AAPT Programs & Conferences Tools

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Generic Abstracts

PER: Exploring problem solving approaches and skills

Abstracts Submitted (# 16)

Abstract Title: Can analogical reasoning help students learn to solve synthesis problems? 5456

Paper Type: Contributed

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Improving students' skills in solving synthesis problems, which are problems requiring the application of multiple concepts such as energy conservation and kinematics, is typically a key instructional goal. We have previously found that students struggle with some synthesis problems more than their single-concept counterparts in part because of difficulty recognizing all the relevant concepts or that multiple concepts are needed. Analogical reasoning, which involves practice activities that guide students through comparisons of the deep structure of physics problems, is a promising technique for helping students recognize relevant concepts in novel problems. We report on a couple experiments testing simple implementations of analogical reasoning and show that these activities can be effective in improving student performance on synthesis problems. However, we also show evidence that these activities may not be as useful in cases where concept recognition is a less significant

bottleneck.

You have submitted comments on this item

Change Session

No Yes

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Order

5

Comment:

Representations cluster

Update

Abstract Title: Elective Recitation Sections in Freshman E&M Courses 5273

Paper Type: Contributed

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Students from twenty-three departments on the Cal Poly Pomona campus are required to take Freshman physics service courses. Many of them struggle to succeed. Introductory physics courses at Cal Poly Pomona do not normally include any recitation sections focused on concepts and problem solving skills. We present data that we used to assess the effectiveness of elective recitation sections designed to accompany our Freshman E&M course.

You have submitted comments on this item

Change Session

No Yes

PER: Evaluating instructional strategies--G

Order

Comment:

Update

Abstract Title: Eye gaze patterns while viewing visual cues and video solutions 5468

Paper Type: Contributed

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Transfer of learning is a valued educational goal, but it is usually hard to achieve. Visual cues and video solutions have been shown to facilitate this process. Students from an algebra-based physics class participated in our study. Each participant solved two different sets of tasks. In each set students solved one initial task, completed an intervention depending upon condition, and then solved a near transfer and far transfer task. Students were randomly assigned to one of three conditions. The visual cue condition completed four isomorphic training tasks with visual cues. The video solution condition was shown multimedia solutions of two isomorphic tasks. The third condition completed two isomorphic training tasks with visual cues and were shown one multimedia video solution. We compared the eye movements on the initial, near transfer and far transfer tasks in the three conditions.

Footnotes: Supported in part by NSF grant 1348857.

You have submitted comments on this item

Change Session

No Yes

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Order

1

Comment:

Tech cluster

Update

Abstract Title: How do Multimodal Hints Affect Conceptual Physics Task Solving? 5351

Paper Type: Contributed

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Students' visual attention on conceptual physics tasks with diagrams can provide us insight into how multimodality hints affect students' task performance on conceptual physics tasks. We conducted a 2 (visual hint or not) × 2 (text hint or not) × 2 (audio hint or not) full factorial experiment design. One hundred sixty-two subjects from a conceptual physics class were recruited to participate in individual clinical interviews with randomly assigned multimodal hints according to the condition. All of the interviews were video and audio recorded. An eye tracker was used to record the subjects' eye movements. The data were analyzed to compare how the experimental conditions affected performance on conceptual physics tasks and their visual attention in relevant areas on the task diagram.

Footnotes: This research is supported in part by the U.S. National Science Foundation under Grants 1348857 and 1138697. Opinions expressed are those of the authors and not necessarily those of the Foundation.

You have submitted comments on this item

Change Session

No Yes

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Order

2

Comment:

Tech cluster

Update

Abstract Title: Identifying Student Difficulties In Causal Reasoning 5121

Paper Type: Contributed

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There has been an increasing push for the refinement of curricula in university level algebra-based and calculus-based physics classes to focus on scientific reasoning skills. There are nine recognized domains of scientific reasoning, and this study focused on the causal reasoning domain. Quantitative data were gathered from selected items given as part of the Inventory of Scientific Thinking and Reasoning (iSTAR) assessment at the beginning and end of two semesters. The focus of this analysis was to identify student difficulties in making causal judgements. Initial results from the data suggested that students entangle forward and reverse causality statements; they often selected a forward causal statement "X causes Y" and a reverse causal statement "Y causes X" simultaneously to explain some observed result.

