2008 National AAPT Meeting – Summer
Notes from July 21-24
Edmonton, AB, Canada

The following notes were taken by Dr. Van Domelen during the regular sessions of the 137th National Meeting of the American Association of Physics Teachers.

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Abbreviations

There are a few concepts that came up frequently enough in the talks I attended that I refer to them solely by abbreviation, making up my own where necessary. (Not all will appear this time; I just pasted in the 2004 glossary and added to it as necessary.)

ADT – Astronomy Diagnostic Test

BCI – Biology Concept Inventory

BEMA – Brief Electricity and Magnetism Assessment

CAPS – Colorado Assessment of Problem Solving.

C-LASS – Colorado Learning Attitudes about Science Survey

"Clicker" – Not an abbreviation grammatically, but it covers a LOT of other terms, such as PRS (see below), and it seems to be the semi-generic term of common usage now. It's also apparently a word I can't consistently write correctly when I'm taking notes at high speed, which occasionally causes me problems. ☺

ComPADRE - Communities for Physics and Astronomy Digital Resources for Education.

CoMPASS - Concept Map Project-based Activity Scaffolding System.

CSEM – Conceptual Survey of Electricity and Magnetism.

DFW or D/F/W – Drop/Fail/Withdraw, a measure of the proportion of students who do not pass a course. As opposed to Dallas/Fort Worth, which measures something else entirely.

EBAPS – Epistemological Beliefs Assessment for Physical Science.

ECCE – Electronic Circuits Concept Evaluation, developed by Thornton and Sokoloff.

ECR – Elicit, Confront, Resolve. The University of Washington method.

FCI – Force Concepts Inventory, a common mechanics test.

FMCE – Force and Motion Concept Exam, a common mechanics test. I may sometimes type it as FCME.

GG – Gender Gap, a disparity between male and female results, usually to the detriment of the women.

IE – Interactive Engagement, one of many strategies that get students more involved in their own learning.

ILD – Interactive Lecture Demonstration.

ISLE – Investigative Science Learning Environment, developed at Rutgers.

K-n – Kindergarten through grade n education (i.e. K-8, K-12, K-22).

LA – Learning Assistant, typically an undergraduate hired to help in a class they previously took. Considered distinct from an undergraduate TA.

Lawson Test – Again, not an acronym, but deserves some explanation. This is the Lawson Classroom Test of Scientific Reasoning, which measures several dimensions of scientific thinking.

MBL – Microcomputer Based Labs

MBT or MBLT – Mechanics Baseline Test

MPEX – Maryland Physics Expectations Survey, a test of student expectations about physics and physics courses. MPEX2 is a recent revision.

NDSL – National Digital Science Library. ComPADRE is part of this.

N1L, N2L, N3L – Newton's First Law, Second, Third.

NCLB – No Child Left Behind, national educational accountability legislation. (Included for the benefit of any readers not from the United States.)

OCS – Overview Case Study (CE/OCS is Conceptual Exercises OCS)

PBI – Physics By Inquiry (or PbI sometimes), frequently used conceptual physics course using a workshop setting, developed at University of Washington.

PET/PSET – Physics and Everyday Thinking/Physical Science and Everyday Thinking. A reform curriculum. PET is sometimes abbreviated PhET.

PI – Peer Instruction

PRS – Personal Response System, a means of letting students answer multiple choice questions in class using a remote control. See Clickers above.

Regents Test – For the purposes of these notes, a series of high-stakes tests used in New York State public schools (www.nysed**regents**.org). There are other Regents' tests out there, but so far all AAPT talk references to Regents tests are the NY ones.

SCALE-UP - Student-Centered Activities for Large Enrollment Undergraduate Programs.

SPS – Society of Physics Students

STEM – Science, Technology, Engineering and Math. The cluster of "science-y" majors.

TIMSS – Originally "Third International Math and Science Survey", but they changed what the acronym means in order to keep using all the logo stuff as they move on. ☺

TIPER – Tasks Inspired by Physics Education Research (subsets include eTIPERs and mTIPERs for electrostatic and magnetic activities respectively)

TYC – Two Year College, such as a Community College (CoCo) or Junior College (JuCo).

ZPD – Zone of Proximal Development, the space between "too hard to learn even with help" and "easy enough to learn without help".

I will sometimes add personal comments in [brackets]. I will try to withhold value judgments most of the time...if you feel the need to argue a point about a paper, please contact the author, not me (email addresses provided). However, if you are the author and feel I have missed the point of your paper, let me know and I will attempt to remedy the situation.

"ZOOM"

Every so often in my handwritten notes is the word "ZOOM". This means that the speaker, when faced with the fact that they had more material than could reasonably be fit into a talk of the scheduled length, elected to try to get through it all anyway rather than editing it down. This makes it difficult, if not impossible, to take meaningful notes or even follow the topic of the talk.

If you have a lot of information and just can't fit it all in your time slot, **please** consider submitting a poster for the extra information, and then pare things down so that your presentation can be followed by people who aren't professional stenographers. Thank you.

Monday, July 21, 2008

AB: Learning to Think Like a Physics Education Researcher (a session to honor Alan Van Heuvelen)

This session was organized by Xueli Zou in honor of Alan Van Heuvelen's upcoming retirement. It is a mix of invited serious (or semi-serious) talks and more humorous intermissions.

AB01: A Physics Education Researcher Motivating a Community – Thomas O'Kuma, Lee College, tokuma@lee.edu (with Curtis Hieggleke, Joliet Junior College)

This talk focused on the contributions Alan made to the Two Year College (TYC) community, in large part through the TYC Workshop Project.

O'Kuma's first significant contact with Alan was at the Introductory University Physics Project in 1989. Alan was working with the Overview Case Study (OCS) approach under a FPSE grant, which was in the process of evolving into Alan's version of Spiral Teaching (cover the same material repeatedly, "spiraling" through it at multiple levels: qualitative, quantitative, case studies). O'Kuma worked with Alan to adapt the materials into an ALPS kit, and in his own teaching integrated lab and lecture. Most of their collaboration at this time was via snailmail, since they didn't have an email contact.

Their next face to face contact was at an NSF program at New Mexico State in 1991, during which Alan helped set O'Kuma straight on why bar charts (as opposed to a simple checklist) were vital to Alan's energy approach.

O'Kuma and David Maloney then teamed up at a TYC Workshop at IUPU-FW. What followed were 18 CE/OCS workshops by Alan over the years 1991-2005. Alan tended to debut new ideas at these workshops, such as Experiment Problems in 1993. Spiral Physics was further developed with alternate problem types (i.e. ranking tasks) and Critical Analysis Tasks (given a solution, students were asked to determine what, if anything, was wrong with it, An example would be a ballistics solution that has a basketball intersect the hoop, but coming in from below).

Goal-Free Problems were another thing that came up in these workshops. It's a process, not a product! Have students do all the setup and representations they can, but don't give them an end goal.

The 1995 TYC Workshop saw the beginning of the development of the CSEM, in its original CSE and CSM components. They were united as the CSEM in 1997, and a final version came out in 2001 (AJP **69**, S12-23).

The 1996 workshop was the debut of ActivPhysics.

Alan was generally quite heavily involved in the development of various things now grouped as TIPERS, such as ranking tasks, Jeopardy problems, etc.

Intermission: The Top Ten Things We Learned From Alan Van Heuvelen, Dave Van Domelen, Kansas State University, dvandom@phys.ksu.edu

A somewhat silly PowerPoint presentation, available by request.

