AAPT Programs & Conferences Tools

Hello, *Eleanor Sayre*!

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Paper Sort

Select Meeting: ---Select--- go

Sacramento - California (SM16) / Status: Inactive

Abstract List | Sort All | Sort All Collapsed View

Generic Abstracts

PER: Examining content understanding and reasoning

Abstracts Submitted (# 32)

Abstract Title: Classical Physics Learning from Analysis of Modern Physics Data II 5450

Paper Type: Contributed

Author: Kenneth W. Cecire
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kcecire@nd.edu

Whether students are studying classical physics or cutting edge physics, many of the same principles apply. For example, the conservation of momentum is a time-honored classical topic that is absolutely necessary to understand the products of particle collisions in the Large Hadron Collider. The authors have created a pre- and post-study instrument to try to determine if students are more motivated to learn about classical principles from activities which employ authentic data from current, cutting-edge experiments and if such activities might enhance learning of such classical topics.

Conflicts: First author is chair of Committee on Modern Physics and must be available for related events; first author is also presider of Particle Physics Investigations by Students session.

You have submitted comments on this item

Change Session

No Yes

PER: Evaluating instructional strategies--G

Order

5

Comment:

Research-based assessment instrument cluster

Update

Abstract Title: Comparing Two Activities' Effectiveness Improving Reasoning with Multiple-Variable Graphed Information 5364

Paper Type: Contributed

Author: Rebecca J. Rosenblatt
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rosenblatt.rebecca@gmail.com

Past findings show large differences in student ability to use, and reason with, certain graphed data. Namely, many students incorrectly assume there must be dependence between the axes of any graph whether-or-not the data suggests a relation and whether-or-not a controlled experiment was done. In addition, students have similar difficulties reasoning with multivariable data displayed on a graph in multiple trend-lines. A majority of the errors made are consistent with a failure to properly control variables and/or reasoning illogically about the data. We developed and pilot tested two different one-hour group work activities to improve student understanding. One activity was laboratory based and focused on control of variables and experimentation. The other was recitation based and focused on logical reasoning and data manipulation. Results show the relative effectiveness of the activities and suggest interesting facts about the importance of logical reasoning vs. control of variables when working with graphed data.

You have submitted comments on this item

Change Session

No Yes

PER: Problem Solving--G

Order

12

Comment:

Representations cluster

Update

Abstract Title: Concept Inventories and the Next Generation of Assessment 5341

Paper Type: Contributed

Author: James T. Laverty
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620 Farm Lane Erickson Hall Room 115
East Lansing, MI 48824-1046
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In 2012, the National Research Council released A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. This report synthesized the literature on how students learn science into three dimensions that should be blended together in instruction, curriculum, and assessment. This "three-dimensional learning" is the basis for the Next Generation Science Standards and researchers have recently made calls to bring it to higher education as well. We have developed the Three-Dimensional Learning Assessment Protocol (3D-LAP), which can characterize assessments in introductory science courses as aligning (or not) with scientific practices, crosscutting concepts, and core ideas. In this talk, I apply the 3D-LAP to some commonly used concept inventories in physics to characterize their alignment with the three dimensions from the Framework. I will explore the potential utility of these concept inventories in the era of the Next Generation Science Standards.

You have submitted comments on this item

Change Session

(•) No ( ) Yes

PER: Evaluating instructional strategies--G

Order

6

Comment:

Research-based assessment instrument cluster

Update

Abstract Title: Construction and interpretation of linear best-fit graphs in introductory labs 5623

Paper Type: Contributed

Author: Craig C. Wiegert
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Department of Physics and Astronomy
Athens, GA 30602-2451
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wiegert@physast.uga.edu

Instructional labs are an important element of undergraduate introductory physics. Many lab activities require students to construct graphs of their data and interpret their results, connecting their lab experience to underlying physics concepts. We investigated students' construction and interpretation of linear best-fit graphs in the context of two lab activities. Students' graphs were evaluated for overall quality as well as for the quality of the best-fit line. We then interviewed students to determine the strategies used in graph construction and fitting, and to assess student understanding of the meaning of the graph. Our results indicate that undergraduate introductory physics students can successfully construct best-fit linear graphs while struggling to interpret graphs according to the physical concept under investigation. Furthermore we found, perhaps surprisingly, that the most challenging aspect of graph construction for students was establishing a correct and useful scale.

