The MPEX2: Modification of a Survey Instrument

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The Story So Far

- The original MPEX is a 34-item 5 point Likert scale (agree-disagree) survey designed to probe the cognitive expectations of students in physics courses. (Steinberg, Saul, and Redish, 1998)
- Students' responses are summed and analyzed, then compared with "favorable" responses given by experts. The test is scored based on a class's totals.
- This test probes six dimensions: *independence*, *coherence*, *concepts*, *reality link*, *math link*, and *effort*.

What We've Done (and why)

- Modified/added/deleted various items to
 - separate epistemology from expectations where possible
 - minimize student misinterpretations of items
 - provide better contexts for responses
- Rethought the clustering
 - One cluster (effort) was believed to be invalid.
 - Questions from others (*reality link* and *math link*) fit more appropriately within *coherence* and *concepts*.

Getting the Epistemology Out

- Items from the Epistemological Beliefs Assessment for Physical Science (EBAPS) survey were included to get at "pure" epistemology. (White, et al., 1999)
- Example:

Tamara just read something in her science textbook that seems to disagree with her own experiences. But to learn physics well, Tamara shouldn't think about her own experiences; she should just focus on what the book says. (Agree/Disagree)

Adding Context TAE CAT

- Some of the new survey items try to introduce or activate specific contexts so students are more likely to have "gut" reactions to them.
- Example:

To really help us learn physics, professors in lecture should show us how to solve lots of problems, instead of spending so much time on concepts, proofs of general equations, and one or two problems.

Adding Context (more overtly)

Roy and Theo are working on a homework problem.

- Roy: I remember in the book it said that anything moving in a circle has to have a centripetal acceleration.
- Theo: But if the particle's velocity is constant, how can it be accelerating? That doesn't make sense.
- Roy: Look, right here, under 'Uniform Circular Motion' here's the equation, $a = v^2 / r$. That's what we need for this problem.

Adding Context (more overtly)

Theo: But I know that to have an acceleration, we need a change in velocity. I don't see how the velocity is changing. That equation doesn't seem right to me.

If you could only work with one of them, who do you think would be more helpful?

- A. Roy would be much more helpful
- B. Roy would be slightly more helpful... etc.

Eliminating *Effort*

- We were concerned that the effort cluster questions could be answered "favorably" or "unfavorably" by both sophisticated and unsophisticated students, and we have no way of making the distinction.
- Examples:
 - I go over my class notes carefully to prepare for tests in this course.
 - I read the text in detail and work through many of the examples given there.

Results and Reclustering

- The survey was given to our PHYS 121 course in Fall 2002, an algebra based mechanics course taken by life science majors. (N=146)
- Data are matched pre-post, and the surveys were not graded.
- Three main clusters were scored: *concepts, coherence,* and *independence*.

Clustering

- Items that were in the old *reality link* or *math link* clusters were regrouped into one of the "big 3."
- Those items that probed beliefs on the interconnectedness of physics concepts or the connection between experience and formal physics were called *coherence* items.
- Those that probed the "concepts vs. equations" conflict or the importance of conceptual knowledge were called *concepts* items.



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The Splitting of Coherence

- The set of *coherence* items on the MPEX2 probes student views on the connectedness between all forms of information used to build physics understanding.
- Some questions ask about the connection between physics and reality, these form the *reality* subscale.
- Others (the *math* subscale) probe student views on the importance and role of equations in physics.

Coherence cluster





The Splitting of Independence

- Three MPEX2 items try to get at whether a student thinks he or she can figure things out without absorbing it from an outside source. These are called the *personal* subscale.
- Example: If I don't remember a particular equation needed for a problem in an exam, I can probably figure out an ethical way to come up with it, given enough time.
- The other questions in the *independence* cluster are not as confidence dependent, and are thought to be more purely *epistemological*, hence the subscale.

Independence Cluster



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Caveats



- Clustering of the MPEX2 is not set in stone, the arrangement of the clusters is arbitrary to some degree. Also, they're not necessarily independent.
- The MPEX2 is no better at gauging individual student expectations/epistemologies than the original MPEX.
- We have no way of knowing for sure how seriously the survey is taken by students.

Summary



- In creating the MPEX 2:
 - We added items that tried to better tease apart epistemology from expectations
 - We tried to introduce context better to elicit more (hopefully) honest "gut" responses from students
 - We rethought the clustering
- Our trial with this survey yielded positive results for an epistemologically driven algebra based course.
- Baseline statistics would be useful.