AB02: Alan Van Heuvelen at New Mexico State University – Stephen Kanim, NMSU, skanim@nmsu.edu

Alan has sort of come full circle as he prepares to retire from Rutgers, since he got his BS there in 1960. He then got his PhD from the Colorado School of Mines in 1964 and went right to work at NMSU, becoming a full Professor in 1973. His first area of research involved spectroscopic techniques, but he drifted into chelates (which he pronounced "chalets") and by the 1980s was looking more at biomedical applications. For instance, he created a quantitative measure for measuring dehydration, and invented an implantable blood glucose monitor that used laser LEDs and took advantage of how glucose affected the index of refraction of blood. In 1982, he wrote Physics – A General Introduction (algebra-based text), and it was successful enough to go to a second printing in 1986. It can now be found on Amazon for 12 cents.

Kanim's own first exposure to Alan was when he was doing some student teaching and filling in for Art Farmer, who was in on the beginning of OCS teaching. This brought him to Alan's attention, and Alan pointed Kanim at a job opening at Las Cruces High School (LCHS), about a mile from the NMSU campus) that started in 1987.

As an aside, "Spiral Physics" didn't start with Alan, Joan Baez's physicist father created a Spiral Physics text in the 1960s.

During Kanim's time at LCHS, Alan would visit frequently, such visits going over quite well (unlike some guests from NMSU). However, when using eggs as simulated crash test dummies, it's a good idea to make sure the eggs are **fresh**,

By 1991, Alan had fully shifted to PER.

Intermission: A Socio-Cultural Analysis of How Alan Trains His Graduate Students – David Brookes, University of Illinois, presenting on the behalf of Yuhfen Lin

[A tongue-in-cheek deadpan presentation with a serious core.]

Alan trained his graduate students according to three important principles: epistemological development (students learn to stop relying on authority and start to construct their own knowledge), legitimate peripheral participation (learning by doing, stop treating the students as underlings and start treating them as equals or partners) and cognitive apprenticeship (learning to think like a researcher).

The work of Baxter-Magolda (2004) applies in the case of epistemological development. Students learned to stop relying on authority because Alan has a talent for joking with a straight face, undermining our ability to trust what he says.

For legitimate peripheral participation, the work of Lave and Wenger (1991) seems relevant. Alan values all opinions equally, and is easy to talk to as a colleague.

Alan also generally demonstrates the elements of thinking like a researcher, unpacking them for his students:

Situated Learning – Doctoral students are thrown into the pool at the deep end, becoming real researchers practically from day one.

Culture of Expert Practice – Students often end up advising each other rather than relying on Alan's sage advice (delivered on napkins, often as not).

Intrinsic Motivation – Toys are fun! And they're task-involved.

Exploiting Cooperation – Alan is the "guru of networking", arranging meetings both within and between institutions.

Exploiting Competition – Well, this one doesn't get demonstrated. Alan's just so humble!

That last one aside, Alan is generally very good at applying cognitive apprenticeship.

AB03: Multiple Representations of a Physics Education Research Mentor – Kathy Harper, Denison University, harper.217@osu.edu (will change soon)

Five representations of Alan are proposed: a sponge (that absorbs all), a diamond (the "mogul diamond" reader of Coleridge's description), a mother bird, a mute and a case of nuclear fusion.

"A fool sees not the same tree that a wise man sees," said William Blake. And Alan frequently doesn't see the same talk that others do either, finding useful and interesting things in even the worst sessions. Like Coleridge's diamond, he takes in all and makes it more brilliant.

During the time at THE Ohio State University, Alan had gotten a Graduate Research Training grant to support several graduate students. Since this was not tied to a particular project, that let us work on a wide variety of topics (energy representations, problem-solving, magnetic induction).

"The only problem with [working with] Alan is figuring out which coffee shop he is currently frequenting." – John Demel, OSU Engineering, partner in the Gateway Project.

In his mother bird representation, Alan follows the dictum of Kobi Yamada and pushed us out of the nest, encouraging us to build our wings on the way down.

As a mute, Alan has found, "The less I talk in class, the higher the gains on the FCI and CSEM!" Perhaps a semester of standing silently at the front of the room would result in 100% gains!

"A mind is a fire to be kindled, not a vessel to be filled." – Plutarch. Or a fusion reaction to be stoked, as Alan often did.

As a final thought, "Well, I don't know…" was Alan-speak for "That's stupid!"

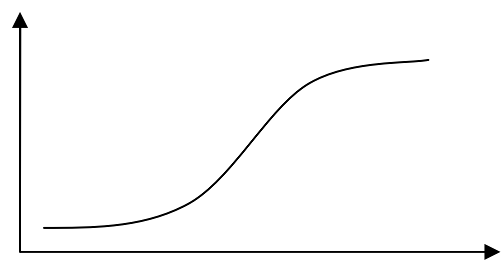
Intermission: Alan Van Heuvelen Baseline Inventory – Xueli Zou, CSU Chico, xzou@csuchico.edu

[A clicker task, available by request.]

Closing Remarks: Alan Van Heuvelen, Rutgers University

We may think that things aren't changing very quickly, but it's all a matter of perspective. In terms of geological time, it's an eyeblink. Even in terms of recorded history, PER has changed things very quickly. It may seem slow on the scale of our lifetimes, but only just barely…as recently as the 1950s, the job market's demand for skilled labor was about 20% of the population. The old cookbook-style labs suited our nation's educational needs perfectly fifty years ago, where most people were trained on specific jobs rather than needing a versatile skill set.

However, now about 85% of jobs are considered "skilled", and the cookbook labs are inappropriate. The world, and education, have changed a lot just during the time Alan's been active, and we may be approaching the steep part of the sigmoidal curve of adopting innovation in PER.



(a sigmoidal curve)

CB: PER – Disseminating Results and Resources in Physics Education (Panel Discussion)

M (Moderator): Leon Hsu
1: Jan Tobochnik, Kalamazoo College, jant@kzoo.edu – Editor of the American Journal of Physics
2: Karl Mamola, Appalachian State University, mamolak@appstate.edu – Editor of The Physics Teacher
3: Bruce Mason, University of Oklahoma, tmason@ou.edu – Representing ComPADRE

1: AJP is eclectic to the point that no one's really sure what's appropriate for submission. They try to mainly run articles that provide insight into a topic that may be useful educationally, or at least to an audience broader than those in the specialty field that generated research on the topic.

Articles must be interesting, clearly-written (not just grammar and usage, but also make sure they're comprehensible to non-specialists), contain some level of novelty (i.e. "here's the modification made to my detector this year" articles need not apply, although new takes on old ideas are welcome).

20% of all rejected articles are simply incorrect in terms of the physics. Most of these are submitted by non-physicists. [Unstated but lightly implied was that a significant percentage of these are your basic "I have found a totally new way to describe all physics, let me show you it" sort of articles that score high on the Crackpot Index.]

AJP avoids specialist articles as a rule. Try to write for a general physicist audience…it's okay to assume your readers have a degree in physics, but don't assume they're following your particular subset. Specialist PER articles should go to the PhysRev Special Topics in PER journal.

2: TPT is similarly for generalists, but the target audience is introductory (High School/TYC/University) physics teachers. "Introductory" does cover a pretty broad range, of course, but try to hold back the technical stuff a bit more than you might in an AJP article. About a third of all subscribers are high school teachers.

TPT has a mix of refereed articles and "invited" columns, with about a 1/3 acceptance rate for articles. Papers tend to be on the short side, rarely over three pages.

Before submitting, ask yourself of your article, "How useful would this be to an introductory physics teacher?" Not just "how interesting". TPT is not a research journal, for all that some of the earlier PER research results showed up there. However, a paper summarizing a more technical research piece (say, with a focus on implementation of the ideas found in the technical paper) would be appropriate.

3: ComPADRE is a database of various resources, such as PhET, TIPERS, and so forth, pulling together these resources in ways that make sense. They really try to emphasis the "Com" (short for communities) in their title. ComPADRE is organized around community subsites.