You have submitted comments on this item

Change Session

No Yes

PER: Problem Solving--G

Order

13

Comment:

Representations cluster

Update

Abstract Title: Developing metacognitive knowledge about productive reflection on salient distracting features* 5211

Paper Type: Contributed

Author: Thanh K. Le
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When students work on physics problems, certain problem features may cue specific lines of reasoning. In particular, salient distracting features (SDFs) are surface, situational, or contextual features of a problem that frequently cue incorrect lines of reasoning and inhibit the exploration of more productive reasoning approaches. A potential approach for addressing SDF-related reasoning difficulties is to target and enhance student metacognition. In the second semester of the calculus-based introductory physics sequence at the University of Maine, we developed and administered a flexible, web-based instructional intervention designed to help students construct metacognitive knowledge about productive reflection on the role of SDFs in influencing reasoning. In the intervention, students are asked to synthesize contrasting cases in which hypothetical students reflect upon physics problems containing SDFs. Preliminary data and emerging findings will be presented. *This material is based upon work supported by the National Science Foundation under Grant Nos. DUE-1245313 and DUE-0962805.

You have submitted comments on this item

Change Session

No Yes

PER: Problem Solving--G

Order

14

Comment:

Representations cluster

Update

Abstract Title: Early mathematization obstacles: Uncovering roots of student difficulties in majors' courses 5536

Paper Type: Contributed

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Experts in physics create and communicate knowledge through mathematization, the mental practice of translating between the physical world and the symbolic world. While Physics Education Research at the upper division undergraduate level has uncovered many specific challenges that students understandably face with sophisticated mathematization, there is a growing body of evidence that even well prepared introductory college physics students struggle with the idiosyncratic ways that familiar mathematics is used in physics. This talk draws parallels between the published struggles that students have with mathematization in the upper division courses (1) and obstacles that we are beginning to uncover as we investigate trends in student reasoning with ratio and proportion, quantification, and symbolizing within the calculus-based introductory physics course.(2)

Footnotes: 1. Caballero, Wilcox, Doughty, and Pollock (2015) 2. Brahmia, Boudreaux and Kanim (under review)

You have submitted comments on this item

Change Session

(•) No ( ) Yes

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Order

1

Comment:

Math cluster

Update

Abstract Title: Examining student reasoning with multi-variable expressions* 5590

Paper Type: Contributed

Author: Mila Kryjevskaia
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It has been shown that students encounter significant reasoning difficulties when interpreting and applying multi-variable expressions. For example, students often argue that because the frequency of a periodic wave is expressed in terms of wavelength and propagation speed, the frequency must change when the speed changes. Similarly, many students think that the capacitance of a parallel-plate capacitor will change if the potential difference between its plates is varied. In this talk, we report on an investigation of the extent to which problematic reasoning approaches are related to (1) the level of abstractness of a presented situation and (2) the specific features of the task itself.

Footnotes: *This material is based upon work supported by the National Science Foundation under Grant Nos. DUE-1431857, 1431940, 1432052, and 1432765.

