AAPT Programs & Conferences Tools

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PER: Informing Physics Instruction

AAPT | **Type:** Con | **Organizer:** AAPT

Description:

Call for Papers:

Abstracts Submitted (# 13)

Abstract Title: Assessing the Efficacy of an Online Tool for Problem Solving*

Paper Type: Contributed

Author: Evan Frodermann
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Speaker Order: BG06

Assessing a complex cognitive skill such as problem-solving in an authentic environment such as an introductory physics classes is a challenging task, given the difficulty of measuring students' problem-solving skills, constructing appropriate comparison groups, and managing the many factors that may block or mask such skills in student performance. This talk describes our progress in analyzing a large-scale study at the University of Minnesota to measure the educational impact of computer coaches designed to improve students' problem-solving skills.

Footnotes: *This work was partially supported by NSF DUE-0715615 and DUE-1226197.

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Abstract Title: Clinical Comparison of Mastery Style Versus Immediate Feedback Online Activities
Paper Type: Contributed
Author: Noah Schroeder
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Speaker Order: BG08

Mastery style activities that included narrated animated solutions for instructional support were compared with immediate feedback activities similar to most online homework. In a clinical study, the mastery group attempted question sets in four levels, with animated solutions between each attempt, until mastery was achieved on each level. This combined elements of formative assessment, the worked example effect, and mastery learning. The homework group attempted questions with immediate feedback and unlimited tries. The two groups took a similar amount of time to complete the activity. The mastery group significantly outperformed the homework group on a free response post-test that required students to show their work in solving near and far transfer problems.

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Abstract Title: Connection Between Participation in Interactive Learning Environment and Teamwork Learning
Paper Type: Contributed
Author: Binod Nainabasti
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Speaker Order: BG12

Research has shown that an Interactive-Learning-Environment (ILE) can be an effective learning environment for acquiring transferrable knowledge. Our research analyzed characteristics of students' participation in an ILE and their teamwork learning ability, in different areas of two consecutive interactive learning physics classes that implemented the Investigative-Science-Learning-Environment (ISLE) curriculum—a type of widely used ILE. We

quantified students' participation in two broad areas: in-class learning activities and class review sessions. To analyze teamwork learning ability, we gave students six problems to be solved in groups (group exams), using physics they had not yet learned. We then gave them six standard physics problems related to the group exams to solve individually. Our results show that the frequency with which students participate in "on topic" physics discussions while engaged in learning activities is only weakly associated with learning, but being off-topic and disengaged has a consistently significant negative relationship with learning and transfer.

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Abstract Title: Evaluating SDL and SRL Skills in PBL-based Physics Courses

Paper Type: Contributed

Author: Gintaras Duda
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Speaker Order: BG01

The problem/project-based learning (PBL) literature makes the claim that the use of PBL pedagogy in the classroom helps students develop and grow their self-directed learning (SDL) and self-regulated learning skills (SRL). This talk will detail the creation/adaptation of a Likert-scale survey instrument to measure SDL and SRL skills in a wide-variety of physics courses. Preliminary data will be presented that suggests that PBL methodologies in physics do in fact spur growth in these areas. Further evidence gathered from student reflections will be presented that support and validate this claim.

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Abstract Title: Getting Physics Students to Effectively Read Texts Through Elaborative Interrogation
Paper Type: Contributed
Author: Robert C. Zisk
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Speaker Order: BG02

Throughout the past three years, Elaborative Interrogation, which has students read a passage from the text and respond to the prompt "Why is this true?" for a sentence from the passage, has been employed in an introductory algebra-based physics course at a large Northeastern university. Students in the course were asked to complete elaborative interrogation questions based on assigned readings as part of their homework each week. In this talk we will present data collected during this intervention that show a relation between student performance and improvement on the elaborative interrogation questions and their course exam scores. We will also discuss data from cognitive interviews conducted as students were responding to the interrogation questions that provide insights into what the students are doing as they are reading the text and answering the questions.

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Abstract Title: Identifying Learning Patterns in Students that Used Two Active Learning Methodologies for the Learning of Basic Electric Circuits' Concepts in High School Students
Paper Type: Contributed
Author: Daniel Sanchez-Guzman
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Speaker Order: BG04

Educational Data Mining (EDM) is the process of finding learning patterns and to predict some results that can materialize in the learning procedure. These data can be engendered from students through evaluation tests, virtual or physical activities, and homework corresponding to most of the activities that students have to make out with their respective instructional design. In the present work we show the effects of applying EDM algorithms from the results obtaining of two active-learning experiments designed ad-hoc for the learning of Basic Electric Circuits' Concepts in High School students. We examined the effects of using simulations as one active-learning methodology and the use of low-cost experiments in the classroom as the second active-learning methodology this let us to compare the effects of the learning sequences in each methodology and with the results we can re-design the learning sequence and adapting the best exercises of each instructional design.

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Abstract Title: Implementation of Online Mastery-style Homework in a Large Introductory Class

Paper Type: Contributed

Author: Brianne N. Gutmann
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Speaker Order: BG09

In our preparatory kinematics and dynamics course of about 500 students, we replaced traditional immediate feedback homework with mastery-style homework. This mastery mode required students to perfect a set of questions before moving on to the next level of increased difficulty, and implemented narrated animated solutions to provide instructional support, if necessary. Results, including class performance compared to previous years' students and student behaviors, will be discussed.

