Outpacing New Technologies with Novel Pedagogies:

The role of PER in the Transforming Landscape of Higher Education

Physics Education Research Conference
July 30 & 31, 2014
University of Minnesota - Twin Cities

PERC 2014: Schedule

Wednesday, July 30

3:00pm - 4:30pm	AAPT/PERC Bridging Session *Speakers:* *Mike Dubson (CU Boulder)* *Jim Fairweather (MSU)*	Northrop Auditorium
5:00pm - 6:30pm	Dinner *Speaker: Ken Koedinger (CMU)*	Meridian Ballroom
7:00pm - 8:30pm	Contributed Poster Session 1 (P1)	Meridian Foyer/Summit

Thursday, July 31

8:30am - 10:00am	Contributed Poster Session 2 (P2) & Continental Breakfast	Meridian Foyer/Summit
10:30am - 12:00pm	Parallel Session I	Pinnacle Ballroom Think 3 Think 4 Pathways Room
12:00pm - 1:30pm	Lunch Break	On your own
1:30pm - 3:00pm	Parallel Session II	Pinnacle Ballroom Think 3 Think 4 Pathways Room
3:00pm - 3:30pm	Coffee Break	Meridian Ballroom
3:30pm - 4:15pm	Plenary *Speaker: Carl Wieman (Stanford)*	Meridian Ballroom

PERC 2014: Theme

Outpacing New Technologies with Novel Pedagogies:

The role of PER in the Transforming Landscape of Higher Education

Students' unprecedented access to information on-line is dramatically and irreversible transforming higher education. This transformation provides fantastic opportunities to improve education, but at the same time we are presented with the equally fantastic risk of losing the core elements that make higher education so valuable. Whether it has been on-line homework, electronic voting systems, or screen-casted lectures, the physics community has been on the bleeding edge of new educational technology.

Our community must engage in a scholarly dialog around these new environments including the opportunities they afford, the challenges they present, and the research enterprise necessary to address these. The opportunities for access and equity in MOOC, on-line, hybrid, and flipped classrooms, as well as the challenges these new educational models present for engagement, assessment, and community development are all important aspects to consider. Conference participants will gain deeper insight into these technologically-driven environments by discussing the magnitude and rapidity of these changes, developing an understanding of the national dialog around on-line education, and discussing how physics education research can guide the development of new pedagogies for and assessments of these environments.

Organizers:
Danny Caballero (Michigan State University)
Tim Stelzer (University of Illinois)
Mats Selen (University of Illinois)

PERC 2014: Plenary Speakers

Michael Dubson, University of Colorado Boulder

Dr. Michael Dubson is a Senior Instructor in the Physics Department at the University of Colorado at Boulder, where he is Associate Chair for Undergraduate Studies and a member of the PER group. As a youngster, he was fortunate to have access to a first-rate affordable undergraduate education at the University of Illinois at Champaign-Urbana (B.S. 1978). This was followed by graduate work in condensed matter experiment at Cornell University (PhD 1984) under the wise tutelage of Don Holcomb. For ten years he worked as a condensed matter experimentalist, first as a post-doc at The Ohio State University, then on the physics faculty of Michigan State University. In 1995, he switched careers and joined the faculty at Boulder, where he started working on interactive instruction and undergraduate curriculum development. He is the winner of several teaching awards, including the 2006 AAPT Award for Excellence in Undergraduate Education. He is also a software developer for PhET (http://phet.colorado.edu), which is "the best science education that money can buy, except you can't buy, because it's free." His other recent professional labels include textbook author, airline crash investigator, and optical engineer. In the Fall of 2013, he taught a Massive Online Open Course, through Coursera, entitled "Physics 1 for Engineers". The number of students who took the course was 15,000 or 300, depending on how you count.

James Fairweather, Michigan State University

Dr. James S. Fairweather serves as co-Principal Investigator of the AAU Undergraduate STEM Education Initiative. He is Professor and Director of the Center for Higher and Adult Education, Michigan State University. He is the immediate past Mildred B. Erickson Distinguished Chair in Higher, Adult, and Lifelong Education at MSU. Dr. Fairweather is widely known for his work on faculty roles and rewards, engineering education, and higher education policy. His books entitled Faculty Work and Public Trust: Restoring the Value to Teaching and Public Service in American Academic Life and Entrepreneurship and Higher Education are considered seminal in the field. Dr. Fairweather has extensive experience in researching and reforming STEM education. He and his colleagues on the National Academy of Sciences Committee on Disciplinary-based Educational Research recently published the principal summative work on the status of postsecondary STEM education. He has been co-PI of the Engineering Coalition for Schools for Excellence in Education and Leadership (ECSEL) and the Center for the Integration of Research, Teaching and Learning. For the National Academy of Sciences he authored the White Paper Linking Evidence and Promising Practices in STEM Undergraduate Education. Dr. Fairweather has served as chair of the editorial board of the most prestigious journal in the field, Journal of Higher Education, received the career research award from the American Educational Research Association Division J, been named a Fulbright Scholar, and awarded an Erasmus Mundus Professorship by the European Union. He received his Ph.D. in Higher Education from Stanford University in 1980.

Kenneth R. Koedinger, Carnegie Mellon University

Dr. Kenneth Koedinger is Professor of Human-Computer Interaction and Psychology at Carnegie Mellon. His research has contributed new principles and techniques for the design of educational software and has produced basic cognitive science research results on the nature of mathematical thinking and learning. Dr. Koedinger is a co-founder of Carnegie Learning (carnegielearning.com) and the CMU Director of the Pittsburgh Science of Learning Center (learnlab.org). The center leverages cognitive and computational approaches to support researchers in investigating the instructional conditions that cause robust student learning.

Carl E. Wieman, Stanford University

Dr. Carl Wieman holds a joint appointment as Professor of Physics and of the Graduate School of Education. He has done extensive experimental research in atomic and optical physics. His current intellectual focus is now on undergraduate physics and science education. He has pioneered the use of experimental techniques to evaluate the effectiveness of various teaching strategies for physics and other sciences, and recently served as Associate Director for Science in the White House Office of Science and Technology Policy.

PERC 2014: Parallel Session I

Getting Involved in Online PER

Poster Symposium - **Pathways**

Organizers: Michael Schatz, Georgia Institute of Technology; David Pritchard, Massachusetts Institute of Technology

Abstract: The advent of Massive Open Online Courses (MOOCs), flipped and blended classrooms and the use Big Data in the classroom indicate that online education has come of age college administrations have decided to support it, research has shown great on-campus learning gains from blended classrooms, and "big" educational data is now showing promise of improving teaching, allowing clean experimental/control group studies, and ultimately of guiding instruction for individuals. The collected posters in this session will give examples of success and suggest ways for PER people to become involved.

Reform expansion beyond a single classroom

Poster Symposium - **Think 4**

Organizers: H. Vincent Kuo, Colorado School of Mines

Abstract: This session will focus around implementations and adaptations of reformed classroom environments, including technology-enabled pedagogy, beyond the original inception.

Gender issues in introductory physics: Recruitment, performance, and retention

Poster Symposium - **Pinnacle**

Organizers: Geoff Potvin, Florida International University

Abstract: The underrepresentation of women in physics has been a persistent issue for the physics community and, unlike many other science disciplines, continues to be so. In this symposium, we will explore gender issues in introductory physics from several perspectives: how pre-college experiences can influence women's persistence in physics in college, how reformed pedagogies may differentially affect the performance of women in physics classes as well as their performance in subsequent, advanced physics courses, and ways in which women's particularly poor physics identities may be impacted through deliberate classroom interventions. The papers in this session employ several different methodologies including both qualitative approaches (e.g. case studies utilizing longitudinal interview data) and quantitative approaches (e.g. correlational, quasi-experimental, and experimental methods utilizing survey, conceptual inventory, and course performance data).

PERC 2014: Parallel Session I

Raising Calculus to the Surface in Physics: Explorations using Surfaces

Workshop - **Inventor 1**

Organizers: Aaron Wangberg, Winona State University; Brian Fisher, Pepperdine University; Eric Weber, Oregon State University; Jason Samuels, City University of New York - BMCC

Abstract: Visualization and geometric reasoning are key components of solving problems in science. However, students often struggle to develop these skills in higher dimensional settings. We've developed clear plastic 'surfaces' with a dry-erase finish which let students discover key relationships between mathematical concepts in the multivariable setting. Participants in this workshop will have an opportunity to play, draw, and make measurements on the surface manipulatives. In addition to sharing how we use the materials to help students understand the geometry behind ideas like gradient, partial and directional derivatives, level curves, and various forms of integrals, we will spend significant time exploring and discussing how these surface manipulatives could be utilized in the physics classroom.