If you have any PER dissertations that aren't on ComPADRE, please submit them.

There's a fair amount of overlap between collections, but this is intentional. It's preferable to make it easy to find things than to have everything neatly categorized. And, of course, since it's an electronic system rather than a physical one, there's no storage issue arising from filing a single resource under many categories (i.e. no need to have ten paper copies and make sure they're all the same and kept up to date).

They're trying to get into providing web services to the userbase, so people don't have to self-host everything. Open Source and free submissions are nice, but not necessary. Contributing to the system is as easy as they can make it, and if you currently have material linked in from an external site, you might want to consider uploading it to their servers in order to help avoid link rot. (In Q&A it came up that they have yet to delete any links for being out of date, since it's possible the failure was only temporary and it'll be back up soon.)

They have a short form and a long form for submission. The short form gives fewer options and less control, naturally. However, if you have a large block of material you want to upload (say, all your department's theses for a decade), contact them to arrange help.

[If I was able to identify a questioner, they will be listed by name. Otherwise, they'll just be listed as **Q**. But not portrayed by John DeLancie.]

Phil Young: Is all the ComPADRE material hosted there?

3: Most of the material is from external links, although there's automated and regular link-checking to avoid link-rot. [He didn't say if suspect links are tagged, just that so far none have been removed.]

Noah Finkelstein: Please comment on sustainability and growth in terms of funding.

1: AJP is fine in terms of funding. It's very important to AAPT (as is TPT), so they're fairly insulated from funding pressure and the whole open access issue. [I'm not totally sure what that issue is, but I think it's a matter of journals being pushed to make all materials available for free online, which naturally cuts into revenue.] Even if forced to go with open access, however, they don't foresee implementing page charges. The submissions rate is healthy and incredibly stable over time.

2: Ditto. There has been a rise in international contributions (mainly from India and China) lately, but the rejection rates on those are pretty high due to their lack of familiarity with what makes for a good TPT submission.

3: The current grant funding ComPADRE has 3-4 years left on it. No one really knows yet how to sustainably fund a digital library, though. The idea has been floated to ask people to include ComPADRE funding lines in their grant submissions (in the same way people ask for funding for page charges, or for conferences…part of the dissemination section). AAPT and AAS are both interested in seeing ComPADRE continue to thrive. Currently there are no plans for general membership fees, but they might institute special memberships to give access to certain areas (i.e. a PER-focused membership that gets you at more data and other goodies).

Q: Are any other sciences doing anything like ComPADRE?

3: Yes. ComPADRE is part of the National Digital Science Library, which is aggressively cross-disciplinary. Searches from ComPADRE can be sent out into all parts of the NDSL.

Bill Reay: How does this look to grant-giving institutions? For instance, "Previous work published in AJP" always looks good, but how about "Previous work available on ComPADRE"?

3: ComPADRE doesn't have the same cachet, but they're working on it.

Q: How about international equivalents of ComPADRE?

3: There's some in England and Germany, but they mix science education and pure science research. ComPADRE has some international entries, but is mostly American.

Q: (A plug for "Internet Physicist", a British effort. The INTUTE Project.)

Noah Finkelstein: Considering the counterparts in other disciplines (i.e. Chemistry Education Research), please comment on what's going on in other disciplines that we might borrow and use.

1: Don't really know. The Journal of Chemistry Education is venerable, but the equivalent in Biology is just starting up. Neither is as eclectic as AJP, however. The European Journal of Physics is similar to AJP.

2: There are some other international equivalents of TPT, but no interdisciplinary ones. [I'm not sure if I meant no interdisciplinary education research journals, or just no chemistry/biology equivalents to TPT…it was a short comment and my notes aren't clear.]

3: JChemEd is running the NDSL, and the Journal of Online Mathematics Applications is involved. "Teach Engineering" is another resource, aimed at K-12.

M: Will the print journals ever go away?

1: Some journals have officially moved to an online stance, with the print versions being a bonus extra for those who want paper in their hands. But print will continue to exist until either all the old guard die off or we get a truly satisfying e-paper.

2: TPT will stay in print for a long time to come, but more content is being moved into the online version, such as animations and the like.

3: A word of caution – no one's really sure how to do a stable century-scale archiving of electronic journals.

Q: (comment, not question) One school digitized all their math books a while back, only to have to redo them all a few years later to retain compatibility. Electronic storage has serious legacy problems, where books only need to worry about physical decay.

Bill Reay: Do you measure the article hit counts?

1: The online AJP gets about 40-50 thousand unique IP addresses per month. They do track the more popular individual papers, but don't really look that closely at the numbers. [I suspect a lack of an ad-driven model contributes to this indifference to hit counters.] However, one interesting thing to come out of the numbers is that the Indian Institute of Technology is a major consumer of the online AJP.

2: AIP (which hosts the online TPT) reports all hit data to TPT, including hits per article. They plan to make this data available to TPT readers in the near future, eliciting amused comparisons to "Hot or Not" sites.

1: AJP is considering discussion boards linked to articles.

2: A "Blog this article" sort of link is also planned for TPT online.

1: Not really sure how useful this sort of thing will actually be, but they're looking at it anyway.

M: Where do you want to be in ten years?

1: See the evolution continue. Articles made more useful, more connected to one another and to outside sources. [For instance, clicking on a citation to take you directly to the cited article would be a Good Thing.] The nature of the articles will likely change, and all sorts of new content can be added in an electronic form that can't be captured in print. However, this process may take more than ten years.

2: The online version will better or more fully supplement the paper version, but the paper version won't change much in the next decade.

3: Hoping to still be funded. (audience laughter) Would like to flesh things out to cover all the bases, but if AAPT and AJP (among other places) do too good a job on their own sites, it might draw away resources and interests from ComPADRE and kill it with irony.

1: Online publication may lead to broader co-authorship and more collaboration. Science publishing and science itself will change.

CJ: Klopsteg Award

[As is customary for me at awards talked, this will be scattered notes on things that struck my interest, and not an attempt to reproduce the narrative flow or logical thrust of the talk as a whole.]

CJ01: Physics of the Impossible – Michio Kaku, City College of New York, kaku@sci.ccn.cuny.edu

As a boy, Kaku was inspired by Einstein's final, unfinished manuscript: Unified Field Theory. Einstein died while Kaku was in elementary school. In high school, he built a betatron particle accelerator in his mom's garage. It blew every fuse in the house, but it did earn him a scholarship to Harvard.

Lord Kelvin described as impossible a number of things that turned out to be true and/or useful. It's always dangerous to call something impossible, since it may really just be that we don't yet have a theory to explain it. It can also expose your own ignorance, as the New York Times did when they called Goddard's work impossible on the grounds that there was nothing in space for a rocket to push against.

With those caveats, there are three classes of impossible.

Class I Impossibility – Not currently possible, but possible within a few decades. Examples include artificial intelligence and functional invisibility. More of a practical than a theoretical impossibility. Overcoming this sort of impossibility requires improved application of existing rules.

Class II Impossibility – Possible within centuries or maybe millennia. These things don't necessarily violate any known laws of physics, but neither do we have any idea how to make them work. Time travel falls into this category. Overcoming this sort of impossibility requires finding new rules.

Class III Impossibility – These things violate known laws of nature, like perpetual motion machines. To get these things to work not only requires finding new rules, but also discarding old ones.

The Physics of the Impossible miniseries will be airing on the Science Channel (typically on digital cable in most markets) starting on August 10. [It will likely find its way to Discovery Channel later on.]

Invisibility was demonstrated for microwave frequencies using metamaterials a few years ago, and this year a proof of principal study was completed for red and blue visible light (very minor bending, but enough to show it was possible). Now invisibility has been reduced to more of an engineering problem, a Class I Impossibility.