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Abstract Title: Improving Physics Essential Skills Through Brief, Spaced, Online Practice

Paper Type: Contributed

Author: Andrew F. Heckler
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Speaker Order: BG05

We developed and implemented a set of online "essential skills" tasks to help students achieve and retain a core level of mastery and fluency in basic skills necessary for their coursework. The task design is based on our research on student understanding and difficulties as well as three well-established cognitive principles: 1) spaced practice, to promote retention, 2) interleaved practice, to promote the ability to recognize when the learned skill is needed, and 3) mastery practice mastery practice, to promote a base level of performance. We report on training on a variety of skills with vector math. Students spent a relatively small amount of time, 10-20 minutes in practice each week, answering relevant questions online until a mastery level was achieved. Results indicate significant and often dramatic gains, with retention at least several weeks after the final practice session, including for less-prepared students.

Conflicts: One potential conflict: I am on the PRST:PER editorial board, which normally meets Tuesday at lunch 12p-2p.

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Abstract Title: MBL-based Online Instruction as an Introductory Tool

Paper Type: Contributed

Author: Katherine Ansell
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Speaker Order: BG10

Microcomputer-based laboratory (MBL) formats in non-traditional settings allow us to vary the timing of laboratory-type experiences within the course design. We have used a clinical study to investigate the role of MBL experiences, using the IOLab system, as a tool to introduce new physics topics to students. In the study, college students with little to no physics background were given both passive and active online MBL instruction in varying order. We will discuss the effects of the format and order of instruction on student conceptual learning and retention, as well as the implications of these results for future course design.

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Abstract Title: Practice with Feedback: Comparing Multiple Choice and Natural Language Formats

Paper Type: Contributed

Author: Ryan C. Badeau
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Speaker Order: BG07

Force, velocity, and acceleration represent an interesting set of physics concepts in that they are foundational and a persistent source of student difficulty even after instruction. In order to evaluate the effectiveness of different question formats combined with immediate feedback in training on this set of concepts, we have compared computer-based practice with natural language and multiple choice question formats for two different populations of introductory physics students. In addition to comparisons of student progress through the training, student performance is analyzed based on their responses to a previously validated force and motion assessment. Results from an introductory physics course (first semester mechanics) suggest that natural language format questions may provide advantages over their multiple choice counterparts. However, subsequent results in a different introductory physics course (second semester electromagnetism) show that this finding may only be true for less-prepared students and that further replication is necessary.

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Abstract Title: Rasch Analysis of Student Responses to the CLASS

Paper Type: Contributed

Author: Xi Tang*
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The Colorado Learning Attitudes about Science Survey (CLASS) has become a standard instrument for assessing

changes in student attitudes. The standard data analysis protocol compares student responses to those of experts, and assigns a percentage ranking to each respondent. This analysis assumes students fall on a continuum from novice to expert. Another analysis model, the Rasch Model, is also based on this assumption. The Rasch Model also provides information about survey items simultaneously with information about respondents. For this reason, the Rasch Model provides an alternate, and perhaps more robust, method of analyzing CLASS data. To compare the Rasch Model to the traditional analysis methods, we have applied the Rasch Model to data that had been previously analyzed using the protocol developed at the University of Colorado. We will present the results of the Rasch Analysis, and discuss the differences between it and the standard analysis.

Footnotes: *Sponsored by David Donnelly

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Abstract Title: Student Learning Gains from Scientific Induction Labs, Discussions, and Readings

Paper Type: Contributed

Author: Emily Knapp
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Speaker Order: BG03

Our research team, composed of four high school physics teachers and two pre-service teachers, believe scientific induction is valuable and critical to student learning. We are exploring at what point in the learning cycle students gain ideas that align with those of the scientific community, i.e. scientific principles. Eight high school physics teachers piloting the Physics and Everyday Thinking (PET) curriculum collected data about student ideas using short diagnostic assessments. These were administered at three points during the learning cycle: before students shared initial predictions, after students conducted laboratory activities, and after students engaged in whole class discussions and readings about the scientific principles. We will present initial findings about student learning gains during induction-type activities. Further analysis will help us capitalize on students' content understanding gains during the PET learning cycle and allow us to tailor future lessons so our instructional moves leverage that portion of the lesson.

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Abstract Title: Student-generated Content: PeerWise Use in Undergraduate Physics Classrooms

Paper Type: Contributed

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Speaker Order: BG11

In recent years a number of online platforms have been developed to facilitate the creation of student-generated course content. One widely used system is PeerWise, which provides a space where students can create and share multiple-choice questions; answer and rate other students' questions; and engage in discussion with their peers. These types of activities have long been recognized as being effective in increasing students' engagement and enhancing the development of knowledge and understanding, critical thinking, and problem solving skills. As part of a wider study across courses in physics, chemistry, and biology, we present findings from a multi-year study of PeerWise use in early-years undergraduate physics courses. In the majority of courses there is a positive relationship between engaging with PeerWise and end of course exam performance, even when taking into account other influences on performance, such as students' prior ability.

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Date Last Updated: February 4, 2011