *Targeted Poster*

Organizers: Noah Finkelstein and Chandra Turpen

This interactive poster session will lead a community discussion around two major themes: 1) what are ways and models for us to enact and make explicit our efforts to address the hidden curriculum (beyond standard content learning) in physics classes, and 2) what barriers are faced in doing so. We will emphasize how we might take responsibility for what actually happens in the classroom, as well as the historical and institutional resources and barriers that we face. Four posters will highlight the variety of scales and approaches that may be used to address the hidden curriculum and serve as a focal point for our collective discussions. Be prepared to share your own successes and challenges. We will begin discussions by focusing on our roles and goals as educators, and will happily draw on theory and practice alike.

Posters:

- *Hidden benefits of engaging students in experimental design and invention of physics concepts*, E. Etkina, A. Karelina, M. Ruibal-Villasnor, and G. Suran
- *Modeling Instruction curriculum and pedagogy: what is exposed and what is hidden within the 'hidden curriculum,'* E. Brewe, L. Kramer, and G. O'Brien
- *Street-fighting mathematics: Teaching mathematical courage*, S. Mahajan
- *Copying the lab key, or: How to apply the Algebra Project to science teacher professional development,* H. Close

2E, 3E **[The influence of theoretical frameworks on researchers' attitudes towards students]** **Broadway I** ***Targeted Poster***

Organizer: Renee Michelle Goertzen and Noah Podolefsky

Education research is highly value laden. [1] This session focuses on the issue of respect for the subjects of research, for instance students. Theoretical frameworks in education can influence which data is collected and analyzed, as well as how that data is interpreted. We assert that both theories and methods in education research entail a variety of values, and hence attitudes toward students. We will ask: how do theoretical frameworks in PER align with our morals and personal values? And, how might morals and personal values influence our choice of theoretical framework? The presenters will illuminate and confront the relationship between their personal values and research, particularly attitudes toward and treatment of students.

Posters:

- *Dignifying the human condition. How PhET sim design respects student agency,* N. Podolefsky
- *Viewing the assessment of instructional reform through the eyes of the stakeholders,* M. Sabella
- *A resource framework can support a respectful perspective towards TAs,* R.M. Goertzen, R. Scherr, and A. Elby

Session 3

3A **[Experimental methods for studying student metacognition and affect*]** **Parlor A** ***Workshop***

Organizer: Brett van de Sande

This workshop will focus on the use of intelligent tutor systems in a classroom setting to study student meta-cognition and affect. We have been using a tutoring system to study gaming behavior (that is, attempting to succeed in a learning environment by exploiting properties of the system rather than by learning the material) as students work on introductory physics homework problems. Gaming behavior can be explained by either student affect (e.g., frustration or lack of motivation) or meta-cognition (e.g., "reading hints won't help me learn"). Join us as we: 1) survey research methodologies for studying affect and meta-cognition, listing their strengths and weaknesses; 2) present some relevant studies of meta-cognition and affect using intelligent tutor systems as an experimental probe; 3) conduct a hands-on introduction of the new version of our physics tutoring system, Andes, that allows natural language conversation through chat; and, 4) brainstorm possibilities for future studies.

* *Participants should bring a laptop to the session.*

Presenter: Brett van de Sande

3B **[Characterizing Participation in and around the physics classroom]** **Parlor B** ***Targeted Poster***

Organizer: Brian Frank

Understanding how specific learning environments influence student participation in science classrooms is fundamentally important to physics education research and its efforts at educational reform. Over the past few decades, science education researchers have shown an increased interest in the role that scientific argumentation plays in school science, both as an aspect of authentic scientific practice and as an instructional approach to learning. We report on an ongoing investigation to understand how curricular structures common to physics education shape student participation in scientific inquiry, using student argumentation as a window into classroom participation. In this paper, we provide a brief analysis of students' collaborative arguments during an inquiry lesson on the nature of light in order to illustrate how students' arguments about the physical phenomena interact with the specific claims students make about the lesson, and discuss the impact this has on students' opportunities to participate and learn. The research has been funded in part by the National Science Foundation under Grant No. REC-0633951.