Quantum teleportation is next on the list. Photons have been teleported as far as 100 miles so far, and atoms have gone as far as 600 meters. However, since the information on the original particle is **lost** and then copied onto a new location, there's more than a mere engineering question behind this…there's a philosophical one. If this ever gets to the point of being usable on people, would the person arriving at the other end really be considered the same person, or would the original have been killed by the teleporter and replaced by a copy? In any case, single molecule teleportation may be Class I, but teleporting people seems to be a Class III Impossibility due to information theory issues.

Planetkiller ray guns (a la the Death Star) are physically possible, if impractical from an engineering standpoint. Real life examples do exist, however, in the form of gamma ray bursters. WR104 is a "nearby" system (8000 ly away) with the potential to fire a gamma ray burst right at us when it finally goes supernova. 8000 ly is point blank range for a gamma burster, and while the planet may survive the experience, nothing on the surface will. Of course, the energy requirements of a weaponized GRB make it solidly Class II Impossible.

Brain Gate is a working, if limited, cybernetic interface. The first test subject can now use a computer via mental commands…it's hardly Gibsonian cyberspace, but it's genuine cyberkinesis. Consumer-level cyberlinks are a Class I Impossibility.

When doing functional Magnetic Resonance Imaging of the brain, more areas light up when someone lies than when they tell the truth. The theory is that not only do the areas associated with the truth light up (you need to keep track of it in order to tailor your lie) but other bits also light up for imagination, connection, etc. A more detailed "emotional encyclopedia" is also being worked on, correlating fMRI results to different emotional states. While telepathy in the "listening in on what someone's thinking" sense may be Class II or even III, a sort of mind-reading is Class I.

Computers that can be built into contact lenses are possible in the near future. [Not that I really want contact lenses that are capable of snarking at me!]

Swallowable cameras may soon replace colonoscopies, which should dramatically increase participation in that particular form of preventative medicine.

A solar-sail craft pumped by lasers could potentially reach half the speed of light using materials that either exist or can plausibly be made within the next decade or so. We should also consider exploring space via Von Neumann probes, self-assembling micromachines that cannibalize asteroids and planetoids for raw materials. In fact, in a scene cut from the original 2001, the Monoliths were cast in the role of alien Von Neumanns. [In the recent novel <u>Von Neumann's War</u>, however, that whole "scavenge local materials to build more probes" thing is shown pretty graphically to be a Bad Thing if anyone happens to live on a planet being explored this way! Nanoplagues are an unpleasant business, and it wouldn't take much to corrupt the programming of something headed through interstellar space.]

Our smartest robots are on the intellectual level of a **retarded** cockroach. Still, even roach-emulation is pretty good, all things considered. [I only realized during this talk that the robot ASIMO was a letter-removal pun on Asimov in addition to its official definition, d'oh.]

On the topic of time travel, the old chestnut of "Why aren't there tourists from the future if time travel is possible?" was answered with "Maybe they're invisible!"

Alice's looking glass is a wormhole to a universe with different physics [and a total lack of jam today].

[At this point he was running out of time and skipped through a lot of slides, I had to look up a few things to flesh the next bit out.]

It has been recognized for a while that you can divide civilizations into four basic types:

Type 0 – What we have right now. Incomplete exploitation of the resources of the homeworld.

Type 1 – Exploits the totality of the homeworld, colonizes other planets.

Type 2 – Harnesses the total output of entire stars (a la a Dyson Sphere), colonizes other star systems.

Type 3 – The universe is their playground, entire galaxies are yoked to their metaphorical plows.

However, during a previous talk, a youngster suggested to Dr. Kaku that there was also a Type 4 in that taxonomy: those who exploit entire universes and can colonize other realities. The only example of that in fiction so far [to Dr. Kaku's knowledge, although I've run across others, and one might argue that most mythical pantheons qualify here] is the Q Continuum from Star Trek.

The talk closed on the "Einstein's Chauffeur" story. [http://www.snopes.com/humor/jokes/chauffeur.asp covers it in detail if you're curious.]

DA: PER – Issues in Instructional Reform

DA01: Preliminary Categorization of Change Strategies" – Charles Henderson, Western Michigan University, Charles.Henderson@wmich.edu [Original title: "Facilitating Change in Undergraduate STEM: Preliminary Results from an Interdisciplinary Literature Review"]

[Note, this was really an invited-length talk condensed into contributed time constraints. As such, I missed a lot of what was said.]

Scaling effective practices up to large classrooms is difficult. There are several types of groups working on this, largely in isolation from each other:

SER – STEM Education Research (PER, AER, ChemER, etc)

FDR – Faculty Development Research

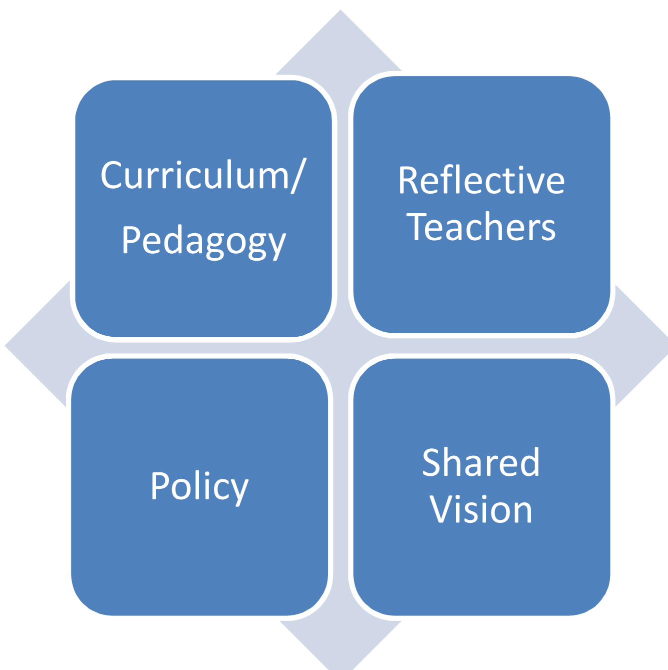
HER – Higher Education Research

A literature review was done for these disconnected groups, analyzing 130 articles and categorizing the strategies along two axes:

Axis 1 – Focus on changing individuals versus focus on changing the environment or institutional structures.

Axis 2 – Prescribed final conditions versus emergent final conditions.

Focus on Changing Individuals



Prescribed final condition

Emergent final condition

Focus on Changing Environment/Structures

People who focus on one of the four blocks tend to think that the other three are beyond their ability to control. For instance, those with a policy focus may think that teachers lack the preparation for new curriculum, the inclination for reflection or the willingness to share a vision with the administration.

DA02: Survey of Instructors' Tendency to Adopt Innovation in Teaching – David Pundak, ORT Brande College (Israel), dpundak@brande.ac.il

The STEM faculty decided to take a traditional set of courses and apply SCALE-UP methods to 3 math courses, 3 physics courses and 2 chemistry courses.

The found greater flexibility in teaching, a change in the student/teacher connection, and everyone was better able to see how knowledge is organized (students and teachers alike). It became easier to provide support and guidance to students.

Since not all courses had been reformed, they looked to see what the gap might be between the "active" and "traditional" instructors.

[At this point I stopped taking notes, as the speaker was flashing through slides too quickly. Additionally, the talk was simply badly organized, so I had trouble even figuring out where he was going with it, much less keeping up.]

DA03: Differences in Classroom Norms Surrounding *Peer Instruction* Faculty Practices and Student Perceptions – Chandra A. Turpen, University of Colorado at Boulder, Chandra.Turpen@colorado.edu [Original title: "Effects of Variation of Faculty Practice on Student Perceptions"]

Data was taken from numerous sources, but this talk concentrated on the results of student surveys and classroom observations. Peer Instruction was used in three courses (all part of a three-term sequence), coded by color:

Yellow – Instructor had prior experience with PI, and was being extensively mentored. Class was Physics 1.

