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Description:

Call for Papers:

Abstracts Submitted (# 11)

Abstract Title: AACR: Probing Student Thinking with Computer Analyzed Constructed Response Questions

Paper Type: Contributed

Author: Matthew M. Steele
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Speaker Order: CH05

Constructed response questions (short-answer, open-ended items) have the potential to provide more insight on student thinking than the multiple choice questions often employed in large introductory STEM courses. However, the time and costs associated with the evaluation and analysis of large data sets of constructed response has traditionally been a barrier to their adoption. In an effort to provide instructors with greater insight into their student understanding of core STEM concepts the Automated Analysis of Constructed Response (AACR, www.msu.edu/~aacr) Research Group is working to create a system for the automated analysis of student constructed responses. In this presentation we present recent work developing constructed response items to evaluate students understanding of foundational concepts in physics and astronomy, and discuss preliminary results produced by these items.

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Abstract Title: Examining the Effects of Testwiseness Using the Force Concept Inventory
Paper Type: Contributed
Author: Seth T. DeVore
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Speaker Order: CH01

Testwiseness is generally defined as the set of cognitive strategies used by a student and intended to improve their score on a test regardless of the test's subject matter. To improve our understanding of the potential effect size of several well documented elements of testwiseness, we analyze student performance on questions present in the Force Concept Inventory (FCI) that contain distractors, the selection of which can be related to the use of testwiseness strategies. We further examine the effects of both the positive and potential negative effects of testwiseness on student scores by developing two modified versions of the FCI designed to include additional elements related to testwiseness. Details of the development of the modified versions of the FCI and the effect sizes measured in all versions of the FCI will be discussed.

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Abstract Title: Expert/Novice Differences in Viewing Physics Diagrams Using the "Flicker" Technique
Paper Type: Contributed
Author: Jason W. Morphew
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Speaker Order: CH07

We present an experiment in which subjects with differing levels of physics experience were timed in their ability to detect small changes in nearly identical pairs of diagrams that are representative of typical introductory

physics situations. It was hypothesized that higher physics expertise would guide attention and result in faster detection times for those changes that affected the physics, whereas no expertise advantage in detection times would result for changes that did not affect the physics. Our findings partially confirmed the hypothesis. We present results on how the response time for noticing physics-relevant changes in the diagram pairs is faster than for physics-irrelevant changes for those with more extensive physics experience and slower for those with less extensive physics experience. We discuss the cognitive implications of our findings.

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Abstract Title: How Accurate Are Students in Gauging Changes in their Understanding?*

Paper Type: Contributed

Author: Andrew Boudreaux
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Speaker Order: CH06

Research over several decades has shown that active self-monitoring is characteristic of expert learners. More recent studies have examined student metacognition in introductory physics contexts. As part of a multi-institutional collaborative effort, we have been investigating reflective metacognition – student ability to describe in hindsight what they have learned about a specific physics concept, and how they have learned it. We are interested in how student descriptions of their own learning compare with how instructors might evaluate their learning. Our methodology involves matched written assessment questions given at the start and end of a learning episode. After the post-test, students reflect on how their thinking has changed. Comparison of self-reported and researcher-characterized changes allows the accuracy of student reflections to be examined. The study design was described in a presentation at the Winter 2015 AAPT meeting in San Diego; the current talk shares preliminary results.

Footnotes: *This work partially supported by NSF DUE-1245999, DUE-1245993, DUE-1245313 and DUE-1245699.

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Abstract Title: Influence of Language of Administration Upon Physics Concepts Measuring Instruments
Paper Type: Contributed
Author: Thomas - Olsen
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Speaker Order: CH02

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. In 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 is 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. Results for the first semester of this study will be presented along with preliminary analysis.