You have submitted comments on this item

Change Session

No Yes

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Order

2

Comment:

Math cluster

Update

Abstract Title: Examining students' abilities to follow and evaluate qualitative reasoning chains 5402

Paper Type: Contributed

Author: William N. Ferm
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While there has been a large body of work investigating the effectiveness of scaffolded, researched-based physics instruction, much less is known about the development of students' reasoning abilities in these instructional environments. As part of a larger collaborative project, we have been examining the ability of students to construct qualitative reasoning chains. In particular, we have been designing and implementing tasks to assess the extent to which introductory physics students are able to logically follow and characterize hypothetical student reasoning in a variety of physics contexts. In one task, for example, students are asked to infer the conclusions that would be drawn from different lines of reasoning articulated by hypothetical students. In this presentation, we will discuss the development of such tasks and share preliminary results. This material is based upon work supported by the National Science Foundation under Grant Nos. DUE-1431857, DUE-1431541, DUE-1431940, DUE-1432765, DUE-1432052, and DUE-0962805.

You have submitted comments on this item

Change Session

No Yes

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Order

3

Comment:

Math cluster

Update

Abstract Title: Examining students' multi-step reasoning in energy contexts* 5525

Paper Type: Contributed

Author: Andrew Boudreaux
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516 High St
Bellingham, WA 98225-9164
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andrew.boudreaux@wwu.edu

As part of a multi-institution collaboration, we are examining students' multi-step, qualitative reasoning in physics. An important part of this work is developing methods for disentangling conceptual understanding from reasoning. In this talk, we present and analyze responses on tasks in which students apply energy concepts to simple situations. One such task involves a hand moving a book with changing speed through a uniform gravitational field. Most students struggle to coordinate the energy input (work done by the hand) and the energy changes (changes in kinetic energy and in gravitational potential energy). At the 2016 Winter AAPT meeting, Lindsey described the reasoning of introductory physics students at Penn State Greater Allegheny; this talk follows up by presenting results from interviews with preservice teachers and upper division physics students at Western Washington University.

Footnotes: *This work was supported in part by the National Science Foundation under Grant Nos. DUE-1432052 and DUE-1431541.

You have submitted comments on this item

Change Session

No Yes

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Order

4

Comment:

Math cluster

Update

Abstract Title: How Students Combine Knowledge Elements While Learning 5202

Paper Type: Contributed

Author: Alan Richards
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9087970633 (p)
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We recorded preservice physics teachers learning about the physics of solar cells. Using a knowledge-in-pieces theoretical framework, we analyze their interactions in order to make inferences about the elements of prior knowledge they call upon as they build understanding of how these devices function. Of special interest are the instances when a student makes a significant conceptual breakthrough. We find that students who combine different aspects of their prior knowledge in specific ways may be more likely to make breakthroughs. We will discuss what instructors can do to prime learners to combine knowledge in productive ways so they are better able to achieve these breakthroughs.

Change Session

No Yes

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Order

Comment:

Submit

Abstract Title: Improving student understanding of degenerate perturbation theory in quantum mechanics 5043

Paper Type: Contributed

Author: Christof Keebaugh
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4126874764 (p)
4126874764 (f)
clsingh@pitt.edu

We investigate student difficulties with degenerate perturbation theory in quantum mechanics by administering free-response and multiple-choice questions and conducting individual interviews with advanced students. We find that students display many common difficulties related to this topic. To improve student understanding, we use these difficulties as resources and develop a Quantum Interactive Learning Tutorial (QuILT) along with a pre-test and a post-test using an iterative approach. We will discuss the development and evaluation of the QuILT. We thank the National Science Foundation for support.

Footnotes: This session is being sponsored by Chandralekha Singh for Christof Keebaugh who is a student and is not yet an AAPT member. He will become a member of AAPT before attending the meeting.

You have submitted comments on this item

Change Session

No Yes

PER: Evaluating instructional strategies--G

Order

Comment:

Update

Abstract Title: Improving Student Understanding of Vector Fields in E&M 5578

Paper Type: Contributed

Author: Bert C. Xue
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817-944-6461 (p)
bertxue@gmail.com

The Physics Education Group at the University of Washington has been developing tutorials for the junior-level electrodynamics courses. We have observed that most students enter these courses with a working knowledge of static electric and magnetic fields in simple systems. However, these students have significant difficulties in transferring this knowledge to other vector fields or to more complex systems. This talk will present results from our attempts at improving student understanding of vector fields and the physical interpretation of vector derivatives.