The utility and prospects of computers coaching students in physics

Roundtable Discussion - **Think 3**

Organizers: Leon Hsu and Ken Heller, University of Minnesota - Twin Cities; Sanjay Rebello, Kansas State University

Abstract: People have tried to use computers to help students learn physics for almost as long as there have been computers. These efforts have ranged from Computer Assisted Instruction, in which a rigid program or curriculum is presented by a computer, to Intelligent Tutors, which can utilize student responses to provide a student with individualized and targeted practice. In this roundtable, we will discuss the prospects for computer coaches in the near future based on past performance and realistic extrapolation.

PERC 2014: Parallel Session II

Flipped Physics Teaching

Roundtable Discussion - **Inventor 1**

Organizers: Heidi Fencl, University of Wisconsin Green Bay; Andy Rundquist, Hamline University

Abstract: Physics educators began flipping the classroom long before the approach was given a sleek new name. We called it, for example, Workshop Physics, Physics by Inquiry, or Peer Instruction. Yet in spite of the strong research behind these approaches and the breadth of materials available, most physics courses remain steadily on their feet. Especially in regional comprehensive universities, class size and limited resources provide constraints that can be hard to envision away. In this session, we would like to open conversation about opportunities that now-common technologies provide to change those constraints. Whether you already flip, sort of flip, or would like to flip, please join us in this conversation about flipping physics even in strongly upright surroundings.

Using technology to enhance physics teaching: Research-based technology innovations

Poster Symposium - **Pinnacle**

Organizers: Ben Van Dusen, Valerie Otero, Emily B. Moore, and Katherine Perkins, University of Colorado Boulder; André Bresges, University of Cologne; Stefan Heusler, Münster University; Raimund Girdwidz, University of Munich

Abstract: In this session, an international group of researchers will invite participants to explore new ways of teaching with technology through multimedia demonstrations and poster discussions. Spanning the use of screencasts, digital lab reports, iBooks, animated illustrations, and interactive simulations, researchers will share their recent findings for innovative technology use capable of enhancing physics teaching from middle school to undergraduate classrooms.

Instructional Goals and Research Methods in the International PER community: A GIREP Symposium

Poster Symposium - **Think 3**

Organizers: Paula Heron, University of Washington

Abstract: The Groupe International de Recherche sur l'Enseignement de la Physique or "GIREP" (GIREP.org) is an international membership organization founded in 1966. GIREP is open to individuals interested in improving the teaching of physics at all levels. GIREP conferences, workshops and symposia are major events in the international PER community and provide essential opportunities for the dissemination of research findings and other advances in physics teaching. This symposium is intended to promote closer connections between the US and international PER communities. Speakers will present their own research findings, highlighting some of the methodologies that are common outside the US, as well as the diverse educational goals and institutional contexts that inform that research.

PERC 2014: Parallel Session II

Game-Based and Game-Informed Approaches to Physics Instruction

Poster Symposium - **Think 4**

Organizers: Ian D. Beatty, University of North Carolina Greensboro

Abstract: Games are emerging as a major new literacy in our society, especially in the lives of our students. They have affordances far beyond those of other media for engaging, for persuading, and for educating. Scholars have noted that good video games are in fact carefully engineered learning machines, and that we in science education and the learning sciences have much to learn from game designers. One course of action is to use games to support or supplement instruction; another is to identify the fundamental principles and dynamics of game-based learning, and then investigate ways to incorporate those into non-game instruction. This targeted poster session will highlight a range of current efforts to improve physics instruction by studying or using games in creative ways.

Competency-Based Assessment: Goals and a Research Agenda

Roundtable Discussion - **Pathways**

Organizers: Thomas Foster, Southern Illinois University Edwardsville; Andrew Morrison, Joliet Junior College

Abstract: Competency-Based Assessment goes by many different names, such as Outcomes based Grading, or Mastery Learning, but it is the idea that is enticing. Rather than assign a grade based upon performance on individual tasks, the learner instead must produce evidence that she or he has mastered a set of skills or concepts. The purpose of this roundtable is to discuss these skills and concepts as they relate to a PER-based agenda. Fundamentally, does Competency-Based Assessment produce significant changes in student understanding and use of physics?

PERC 2014: Abstracts

Poster Symposium -
Getting Involved in Online PER
Organizers: Michael F. Schatz

1) Flipping/Blending a Physics Course Using MOOC Content: Real World Examples

Michael F. Schatz, Georgia Institute of Technology

Georgia Tech offers a blended introductory calculus-based mechanics course with a lab. This class uses online content from an introductory mechanics MOOC offered by Georgia Tech. Students watch lectures and perform laboratory exercises outside of the classroom? in-class time focuses on activities involving group problem-solving and scientific communication. Details on implementation and assessment of the course will be presented.

2) Student Engagement with Online Resources in a Blended Introductory Physics Course

Shih-Yin Lin, Georgia Institute of Technology

In the Georgia Tech blended introductory calculus-based mechanics course, pre-recorded lecture videos are used to introduce students to new materials outside of the classroom. Students also participate in online homework and forum discussions. This poster describes how students engage with different online elements in the course and how such understanding of student behaviors can provide insight into student learning.

3) A/B Experiments, Machine Learning, and Psychometrics in MOOCs can Accelerate your PER

Zhongzhou Chen, Neset Demerici, David Pritchard, Massachusetts Institute of Technology

Massive Open Online Courses (MOOCs) present education researchers with a unique opportunity to do PER, develop educational resources, and compare pedagogies. The MOOC environment has several advantages: the opportunity to apply psychometric and machine learning analyses such as IRT, Hidden Markov Models, student habit clustering, etc. with a large sample size? the ability to do perform controlled experiments involving different instructional resources and pedagogies with minimum student pushback? access to detailed records of what resources students study and when, and a wide variation in demographics (e.g. 25% with a high school education or less and 25% who are physics teachers in the same MOOC). We will discuss the A/B experiments and instrument development we are performing in our summer MOOC: 8.MReVx Mechanics Review, on the edX platform, invite discussion, and hopefully recruit some future collaborators who can leverage our data analysis for doing their PER in our next MOOC at the AP-level.

PERC 2014: Abstracts

Getting Involved in Online PER (continued...)

4) There is Learning in MOOCs - What Causes It?

David Pritchard, Kim Colvin, John Champaign, Qian Zhou, John Doucette, and Alwina Liu
Massachusetts Institute of Technology

We have shown that there is learning in our MOOC both using pre/post testing and week to week ability analysis using Item Response Theory. The normalized gain is ~ 0.31, higher than traditional courses, but lower than most interactive courses. Students with lower initial skill, less educational attainment, or weak preparation in physics and math learn as much as other students. We observe correlations with time spent on different resources and also observe different learning habits of students showing relative improvement vs. those with relative decline over the course.

5) Peer Evaluation of Scientific Communication in a Blended Introductory Physics Course

Scott S. Douglas, Shih-Yin Lin, John M. Aiken, Edwin F. Greco, Michael F. Schatz,
Georgia Institute of Technology

The Georgia Tech blended introductory calculus-based mechanics course emphasizes scientific communication as one of its learning goals, and to that end, we gave our students a series of five peer-evaluation assignments intended to develop their abilities to present and evaluate scientific arguments. Within these assignments, we also assessed students' evaluation abilities by comparing their evaluations to a set of expert evaluations. This poster summarizes our development efforts and describes the changes we observed in student evaluation behavior.

6) Using the Tools of Online Analytics and Big Data in the On-Campus Classroom

John M. Aiken, Shih-Yin Lin, Scott S. Douglas, Brian D. Thoms, Marcos D. Caballero, Michael F. Schatz, Georgia Institute of Technology

Online environments produce large corpuses of Big Data which researchers can use to analyze user interaction. In MOOCs, students' use of videos, written text (forums, assignments, etc.), social interactions, quizzes, and exams are all instantly recorded and can be used to provide real-time feedback to instructors. On-campus instructors using MOOC materials in their courses can also use these analytics tools to inform instruction in their own classrooms. At Georgia Tech, we have taken an in-depth look at how students engage video lectures in a flipped/blended introductory physics course. We describe the physics content students appear to attend to based on their play, pause, and seeking behavior while watching videos.

PERC 2014: Abstracts

Getting Involved in Online PER (continued...)

7) From Reformed Blended Course to MOOC

Saif Rayyan, Colin Fredericks, Kim Colvin, Alwina Liu, Raluca Teodorescu, Analia Barrantes, Andrew Pawl, Daniel Seaton and David E. Pritchard, Massachusetts Institute of Technology

We describe the development of an introductory mechanics MOOC originating from content and pedagogy developed for a blended classroom. The content was created to support the implementation of MAPs pedagogy : Modeling Applied to Problem Solving. Using MAPS, students work in groups on multi concept problems during class,while online content is used to provide pre-requisite knowledge of MAPs before class, and to build problem solving skills after class where students choose their own path through homework presented in increasing levels of difficulty. The courses evolved to a MOOC that is advertised as a "Re-View" for people with some background in introductory mechanics, attracting 20,000 registrants over the 3 offering from Spring 2012-Summer 2013. We describe the similarities and differences between the residential course and the MOOC offerings, including demographics, use of resources and student behaviour and engagement.

