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K-12 PER II

| **Type:** Con | **Organizer:** Dan Crowe

Description:

Call for Papers:

Abstracts Submitted (# 10)

Abstract Title: "Am I Stealing Your Glory?" - Supporting Students' Agency During Discussions

Paper Type: Contributed

Author: Enrique A. Suarez
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Speaker Order: FB05

Discussions, whether in small or large groups, are one of the cornerstones of learning through engaging in scientific disciplinary practices. They provide opportunities for teachers to explore student understanding, and for students to co-construct physics principles from evidence-supported claims. However, it is not always obvious how to best facilitate these discussions in a way that supports students' epistemic agency. The PER study reported here explores teachers' moves during consensus discussions while implementing the Physics and Everyday Thinking (PET) curriculum. Teacher moves were analyzed for how they promote or constrain students' participation in dialogic discourse. We will discuss specific moves that supported and enhanced student discourse, as well as moves that derailed rich student thinking and conversations. Finally, we propose strategies based on this research for facilitating discussions and pitfalls teachers may want to avoid.

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Abstract Title: Classical Physics Learning from Analysis of Modern Physics Data
Paper Type: Contributed
Author: Kenneth W. Cecire
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Speaker Order: FB09
Many of the classical physics principles we teach are hundreds of years old. So, unfortunately, are many of the examples we use. However, these same principles apply - and are vital - in research at the frontiers of physics. For example, conservation of momentum and energy are necessary to understand the products of particle collisions in the Large Hadron Collider. The authors make a first attempt to determine if students are more motivated to learn about classical principles through activities which employ authentic data from current, cutting-edge experiments. They also seek to determine if such activities enhance learning of classical topics in the physics canon.

Conflicts: Chair of CoPHS, organizer/presider of "LHC in the classroom"

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Abstract Title: Consequences of Teachers' Content Difficulties on Planned Instruction and Assessment
Paper Type: Contributed
Author: Gregory D. Kranich
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Speaker Order: FB02
As part of the Maine Physical Sciences Partnership (NSF #0962805), we have studied a group of middle school

teachers' modifications of curriculum materials, and their developing of common assessments for measuring student understanding. A team of teachers has made modifications to problematic areas of a force and motion unit, placing a new emphasis on a conceptual development of ideas that were found to be missing, specifically uniform and non-uniform motion. We observe a shared discomfort with the concept of acceleration, the implications of its sign, an inherent coordinate system choice, and whether an object is speeding up or slowing down. In this talk, I will discuss how teachers' ideas about the sign of acceleration affected their choices for planned instruction and assessment of student understanding.

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Abstract Title: Debating One Conceptual Question Throughout a Unit: Benefits and Reflections

Paper Type: Contributed

Author: Colleen G. Nyeggen
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Speaker Order: FB03

High School physics teachers often use conceptual questions at the beginning of a unit, to elicit students' prior understandings or motivate the topic, or at the end of a unit to apply concepts already learned. In this talk, I discuss how a sufficiently rich conceptual question can be productively revisited throughout a unit, serving as the subject for an ongoing, whole-class debate. Revisiting a well-chosen question multiple times allows students to: (a) Refine their own intuitions and experiences as they construct explanations; (b) Engage in scientific practices such as asking questions, developing models, engaging in argumentation, and evaluating information; (c) Rethink their own ideas continuously in light of new evidence and others' reasoning; and (d) Recognize and reflect on whole-class progress in understanding. I will show evidence of high school students engaging in these behaviors and share strategies for using this process in any physics unit.

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Abstract Title: Developing Teaching Materials that Work
Paper Type: Contributed
Author: Martin Richard Hopf
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Speaker Order: FB06

For several years now, the PER Group in Vienna, Austria, has been working on the development of teaching materials for high school physics teaching. Our main focus is to construct materials that work. For this we rely on a cyclic process of construction, evaluation, re-construction etc. Part of this research is to identify explanations of physics concepts that are accepted by students. So far, ready-to-use materials exist on teaching Newton's mechanics in 7th grade [1] and on geometrical optics [2]. Also draft materials exist for infrared and ultraviolet radiation, special relativity, electromagnetic fields and particle theory. In the talk a short overview on the research agenda is given. The main focus will be the presentation of the teaching materials for mechanics and research results regarding their use in classrooms.

Footnotes: [1] Hopf, M.; Wilhelm, Th.; Tobias, V.; Waltner, Chr. & Wiesner, H. (2011): Promoting students' understanding of Newtonian mechanics through an alternative content structure – Results from an empirical study. Paper presented at the ESERA 2011. [2] Haagen-Schützenhöfer, C. (2014). The relevance of students' conceptions for teaching geometrical optics in practice. Paper presented at ICPE 2013.