Green – Instructor was a novice at PI and had no particular help. Class was Physics 2.

Red – PER Faculty instructor with experience with PI. Class was Physics 3.

When looking at the "answermaking" versus "sensemaking" spectrum, Green was close to the extreme of answermaking, Yellow was more answermaking than sensemaking but not as extreme as Green, while Red was fairly strongly at the sensemaking end.

Two items from the student surveys were considered:

Q1 – "Knowing the right answer is the only important part."

Q2 – "How important is articulating reasoning?"

Chi-squared tests were performed on pairs of instructors. Red was significantly different from both Yellow and Green on Q1, while Green and Yellow were not significantly different from each other. On Q2, Green and Yellow were very significantly different ($p < 0.000003$), and there was a significant difference between Red and Green, but not between Red and Yellow.

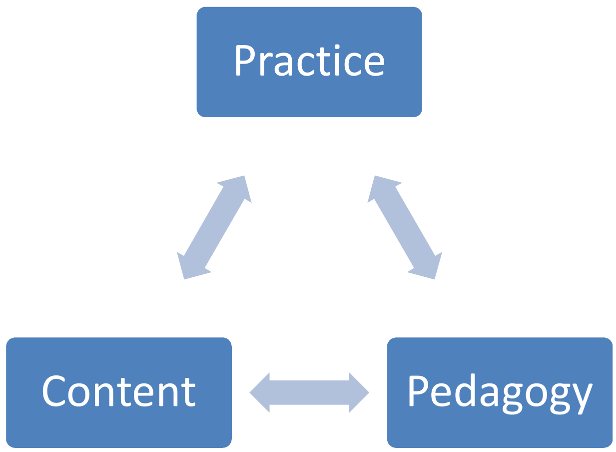
On Q1, Red's students were more likely to disagree, but all three groups mostly disagreed. For Q2, Red's students averaged at "important", while Green's and Yellow's students averaged "somewhat important".

Conclusion: differences in the practices used in PI can create different classroom norms.

DA04: Analysis of Learning Assistants' Views of Teaching and Learning – Kara Gray, University of Colorado, kara.gray@colorado.edu

LAs are undergraduate TAs who are specifically hired to help with courses they have already taken. They're also a pool from which K-12 teachers are often drawn. LAs lead learning teams of students, although the specific experience varies by department (LAs are used by multiple departments at University of Colorado).

LAs meet weekly in planning sessions for the content, as well as a weekly seminar for the learning of pedagogy. This forms a triangular cycle of practice (departmental policy), content and pedagogy.



The analysis looked at how LAs view their roles, and how they think questioning should work relative to the department's views on the matter. Ten first-time LAs in the Physics Department were studied; they were using UW Tutorials in an introductory calculus-based physics course. These LAs were required to fill out weekly online teaching reflections, six questions that were repeated each week. These reflections were analyzed for mention of questioning.

The responses were sorted into six bins plus an "other" category, and the six bins were further lumped into four roles: Content Facilitator, Sensemaking Facilitator, Shaping the Learning Environment, Professional Development. Here are the six bins, split up by roles:

Content Facilitator – "Get the student to answer", "Not giving the right answer"
Sensemaking Facilitator – "Encourage thinking", "Encourage group discussion"
Shaping the Learning Environment – "Understand student thinking"
Professional Development – "Working on questioning"

As time passes, the LAs seem to stop focusing on questioning in their reflections. It is not yet known if they're backsliding, or if questioning is simply becoming so ingrained that they don't consciously think about it anymore and don't mention it in their reflections. The second option seems to have some support in the text of the reflections, but more work is needed. They also plan to repeat this work in other departments to see if there's a pattern across disciplines.

DA05: How TA Buy-in Affects Tutorial Implementation – Renee Michelle Goertzen, University of Maryland at College Park, goertzen@umd.edu [Original title: "How Physics Graduate Student TAs Frame Tutorial Teaching"]

"Buy-in" is defined as how well the TA aligns themselves with the intentions of curriculum developers. Do they believe in the same things as the developers, or just try to fit the materials into their own views?

The question addressed in this talk is, "Is it more important that TAs follow instructions, or is believe in the curriculum more important?" [I'd add that "follow instructions" could be rephrased as "follow a reasonable number of instructions" for clarity. The goal is to not have to micromanage the TAs down to ever last word or action.]

"Oscar" was the case study for this report. He is a TA who clearly cares about student learning, has requested to keep teaching the course (TAs generally rotate around if they don't request a steady assignment), and has experience with tutorials in general, although some tutorials were new to him in the semester of interest. He's clearly committed to teaching in general, and follows instructions.

A video was shown of Oscar in a training session for a tutorial he had not previously taught. He was goofing off, impeding the learning of his partners (i.e. taking the experimental apparatus and turning it into something not related to the tutorial, thus denying its use to the others), etc. Another video showed Oscar in action in the classroom, and it was clear that he hadn't bought in to the ideas of group work, conceptual understanding or the construction of one's own knowledge. He's clearly in a "received wisdom" epistemological mode, and frequently undermines the tutorials in order to give students the answers, the way he thinks things should be taught.

Oscar doesn't want to "force" students to construct their own knowledge, so he frequently tells them the answers if they seem to be getting frustrated. He openly sneers at the tutorials in front of the class, and "follows instructions" only in a fairly loose sense. His lack of buy-in results in significant sabotage…but with the best of intentions. He wants to help the students, but he's still stuck in their epistemological mode and doesn't realize that he's not really helping them. [Most people in the audience had their own tales of this sort of thing, myself included. I have a recurring problem with TAs taking my open-ended design labs and "improving them" by making up fill-in-the-blank worksheets to hand out to the students.]

In short, TAs who are still in the "knowledge from authority" mode will helpfully try to remove all that confusion we deliberately injected into the curriculum. They really think they're helping, even if they're completely breaking the class.

DA07: Peer Instruction: From Harvard to a Two-Year Canadian College – Nathaniel Lasry, Harvard University/John Abbott College, lasry@seas.harvard.edu [Original title: "Peer Instruction: From Harvard to the Two-Year College"]

After working with PI at Harvard, the speaker wondered if it could work at a TYC, with students who were not exactly Harvard material. Lasry and another new teacher decided to try the experiment, with Lasry teaching a PI course and his colleague teaching in a more traditional mode. Other than this difference, the two were very similar in background and style. Problem-solving was measured using a traditional final exam that both classes shared, and conceptual knowledge tested with the FCI ($<g>_{trad} = 0.33$, $<g>_{PI} = 0.50$). The FCI data matched well with Harvard data.

The PI group did a little better than traditional on the final exams, but the number of students was too small for the difference to be significant. However, the fact that it wasn't significantly worse was sufficient; since the worry from the department was that the conceptual gains would come at the expense of poorer exam performance. "No statistical difference" is a victory in that sense, since there were significant [in both senses of the word…we really need a commonly-agreed-upon term to mean "significant, in the sense that anyone should care, not in the statistical sense"] conceptual gains.

PI seemed to help the better students more than it did the worse students, but even the students in the bottom quartile did better on the FCI than the top quartile of the traditional class. DFW rates were lower in the PI section (5%, compared to 20% in traditional), which jibes with Harvard's data (3% PI, 11% traditional).

Conclusion: PI works across institutions and for all backgrounds. The increase in frequency and quality of feedback means that PI students know they're in trouble early enough to do something about it, rather than their first hint being the flunked midterm that leads them to drop.