8) Using MOOCs for Professional Training of In-service Teachers

Dave Cormier (UPEI), Piotr Mitros (edX), and David E. Pritchard (MIT)

We report on two projects. First, the 8.MReV xMOOC is a course in mechanics, covering the same material as the MIT freshman physics course. Over it's past iterations, over 25% of the "students" have been teachers. A special discussion section allows teachers to discuss pedagogies for teaching each chapter's material, and CEU credits are given. Second, we report on a recent short pilot of a hybrid cMOOC/xMOOC, called Maker Physics. It introduced participants to specific points of pedagogy, developed their comfort level with the EdX.org platform and encouraged the creation of physics content. Two working groups showed community style interactions during the creation of over 50 educational resources, although the pilot did not develop a course-wide community. The course revealed a lack of shared premises and vocabulary between different areas of the educational community and began work on a shared discourse that could be the foundation of future collaborative models. Second, we found several places where both the technology and the pedagogy of the course needed smoother on-ramps for students.

PERC 2014: Abstracts

Poster Symposium -
Reform expansion beyond a single classroom
Organizers: H. Vincent Kuo

1) Research-based Reform: Faculty as Change Agents in Multiple Departments

Adrienne Traxler, Florida International University

The FIU Science Collaborative is a four-year project to reform undergraduate science education at Florida International University, driving institutional change through community building and faculty development across multiple departments. Each year, a cohort of faculty scholars undertakes transformation of their courses to incorporate and assess active learning. Scholars engage with reform in a variety of ways, from adoption of published research-based materials to creation of their own. We discuss examples and the bridges between faculty developers, faculty, and science education researchers that foster successful change.

2) LEAP: A Learner-centered Environment for Algebra-based Physics

Paula Engelhardt, Tennessee Technological University

This presentation will focus on the curriculum development work that we have been doing with our algebra-based course sequence. LEAP* is guided by research on student learning of physics and builds on the work of the NSF supported project, Physics and Everyday Thinking (PET). Students work in groups to develop their understanding of various physics phenomena including forces, energy, electricity and magnetism, light and optics. Students utilize hands-on experiments and computer simulations to provide evidence to support their conceptual understanding. Traditional problem solving is scaffolded by using the S.E.N.S.E. problem solving strategy. An overview of the curriculum and assessment results will be presented.

Reform expansion beyond a single classroom (continued...)

3) Studio at CSM: Intro Physics and Beyond

Patrick Kohl, Colorado School of Mines

Studio and SCALE-UP (developed at RPI and NCSU respectively) have a long history in PER and at the Colorado School of Mines. CSM has been using Studio methods continuously since 1997, when the physics department implemented pilot sections of introductory calculus-based mechanics. Since then, Studio at CSM has expanded steadily. As of 2014, all of Physics I & II and Biology I are taught via Studio, along with pilot sections of Probability & Statistics. There are discussions in place to spread Studio to several other courses in the near term, including upper-division physics. In this talk, we'll briefly review the overall structure of Studio and some relevant performance data. The remainder will focus on the actual spread of Studio at CSM, highlighting a number of problems and how they were overcome, and reporting on the personal experiences of many of the instructors involved.

4) Studying the Spread of Research-based Instructional Strategies: Rich Case Study of SCALE-UP

Kathleen Foote, North Carolina State University

Much time, money, and effort has been spent developing innovative teaching pedagogies. But, the majority of college instruction in physics fields is inconsistent with research-based recommendations. This project investigates the dissemination and implementation of research-based instruction by using a web survey to understand the spread of SCALE-UP (Student-Centered Active Learning Environment with Upside-down Pedagogies). Responses from 659 people indicate that SCALE-UP is used at over 250 institutions worldwide and has also spread to disciplines beyond physics. Information about SCALE-UP has traveled through both formal and informal channels. Secondary sites frequently modify the original SCALE-UP model, which may impact the success of the implementation. According to the Diffusion of Innovations theory, the developer may need to change the message to continue increasing the number of sites beyond early adopters.

Reform expansion beyond a single classroom (continued...)

5) Transitioning Introductory Physics at UNC Chapel Hill

Alice Churukian, University of North Carolina at Chapel Hill

At the University of North Carolina at Chapel Hill we have been teaching one reformed section of calculus-based introductory physics using the SCALE-UP (Student Centered Active Learning Environment for Upside-down Pedagogies) methodology since fall 2010. While the pilot study proved successful, we were unable to take the next step of "scaling up" to use this approach for all students. Beginning fall 2013 we adopted a Lecture/Studio methodology -- a hybrid of traditional and interactive engagement -- for all students. In this approach, students have one hour of lecture and two hours of studio twice per week. In this fashion we were able to offer large lecture sections for efficiency, but retain smaller, more intimate studios for hands-on, minds-on problem-solving and laboratory activities. How we got to where we are today, and the lessons learned along the way, will be discussed.

6) A Widely Disseminated, Discipline Crossing, Radical Reform: The SCALE-UP Story

Melissa Dancy, University of Colorado Boulder

Scale-Up is a radical reform geared toward high levels of student engagement utilizing integrated lab-lecture in a redesigned room. The first Scale-Up course was taught in 1997. Since then Scale-Up as spread widely across many institutions and disciplines. A recent survey identified 314 departments at 189 institutions in 21 countries that report being influenced by or using some version of SCALE-UP style instruction. Departments represented many distinct disciplines. We are in the process of studying the dissemination of SCALE-UP though a social network analysis, surveys, interviews, and site visits. Research questions include: How has knowledge about SCALE-UP spread? What leads a department to consider, adopt, modify or abandon SCALE-UP? How does the method of learning about SCALE-UP and departmental factors impact how SCALE-UP is implemented? In this talk we report on findings to date from this project.

PERC 2014: Abstracts

Poster Symposium -
Gender issues in introductory physics: Recruitment, performance, and retention
Organizers: Geoff Potvin

1) Exposure to underrepresentation discussion: The impacts on women's attitudes and identities

Geoff Potvin, Zahra Hazari, Robynne Lock

In earlier work, we found that women who reported experiencing the "discussion of underrepresentation" in their high school physics classes were more likely to report a career interest in the physical sciences in college. To explore this effect in more detail, we conducted two double-blind, random-assignment experiments on students enrolled in introductory, algebra-based college physics. In the first, students were randomly assigned to read one of two short essays (one focused on the underrepresentation of women in physics, the other reporting on AMO physics research led by a woman) followed by a uniform set of reflection questions. In the second, another cohort of students was primed on their beliefs about gender differences in physics before undergoing the same treatment (one of two essays and reflection questions). In this paper, we compare the impacts on students' general science identity, physics identity, and performance gains on selected FMCE problems.

2) Female Students' Persistence and Engagement in Physics: The Role of High School Experiences

Zahra Hazari, Eric Brewe, Theodore Hodapp, Renee Michelle Goertzen, Robynne M. Lock, Cheryl A. P. Cass

Prior research has emphasized the importance of early science experiences for engaging female students such that their science interests persist and they opt towards STEM careers in the future. However, this research is not specific to physics and the question of when and how female students become engaged with learning physics in ways that may lead to their persistence remains largely unexplored. Drawing on data from more than a thousand undergraduate women in physics who completed a survey as part of the application process for the Conferences for Undergraduate Women in Physics, we identify the important role that high school physics plays in attracting female students to physics careers. Drawing on longitudinal interview data from nine female students, we further explore the ways in which high school physics experiences can have a lasting impact, especially as these experiences become more temporally distant. Supported by NSF Grant 0952460 and 1346627.

3) The Impacts of Instructor and Student Gender on Student Performance in Introductory Modeling Instruction Courses

Daryl McPadden, Eric Brewe

This study considers the impact of instructor on the gender gap in students' scores on the Force Concept Inventory (FCI) in Modeling Instruction (MI) courses at Florida International University (FIU). Earlier work has shown that MI had increased FCI scores overall when compared to traditional lecture courses; however, the gap between male and female students' scores in the MI courses increased over the course of the semester. Student data was collected from 600 students at FIU, over 19 semesters, with 11 different instructors. General Linear Regression was used to determine the significance of the student gender and instructor factors in predicting a student's FCI score post-instruction and the fraction of variance explained by these factors. Effect sizes were then calculated from the difference in female students' scores from male students' scores and compared between instructors.