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Abstract Title: Energy-->Momentum-->Force-->Kinematics: Redesigning the High School Mechanics Curriculum
Paper Type: Contributed
Author: Alexander Robinson*
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Speaker Order: FB07

While much of the early research on "misconceptions" focused on the rationality of these ideas, current physics curriculum materials and assessments emphasizing well-documented "misconceptions" about mechanics seek to "root out" students' intuitive ideas and to replace them with the correct scientific ones. Yet by the time students enter high school physics classrooms, these ideas have worked well in over a decade of experience interacting with moving objects. Thus, over the past three years, we have engaged in iterative cycles of curriculum design research, exploring whether we can leverage (rather than root out and replace) students' intuitive ideas about motion by reversing the order in which mechanics topics are typically taught in high school physics. Drawing on classroom videos, weekly video-recorded student cognitive interviews, and student responses to a multiple-choice diagnostic assessment administered five times each semester, we describe how student thinking develops using our redesigned curriculum.

Footnotes: *Sponsored by Alicia Alonzo.

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Abstract Title: Interactive Whiteboard: A Catalyst for Student Use of Gestures

Paper Type: Contributed

Author: Bor Gregorcic
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Speaker Order: FB04

In a qualitative study we have observed and analyzed the interactions of small groups of high school students who collaboratively investigated orbital motion in a gravitational field using a virtual experiment on an interactive whiteboard. We have observed that during the activity, students communicated not only by talking, but that an important part of the communication was through body and hand gestures. In the talk, we will show how using gestures in combination with spoken language helped students express complex ideas and communicate them to other students without the need for using advanced vocabulary that students were still not familiar with. Student use of gestures can be encouraged by providing them with an appropriate content, environment, and tools for inquiry.

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Abstract Title: Putting the Puzzle Pieces Together: Teachers' Reasoning About Student Thinking

Paper Type: Contributed

Author: Alicia C. Alonzo
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Speaker Order: FB08

Learning progressions (LPs) – descriptions of increasingly sophisticated ways of thinking – are influencing materials for teachers. Underlying much of this work is a strong, though often tacit, assumption that students' conceptual thinking is theory-like and context-independent. Yet theoretical perspectives (e.g., naïve conceptions, knowledge-in-pieces) and empirical evidence suggest more fragmented models of student thinking. Interested in this potential mismatch, we explored how high school physics teachers reasoned about student thinking when presented with LP-based diagnostic information. While teachers were able to make sense of the LP perspective, they tended to treat student thinking about force and motion as less coherent. Each teacher switched among several different perspectives to interpret the information provided, with variation in the amount of structure they attributed to the "pieces" comprising understanding of force and motion. We consider how these results can inform LP-based professional development that leverages teachers' multiple perspectives about student cognition.

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Abstract Title: Resource-based Item Response Curves

Paper Type: Contributed

Author: Alexander M. Axthelm
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Speaker Order: FB01

As part of a larger project to study middle school teachers' knowledge of their students' ideas, the Maine Physical Sciences Partnership (NSF #0962805) has developed a multiple-choice survey on energy that has been administered to thousands of students. We analyze our results using a modified version of Item Response Theory which does not focus on correctness of answers but instead focuses on the ideas that students use when choosing their answers. In this talk, I will present a coding scheme which goes beyond the "correct/incorrect" paradigm, and looks at the possible lines of thought that could lead a student to a particular response. By comparing ideas used across many questions, we can conclude which resources are most productive for students. I use these results to describe productive student reasoning about energy on this survey.

Conflicts: Earlier today, I submitted an abstract with the same title (Resource-based Item Response Curves), before it was ready. This submission includes all the authors, and funding acknowledgement. I apologize for the inconvenience my mistake has caused, I hope you will consider this abstract instead. Thank you.

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Abstract Title: Searching Possibility of Integrated Education with Science and Mathematics

Paper Type: Contributed

Author: Youngseok Jhun
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Speaker Order: FB10

National science curriculum of Korea is divided into four fields: Physics, Chemistry, Biology, and Earth Science. It has been said that the students have more difficulty in learning physics than the other fields, and "The Speed of Objects" rank the most difficult classes. One of the biggest causes of the difficulty is related with the mathematics. Students have to draw graphs which they are not skilled well in the classes of mathematics. Many students also have difficulty in calculating objects' speed. It seems that students need a mathematical background for studying these classes. However, we have different ideas; Learning Science can help learning mathematics, instead of "learning mathematics is necessary for studying science." Students may learn mathematics easily when they deal with the context of the real world. We designed a strategy to teach mathematics additionally in science classes on "The Speed of Objects," and we examined the leaning process of the students.

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Date Last Updated: February 4, 2011