DA08: Transforming Upper-Division Electricity & Magnetism I – Stephanie V. Chasteen, University of Colorado at Boulder, stephanie.chasteen@colorado.edu [Original title: "Transforming Upper-Division Undergraduate Electricity & Magnetism"]

The introductory courses at Colorado have added tutorials and clickers and shaken out the bugs, now it's time to start moving up the ladder into upper division courses. However, the attitude that one must stop "coddling" students in the upper division courses tends to impede efforts at reform. Your basic, "I struggled and sweated over the material, they should too!" attitude.

The E&M I course pretty much defines what it means to be a physics major at Colorado. They managed to get faculty collaboration on reforming this course. They made the learning goals explicit, introduced interactive techniques, concept tests, modified homework assignments, homework help sessions and new tutorials designed for the course.

The format was a traditional lecture punctuated with interactive elements (simulations, demos, kinesthetic activities, whiteboarding for problem solving, concept mapping), and broken up by clicker-task concept tests. Students would spend 5-7 minutes discussing and debating ideas while working on clicker tasks.

They modified the homework to explicitly address sensemaking issues and add real-world context. Office hours for TAs were replaced by optional Socratic-questioning homework help sessions, about 2/3 of the students participated in these sessions at least once.

Attitude surveys were generally positive and an improvement over similar fully-traditional courses. Attendance was better, and more time was spent on homework [I forget how they knew that, perhaps it was online homework]. On some upper-division concept inventories developed at Colorado, students in the transformed course beat or tied those from traditional classes on all measures.

http://www.colorado.edu/sei/departments/physics_3310.htm is the course webpage.

DA09: The Persistence of the Gender Gap in Introductory Physics – Lauren Kost, University of Colorado at Boulder, Lauren.Kost@colorado.edu

Participation of women in physics drops off with age. In high school physics courses, enrollment is about 50%. About 22% of physics bachelor's degrees are granted to women, and about 10% of physics faculty are female.

The claim by Harvard researchers is that Interactive Engagement courses eliminate the performance gap, but Colorado results are less certain, being inconsistent and statistically insignificant. The performance gap seems to persist with men outperforming women by about ten percentage points.

Breaking it down, women do better on homework and course participation, but men do better on exams. Since exams are weighted more heavily than homework or participation, the men outperform women in general.

When looking at attitude surveys such as the C-LASS, while all students come out of the class with worse attitudes than when they came in, the drop for women is worse than for men.

Men come into the class with higher SAT/ACT scores, but women come in with higher high school GPAs. Men outscore women on the FCME pretest, but there doesn't seem to be a gender impact on the FCME posttest.

After examining all of the background differences, however, about 70% of the gender gap could be explained by those (in other words, the combined R^2 for performance versus all background elements other than gender was 0.7). At most a 3% performance gap was explained by gender alone. So maybe the gender gap is more of an opportunity gap, as female students were less likely to come in with advantageous backgrounds.

Papers can be found at http://per.colorado.edu for more info.

DA10: Mind the Gap Please: Examining the Role of Self-Efficacy in Achievement Tests – Vashti Sawtelle, Florida International University, davisvas@gmail.com [Original title: "Mind the Gap Please"]

Women are sorely underrepresented in the granting of Physics B.S. degrees, even when compared to other hard sciences like Chemistry. The DFW rates are huge in traditional classes, at 43%, but much lower in modeling classes (about 10%). [I think these numbers were just for females.] Modeling has definitely helped with persistence.

The gender learning gap on the FCI still increases from pretest to posttest, even in the modeling classes, so the increase in persistence for women can't be explained by improved learning rates.

An alternate explanation for the increase in persistence is improvement in self-efficacy. Even if the women are outperformed by the men, if their self-assessed ability is better, they'll stay in the class and pass at higher rates. In other words, women don't need to do as well as men to avoid DFW; they just need to feel like they're doing as well.

Modeling-style courses help with the "verbal persuasion" and "vicarious experience" elements of efficacy tests that women seem to be strongly affected by, even if the "personal mastery" elements are lacking for this physical state.

[I think my last line of notes is about a future study, that they intend to look more closely at persistence versus self-efficacy at FIU, using survey and interview data. It doesn't seem like she was talking about the study already having been done.]

DA11: Gender Differences in Difficulties with Physics for Engineering Lab Projects – Leong Lan, Monash University, lan.boon.leong@eng.monash.edu.my

[Talk cancelled, speaker was not present]

DA12: Students' Ideas of Force-Distance Tradeoff in an Inclined Plane – Jackie Chini (nee Haynicz), Kansas State University, haynicz@phys.ksu.edu

The CoMPASS curriculum developed at University of Wisconsin was examined for this project. CoMPASS is design-based and project-based, with interactive hypertext for things like concept maps and text descriptions.

Specifically, the unit on inclined planes was considered. The class was a conceptual physics course aimed mainly at pre-service elementary education majors, and was overwhelmingly female and "traditional college age" of 18-22 (over 90% in each case).

Students were interviewed, and videos were taken of their activities. Copies of their worksheets from those activities were also made and examined. The problem under consideration was working with a ramp to help move a piano into a truck: what angle would be best, would you want friction, various other factors that the students thought might be important.

Physically important factors were the length of the ramp and the surface friction. Most students felt there should be some friction so that the people moving the piano could get a grip on the ramp. They worked with examples of "same surface, different length" and "same length, different surface" in the exercises.

Afterwards, they were given pairs of situations and asked which element of the pair would require the least "effort force". "Effort force" is a term used by the CoMPASS developers because the target audience for the exercise (elementary students) might not know what force was in a technical sense, but at the same time "effort" could be confused with "energy" on its own. They were trying to get at a sort of "how hard would you have to push/pull?" term without having to say that phrase over and over.

The five pairs were: same height different slope, ramp versus straight up, same length of ramp with different heights, friction versus no friction, and same slope with different heights. The last pair had the worst performance, as the students tended to think that the shorter ramp required less force, possibly still conflating force with total energy expenditure. About 45% of the class got the last pair correct on the post-test.

Students tended to focus on single factors, such as height or length, rather than combined factors like "steepness".

DA13: Physics Problem Solving Course Creates Bridge for Student Success – Carol D. Voight, University of Houston, cvoight@uh.edu

A high DFW rate in traditional introductory physics courses at UH inspired the creation of a new course. They created their own diagnostic test of mathematical skills (multivariate context, physics-like problems with the physics content removed or suppressed), and found that diagnostic test scores correlated well with pass rates.

Physics 1100 was created in response, a 1 credit lab course in "Physics Problem Solving". It addresses math anxiety, uses inquiry-based group instruction, reinforces concepts with mini-labs and explicitly addresses critical thinking skills. Students who did poorly on the math diagnostic were strongly encouraged to take Physics 1100 before the traditional Introductory Physics course (which itself was not reformed yet).

It's too soon to tell much about DFW rates, especially since the 1100 course was not mandatory, but the preliminary results seem promising. Starting in Fall 2008, those who fail the math diagnostic test will be required to take Physics 1100, and there are plans to integrate more inquiry-style teaching into the main Introductory Physics course.

Tuesday, July 22, 2008

EA: PER – Assessing Student Understanding

EA01: Student Difficulties Concerning Derivative and Slope Concepts in Multivariable Calculus – Warren Christensen, University of Maine, warren.christensen@umit.maine.edu

While the issue of whether physics conceptual difficulties are caused by math conceptual difficulties has been widely argued, it looks like math problems may be a valid cause for physics problems in upper division courses, such as thermodynamics. Specifically, the fact that second partial derivatives show up a lot in thermodynamics, and a student's conceptual difficulties with partial derivatives could keep them from understanding the more abstract physics seen in that course.