Posters:

- *Documenting and interpreting ways to engage students in 'Thinking like a physicist',* E. van Zee and C. Manogue
- *Changing participation through formation of student learning communities,* E. Brewe, L. Kramer, and G. O'Brien
- *Opportunities for learning: Hybrid spaces, Vygotsky, and the endorsed narrative,* V. Otero
- *How students structure argument through the interplay of claims made about phenomena and instruction,* B. Frank

---

3C, 1E **Facilitating thinking and learning in the physics classroom** — **Broadway II** ***Targeted Poster***

Organizer: Chandralekah Singh; **Presider:** Jose Mestre

Presenters: D.H. Nguyen, J. Mestre, A. Mason, S.Y. Lin, D. Maloney
See Session 1E.

3D **How to think and talk like a physicist?** — **Parlor C** ***Targeted Poster***

Organizer: Homeyra Sadaghiani

This targeted poster session will focus on projects involving the use of curriculum materials as well as class discussion techniques that will enhance student critical and reflective thinking skills. How can we facilitates a learning environment to assist student to think and talk like a physicist: pursue relevant and reliable knowledge, ask insightful questions, gather relevant information, reason logically from this information, and come to scientific conclusions about the world? We will report on our efforts, success, and challenges in engaging students in such activities.

Posters:

- *Developing thinking & problem-solving skills in introductory mechanics***,** V. Coletta and J. Phillips
- *Critical and scientific thinking for pre-service elementary teachers,* H. Sadaghiani
- *Promoting and studying deep-level dialogue during large-lecture intro physics,* D. Demaree, S. Li, and J. Roth
- *Encouraging scientific discourse in the introductory physics classroom,* C. De Leone
- *Structuring classroom discussion using formative assessment rubrics,* D. Brookes

---

3E, 2E **The influence of theoretical frameworks on researchers' attitudes towards students** — **Broadway I** ***Targeted Poster***

Organizer: Renee Michelle Goertzen and Noah Podolefsky

Presenters: N. Podolefsky, M. Sabella, and R.M. Goertzen

See Session 2E.

Presiding: Dewey Dykstra, Boise State University

3:30 – 4:00 pm

Toward meaning and scientific thinking in the traditional freshman laboratory: Opening the "idea space"

Saalih Allie, University of Cape Town, saalih.allie@uct.ac.za

The physics freshman laboratory curriculum would appear to be a natural place for students to participate in activities related to critical thinking. However, several elements of the more traditional curriculum, such as an instruction driven recipe-like approach in order to reproduce well-known results, conspire together to send a message that is at odds with broad scientific thinking. It is postulated that this type of formulation of laboratory activities causes a closing of the student "idea space". For meaningful reflection and critique to be a natural part of the learning activities it is necessary to open the idea space by choosing suitable ways of framing the activities in terms of the parameters that control the idea space. In the talk we look at three such parameters that appear to control the idea space: metaphors, audience and language usage.

4:00 – 4:30 pm

Introducing students to the culture of physics: Explicating elements of the hidden curriculum

Edward F. (Joe) Redish, University of Maryland, redish@physics.umd.edu

When we teach physics to prospective scientists and engineers we are teaching more than the "facts" of physics – more than the methods and concepts of physics. We are introducing them to a complex culture – a mode of thinking and the cultural code of behavior of a community of practicing scientists. This culture has components that are often part of our hidden curriculum: epistemology – how we decide that we know something; ontology – how we parse the observable world into categories, objects, and concepts; and discourse – how we hold a conversation in order to generate new knowledge and understanding. In order to understand these often-tacit components of our teaching, we need an understanding of how students' minds work, how they perceive the activities of science, and how we perceive those activities. To teach our hidden curriculum we must pay attention to students' intuition and perception of physics, not just to their reasoning.

4:30 – 5:00 pm

What we learned by moving beyond content understanding and diversifying our research agenda

Mel Sabella, Chicago State University, msabella@csu.edu

Physics Program at Chicago State University has been investigating student learning for the past eight years in an effort to construct an effective instructional environment for the urban physics student. In our initial work, the targeted analysis on student content understanding caused us to miss the specific attitudes, thinking, and reasoning skills present in our students. As our research focus began to shift to identifying these other skills, we began to identify specific student resources that foster an active learning environment in the introductory physics course. In addition, we began to uncover a set of coherent, robust content knowledge that we had previously overlooked. Research studies on collaboration in the classroom and work on identifying intuitive and formal reasoning has since provided a rich, complex picture of student understanding and has informed the development of our instructional environment.