4) The Long Term Impacts of Modeling Physics: The Performance of Men and Women in Follow-on Upper Level Physics Courses

Idaykis Rodriguez, Eric Brewe, Laird H. Kramer

Active-learning approaches to teaching introductory physics have been found to improve student performance and learning gains in those introductory subjects. This study goes further by investigating student performance in upper level physics courses after having previously taken Modeling Instruction introductory physics courses at Florida International University. Student performance data were analyzed for academic years 2010-2013 in upper level courses including Modern Physics, Mechanics, Electromagnetism, and Quantum Mechanics. We compare how students who took traditional or Modeling Instruction introductory courses perform in these subsequent courses. We also look for differential effects between men and women who had these two types of introductory experiences. The implications of this work for our understanding of the impacts of active-learning experiences will be discussed.

PERC 2014: Abstracts

Poster Symposium -
Using technology to enhance physics teaching: Research-based technology innovations
Organizers: Ben Van Dusen

1) Blurring the Boundary Between Physics Problem Solving and Students' Peer Cultural Practices

Ben Van Dusen & Valerie Otero (University of Colorado Boulder)

This study investigates differences in AP physics students' solutions to problems when creating them in traditional pencil and paper notebooks and in screencasts. The students' notebook and screencast solutions were examined for structural differences in their problem solving procedures and for correctness. These findings were combined with the examination of students' self-reports of behaviors and experiences while creating their solutions. Findings show that, within this classroom environment, students created more complete solutions to traditional physics problems and were more likely to get the correct answer when doing them on screencasts versus notebooks. Student surveys show that they felt more socially connected, increased authorship, and less frustration when creating solutions in their screencasts. Our findings suggest that the improvements in student work and increased social interactions were associated with the iPad-based screencasts acting as boundary objects, giving students the opportunities to creatively incorporate personally meaningful practices into their physics assignments.

2) Creating digital lab reports - effects on student's skill development

André Bresges (University of Cologne)

Building up competence in planning, conducting, assessing and evaluating experiments and communicating their outcome are core competencies in most national curriculas. Grading a lab report gives only limited amount of information about how far this competencies have been developed in an individual. Tablet-PCs with their integrated cameras, internal and external measurement devices, and integrated video editing suites give the opportunity to create video lab reports that provide additional informations about student's experimental and presentation skills - while, possibly, leaving out other informations.
In a Design Based Research (DBR) Project targeted both at middle school and university students, we seek optimized processes to prepare for experimental labwork, building and testing factual knowledge, conduct and document experiments and store and grade electronic lab reports. Research methods include electronic pre/post testing with comparison groups, parttaking observation and guided interviews. Preliminary results show enhanced groupwork and a tendency to more theory-guided experimenting. Factual knowledge, on the other hand, needs still to enhanced e.g. by rigid pre-testing prior to the lab session.

Using technology to enhance physics teaching: Research-based technology innovations (continued...)

3) Magnetism 2.0: Concept and Evaluation of a Multimedia Learning Environment

Stefan Heusler (Münster University)

The topic of magnetism fascinates people already since 2000 years and has always been an inherent part of curricula in physics education. Based on the properties of static textbooks the dynamic processes of magnetism were excluded in the present models. This fact is a problem in the understanding of magnetic phenomena and the compatibility of existing models with current scientific research in physics. Such a dynamic model of magnetism could be provided with the help of a multimedia learning environment (iBook) and usage of scientific methods for the visualization of magnetism (MOKE, MFM) on school level. To identify essential properties of such model, the knowledge of physics teachers about magnetism and interesting applications of magnetism for school a questionnaire has been developed and a teacher survey has been conducted. Considering the results of this survey and notable perceptions of physics education research regarding the existing models a first prototype of multimedia textbook was developed.

4) Animated Illustrations, Multicoding and Multimodality - Finding critical factors for an effective information processing

Raimund Girdwidz (University of Munich)

What are important settings for making learners benefit from illustrations and animated visuals? One aspect is that the learning content as such has to be considered. Here we focus on phenomena that are not visible with naked eyes. Pictures and animations (in combination with text and formulas) are used to illustrate relevant physical characteristics that cannot be seen in reality. Examples and classifications will be shown. Another important aspect is to assist information processing using multimedia to offer interactive visualizations and to provide possibilities also for combinations with acoustic information. Results from a study with 99 students who worked with a multimedia learning environment will be discussed. Distinction should be made between knowledge that was primarily based on pictorial information or on text based information. The best results provided animations with spoken explanatory text where pictorial imagination is important for understanding. This was significant for all students, but especially fruitful for the not so capable students. Concerning abstract, text based information students with higher abilities profited from written text, while students with lower abilities (median split) gained better results with spoken text. These results relate to material explaining how infrared motion detectors and infrared thermometers work, and how Planck's law and infrared radiation can be made more familiar. Possibilities for transfer to other areas will also be discussed.

Using technology to enhance physics teaching: Research-based technology innovations (continued…)

5) Student use of an interactive simulation in a large-lecture setting: Analysis of students' simulation interactions, discussions, and perceptions

Emily B. Moore and Katherine Perkins (University of Colorado Boulder)

Interactive simulations are popular pedagogical tools with wide use in lecture demonstrations and recitation activities. Here, we investigate what can happen when students use interactive simulations as part of small-group activities in a large-lecture setting. In one general chemistry class, the eighty students (organized into self-selected small groups) were given 10 minutes to explore the PhET simulation Molecule Polarity without instructions on how to interact with the simulation. During this exploration time, we collected simulation interaction data (student mouse clicks), audio recordings, and clicker question responses from all student groups. We found that students explored the simulation fully without instructions, engaged in predominately on-topic conversations during exploration, and found the simulation easy to use and helpful for their learning. Further discourse and interaction analysis of a subset of on-topic student discussions uncovered rich examples of mechanistic reasoning supported by the simulation.

PERC 2014: Abstracts

Talk Symposium -
Instructional Goals and Research Methods in the International PER community: A GIREP Symposium
Organizers: Paula Heron

1) The process of an iterative design of a teaching learning sequence on electromagnetic induction

Kristina Zuza, University of the Basque Country, Spain, kristina.zuza@ehu.es

This contribution proposes a iterative methodology for designing teaching-learning sequences. We will describe the didactical tools used in the design of the sequence which involve contributions from Physics Education research, STSE aspects and epistemological analysis of the contents of the school curriculum. In the presentation will be specified the methodology for the case of electromagnetic induction. This topic, in the usual teaching, is usually quickly analyzed, spending most of the time to solve problems in a more or less rote manner. However, Physics Education research has shown that the fundamental concepts of the electromagnetic induction theory are barely understood by students.

2) Project laboratory for beginning physics majors: Think like a physicist from the start

Gorazd Planinsic, University of Ljubljana, Slovenia, gorazd.planinsic@fmf.uni-lj.si

I will present 12 years of experience of leading "Project laboratory" course for first and second year physics majors. The main goal of the course is to develop students' science competences and skills in situations that are close to working conditions of physicists. This goal is achieved by giving the students an opportunity to work in small groups on open ended practical problems. The work takes 9 hours of class time (and more hours outside of class) and is spread over three weeks. Students design/build their own equipment, plan their own investigations and interpret and explain collected data. I will discuss the logistical and technical aspects of the course (equipment, examples of project tasks, etc.) present the examples of projects that students completed and share students' perceptions of learning in the course as expressed in their course evaluations.

PERC 2014: Abstracts

Instructional Goals and Research Methods in the International PER community: A GIREP Symposium (continued…)

3) Learning with pictures, figures, graphs and text

Raimund Girwidz and Bianca Watzka, Ludwig-Maximilians-University Munich, Germany, girwidz@lmu.de

Pictures, figures, charts, symbols or graphs present information in many different ways. However, there are also specific suitable working methods for using them and for activating effective mental processing of information. Otherwise they will not contribute to multiple knowledge representations. The use of pictorial task exercises was tested in a quasi-experimental study. 177 students (9th graders) participated in the study. The influence of working with different representations on knowledge acquisition and on knowledge transfer was examined. Knowledge acquisition, knowledge transfer, cognitive activities, and motivation were measured in the three groups that worked with: (a) written task exercises, (b) pictorial exercises and (c) mixed exercises. This study was realized in a broader context of context oriented leaning with modern sensors, also to overcome inert knowledge. This context, the study, statistics and the findings will be discussed.

4) Developing formal thinking from phenomena exploration

Marisa Michelini, University of Udine, Italy, marisa.michelini@uniud.it

In the framework of the Model of Educational Reconstruction we study the development of formal thinking starting from phenomena exploration. Research is focus on contributing to practice developing vertical coherent content related learning proposals by means of Design Based Research and on finding ways to offer opportunities for understanding and experience what physics is, what it deals with and how it works in operative way. The research is not only limited to those that function in practice, but integrate learning processes analysis. Empirical data analysis is carried out on three main research problems: 1) individual common sense perspective with which different phenomena are viewed and idea organization, in order to activate modeling perspective in phenomena interpretation, 2) the exploration of spontaneous reasoning and its evolution in relation to a series of problematic stimuli in specific situations, in order to formulate activity proposals, 3) recognizing the modalities for overcoming conceptual knots in the learning environment in order to reproduce these conditions. Three main aspects are studied: 1) object-models role in favoring the student's first interpretative steps, 2) ICT role in overcoming conceptual knots, 3) developing theoretical thought in an educational path concerning quantum mechanics.