Conflicts: Both this talk and the talk by Ryan Hazelton involve junior-level E&M research at the University of Washington. If possible, this talk should be scheduled after Ryan Hazelton's talk, preferably immediately after.

Change Session

No Yes

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Order

Comment:

Submit

Abstract Title: Improving understanding of Gauss's law by replacing examples with reasoning 5513

Paper Type: Contributed

Author: Marshall J Styczinski
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Seattle, WA 98195-1560
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mjstyczi@uw.edu

Gauss’s law is a fixture in introductory physics classes in part because the reasoning skills and fundamental physics knowledge required for its application represent important course goals. We have found that students struggle to apply Gauss’s law to conceptual questions as well as typical end-of-chapter problems, even after coverage in lecture and the relevant sections of Tutorials in Introductory Physics(1). To address persistent difficulties we are modifying tutorial curriculum to reduce the number of examples and emphasize the development of a conceptual framework around flux and Gauss’s law. The goal is to improve student performance on both conceptual questions and typical calculation questions. A summary of the student difficulties uncovered, details of modifications to the established curriculum, and preliminary results will be presented.

Footnotes: (1) McDermott, Shaffer, and the UWPEG (2012). Tutorials in Introductory Physics. Pearson Learning Solutions. * This material is based upon work supported by NSF Grant No. DUE-1022449.

You have submitted comments on this item

Change Session

No Yes

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Order

Comment:

Update

Abstract Title: Influence of Language of Administration upon Physics Concepts Measuring Instruments 5310

Paper Type: Contributed

Author: Thomas Olsen
Dar Al Uloom University
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Riyadh, Riyadh 13314 Saudi Arabia
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The Force Concept Inventory (FCI) has become a world standard as an instrument to measure students' conceptual understanding of Mechanics. In particular, the Normalized Gain has proven to be a robust measure of the effect of pedagogy upon student learning. While the original FCI was developed in English, translations have been made. This study seeks to determine the effect, if any, of administering the FCI in different languages to different groups of students, taken from the same student population. As an English language university in Riyadh, Saudi Arabia, Alfaisal University would seem to be an excellent laboratory for such a study. The FCI has been administered to all introductory physics students at Alfaisal, at the beginning and the end of the first physics course Spring 2015 semester. The students were randomly assigned English and Arabic administrations. We will share some of the data from this study with some preliminary analysis. The prospects for subsequent study will also be discussed.

You have submitted comments on this item

Change Session

No Yes

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Order

7

Comment:

Research-based assessment instrument cluster

Update

Abstract Title: Investigating student ability to reason in different directions* 5569

Paper Type: Contributed

Author: MacKenzie R. Stetzer
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As part of a larger, multi-institutional effort to investigate and assess the development of student reasoning skills in the context of scaffolded physics instruction, we have designed and administered new tasks in order to examine student ability to reason in different directions in introductory calculus-based physics courses. In these reasoning reversal tasks, two different versions of a physics problem are randomly administered to students in the course. In one version, students are asked to predict how a modification to an experimental setup will change the outcome of the experiment; in the other version, students are asked to infer the modification to the experimental setup that led to a specified change in the outcome of the experiment. In this talk, we will present preliminary results from these reasoning reversal tasks.

Footnotes: *This material is based upon work supported by the National Science Foundation under Grant Nos. DUE-1431857, DUE-1431541, DUE-1431940, DUE-1432765, DUE-1432052, and DUE-0962805.