Supported by the NSF Course, Curriculum, and Laboratory Improvement Program and the NSF Robert Noyce Teacher Scholarship Program (0632563, 0618128, 410068, 0833251).

5:00 – 5:30 pm Closing Discussion

Contributed Posters*

Title	Primary Author
1. Assessing students' attitudes in a college physics course in Mexico	Alarcon, Hugo
2. Influence of learning styles on conceptual learning of physics	Alarcon, Hugo
3. Understanding confusion: Is it as bad as it seems?	Araujo, Ives
4. Constructing definitions as a goal of inquiry	Atkins, Leslie J.
5. Newton's Third Law in middle school	Aubrecht, Gordon
6. Interpretation in quantum physics as hidden curriculum	Baily, Charles
7. Trends in the PERC Proceedings	Barbato, Lyle
8. Generating explanations for an emergent process: The movement of sand dunes	Barth-Cohen, Lauren
9. Is explanation enough to assess student understanding?	Bartiromo, Tara
10. Supporting scientists' ability to communicate about science in everyday language	Bartley, Jessica E.
11. Flat as a pancake: A pseudo-longitudinal study of attitudes and beliefs at the University of Edinburgh using CLASS	Bates, Simon
12. How students' conceptual understanding is influenced by the grammatical structure of physics equations	Brookes, David T.
13. Developing, deploying, and evaluating computer modeling homework	Caballero, Marcos D.
14. Learning gains on Newtonian conceptual reasoning in an iterative, project-based course design	Camp, Paul J.
15. How does visual attention differ between experts and novices on physics problems?	Carmichael, Adrian
16. But does it last? Sustaining a research-based curriculum in upper-division electricity & magnetism	Chasteen, Stephanie V.
17. Effects of a prior virtual experience on students' interpretations of real data	Chini, Jacquelyn J.
18. How the aesthetic experience engage in understanding of science?	Choi, Sung-Youn
19. Energy in action: The construction of physics ideas in multiple modes	Close, Eleanor
20. Addressing student needs in instruction on the expansion and age of the Universe	Cochran, Geraldine L.
21. The use of a web-based classroom interaction system in introductory physics classes	Corpuz, Edgar
22. Transfer of learning in the context of an inquiry-based general physics laboratory	Corpuz, Edgar
23. Pedagogical concepts and strategies evidenced in Learning Assistant teaching reflections	Crenshaw, Diane
24. Preliminary validation data for an assessment of textbook problem solving ability: An argument for right/wrong grading?	Cummings, Karen
25. What factors lead to faculty trying research based strategies?	Dancy, Melissa
26. TA beliefs in a SCALE-UP style classroom	DeBeck, George DeBeck
27. Can some wrong answers be more right than others?	Dedic, Helena
28. Radical transformation of an upper division quantum mechanics course; pointing to the superiority of a student centered highly interactive engagement	Deslauriers, Louis
29. How do the students perceive the reasons for their success in a modern physics course?	Didis, Nilufer
30. Predicting FCI gain with a nonverbal intelligence test	Dietz, Richard D.
31. Enhancing problem-solving abilities by repeated training with scaffolded synthesis problems	Ding, Lin
32. A conceptual analysis approach to physics problem solving	Docktor, Jennifer L.

* Authors of the odd numbered posters should be available to discuss their poster from 8:00 to 9:00 pm. Authors of even numbered posters should be at their posters from 9:00 to 10:00 pm.