You have submitted comments on this item

Change Session

No Yes

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Order

6

Comment:

Representations cluster

Update

Abstract Title: Introductory Physics Students' Perception of Worked-Out Problem Solutions 5349

Paper Type: Contributed

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Worked examples are common instructional tools used in the teaching and learning of problem solving. As part of a larger study to explore how worked examples could be designed and used effectively to facilitate student learning, we investigate how students perceive features in worked examples that are designed to model expert-like problem solving strategies. Thirty students enrolled in an introductory physics course were provided with different instructor solutions for the same physics problem and asked to discuss the features

they noticed from these solutions. They were also asked to discuss how important each of these features was when solving physics problems as well as whether they would like to see these features included in worked out examples provided to them. We will present the findings.

You have submitted comments on this item

Change Session

No Yes

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Order

7

Comment:

Representations cluster

Update

Abstract Title: Probing students' mathematical difficulties in introductory physics 5307

Paper Type: Contributed

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Instructors often report apparent difficulties among introductory university physics students with mathematical skills and concepts normally taught in high school or earlier. As part of a systematic effort to identify and address such difficulties, we have begun to investigate skill levels with trigonometry, basic algebra, symbolic manipulation, and vector concepts, among students in algebra- and calculus-based introductory physics. We will present a summary of our initial results, and outline a strategy for addressing these difficulties within the context of physics classes themselves.

Footnotes: Supported in part by NSF DUE #1504986.

You have submitted comments on this item

Change Session

No Yes

PER: Examining content understanding and reasoning--G

Order

Comment:

Update

Abstract Title: Prompted evaluation in calculus based introductory physics 5617

Paper Type: Contributed

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Physics instructors generally expect students to think about the correctness and reflect on the meanings of their answers. This answer evaluation process may include a variety of considerations, including checking units, looking at limiting cases, and thinking about the reasonableness of numbers. In order to encourage answer evaluation, instructors explicitly prompt for it in class assignments. We examine students' responses to such a prompt on homework and exam problems in a large enrollment first term calculus-based physics course. We will discuss the distribution of strategies students used, student performance with these strategies, and the extent to which the development of answer evaluation skills was supported throughout the course.

You have submitted comments on this item

Change Session

No Yes

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Order

7

Comment:

Representations cluster

Update

Abstract Title: Purpose of Representation Use in Modeling Instruction Physics 5458

Paper Type: Contributed

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Representations (i.e. graphs, equations, pictures) are the foundational tools that students use to understand and solve physics problems. This study aims to understand the purpose with which students use particular representations. In the Modeling Instruction courses, representation use is a primary focus with explicit class time spent on introducing, practicing, coordinating, and applying multiple representations. Consequently, we conducted pre/post think-aloud, problem-solving interviews with groups of students in the Modeling Instruction – Electricity and Magnetism (MI-E&M) course. In each recorded interview, students were asked to solve three physics problems, which varied by context (mechanics and E&M), difficulty, and familiarity with the topic to show the breadth of how students use representations when problem solving. From video analysis and coding, we will present the common themes and purposes with which students use various representations.

Conflicts: Cannot be scheduled with the Graduate Student Topical Discussion or Graduate Student Professional Development Session as I am co-organizing these sessions.

You have submitted comments on this item

Change Session

(•) No ( ) Yes

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Order

8

Comment:

Representations cluster

Update

Abstract Title: Reading between the lines: lab reports help develop scientific abilities 5188

Paper Type: Contributed

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Science practices are an integral part of learning science. Over the course of the 2015-2016 school year, high school physics students, initially unfamiliar with an inquiry-based environment, engaged in ISLE labs that focus on the development of student scientific abilities. Based on the last year's investigations, we know that factors such as time, ability type, student grouping, and instructor influence student development of scientific abilities. This year, we are continuing to examine student lab reports in order to better understand the process students go through when they write these reports. The revision history feature of the Google Documents provides insight into development of discourse as well as collaboration amongst students. We also continue to investigate differences in individual and group reports and students' self-assessments and reflections of their progress in development of these different abilities.

You have submitted comments on this item

Change Session

No Yes

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Comment:

Update

Abstract Title: Students learning to coordinate mathematical and physical models in biology 5522

Paper Type: Contributed

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In science, mathematics facilitates theory building and experimental design. In science

education, however, learning with mathematics can degenerate into students memorizing equations and algorithms without connecting these formalisms to meaningful representations of science concepts. By leveraging the theory of Knowledge-in-Pieces, I will present a study that illustrates how students learn to coordinate conceptual knowledge of mathematical and physical models in biology education. I report on how undergraduate physiology students used a multi-representational learning environment to coordinate their knowledge and how an innovative assessment reveals their learning through a pre-/post- design. Analysis of students' talk and eye-movements provided contrasting cases—some students learned to coordinate the physical quantities and others did not. Despite the cases contrasting, students' performance on the written assessment revealed similar growth. These finding suggests that multiple pathways to success exist. At the same time, these findings call our attention to the role that modality plays in assessment.