You have submitted comments on this item

Change Session

No Yes

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Order

8

Comment:

Research-based assessment instrument cluster

Update

Abstract Title: Investigating Student Understanding Of Radioactivity With The Radiation Conceptual Evaluation 5658

Paper Type: Contributed

Author: Brant E. Hinrichs
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As part of developing a comprehensive package of classroom materials for radiation literacy, the Inquiry into Radioactivity (IiR) project has drafted a Radiation Conceptual Evaluation (Rad CE). This instrument detects major problematic categories of student thinking such as the "substance-like view" of radiation, and ionizing radiation as waves. Students with the substance-like view think of radiation as "bad stuff" that is emitted from radioactive objects and contaminates other objects when it gets on them, making them radioactive in turn. Students with this view typically do not distinguish radiation from the condition of being radioactive. Pre and post testing using the Rad CE at two different universities indicate that nearly all nonscience majors begin the IiR course with the substance-like view, but gradually transition to a "particles-in-motion" view over time. We compare data from both universities and draw implications for teaching radioactivity.

Footnotes: This project was supported by NSF DUE grant 0942699.

Conflicts: I am on two posters. I don't think poster times conflict with talk times, but just want to make sure.

You have submitted comments on this item

Change Session

No Yes

--Select here if you would like to change the session --

Order

9

Comment:

Research-based assessment instrument cluster

Update

Abstract Title: Investigating Student Understanding of Vector Calculus in E&M 5572

Paper Type: Contributed

Author: Ryan L C Hazelton
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Over the past several years the Physics Education Group at the University of Washington has been working to probe the difficulties students encounter in junior-level electrodynamics courses. A large proportion of these difficulties involve interpreting mathematical statements about physical systems. A major subset of these difficulties involve student understanding of the divergence and curl operators. This talk will discuss several examples of these difficulties in the context of Maxwell's equations.

Conflicts: Both this talk and the talk by Bert Xue involve junior-level E&M research at the University of Washington. If possible, this talk should be scheduled before Bert Xue's talk, preferably immediately before.

Change Session

(•) No ( ) Yes

--Select here if you would like to change the session --

Order

Comment:

Submit

Abstract Title: Investigating students' understanding of ac biasing networks* 5213

Paper Type: Contributed

Author: Kevin L. Van De Bogart
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Orono, ME 04469 United States
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kevin.vandebogart@maine.edu

As part of an ongoing effort to investigate the learning and teaching of bipolar junction transistor circuits (e.g., the common-emitter amplifier) in physics and engineering courses, we have begun to examine student understanding of ac biasing networks. These biasing networks are critical for signal processing via transistor circuits, yet the coverage of such networks in both courses and texts is typically sparse and frequently secondary to coverage of the amplifier circuits themselves. In this cross-disciplinary project, we have been examining the extent to which students are able to correctly predict the behavior of the biasing network under both dc and ac conditions. In this presentation, we will use specific examples to highlight the most prevalent conceptual and reasoning difficulties identified. Implications for instruction emerging from this investigation will also be discussed.

Footnotes: *This material is based upon work supported by the National Science Foundation under Grant Nos. DUE-1323426 and DUE-0962805.

Change Session

No Yes

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Order

Comment:

Submit

Abstract Title: Investigating the Impact of Different Prompts On Student Reasoning * 5433

Paper Type: Contributed

Author: Cody Gette
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Fargo, ND 58103
7012305866 (p)
cody.gette@ndsu.edu

Prior research suggests that students who demonstrate conceptual knowledge on one task often fail to apply consistent thinking on closely related tasks. This is consistent with the

dual-process theory of reasoning that suggests that some students tend to focus on surface features that often elicit intuitive ideas. As such, these students tend to provide answers based on their first reactions or gut feelings. We applied a paired-question methodology, in which screening and target questions required the application of the same concepts and skills. Three versions of screening-target sequences were designed in the context of friction. The sequences only differed in the level of abstractness that describe setups presented in the screening questions. The impact of these differences on student performance on the target question was examined. Results from introductory algebra-based physics class will be presented and discussed.

Footnotes: *This material is based upon work supported by the National Science Foundation under Grant Nos. DUE-1431857, 1431940, 1432052, and 1432765.