"Physics-less Physics Problems" (same multivariate nature as physics problems, but with the context stripped out) were asked in a Calculus 3 course in order to frame it properly as a mathematics issue. The problems involved ranking derivatives and slopes (i.e. of these points on a graph, which has the highest value of the derivative?).

On a particular graph-slope problem asking for the value of the derivative, about 70% of the students got it right, but 5% mapped derivative to area under a curve, and about 7% ranked the lines by their second derivative.

It was determined that this last group was misled by possibly vague wording, and the item was rephrased for the next implementation. Another ambiguity that was spotted was that an $x^{1/2}$ graph looked like it was flattening entirely, so it was redrawn to remove that. Once these things had been clarified, 18% of the students ranked the lines according to their second derivative. Oops.

When explicitly ranking slopes rather than derivatives students were generally correct (80-90 percent), although about 5% used the average slope of a line and about 5% confused height with slope.

Despite three semesters of calculus, about 1 student in 5 couldn't rank slopes reliably, and 1 in 3 struggled with derivatives. Open response explanations were sparse, so the next step will be to conduct interviews to get more information.

EA02: Addressing Thermodynamics Students' Partial Differentiation Difficulties through Research-Based Curriculum Development – Brandon Bucy, University of Maine, Brandon.bucy@umit.maine.edu

Continuation of EA01's project, now focusing on how to change the thermodynamics course in light of the issues brought up in the calculus survey.

The equation of interest is: $(\partial\beta/\partial P)_T + (\partial\kappa/\partial T)_P = 0$

Students tend to set second partial derivatives to zero, mistaking fixed variables for constants. This suggests that giving the students a graphical representation of partial derivatives might help. Walk-throughs were used, and seemed to help, but afterward the students still couldn't correctly use partial differentials on their own.

A two-day tutorial was created for P-V-T graphing, both for the thermodynamics content and as a way to show how moving through a third dimension changes slopes in the other two dimensions. This curriculum change seems to have helped, and eliminated most of the pre-existing problems. However, it may have introduced a new problem, with a sign convention issue.

EA03: Student Conceptions of Integration and their Impact on Thermodynamic Work – Evan Pollock, University of Maine, evan.pollock@umit.maine.edu

A sequel to EA02, mixing together the math and physics issues.

Some students treat everything involving energy as a state function, ignoring the path dependence of things like d(PV). Nor do they seem to understand the link between a definite integral and the area under a curve.

8 students were interviewed: 5 just before starting a thermodynamics course, 1 during the course, 2 after the course had finished. They were asked to consider physicsless physics questions equivalent to P-V integrals.

Even without the P-V context, about a third thought that the integral ∫dx was path-independent. About a quarter of the time, students rated a closed loop integral as equaling zero, and some of those specifically said "no work is done" despite the problem not involving work.

However, the statements "closed loop integral is zero" and "work is zero" didn't always go hand-in-hand. Some students made one or the other statement alone. In general, though, there seemed to be a lack of connection in the students' minds between area and integrals.

Some students drew an analogy to conservative forces rather than work. "∫dx is proportional to path length" came up in some interviews, along with some inappropriate symmetry arguments.

The conclusion drawn from these interviews is that the problems may involve math issues, but they are not **just** math issues.

EA04: Multiple Interpretations of Student Reasoning About Static Friction – Andrew Boudreaux, Western Washington University, boudrea@physics.wwu.edu

A book at rest on a horizontal table is pushed but does not move. Students were asked to explain what the deal was with that, and expected to infer friction.

The study was performed in a large-enrollment non-majors course at WWU.

Students had issues of active force (i.e. a hand) versus passive force (i.e. weight), misapplied the idea that "friction can't help" (i.e. when the hand was trying to slow something down, they had friction acting against the hand), and tended to create a separate friction force to oppose every other force they identified (instead of one friction that opposed the sum of the other forces). Many students had a problem thinking that friction can only happen when there's motion to oppose, and N3L issues raised their head.

It was decided that an IE lesson using ECR might help with some or all of these issues. It's also thought that the "friction opposes" primitive could lead to an instructional response. The actual plan is still being formulated, though.

EA05: How Different Is "Not The Same"? – R. Padraic Springuel, University of Maine, R.Springuel@umit.maine.edu (not connected to talks EA01-03)

How do we quantify difference in responses once we get past the obvious bits?

Response data can be split into four categories [related to the types of data you might have learned about in a statistics class]. From "lowest" to "highest" types they are:

Asymmetric Nominal – Just a list of options, including a null option such as "none of the above".

Symmetric Nominal – A list of options that only spans the available space, no null response.

Ordinal – Discrete ranking within an item or between students.

Scalar – Any real value is possible, although you may need to "whiten" the data to avoid odd weighting from outliers or naturally logarithmic scales. [This includes interval and ratio data.]

Not all question types can get all data types, but some can be "upcast" to be raised up the types (i.e. add more options so you can remove the null option, turning asymmetric nominal to symmetric nominal) or "downcast" (i.e. add a null option).

Missing data needs to be dealt with unless you're lucky enough to get full participation at all points. Some can be dealt with by eliminating "lazy" students (ones with a lot of gaps in their responses) or hard items that many people left blank. Or you can assign a default value (like the class average) to any remaining blanks, but this can affect your statistics. Finally, if just doing comparisons, you can compare any given pair using just the items they both answered, although you need to report that each pair may have a different degree of freedom.

For each of the four data types listed, there exist "distance formulas" so that all types of data can be reported together. (Correlation is a distance formula for scalar data, for instance.) Once you have the distances, you can use cluster analysis to find groupings. [See talk BN07 at the 2007 Summer Meeting, also by Springuel, for more on cluster analysis.]

An example was presented of using this method on student description of the properties of acceleration arrows along a prescribed path, comparing two paths.

EA06: Are Introductory Physics Students Better Prepared for Kinematics and Dynamics? – Jeff Marx, McDaniel College, jmarx@mcdaniel.edu

ILDs have been in use at McDaniel since 2000, and student predictions have been getting more sophisticated. Are the students getting smarter?

Looking at the ILDs with traditionally poor prediction rates (under 50% correct), prediction scores have been steadily trending upwards since 2000. They're not really sure why, it's certainly possible they're getting a better class of student. However, it may be that the changing instructional style is having broader effects, or perhaps the influence of a few particularly sophisticated students is spreading more efficiently through the classes thanks to the way group discussion is set up. [Or perhaps prediction sheets are going into the fraternity test banks?]

EA07: Evolution of Student Knowledge: Pre, Post and in Between – Eleanor C. Sayre, the Ohio State University, le@zaposa.com

We know that scores on various conceptual tests rise between pretest and posttest implementations, but don't really know what the overall time evolution of understanding is. For simpler monotonic curves (like straight lines or gently curving ones) the timing of pretest and posttest don't matter as much, but deeply irregular ones there could be a "sweet spot" for evaluation.

The model under consideration is that there's a rapid rise following intervention on a topic, followed by a more or less exponential decay as rote learning fades and only what was actually understood is retained. The model also includes temporary dips caused by the introduction of a new topic that might be confused with the old (i.e. introducing magnetic force may briefly confuse students regarding electric force as they try to fit everything into the new concept).

Items from the CSEM were administered over the course of the quarter to students in a calculus-based introductory E&M course (Phys132), as well as using an exam question during the test over DC circuits. Scores followed the "spike then decay, with confusion dips" pattern for all students, regardless of the height of their maximum score.

The peak came too long after lecture for the lecture to have been the relevant intervention. However, scores peaked on an item right after WebAssign homework submission also peaked. So doing the homework seems to have been the relevant intervention for these students. Similarly, completion of a homework assignment on magnetic fields corresponds to a dip in scores on "particle in an electric field" items.

The short time constant for decay in scores suggests that most students are employing a "binge and purge" rote learning model.