Conflicts: I will be traveling from another conference that ends on July 17th; I will therefore arrive on the 17th.

You have submitted comments on this item

Change Session

No Yes

PER: Problem Solving--G

Order

16

Comment:

Representations cluster

Update

Abstract Title: The impact of students' epistemological framing and beliefs on a task requiring representational consistency 5038

Paper Type: Contributed

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The ability to flexibly transform between different representations (e.g., from mathematical to graphical representations) of the same concept is a hallmark of expertise. This ability is often lacking in many introductory students as evidenced by the lack of consistency in students' representations (i.e., students construct two representations for the same concept in the same situation that are not consistent with one another). In this study, we asked

students to construct two representations for the electric field for a situation involving spherical symmetry (charged conducting sphere surrounded by charged conducting spherical shell). This type of problem has been found to result in many students constructing representations that are not consistent with one another. Here, we present findings from individual interviews with students which suggest that students' lack of consistency may partly be attributed to the type of knowledge that the graphical and mathematical contexts trigger. Using the epistemic games framework terminology, the two representations students are asked to construct (mathematical vs. graphical) may lead them to play two different epistemic games. We discuss how students' epistemological framing and beliefs may contribute to their lack of representational consistency.

Footnotes: Work supported by the National Science Foundation

You have submitted comments on this item

Change Session

No Yes

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Order

9

Comment:

Representations cluster

Update

Abstract Title: Using phenomenography to better understand student development with computational physics 5516

Paper Type: Contributed

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In Projects and Practices in Physics -- a highly interactive and technologically modern introductory physics classroom with a strong pedagogical foundation -- students are exposed to fundamental physics phenomena with the aid of computation. Within the context of this classroom, we have conducted a phenomenographic investigation of a small cohort of students. This cohort was exposed in-class to a "suite" of three scaffolded computational physics problems focusing on the fundamental physics phenomenon of force and motion. Over the three week duration of this "suite," we invited the cohort to repeated semi-

structured interviews, one for each problem, in order to observe their development in approach to computational problems. From an analysis of the students' perceived variation in the computational features discerned to be critical, we have observed several qualitatively different categories of student development with modeling motion computationally.

You have submitted comments on this item

Change Session

No Yes

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Order

3

Comment:

Tech cluster

Update

Abstract Title: Using Spaced Recall to Encourage Expert Practice 5259

Paper Type: Contributed

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Introductory physics students were shown an example problem and asked to recall the solution from memory over a period of weeks, with feedback after each attempt. The structure of this activity was designed to reward expert practices that benefit the long-term retention of information. For example, reasoning with a diagram to form the proper equation, rather than just memorizing the equation. This talk will discuss the performance of a class of 15 students throughout an entire semester, as well as the analysis of four videotaped interviews.

You have submitted comments on this item

Change Session

No Yes

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Comment:

Representations cluster

Update

Abstract Title: Using the C3PO interface to develop and modify computing coaches. 5653

Paper Type: Contributed

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Improving students' problem-solving skills is a basic goal of many college-level introductory physics courses. At the University of Minnesota, investigators have developed computer programs designed to provide students with coaching to help them become better at solving problems in an introductory college physics course. As a physics instructor at Normandale Community College, I am participating in a study to test the feasibility of using this computer coach interface to modify existing coaches and create new coaches suitable for students enrolled in the introductory physics classes at Normandale and to assess their usability and educational impact with Normandale students. In this talk I will report on my initial experience with using C3PO: Customizable Computer Coaches for Physics Online to create and modify physics computing coaches.

You have submitted comments on this item

Change Session

(•) No ( ) Yes

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Order

4

Comment:

Tech cluster

Update

Abstract Title: Using the Cognitive Reflection Test to investigate student reasoning inconsistencies* 5457

Paper Type: Contributed

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Students who demonstrate correct conceptual knowledge and formal reasoning approaches on one physics question often abandon these approaches in favor of more intuitive reasoning on an isomorphic question. The heuristic-analytic theory of reasoning suggests that the intuitive approaches used by these students stem from the heuristic process and are cued by salient, distracting features of the isomorphic problems. This apparent failure to engage the analytic process productively may stem from a lack of metacognition. We speculate that the students who continue to use formal reasoning on the isomorphic problems tend to be more reflective, analytical thinkers. In order to investigate this possibility, we have been using the Cognitive Reflection Test (CRT) in conjunction with a pair of isomorphic questions to examine the extent to which students' reflection abilities impact performance.

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

PER: Problem Solving--G

Order

17

Comment:

Representations cluster

Update

Date Last Updated: February 4, 2011