Change Session

No Yes

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Order

Comment:

Submit

Abstract Title: Overview of 50+ research-based assessments in physics and beyond 5073

Paper Type: Contributed

Author: Adrian M Madsen
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The PER community has produced 50+ research-based assessments (RBAs) which evaluate the effectiveness of different teaching methods, covering diverse physics topics (both introductory and upper-level) as well as beliefs about the nature of physics, problem solving, lab skills etc. Results on these tests show that PER-based teaching methods lead to dramatic improvements in students learning, so assessment can act as a gateway drug to better teaching. However, physics faculty often struggle with knowing which assessments are available and which to use in their course. We have written a resource letter in which we discuss the details of each research-based assessment, including the course-level, content, purpose, level of research validation and implementation details. We also compare relevant

assessments and give recommendations on when to use each assessment. In our talk, we will give an overview of the categories of assessments, paying particular attention to those that are less well known.

You have submitted comments on this item

Change Session

No Yes

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Order

10

Comment:

Research-based assessment instrument cluster

Update

Abstract Title: Probing Student Ability to Construct Reasoning Chains: A New Methodology 5426

Paper Type: Contributed

Author: J. Caleb Speirs
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Students are often asked to construct qualitative reasoning chains during scaffolded, research-based physics instruction. As part of a multi-institutional effort to investigate and assess the development of student reasoning skills in physics, we have been designing tasks that probe the extent to which students can create and evaluate reasoning chains. In one task, students are provided with correct reasoning elements (i.e., true statements about the physical situation as well as correct concepts and mathematical relationships) and are asked to assemble them into an argument that they can use to answer a specified physics problem. In this talk, the task will be described in detail and preliminary results will be presented.

Footnotes: *This material is based upon work supported by the National Science Foundation under Grant Nos. DUE-1431857, DUE-1431541, DUE-1431940, DUE-1432765, DUE-1432052, and DUE-0962805.

You have submitted comments on this item

Change Session

No Yes

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Order

6

Comment:

Math cluster

Update

Abstract Title: Sense-making with Inscriptions in Quantum Mechanics 5264

Paper Type: Contributed

Author: Erin Ronayne Sohr
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In this presentation, we focus on students’ sense-making with a graphical representation commonly used in quantum mechanics textbooks; that of overlaid potential energy and wavefunction plots in the context of quantum well(s) and barriers. Previous research has pointed to a conflation of the energy and wavefunction axes as leading to common student difficulties in understanding phenomena such as tunneling. The existence of this difficulty has influenced QMCS survey items and design choices in several PhET simulations. We add to this research by investigating how students use and interact with this graphical representation while sense-making. Through fine-timescale analysis of video data from clinical interviews with engineering majors in a modern physics course, we document that the inscription can play both communicative and generative roles in the student's reasoning. We report the different ways in which the inscription gets embedded in students’ reasoning and potential instructional implications.

Footnotes: This work is supported by NSF-DUE1323129

You have submitted comments on this item

Change Session

No Yes

PER: Problem Solving--G

Order

15

Comment:

Representations cluster

Update

Abstract Title: Student ability to use complex numbers in quantum mechanics 5386

Paper Type: Contributed

Author: Tong Wan
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The Physics Education Group at the University of Washington has been investigating student ability to use complex numbers in quantum mechanics. Complex numbers are essential to quantum mechanics. In particular, the relative phases of quantum states, which can be represented by complex numbers, are critical to understanding quantum concepts such as interference and time dependence. We present data from sophomore and junior-level quantum mechanics courses to illustrate some of the errors that students encounter in using complex numbers.