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Abstract Title: Integrating Scientific Practices into Introductory Physics Assessments
Paper Type: Contributed
Author: James T. Laverty
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Speaker Order: CH04

The Physics and Astronomy Department at Michigan State University recently began to redesign its introductory

physics courses. At the center of this transformation effort is an attempt to include scientific practices, crosscutting concepts, and core ideas in the assessments and instruction of the courses. As part of a research effort, we have been developing the Three-Dimensional Learning Assessment Protocol (3D-LAP) to characterize how assessments used in introductory courses change over time. This instrument provides criteria by which scientific practices, crosscutting concepts, and core ideas can be identified within assessment items. Additionally, this instrument can be used to help write new assessment items or improve existing ones. This presentation will focus on the 3D-LAP and using it to track changes in assessments over time as well as to build assessment items that incorporate all three dimensions.

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Abstract Title: Probing Students' Experiences in the First Year Physics Laboratory

Paper Type: Contributed

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Speaker Order: CH11

As part of a broader study aimed at understanding the first-year laboratory experience from various perspectives, we report on a pilot study in which we probed students' perceptions of the first-year lab course at the end of the first term. For this purpose we developed a written instrument comprising five questions regarding the following areas of interest: expectations, enjoyment, learning, relation to course content, and assessment. Each question on the instrument is framed as a debate in which different points of view were posited. The respondents were requested to choose the view with which they most closely agreed (forced choice response), and more importantly, were directed to explain their choice in detail (free response writing). We detail the analysis and report on some of the preliminary findings focusing on the aspects of enjoyment and the learning experience

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Abstract Title: Quantifying School Students' Reasoning Abilities*
Paper Type: Contributed
Author: Gordon J. Aubrecht
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Speaker Order: CH08

Middle school teachers in our program give students pre- and post-common formative assessments (CFAs) and analyze them. We created a rubric to assess student communication, correctness, use of evidence, and reasoning on the CFAs. We will present results of our analysis of samples of students of control and treatment teachers.

Footnotes: *This work supported in part by grants from the Ohio Department of Education C1457-OSCI-09-49 (2008-2009), C1667-MSP-10-410 (2009-2010), EDU01-0000006141 (2010-2011), EDU01-0000007902 (2011-2012), GRT00029161 (2012-2013), ODE-MSP-10673 (2013-2014), and EDU01-0000013704 (2014-15).

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Abstract Title: Rasch Analysis of Student Responses to the CLASS
Paper Type: Contributed
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Speaker Order: CH03

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.

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Abstract Title: Teaching Weight and Gravitation as Cultural Content Knowledge

Paper Type: Contributed

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Speaker Order: CH10

There is a split in teaching the concepts of weight and gravitation in physics education (Galili, 2001). One group of physics teaches weight as the gravitational force within the developed Newtonian framework (e.g. Young and Freedman, 2012). The second group adopts the modern framework based on the operational definition of weight (e.g. Knight, 2013). Normally the authors in each group ignore the other view. We suggest teaching weight within the cultural perspective (Galili, 2012) which displays the two options and argues for the modern one – the operationally defined weight which does not coincide with the gravitational force. We have performed a comprehensive study on this subject (Stein, 2012) which included teaching experiments in which we applied a constructivist dialogical teaching of the topic of Weight-Gravitation. Our findings showed the ability of students to distinguish between weight and gravitation and meaningfully understand these concepts (Stein & Galili, 2014).

Footnotes: none

Conflicts: none

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Abstract Title: Why Do Students Want to Distinguish Between Net Force and Total Force?

Paper Type: Contributed

Author: Philip B. Southey
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Speaker Order: CH09

In previous research we have shown that novice physics students distinguish between the concept of a net vector quantity and the concept of a total vector quantity. Introductory physics textbooks variably use the terms “net”, “total” or “resultant” when referring to a vector sum, with some textbooks using these terms interchangeably. In particular, we have shown that students distinguish between the concepts of net force and total force, and the concepts of net momentum and total momentum. Phase two of this research has been to analyse the reasons students give for making these distinctions. Using an approach suggested by Grounded Theory, free responses from 400 freshmen have been analyzed and broad reasoning trends have been identified. These trends are contrasted with foundational representational schemas posited by the cognitive sciences, such as “changing position versus changing state”, and “interior viewpoint versus exterior viewpoint”.

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