Contributed Posters*

Title	Primary Author
33. Redefining the instructor's role as a "transient" group member	Durden, Jared
34. An evaluation of the effectiveness of short science workshops for K-12 teachers	Endorf, Robert J.
35. Elements of a college-level inquiry-based physics classroom	Esswein, Jennifer
36. Singapore secondary one students' preconceptions on speed	Foong, See Kit
37. Fluctuations in students' understanding of Newton's 3rd Law	Franklin, Scott
38. Possibilities: A framework for modeling students' deductive reasoning in physics	Gaffney, Jon D. H.
39. The hidden curriculum in laboratory data analysis – development of a diagnostic test and initial results	Galloway, Ross
40. Investigating the perceived difficulty of introductory physics problems	Gire, Elizabeth
41. Development and evaluation of a large-enrollment, active-learning physical science curriculum	Goldberg, Fred
42. Are Learning Assistants better secondary science teachers?	Gray, Kara E.
43. An inquiry-oriented assessment tool for exploring students' reasoning	Haghanikar, Mojgan Matloob
44. Helping students to think like physicists in SDI labs	Hake, Richard
45. QUEST: Quality Elementary Science Teaching	Hanuscin, Dr. Deborah L.
46. Teaching pedagogy in physics	Harlow, Danielle
47. Students' responses to different representations of a vector addition question	Hawkins, Jeffrey M.
48. Variables that correlate with faculty use of research-based instructional strategies	Henderson, Charles
49. Student difficulties with non-Cartesian unit vectors in upper level E&M	Hinrichs, Brant
50. A case study on reflective writing	Huang, Xiang
51. Now you can compare them all!	Ibrahim, Ahmed
52. Which instrument to critically select (among so many)	Ibrahim, Ahmed
53. Yes, I can teach physics, but	Ibrahim, Ahmed
54. Exploring student understanding of atoms and radiation	Johnson, Andy
55. Students' and instructor's impressions of ill-structured capstone projects in an advanced electronics lab	Juma, Nasser
56. Models for seeing colored objects: A case study progression	Kahle, Emma C.
57. Instructional explanations as an interface - The role of explanatory primitives	Kapon, Shulamit
58. Gender gaps in upper division physics courses at the Colorado School of Mines	Kohl, Patrick
59. Direct and indirect approaches to increasing conceptual survey gains	Kohl, Patrick B.
60. Gender differences in Physics 1: The impact of a self-affirmation intervention	Kost, Lauren E.
61. Student difficulties with right hand rules	Kustusch, Mary Bridget
62. Test-retest reliability of the Force Concept Inventory (FCI)	Lasry, Nathaniel
63. Frame analysis as a way to understand the complex dynamic of classroom teaching practice.	Lau, Matty
64. Why is it difficult to lead conceptual change by using a count-intuitive demonstration?: An example from the brachistochrone problem	Lee, Gyoungho
65. Improving students' understanding of electric flux	Li, Jing
66. Survey development for assessing learning identity in an ISLE classroom	Li, Sissi L.

* Authors of the odd numbered posters should be available to discuss their poster from 8:00 to 9:00 pm. Authors of even numbered posters should be at their posters from 9:00 to 10:00 pm.

Contributed Posters*

Title	Primary Author
67. Using analogy for learning introductory physics	Lin, Shih-Yin
68. Redesigning and restructuring classroom assessments to reflect a new set of learning goals	Lin, Yuhfen
69. What does it mean to create a community?	Little, Angela
70. Investigating student understanding for a statistical analysis of two thermally-interacting solids	Loverude, Michael
71. Novice implementation of the Impulse-Momentum Theorem in VPython programs	Lunk, Brandon R.
72. Learning the concept of energy quanta through a portfolio	Maftei, Gelu
73. Usage of the Term “Force,” Reasoning Ability, and FCI Performance II	Maier, Steven
74. Epistemological framing and exterior knowledge in physics problem solving	Martinuk, Mathew “Sandy”
75. Assessing student’s ability to solve textbook-style problems	Marx, Jeffrey
76. Sustainability of K-12 afterschool programs	Mayhew, Laurel M.
77. Student understanding of the correlation between hands-on activities and computer visualizations of NMR/MRI	McBride, Dyan
78. Can spatial skills training improve achievement in introductory mechanics?	Miller, David I.
79. Losing it: The influence of losses on individuals’ normalized gains	Miller, Kelly
80. Curriculum development addressing multiplicity, probability and density of states in statistical physics	Mountcastle, Donald B.
81. REU students’ initial perceptions of scientific ethics	Murphy, Sytil
82. Closing the feedback loop: Assessment in an introductory physics course for nonmajors	Muslu, Nilay
83. Preliminary study of the effects of the use of self awarded homework extensions	Mzoughi, Taha
84. Pilot testing of the pathway active learning environment	Nakamura, Christopher M.
85. Research-based exercises to facilitate students’ transfer of problem solving across representations	Nguyen, Dong-Hai
86. Force concepts in different student groups: FCI with variations and extensions	Pendrill, Ann-Marie
87. Our best juniors still struggle with Gauss’s Law: Characterizing their difficulties	Pepper, Rachel E.
88. Who becomes a physics major? The role of students’ beliefs about physics and learning physics	Perkins, Katherine
89. Physics teacher characteristics and classroom practices	Phillips, Jeffrey A.
90. Characterizing complexity of computer simulations and implications for student engagement	Podolefsky, Noah
91. Clickers or flashcards: An activity theory interpretation	Price, Edward
92. The beginnings of energy in third graders’ reasoning	Radoff, Jennifer
93. Benefit In electricity and magnetism from prior instruction using the Modeling Applied to Problem Solving Pedagogy in mechanics	Rayyan, Saif
94. Supporting teacher leadership for physics education reform – Where do we begin?	Rebello, Carina M.
95. Constructing a model of physics expertise	Rodriguez, Idaykis
96. Changes in students: Conceptual understanding of force, velocity, and acceleration	Rosenblatt, Rebecca
97. Pre-service physics teachers and physics education research	Rosengrant, David
98. The Physics Van Program: Supporting the needs of Chicago area physics teachers	Sabella, Mel
99. The impact of the history of physics on student attitude and conceptual understanding of physics	Sadaghiani, Homeyra
100. Multimedia PreLab Tutorials in conservation laws	Sadaghiani, Homeyra