You have submitted comments on this item

Change Session

(•) No ( ) Yes

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Order

7

Comment:

Math cluster

Update

Abstract Title: Student Construction and Use of Three-Dimensional Coordinate System Differential Elements 5381

Paper Type: Contributed

Author: Benjamin P. Schermerhorn
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As part of an effort to examine students' understanding of the structure of non-Cartesian coordinate systems and the differential elements associated with these systems when using vector calculus in electricity and magnetism (E&M), students in junior E&M were interviewed in pairs. In one task, students were asked to determine differential length and volume elements for an unconventional spherical coordinate system. While all pairs eventually arrived at the correct differential elements, some students unsuccessfully attempted to reason by recalling and/or mapping from elements in spherical or Cartesian coordinates, only to recognize their error later when checking their work. We have documented several ideas that students use, and certain actions they undertake, while working through the task. Across-interview comparisons allow for characterization of student successes and difficulties in terms of whether these ideas are present and how they are grouped and ordered.

Footnotes: This work was supported in part by NSF Grant PHY-1405726.

You have submitted comments on this item

Change Session

No Yes

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Order

8

Comment:

Math cluster

Update

Abstract Title: Student difficulties with expectation values in quantum mechanics 5029

Paper Type: Contributed

Author: Chandralekha Singh
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To investigate the difficulties that upper-level undergraduate and graduate students have with expectation values of physical observables in the context of Dirac notation, we administered free-response and multiple-choice questions and conducted individual interviews with students. We find that advanced students display common difficulties with expectation values. Results will be discussed. We thank the National Science Foundation for support.

Conflicts: I am giving an invited talk so please make sure there is no overlap. Also, please ignore my earlier abstract since I forgot to acknowledge NSF support. Thank you so much!!!

You have submitted comments on this item

Change Session

No Yes

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Order

9

Comment:

Math cluster

Update

Abstract Title: Student Difficulties with Quantum Operators Corresponding to Observables 5048

Paper Type: Contributed

Author: Emily M. Marshman
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emm101@pitt.edu

To investigate the difficulties that upper-level undergraduate and graduate students have with quantum operators in the context of Dirac notation, we administered free-response and multiple-choice questions and conducted individual interviews with students. We find that students display common difficulties with these topics. Results will be discussed. This work is supported by the National Science Foundation.

You have submitted comments on this item

Change Session

No Yes

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Order

10

Comment:

Math cluster

Update

Abstract Title: Student ideas about coordinate systems in the upper division 5451

Paper Type: Contributed

Author: Brian D. Farlow
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brian.farlow@ndsu.edu

As part of a broader study on student thinking about mathematics in the undergraduate physics curriculum, we report on students' ideas about coordinate systems in the upper division. Early evidence suggests that upper-division physics students struggle to answer conceptual and pictorial questions requiring the use of Cartesian and non-Cartesian coordinate systems. Specifically, students have difficulty identifying the motion of objects using plane polar coordinates. Not recognizing that both radial displacement and polar angle change with respect to time for motion along non-circular paths is a specific example of this difficulty. We report findings from one-on-one interviews that used a think-aloud protocol designed to shed light on student thinking within this domain.

You have submitted comments on this item

Change Session

No Yes

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Order

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Comment:

Math cluster

Update

Abstract Title: Student reasoning with vectors through the physics curriculum 5659
Paper Type: Contributed

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The vector concept is used in physics instruction beginning in the introductory level. While initial encounters with vectors are firmly grounded in experience, (e.g., a displacement vector in two- or three-dimensional space, with magnitude and a direction), the vector concept grows to include far more abstract ideas. As part of an NSF-supported research and curriculum development project, we have studied student reasoning across several upper-division physics courses, including mathematical methods. For this presentation, we describe theoretical and empirical views of the development and expansion of the vector concept, with examples of student responses and a discussion of implications for instruction.

Footnotes: Supported in part by NSF grant PHYS-1405616.