PERC 2014: Abstracts

Poster Symposium -
Game-Based and Game-Informed Approaches to Physics Instruction
Organizers: Ian D. Beatty

1) A Model of Video Game Learning Dynamics to Inform Instructional Design

Ian D. Beatty, University of North Carolina at Greensboro

To facilitate the use of video game dynamics and learning principles in physics teaching, I offer a theoretical model that integrates ideas from a broad range of literature. The essence of game play is voluntary engagement with a succession of challenges, powered by four dynamical loops: exploratory learning, identity growth, intrinsic motivation through mastery, and adaptive game response. Game play is a co-construction of the game mechanics and player, and much of a game's power to engage and teach arises from five different types of human-computer "meld" that the player can experience. The model describes coarse- and fine-grained elements of the game mechanics and their interrelationships, and can be applied at four different levels: the micro-level game as a succession of interesting challenges, the macro-level game as a designed experience, and two meta-level games focused on extending or modifying game aspects and on social interactions surrounding it.

2) The intersection of learning design and game design: a robust strategy for creating an effective educational games

Dedra Demaree, William Garr, Stacey Church

To investigate the pedagogic potential of educational games, Georgetown University (GU) is implementing a rigorous instructional design process in which learning objectives are mapped to game actions/analytics and to research questions. The challenge for educational game design is to tap into games' pedagogical potential. Hoffman and Nadelson (2009) write, "Our evidence suggested that games are unlikely to fulfill instructional expectations unless a direct relationship exists between the game and the learning context." This game design process is being implemented at GU through a faculty gaming cohort and has been shown in a pilot project to produce a robust game design effective at achieving stated learning outcomes. We are gathering triangulated data sources to address: correlations between game play and learning outcomes, perceived helpfulness, and enjoyment and/or engagement when playing the game. This poster will detail the design process, its link to game theory, and preliminary findings.

PERC 2014: Abstracts

Game-Based and Game-Informed Approaches to Physics Instruction (continued...)

3) Computer games and learning: The power of analogy

David Brookes, Yuhfen Lin

If we throw students into an academic learning environment that has been designed on the basis of "good" computer game design, how can we help them to recognize and cope with the fact that they are no longer in a traditional academic setting? We will present the "expertise activity" that we implement at the beginning of every new physics class. We ask students to identify a field of expertise outside of their academic life. Computer gaming is frequently identified by students. We ask them to describe a learning cycle that they can show the rest of the class to describe how to become an expert in gaming. We will present qualitative data showing the productive learning attitudes that students activate when learning is placed in the context of computer games. We will discuss the power of having students construct analogies using source domains with which they are familiar.

4) Reverse Game Play as an Introduction to Scientific Reasoning

David P. Maloney, Indiana University Purdue University Fort Wayne

Helping students, especially non-science majors, develop an understanding of three aspects of science -- that scientific reasoning is not something that only certain people are capable of doing, that scientific theories are not "grown-up" hypotheses, and that all scientific findings are tentative -- is a difficult endeavor. Students have few, if any, experiences where they explicitly engage in formulating and testing hypotheses and building a model (theory) of a system. We have used reverse game play to put students into a situation where they have to carry out this program. The students are given the board, playing pieces, and several histories of two people playing an abstract strategy game. Their task, working in small groups, is to infer a model of the game, i.e., the starting positions, legal moves, how to win, etc. Preliminary investigations suggest that students have a tendency to generate vague and/or incomplete hypotheses through weak analysis.

Game-Based and Game-Informed Approaches to Physics Instruction (continued...)

5) Game-ifying Scientific Concepts of Radioactivity

Andy Johnson, Forest Johnson, Black Hills State University

Inquiry into Radioactivity simulators scaffold learning by placing students inside virtual worlds open to exploration and experimentation, with no overt agenda. Game design considerations have influenced the IiR simulators in several ways. They compress time and space, and their appearance achieves a cinematic visual style that welcomes non-science oriented students. Their game-like behaviors encourage curiosity-driven exploration: surprising phenomena (such as ionization or radiation emission) are first seen unexpectedly. Students must figure out what they have just seen, and groups often dive unasked into investigations to make sense of what they have discovered. Like computer games, the simulators display behaviors based on a vision of how the world might be rather than on the real behaviors observed in laboratories. They also deliberately exclude visual elements that might lead to alternate interpretations. Artistic license is used to help students visualize and connect phenomena on wildly different size and time scales.

PERC 2014: Contributed Posters

P1-5: Influence of Visual Cueing and Correctness Feedback on Students' Reasoning during Problem Solving
Elise Agra, Mitchell Burkett, John Hutson, Lester C. Loschky, N. Sanjay Rebello (Kansas State University)

P1-61: Describing Video Viewing Behavior in a Flipped Introductory Mechanics Course
John Aiken, Shih-Yin Lin, Scott S. Douglas, Edwin F. Greco, Michael F. Schatz (Georgia Institute of Technology), Brian D. Thoms (Georgia State University), Marcos D. Caballero (Michigan State University)

P2-6: Training and Career Development of Physics Teaching Assistants
Emily Alicea-Muñoz, Carol Subiño Sullivan, Daegene Koh, Michael F Schatz (Georgia Institute of Technology)

P1-64: Students' discussion: Does active learning facilitate responsiveness among peers?
Carolina Alvarado, Genaro Zavala (Tecnologico de Monterrey)

P1-4: Spatial Reasoning Ability and the Construction of Integrals in Physics
Nathaniel Amos, Andrew Heckler (The Ohio State University)

P1-53: Online Hands-on Introductory Learning in a Flipped Classroom Context
Katherine Ansell, Mats Selen, Timothy Stelzer (University of Illinois)

P1-35: Students' Spontaneous Application of Conservation Laws when Learning about Electron-Positron Annihilation
Bijaya Aryal (University of Minnesota-Rochester)

P1-41: Student Reasoning About the Divergence of a Vector Field in Advanced Undergraduate Electromagnetism
Cecilia Astolfi, Charles Baily (University of St Andrews)

P1-71: Prelecture Explorations
Gordon Aubrecht (Ohio State University, Marion Campus)

P2-21: Design and evaluation of a natural language tutor for force and motion
Ryan Badeau, Andrew Heckler (The Ohio State University)

P1-6: Test of Understanding of Vectors (TUV): Classification of the most frequent incorrect answers
Pablo Barniol, Genaro Zavala (Tecnologico de Monterrey)

P1-30: The Experiences of Women in Post Graduate Physics and Astronomy Programs: The Roles of Support, Career Goals, and Gendered Experiences
Ramon Barthelemy (University of Michigan), Melinda McCormick, Charles Henderson (Western Michigan University)

P2-61: Understanding the Neural Correlates of Problem-Solving Across Multiple Cognitive Domains
Jessica E Bartley, Eric Brewe, Angela R Laird (Florida International University), Kimberly L Ray, Michael C Riedel (Research Imaging Institute, University of Texas Health Science Center)

PERC 2014: Contributed Posters

P2-25: Pwning Level Bosses in MATLAB: Student Reactions to a Game-Inspired Computational Physics Course
Ian D. Beatty, Lauren Harris (University of North Carolina at Greensboro)

P2-57: Aligning Grades to Learning Outcomes for Introductory Physics for Life Sciences
Nancy Beverly (Mercy College)

P1-65: "Tiered" iClicker Recitation Introductions and An Open-Ended Experiment
David Blasing, Andrew Hirsch and Rebecca Lindell (Purdue University)

P2-60: What Do Students Want? Small Group Instructional Diagnoses of STEM Faculty
Jennifer Blue, Gregg Wentzell, Matthew Evins (Miami University)

P1-36: Examination of Students' Ability to Interpret Data in Light of Prior Belief
Abigail M. Bogdan, Andrew F. Heckler (The Ohio State University)

P1-20: Progressions of Student Laboratory Writing Skills
Scott Bonham, Kolton Jones (Western Kentucky University)

P2-43: Toward a coordination of social and cognitive networks
Eric Brewe, (Florida International University) Jesper Bruun (Department of Science Education, University of Copenhagen)

P2-46: Positioning and discussion in effective group interactions
David T. Brookes, Binod Nainabasti (Florida International University), Yuehai Yang (California State University, Chico)