* Authors of the odd numbered posters should be available to discuss their poster from 8:00 to 9:00 pm. Authors of even numbered posters should be at their posters from 9:00 to 10:00 pm.

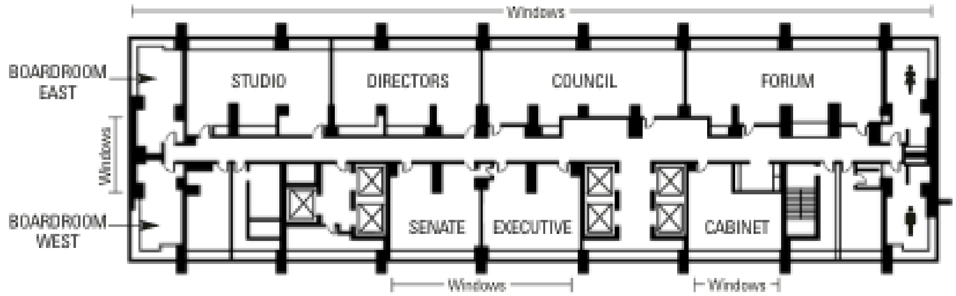
Contributed Posters*

Title	Primary Author
101. Teaching a hybrid online course in electricity and magnetism using Multimedia Learning Modules (MLM)	Sadaghiani, Homeyra
102. Creating classroom reform using a sociocultural mediation process	Samuels, Natan
103. Positive impacts of Modeling Instruction on self-efficacy	Sawtelle, Vashti
104. 'So you're saying...': Paraphrase and interpretation in peer physics interviews	Sayre, Eleanor C
105. Student responses to newly-implemented teaching methods in the advanced physics laboratory	Schell, Julie
106. Energy Theater: Using the body symbolically to understand energy	Scherr, Rachel
107. Two years of testing long-term observation in middle school astronomy	Schmitt, Bill
108. Assessing the effectiveness of the upper-division physics advanced laboratory course	Schuster, David
109. Laptop usage in an introductory physics class: A tale of the haves and the have-nots	Shaw, Kimberly A.
110. Reflective self-corrections of homeworks in a conceptual physics course: An experimental control-group design study	Shekoyan, Vazgen
111. Surveying instructors' attitudes and approaches to teaching quantum mechanics	Singh, Chandralekha
112. Surveying students' understanding of quantum mechanics in one spatial dimension	Singh, Chandralekha
113. Addressing student difficulties with statistical mechanics: The Boltzmann Factor	Smith, Trevor I.
114. Examining the beliefs and practice of teaching assistants: Two case studies	Spike, Benjamin T.
115. Detecting differences in changes to physics diagrams	Strand, Natalie E.
116. Design of a synthesizing lecture on mechanics concepts	Strand, Natalie E.
117. Toward an integrated online learning environment	Teodorescu, Raluca E.
118. Investigating student understanding of thermodynamics concepts and underlying integration concepts	Thompson, John R.
119. Faculty perspectives on using Peer Instruction: A national study	Turpen, Chandra
120. Fun and gaming with Andes	Van De Sande, Brett
121. Fostering scientific thinking by prospective teachers in a course that integrates physics and literacy learning	Van Zee, Emily H.
122. Maximum Likelihood Estimation of students' understanding of vector subtraction	Wang, Tianren
123. Gender, mental rotations, and introductory physics	Watkins, Jessica
124. Understanding how students use physical ideas in introductory biology courses	Watkins, Jessica
125. How students make sense of functional, but incomplete computer programs.	Weatherford, Shawn A.
126. Student and teacher understanding of buoyancy	Wong, Darren
127. Children's attitudes about science as a result of informal science education	Wulf, Rosemary P.
128. Vector addition: Effect of the context and position of the vectors	Zavala, Genaro
129. Students' understanding of the concepts of vector components and vector products	Zavala, Genaro
130. Electric field concept: Effect of the context and the type of questions	Zavala, Genaro
131. Understanding and interpreting calculus graphs: Refining an instrument	Zavala, Genaro
132. Improving students' understanding of quantum measurement	Zhu, Guangtian