You have submitted comments on this item

Change Session

No Yes

--Select here if you would like to change the session --

Order

12

Comment:

Math cluster

Update

Abstract Title: Targeted Student Feedback Using Transition Matrices 5288

Paper Type: Contributed

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We introduce a new tool for adoption by high school and college level physics teachers who use a common assessment such as the Force Concept Inventory (FCI). The tool uses a spreadsheet application to create a simple matrix that identifies the percentage of students that who select each possible pre-/post-test answer combination on each question of the diagnostic exam. From this, it determines changes in students' understanding of concepts and common misconceptions. For those students that selected the wrong answer to a question on both of the pre-/post-tests, we also determine whether they are moving toward a "better" wrong answer. Feedback from the tool allows instructors to close the loop on assessment and tailor instruction in an informed way.

You have submitted comments on this item

Change Session

No Yes

PER: Evaluating instructional strategies--G

Order

Comment:

Research-based assessment instrument cluster

Update

Abstract Title: Teacher Knowledge of Student Difficulties: "Collectively, We're a Genius!" 5495

Paper Type: Contributed

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In a teacher professional development meeting of the MainePSP, teachers were asked a question about potential energy and then to discuss why students might give a particular response to it. Collectively, they came up with a rich, nuanced description of student reasoning, touching on multiple ways of thinking about energy, and how these might affect student responses. Where PD organizers (...the talk authors) had predicted 3 or 4, teachers came up with 6 explanations of a particular answer. These included ideas in the literature (related to time, effort, and work, for example) and ideas not in the literature (a wonderfully compelling reverse deficit model of energy). We find that bringing teachers together and sharing student data within a facilitated community lets teachers arrive at surprising insights about how their students think about energy.

Footnotes: Funded in part by NSF MSP 0962805 and DRL 1222580.

Conflicts: There is a talk by Carolina Alvarado about the same project (but different format and content, probably a different session). I would hope that our sessions are not scheduled in parallel!

You have submitted comments on this item

Change Session

No Yes

Teacher Training/Enhancement--G

Order

Comment:

Update

Abstract Title: Thinking quantum mechanically: introducing students to reasoning in modern physics 5228

Paper Type: Contributed

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Learning quantum mechanics requires students to develop new conceptual understanding and mathematical skills, and to reason differently about the nature of systems (i.e. an electron is no longer a point-like particle). We present a broad view of our research in a Modern Physics course at CU Boulder where second year physics and engineering students

learn the foundations of quantum mechanics. In this work, we focus on classically unfamiliar or unusual cases, such as tunneling and delayed choice experiments, and look at the nature of student reasoning in these situations. We present both qualitative (recorded focus group discussions) and quantitative (conceptual and epistemological survey) data and demonstrate that students are capable of engaging in sophisticated reasoning about quantum phenomena. By explicitly attending to applications and interpretation within instruction, we foster an environment in which students negotiate and grapple with quantum concepts.

Footnotes: Work supported by NSF

You have submitted comments on this item

Change Session

No Yes

--Select here if you would like to change the session --

Order

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Comment:

Upper division topics

Update

Abstract Title: Words vs. graphs: Tracking shifts in students' understanding of forces 5559

Paper Type: Contributed

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Many studies have shown that students often struggle to interpret and generate graphs of various physical quantities. This can be seen in students' responses to the Force and Motion Conceptual Evaluation. When analysing consistency on questions asking students to select graphs of force vs. time to accompany a described motion compared to questions asking them to choose verbal descriptions of forces, we have previously used consistency plots to show that students are more likely to improve on the graph questions than the natural language questions. This suggests that students may have developed a formal understanding of the relationship between force and motion but do not apply it when reasoning about situations related to their daily lives. We expand on these results by incorporating data from multiple colleges and universities and show how these results relate to other analyses of the data.

Conflicts: Please schedule this talk before the poster titled "Tracking shifts in students' understanding: Forces, acceleration, and graphs" by authors T.I. Smith, N.J. Wright, and I.T. Griffin.

You have submitted comments on this item

Change Session

No Yes

PER: Problem Solving--G

Order

18

Comment:

Representations cluster

Update

Date Last Updated: February 4, 2011