P1-44: Developing and Evaluating a Quantum Interactive Learning Tutorial (QuILT) on Larmor Precession of Spin
Benjamin R. Brown, Chandralekha L Singh (University of Pittsburgh)

P2-40: Visual Schema for the Analysis of the Physics Core
Juan R. Burciaga (Mount Holyoke College)

P2-71: High School Students' Understandings and Representations of The Electric Field
Ying Cao, Bárbara M. Brizuela (Tufts University)

P1-63: Comparing Traditional and Studio Courses through FCI Gains and Losses
Jacquelyn J. Chini, Jarrad W. T. Pond (University of Central Florida)

P1-3: Spanning Student Reasoning about P-V Diagrams in Physics and Engineering
Jessica Clark, John R. Thompson, Donald B. Mountcastle (University of Maine)

P2-41: Thinking in Physics -- a book about teaching
Vincent Coletta (Loyola Marymount University)

P2-10: Learning Assistant Identity Development: Is One Semester Enough?
Jessica Conn, Eleanor W. Close, Hunter G. Close (Texas State University)

PERC 2014: Contributed Posters

P2-7: Fostering positive cultural changes in college STEM departments
Joel C. Corbo, Noah Finkelstein, Melissa Dancy, Stanley Deetz, Daniel Reinholz (University of Colorado, Boulder)

P1-8: Students' explanation of real-life situations in an inquiry-based general physics laboratory
Edgar D. Corpuz, Brenda Ramirez (University of Texas-Pan American)

P1-31: Race and Gender and Leaving STEM: Preliminary Results of The Roots of STEM Project
Melissa Dancy (University of Colorado, Boulder) Elizabeth Stearns, Roslyn Mickelson, Stephanie Moller, Martha Bottia (University of North Carolina at Charlotte)

P1-38: Student learning of critical circuits concepts in physics and engineering*
Kevin L. Van De Bogart, MacKenzie R. Stetzer (Maine Center for Research in STEM Education)

P1-33: Quantum Interactive Learning Tutorial (QuILT) on Quantum Key Distribution
Seth DeVore, Chandralekha Singh (University of Pittsburgh)

P2-52: Path analysis of causal factors on conceptual learning in introductory physics
Lin Ding (The Ohio State University)

P2-66: The relationship between centrality and student self-efficacy in an interactive introductory physics environment
Remy Dou, Eric Brewe (Florida International University)

P2-64: Rubric design for open-ended assessments: Example from students' construction of differential equations
Leanne Doughty, Marcos D. Caballero (Michigan State University),
Steven J. Pollock (University of Colorado, Boulder)

P1-69: Peer Evaluation of Video Lab Reports in a Blended Classroom
Scott Douglas, John Aiken, Shih-Yin Lin, Edwin Greco, Michael Schatz (Georgia Institute of Technology), Marcos D. Caballero (Michigan State University)

P2-12: Longitudinal Tracking of the STEM Teacher and Researcher Program
Dimitri R. Dounas-Frazer, John Keller (Cal Poly, San Luis Obispo), Sanlyn Buxner (University of Arizona)

P2-51: Examining Epistemological Beliefs in Undergraduate Thesis Writing
Jason E. Dowd, Julie A. Reynolds, Robert J. Thompson, Jr. (Duke University)

P2-54: Identifying blended ontologies for energy
Benjamin W. Dreyfus, Ayush Gupta, Edward F. Redish (University of Maryland)

P1-21: Investigation of Students' Understanding of Electric Field Concepts and Problem-Solving Strategies
Archana Dubey, Jarrad W.T. Pond (University of Central Florida)

PERC 2014: Contributed Posters

P2-65: Student Epistemologies in Project-based Learning Courses
Gintaras Duda, Kristina Ward (Creighton University)

P2-5: A metacognitive approach for professional development of experienced physics teachers
Osnat Eldar, Shirley Miedjensky (Oranim Academic College of Education)

P2-75: Using CFAs in inquiry-based middle school science teaching
Jennifer Esswein (Tennessee Department of Education), Gordon Aubrecht, Jessica Creamer, Caryn Palatchi (The Ohio State University), Bill Schmitt (Science Center of Inquiry)

P1-19: Feeling a Vector: Using Embodied Learning to Explore Angular Momentum
Susan M. Fischer (DePaul University), Carly Kontra, Daniel J. Lyons, and Sian L. Beilock (University of Chicago)

P1-54: Implementation and Adaption of SCALE-UP: A Case Study of Two Contrasting Universities
Kathleen Foote, Robert Beichner (North Carolina State University), Xaver Neumeyer, Charles Henderson (Western Michigan University), Melissa Dancy (University of Colorado, Boulder)

P2-14: Assessing Future Teachers' Pedagogical Content Knowledge in a Physics Class
Claudia Fracchiolla, N. Sanjay Rebello (Kansas State University)

P1-7: Transformative Experiences and Conceptual Understanding of Force and Motion
Brian W. Frank, Paul Mittura (Middle Tennessee State University)

P1-2: Assessing students' problem-solving skills: Measuring the effect of an intervention
Evan Frodermann, Qing Ryan, Jie Yang, Ken Heller, Leon Hsu (University of Minnesota, Twin Cities), Bijaya Aryal (University of Minnesota, Rochester), K. Alan Jackson (Central Michigan University)

P2-42: Student satisfaction and perceptions of instructor support in studio physics
Jon D. H. Gaffney (Eastern Kentucky University), Amy L. Housley Gaffney (University of Kentucky)

P1-10: Explanatory coherence in an introductory physics for life scientists course
Benjamin D. Geller, Benjamin W. Dreyfus, Julia Gouvea, Vashti Sawtelle, Chandra Turpen, Edward F. Redish (University of Maryland)

P2-37: Efficacy of "A-La-Carte" Research-Based Curricular Elements
Kevin Goering, Elizabeth Gire (University of Memphis)

P2-47: Investigating the Proposed Affordances and Limitations of the Substance Metaphor for Energy
Lisa Goodhew, Amy Robertson (Seattle Pacific University)

P1-57: Designing and investigating new ways of interactive whiteboard use in physics instruction
Bor Gregorcic, Gorazd Planinsic (University of Ljubljana), Eugenia Etkina (Rutgers University)

PERC 2014: Contributed Posters

P2-23: Using Intelligent Tutoring Systems in Physics Education within Latin-American Scenarios: Results from Learning Basic Electric Circuits Concepts
Daniel Sánchez Guzmán (Instituto Politécnico Nacional)

P2-11: From Instructional Goals to Grading Practices: The Case of Graduate Students after One Semester of Teaching Experience
Charles Henderson (Western Michigan University), Alexandru Maries, Emily Marshman, Chandralekha Singh (University of Pittsburgh), Edit Yerushalmi (Weizmann Institute of Science)

P2-73: Characterizing Scientific Creativity in an Afterschool Physics Program
Kathleen Hinko, Margaux Krahe (University of Colorado, Boulder), Yvan Hernandez Charpak (Universidad de los Andes)

P1-81: Examples Of Whole Class "Board" Meetings Overcoming Sharp Initial Disagreements
Brant Hinrichs (Drury University)

P1-76: The impact of lab course learning goals on student attitudes about experimental physics
N.G. Holmes, Joss Ives, D.A. Bonn (University of British Columbia)

P2-35: Reconsidering an Epistemological Framing Explanation
Paul Hutchison, Pavlo Nikolaidis, Benyamin Elias (Grinnell College)

P2-62: Validation of the Japanese translation of the Force Concept Inventory and preliminary data analysis on the effects of class instruction and gender
Michi Ishimoto (Kochi University of Technology)

P2-45: Measuring the effectiveness of collaborative group exams
Joss Ives (University of British Columbia)

P1-77: Pull, feel, and run: signs of learning in kinesthetic activities in physics
Bjørn Friis Johannsen, Jesper Bruun (University of Copenhagen)

P1-26: Examining Resources Expert Physicists Use To Understand Challenging Physics Problems
Darrick Jones, AJ Richards, Eugenia Etkina (Rutgers University), Gorazd Planinsic (University of Ljubljana)

P1-49: Optical microscopy as a context to facilitate learning in interdisciplinary students
Dyan Jones, Shauna Novobilski, Rebecca Wheeling (Mercyhurst University)

P2-24: A Web-based version of the FCI?
Patrick A. Kelley, Rebecca S. Lindell (Purdue University)

P2-17: A Case Study of a School District Assessment System and its Correlation with Student Performance in Physical Sciences
Angela Kelly, Thea Charles, Minsu Ha, Keith Sheppard (Stony Brook University)

PERC 2014: Contributed Posters

P2-2: A Study of the Successful Propagation of Peer Instruction
Raina Khatri, Charles Henderson (Western Michigan University), Renee Cole, Courtney Stanford (University of Iowa) Jeffrey Froyd (Texas A&M University), Debbi Gilbuena (Oregon State University), Courtney Stanford (University of Iowa).