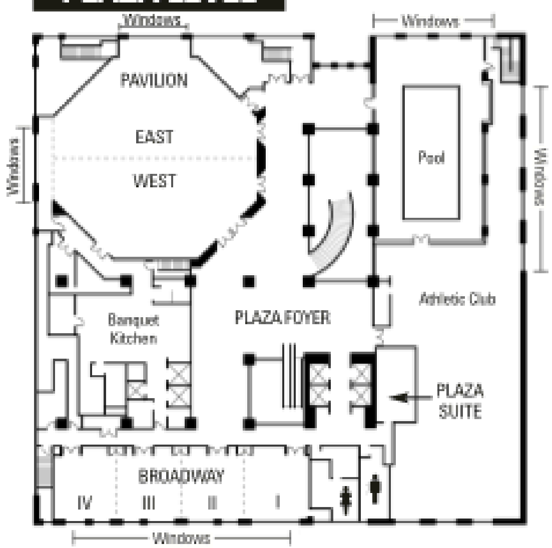
* Authors of the odd numbered posters should be available to discuss their poster from 8:00 to 9:00 pm. Authors of even numbered posters should be at their posters from 9:00 to 10:00 pm.

Map of the Conference Hotel

THIRD FLOOR



PLAZA LEVEL



BALLROOM LEVEL

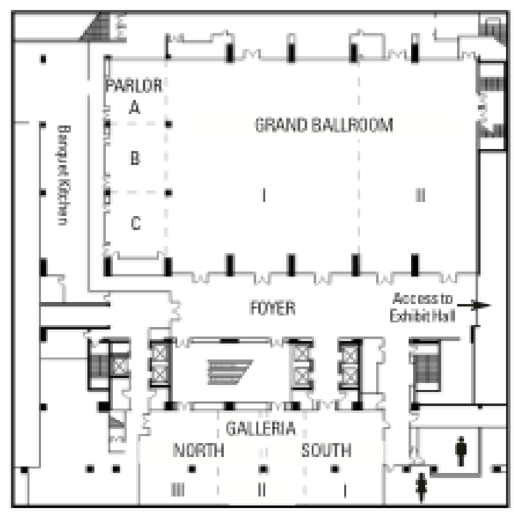
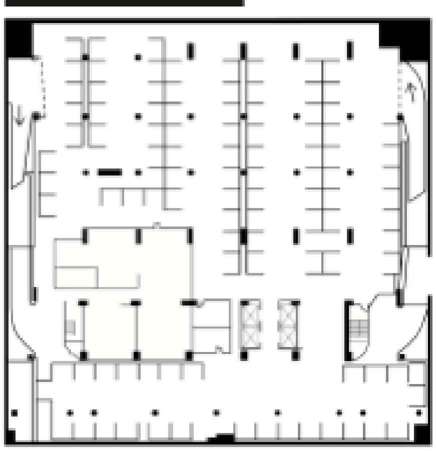


EXHIBIT HALL



HILTON PORTLAND EXECUTIVE TOWER