P1-22: Understanding Student Evaluations of Others' Problem-Solving Competency
Anna Kiefte (Acadia University), Geoff Potvin (Florida International University)

P1-39: Investigating the influence of visualization on student understanding of quantum superposition
Antje Kohnle, Charles Baily, Scott Ruby (University of St Andrews)

P1-9: Assessment of student preparation for calculus-based mechanics
Monika Kress, Olenka Hubickyj, Michelle Lagana, Cassandra Paul, Michael Kaufman (San Jose State University)

P1-16: Examining persistence of student intuitive reasoning approaches in introductory physics courses: The role of metacognition
Mila Kryjevskaia (North Dakota State University), MacKenzie R. Stetzer, Thanh K. Le (University of Maine)

P1-60: Relating epistemology to enjoyment of PER-based discussion section activities
Eric Kuo, Tyler Brown, Engin Bumbacher, Dilia Olivo, Saranapob Thavapatikom, Carl E. Wieman (Stanford University)

P2-33: Learning: Two steps forward, one step back
Nathaniel Lasry (John Abbott College), Jonathan Guillemette, Eric Mazur (Harvard University)

P2-39: Measuring Change in Introductory Physics Courses with Three Dimensional Learning Analytics
James T. Laverty, Stuart H. Tessmer, Melanie M. Cooper, Marcos D. Caballero (Michigan State University)

P2-56: Exploring the role of metacognition in qualitative reasoning
Thanh K. Le, MacKenzie R. Stetzer (University of Maine), Mila Kryjevskaia (North Dakota State University)

P1-27: Students’ Difficulties in Understanding The Explicative Model of DC simple circuits
Ane Leniz, Kristina Zuza, Jenaro Guisasola (University of the Basque Country)

P1-48: Preparing students for research experiences through instructional labs in electronics
Heather Lewandowski, Benjamin Pollard, Noah Finkelstein (University of Colorado, Boulder)

P2-15: On the Road to Becoming a Physicist: Signposts and Detours
Sissi L. Li, Michael E. Loverude (California State University Fullerton)

P2-31: Physics I MOOC – Educational Outcomes
David Lieberman (Queensborough Community College), Michael Dubson, Noah Finkelstein, Katherine Goodman, Edmond Johnsen, Jack Olsen (University of Colorado, Boulder)

PERC 2014: Contributed Posters

P2-20: Peer Evaluations of Video Lab Reports in an Introductory Physics MOOC
Shih-Yin Lin, Scott Douglas, John Aiken, Ed Greco, Michael F. Schatz (Georgia Institute of Technology), Brian D. Thoms (Georgia State University), Marcos D. Caballero (Michigan State University)

P2-49: Is it time to stop using the FCI: A Psychometric Argument
Rebecca S. Lindell (Purdue University)

P1-32: Discussing Underrepresentation as a Means to Increasing Female Physics Identity
Robynne M. Lock (Texas A&M University- Commerce), Zahra Hazari (Florida International University), Reganne Tompkins (Clemson University)

P1-80: Pedagogical Development of University Physics Students in Informal Learning Environments
Peter Madigan, Noah Finkelstein, Kathleen Hinko (University of Colorado, Boulder)

P2-69: Impact of Novel Technologies on High School Science Student Identity
Jonathan Mahadeo, Zahra Hazari (Weston, FL)

P1-29: Exploring the gender gap in one department's algebra-based physics course
Twanelle Walker Majors, Paula V. Engelhardt, Steve J. Robinson (Tennessee Technological University)

P2-16: Performance of graduate students at identifying introductory students' difficulties related to kinematics graphs
Alexandru Maries, Chandralekha Singh (University of Pittsburgh)

P1-51: Quantum Interactive Learning Tutorial (QuILT) on Quantum Eraser
Emily Marshman, Chandralekha Singh (University of Pittsburgh)

P2-80: Using IOLab to connect real-world experiences to controlled laboratory experiments
Eric C. Martell (Millikin University)

P2-67: Survey to Characterize Understanding of Measurement Uncertainty and Proportional Reasoning
Jeffrey Marx (McDaniel College), Karen Cummings (Southern Connecticut State University)

P2-55: Epistemic Impact on Group Problem Solving for Different Science Majors
Andrew Mason, Charles Bertram (University of Central Arkansas)

P2-36: Tethering Ethics to Academic Pursuit
Frances Mateycik (Penn State Altoona)

P1-13: The Categorization of Sense-Makers in Introductory Mechanics
Brinkley Mathews, Elizabeth Gire (University of Memphis)

P1-75: Enhancing student ownership of the exam preparation process
Timothy McCaskey (Columbia College Chicago)

PERC 2014: Contributed Posters

P1-82: Promoting and assessing student metacognition in introductory physics
Alistair McInerny, Andrew Boudreaux (Western Washington University),
Mila Kryjevskaia (North Dakota State University)

P2-63: Student Models of Weather, Climate, and Climate Change
Jignesh Mehta, Anita Roychoudhury, Daniel Shepardson, Andrew Hirsch (Purdue University)

P2-53: Training factors affecting improvement in student fluency with vector algebra
Brendon D. Mikula, Andrew F Heckler (The Ohio State University)

P2-28: Learning About The Energy Of A Hurricane System Through An Estimation Epistemic Game
Bahar Modir, Eleanor C Sayre (Kansas State University)

P2-27: Decreasing Hand Occlusion On Touch-Screen Tablet Devices: Influencing Hand Orientation with Tablet Tilt Angle
Emily B. Moore (University of Colorado, Boulder)

P2-77: Toward Better Physics Labs for Future Biologists: A NEXUS/Physics Lab Curriculum
Kimberly Moore, J. Giannini, K. Nordstrom, W. Losert (University of Maryland)

P1-59: Beyond the Flipped Classroom: student-generated multimedia learning objects in a large introductory physics class
Firas Moosvi, Simon P. Bates, Joss Ives, Georg Rieger (University of British Columbia)

P1-67: Students' participation in a physics class and its relationship to learning.
Binod Nainabasti, David T. Brookes, Yuehai Yang (Florida International University)

P1-66: Comparative Educational Outcomes from Three Introductory Physics Courses
Jack Olsen, Michael Dubson, Noah D. Finkelstein, Katherine A. Goodman, Edmond Johnsen, David H. Lieberman (University of Colorado, Boulder)

P1-45: Tutorials in Quantum Mechanics: Benefits to Students Regardless of Academic Performance
Gina Passante, Paul J. Emigh, Peter S. Shaffer (University of Washington)

P2-48: Student Participation Observation Tool (SPOT): Map classroom participation and identify interactions linked to positive student outcomes
Cassandra Paul, Katrina Roseler, Andrew Reid, Mark Felton (San Jose State University),
Cara Harwood Theisen (University of California, Davis)

P2-34: Is it Disadvantageous to Teach Forces First in Mechanics?
Andrew Pawl (University of Wisconsin-Platteville)

P1-25: Exploring students' use of visual representations in introductory electromagnetism
Alanna Pawlak, Leanne Doughty, Paul W. Irving, Marcos D. Caballero (Michigan State University)

P2-30: Examining the use of PhET interactive simulations in US classrooms
Katherine Perkins, Stephanie Chasteen, Emily Moore (University of Colorado Boulder)

PERC 2014: Contributed Posters

P1-52: An episode of disciplinary engagement during an interactive lecture
Anna McLean Phillips, Jessica Watkins, David Hammer (Tufts University)

P2-44: Using the Cognitive Apprenticeship Model to Develop Educational Learning Modules: An Example from Statics
Francesca G. Polo, Alejandra Magana, Eric Nauman, Robin Adams (Purdue University)

P1-58: Survey of Student Characteristics in Studio-mode Classrooms at a Large Research University: Demographics
Jarrad Pond, Jacquelyn J. Chini (University of Central Florida)

P2-19: Developing and assessing an online version of the PET curriculum
Edward Price (California State University San Marcos)

P1-43: An Effective Teaching/Learning Intervention On Time Dilation Effect and Relativistic Dynamics
Emanuele Pugliese, Lorenzo Santi (Udine University)

P2-70: Investigating Access to and Attitudes toward Programming in a Physics Camp
Gina M. Quan, Ayush Gupta (University of Maryland)

P2-50: Correlations Between Math Background and Class Performance in Conceptual Physics
Lynne Raschke, Katheryne Anderson (The College St. Scholastica)

P2-1: Creating a Resource for Faculty: Assessment Implementation Guides
Jaime E Richards (Rowan University), John D Thompson, Eleanor C Sayre (Kansas State University), Sarah B McKagan, Adrian M Madsen, (AAPT)

P2-68: Identifying and supporting children's narrative reasoning about physical phenomena
Laura Rodriguez-Costacamps, Victoria Winters, Talya Wolf, Harouna Ba (The New York Hall of Science)

P1-17: Comparing student ability to reason with multiple variables for graphed vs. non-graphed information.
Rosenblatt, Rebecca (Illinois State University)

P2-38: Eye-Tracking Student Attention: A Case-Study On An ADD Student
David Rosengrant, Jessica Lang (Kennesaw State Unviresity)

P1-47: Experts' understanding of partial derivatives using the Partial Derivative Machine
David Roundy, Eric Weber, Tevian Dray, Grant Scherer, Corinne Manogue (Oregon State University)

P1-40: Ongoing Validation of an Upper-division Electrodynamics Conceptual Assessment Tool
Qing Ryan, Steven Pollock (University of Colorado, Boulder),
Cecilia Astolfi, Charles Baily, (University of St-Andrews)

P1-37: Investigations of spin first instructional approach in teaching quantum mechancis
Homeyra Sadaghiani (Cal Poly Pomona)

PERC 2014: Contributed Posters

P2-78: eTALK Results: In-Depth Study of Synchronous Distance Labs
William Sams, Colleen Lanz, MA Paesler (North Carolina State University)

P1-72: Designing and Refining Physics for Biologists: The Scaling Up Process
Vashti Sawtelle, Benjamin W. Dreyfus, Benjamin D. Geller, Edward F. Redish, Chandra Turpen, (University of Maryland, College Park), Julia Svoboda Gouvea (University of California, Davis)

P1-68: Meta-analysis of Teaching Methods on the FCI and FMCE
Edward W Schenk, Eleanor C Sayre (Kansas State University), K Alison Gomez (University of Texas-Brownsville), Chase Shepherd, Tyrel Heckendorf (Georgia State University), Adrian M Madsen, Sarah B McKagan (AAPT), Joshua Von Korff (Georgia State University)

P1-74: Periscope: Looking into learning in best-practices physics classrooms
Rachel E. Scherr (Seattle Pacific University), Renee Michelle Goertzen (APS)

P2-9: Quantifying changes in school teachers' practices
Bill Schmitt (Science Center of Inquiry), Jennifer Esswein (Tennessee Department of Education), Gordon Aubrecht, Jessica Creamer (The Ohio State University)

P1-28: Interdisciplinary Affinity: Definitions and Connections to Physics Identity
Tyler D. Scott (Clemson University), Zahra Hazari, Geoff Potvin (Florida International University), Gerhard Sonnert, Philip Sadler (Harvard University)

P1-12: Aspects of Factor Analysis Applied to the Force Concept Inventory
Matthew R. Semak, Richard D. Dietz (University of Northern Colorado)

P2-13: Use of Scientific Language by University Physics Students Communicating to the Public
Jordan Seneca, Noah Finkelstein, Kathleen Hinko (University of Colorado Boulder)

P2-29: Progress in Easy-to-use 3D Programming Environments
Bruce Sherwood (North Carolina State University), Steve Spicklemire (University of Indianapolis)

P1-50: Developing and Evaluating a Quantum Interactive Learning Tutorial on Mach Zehnder Interferometer with Single Photons
Chandralekha Singh, Emily Marshman (University of Pittsburgh)

P1-11: Vector Addition in Different Contexts
Philip Southey, Saalih Allie (University of Cape Town)

P1-79: The Effect of Online Lecture on Performance in a Physics Class
John Stewart (University of Arkansas)

P1-73: A methodology for characterizing student engagement in consensus discussions
Enrique Suarez, Philippe Guegan, Shelley Belleau, Kale Hubert, Michael J. Ross, Valerie Otero (University of Colorado, Boulder)

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P2-32: Comparison between two active methodologies for learning basic electric circuit's concepts: demonstrative experiments and interactive simulations.
Diana López Tavares, Ricardo Garcia Salcedo, Daniel Sánchez Guzmán (Instituto Politecnico Nacional)

P2-76: Opening modern research experiments to undergraduate students with Simulated Interactive Research Experiments (SIRE)
Mathias Tomandl, Christiane M. Losert Valiente-Kroon, Martin Hopf, Markus Arndt (University of Vienna)

P1-78: Re-examining the Meaning of Flipped Classroom in Physics Education in Japan
Sachiko Tosa, (Niigata University and Wright State University)

P1-23: Multiple representations and epistemic games in introductory physics exam solutions
Adrienne L. Traxler, Jonathan V. Mahadeo, Daryl McPadden, Eric Brewe (Florida International University)

P2-72: High school science experiences associated to mastery orientation towards learning
Katrina Velez, Geoff Potvin, Zahra Hazari (Florida International University)

P1-14: Students' use of prior knowledge and metacognitive skills when reading a passage about pressure and density
Joshua Von Korff, Merrin Oliver, Maggie Renken (Georgia State University)

P1-24: A Taxonomy of Student Conceptions about Buoyancy
DJ Wagner, Ashley Lindow, Janice Novacek, Bethany Herb (Grove City College)

P2-18: Making sense of multivariable settings: Discovering Geometric Reasoning with Tangible Surfaces
Aaron Wangberg (Winona State University), Brian Fisher (Pepperdine University), Eric Weber (Oregon State University), Jason Samuels (City University of New York - BMCC)

P1-70: The Role of Student Reflection in Project-based Learning Physics Courses
Kristina Ward, Gintaras Duda (Creighton University)

P2-22: Online, interactive learning modules for undergraduate physics
Margaret J. Wegener, Dominic McGrath, Timothy J. McIntyre (The University of Queensland)

P1-15: Identifying student difficulties with solving multiple-concept problems
Daniel R. White, Ryan Badeau, Andrew F. Heckler, Lin Ding (The Ohio State University)

P2-26: Uncovering Long-Term Trends in Students' Engagement with Online Homework
Craig Wiegert, Shahab Razavi (University of Georgia)

P1-34: Upper-division Student Difficulties with the Dirac Delta Function
Bethany R. Wilcox, Steven J. Pollock (University of Colorado Boulder)

P1-62: Implementing Lecture-Tutorial Exercises in an Introductory Astronomy Course
Eric A. Williams, Caroline E. Simpson (Florida International University)

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P1-18: Conceptualizing children's kinetic and potential energy discourse as narratives
Victoria Winters, Talya Wolf, Laura Rodriguez-Costacamps, Cornelia Brunner (The New York Hall of Science)

P2-59: It's "Just Math": A New Epistemic Frame
Steven Wolf, Leanne Doughty, Paul W. Irving, Marcos D. Caballero (Michigan State University), Eleanor C. Sayre (Kansas State University)

P2-79: Developing and Assessing Scientific Reasoning in Introductory Physics Lab
Krista E. Wood (University of Cincinnati Blue Ash College), Kathleen Koenig (University of Cincinnati)

P1-1: Effect of Training on Students' Reasoning Patterns on Conceptual Physics Problems
Xian Wu, Elise Agra, Claudia Fracchiolla, N. Sanjay Rebello (Kansas State University)

P2-74: Children's Communication Practices in an Informal Physics Program
Rosemary Wulf, Kathleen Hinko, Noah Finkelstein (University of Colorado, Boulder)

P1-55: A Study of Informal Learning Communities: A Tale of Two Physics Courses
Yuehai Yang (California State University, Chico), Binod Nainabasti, David T. Brookes, Eric Brewe (Florida International University)

P2-4: From Instructional Goals to Grading Practices: The Case of Graduate Students Beginning their Teaching Assignment
Edit Yerushalmi (Weizmann Institute of Science), Charles Henderson (Western Michigan University), Alexandru Maries, Emily Marshman, Chandralekha Singh (University of Pittsburgh)

P1-56: Teaching Fluids to IPLS Students via a Multiple-Scale Model and Mechanisms
Dan Young, Dawn Meredith (University of New Hampshire)

P2-3: Teachers' Experiences of Nanoscale Phenomena through the Sense of Touch: An Exploratory Study of the Use of an AFM Visuohaptic Simulation
Tugba Yuksel, Yu Gong, Alejandra J Magana (Purdue University)

P2-8: Assessing High School Teachers' Attitudes in a Scientific Literacy Course
Genaro Zavala, Silvia Tecpan (Tecnologico de Monterrey)

P1-42: 3rd year university physics students' reasoning on physical information encoded in quantum state at a point in time
Giacomo Zuccarini, Marisa Michelini (University of Udine)

P2-58: Making models of measurement tools: Examples from think-aloud student interviews
Benjamin Zwickl, Dehui Hu (Rochester Institute of Technology), Noah Finkelstein, Heather Lewandowski (University of Colorado, Boulder)

P1-46: Revealing differences between curricula using the Colorado Upper-Division Electrostatics Diagnostic
Justyna P. Zwolak, Corinne A. Manogue (Oregon State University)