EA08: The Effects of Testing Conditions on Conceptual Survey Results – Neville W. Reay, the Ohio State University, reay@mps.ohio-state.edu [original title: The Effects of Testing Conditions on Pre-Post Test Results]

Test timing and incentives matter, and can skew results, so be sure to report these things!

Over the course of nine quarters with differences in everything about the classes except the timing of CSEM administration (in the first and last meetings of lab) and incentives (no incentives), there was no difference in the results of matched pre-post scores. Different instructors, different curricula…nothing mattered.

In an unreformed Phys132 course, timing and incentives were varied to see what effect it had. When the CSEM was given after even a single lecture, students' scores on the pretest increased (usually on items related to the material covered in class).

Prior to any modifications in incentive plans, the gains on the CSEM tended to be pretty consistent at <g>=0.18. (All gains reported for matched data sets.)

Group 1 was given points for attempting the CSEM post-test, but the incentive was not tied to performance. <g>=0.26 for this group.

Group 2 was given the option of replacing a low exam score with their CSEM post-test score if the CSEM score was high enough. They had <g>=0.37.

Group 3 simply had the CSEM made a part of the final exam, so it counted for everyone's final grade. This group had <g>=0.47!

EA09: On the Measurement of Scientific Reasoning Ability: A Developmental Perspective – Lei Bao, the Ohio State University, lbao@mps.ohio-state.edu

We wish to have an instrument to measure Scientific Reasoning (SR), and use it to help us develop a curriculum to improve SR skills. SR includes Control of Variables, as is being worked on at University of Washington, and the ISLE curriculum emphasizes SR. Content learning has been shown in the past to improve SR, but it does so at a very slow rate (scale of years, not months), making it very hard to perform controlled studies.

In order to get a large enough inter-group difference to pick out these subtle changes in SR over time, students in American and Chinese schools were examined from grade 3 through 18 (M.S. level). The educational culture in the two groups is markedly different, so graphs of SR versus content knowledge should look different.

Chinese college freshmen seriously outperform American students on both the FCI and BEMA, but have essentially identical performance on the Lawson Test of Classroom Reasoning.

Data for American students follows a sigmoidal curve, with a ceiling of about 83% for the overall Lawson score, a floor of 20% (equivalent to guessing) and a gain of about 9% per year during the upswing of the curve. The data will be broken up by dimension and nationality in EA10.

EA10: Assessing Middle School, High School and College Students' Reasoning Ability – Kathleen M. Koenig, Wright State University, Kathy.koenig@wright.edu

Continued from EA09.

On the six dimensions of the Lawson Test, data was presented for the ceiling C, floor F and midpoint grade b for the overall data set. The midpoint grade is the effective class ranking where students' average score was halfway between floor and ceiling.

Conservation: C = 0.94, F = 0.28, b = 6.7 (no difference between groups)

Proportional Reasoning: C = 0.86, F = 0.05, b = 8.2 (Chinese students reach the midpoint well ahead of American students)

Control of Variables: C = 0.83, F = 0.18, b = 9.8 (no difference)

Probabilistic Thinking: C = 0.79, F = 0.19, b = 10.4 (Americans outperform Chinese at most grade levels, but the items are scenario-based and the scenarios may have cultural biases)

Correlational Thinking: C = 0.86, F = 0.16, b = 10.9 (Americans beat Chinese)

Hypothetico-Deductive: C = 0.82, F = 0.24, b = 10.7 (no difference)

American schools with gifted programs generally did better than the average American school on the Lawson Test. High-achieving American schools outperformed low-achieving American schools and all Chinese schools on Lawson.

Lawson scores correlated strongly with state-level "high stakes" testing, correlation of about 0.5.

Learning STEM in a traditional context does not improve SR.

We would like to have a physics-focused Lawson-like test, so we can develop curriculum to train students in SR skills as they apply to physics.

EA11: Investigating Student Resources for Understanding Wavefront Aberrometry in Group Interviews – Dyan McBride, Kansas State University, dyanm@ksu.edu

Aberrometry is a technique used to diagnose defects in the human eye. A strong light is shone into the eye, where it reflects off the retina and back out through the lens. This light is sent into an array of smaller lenses, which creates a grid pattern of dots. For a perfect eye, the grid is regular, but defects in the eye result in irregularities in this grid.

These irregularities can be analyzed to determine what defects exist and what corrective measures are needed. While aberrometry is increasingly common at the eye doctor's office, it's a good "new context" for transfer exercises. [For instance, while my eye doctor has had an aberrometer in the office for about two years now, the operators don't even know how it works, much less explain it to the patients…it's just a black box, so even a student who has had a recent eye exam is unlikely to have really encountered the concept.]

Students were interviewed after traditional instruction in optics. The interviews used an accommodating eye model and lens array as a sort of toy aberrometer. The lens of the eye model was soft and could be deformed to create aberrations.

"Meaningful Understanding Analysis" was used to categorize concepts. The concepts were sorted into three bins based on how the student seemed to use them:

Descriptive (D) – Things that are directly observable.

Hypothetical (H) – Things that could be observed if you had the right instrument.

Theoretical (T) – Things that, as far as the student knows, cannot be observed directly.

Theoretical concepts are considered "higher" than hypothetical, which are higher than descriptive. Understanding is thought to involve making links between concepts. Links between different levels indicate more understanding than links within the same level, and a link across all three levels is the best.

Interview data was analyzed by multiple raters, with concepts identified and labeled as D/H/T, with links indicated in the analysis. Inter-rater reliability was good.

In a sample set of data, about half the concepts were D, 40% were H and only 10% were H. This pattern was typical of the interview data as a whole. Most of the links that were seen were D-H, with few links of anything to the T level. It is thought that the relatively high number of H concepts happened because the interviews took place right after instruction, so students had a lot of new hypothetical concepts in their heads.

The link-checking method does seem to be useful for this sort of data. It's also usable in a practical sense.

EA12 (original): Identifying Differences in Diagnostic Skills Between Physics Students: Students: Students' Self-Diagnostic Performance Given Alternative Scaffolding – Edit Yerushalmi, Weizmann Institute of Science, ntedit@wisemail.weizmann.ac.il

[Talk moved to GA14]

EA12 (new): Improving Self-Efficacy Amongst First Year Students Using Map Meetings – Christine Lindstrom, University of Sydney, clind@physics.usyd.edu.au

"Link Maps" that are similar to concept maps were used. Concepts were placed on a "fundament sheet" for students, with the relation between concepts written on the link between the concepts. Additional information was written on sub-types. Color coding was used for things like variables, units and equations.

"Map Meetings" were optional add-on tutorials using the Link Maps. The supervisor would go over the map with students for about 15 minutes, followed by group problem-solving work on tasks related to the map. Afterwards, the instructor would work the problems at the board, explaining reasoning and process.

In any given week, about 20% of the class would attend Map Meetings, a mix of repeat customers ("persistent") and those who attended only a few ("non-meeters").

Non-meeters lost self-efficacy on attitude tests, while persistent students stayed steady (and those with very low initial scores actually improved). Map Meetings seemed to preserve a sense of self-efficacy when it was present, and encourage such a sense when it was absent.

As a result of the successful trial, Map Meetings are now integrated into the curriculum.

EA13: Equivalence of the FCME Administered by Web and Paper – Scott W. Bonham, Western Kentucky University, scott.bonham@wku.edu

Online administration of the FCME has many attractive points, but requires some fundamental changes in how the test is presented. This could affect performance, and validation would need to be re-established.

An online administration allows for a less dense layout, since there's no pressure to keep page count down. [The FCME has a number of places where a single diagram is used to answer a bunch of items, which can be intimidatingly dense. But the alternative would be repeating the diagram on several successive pages, not a great plan for a paper test.]

Students across several courses were given either the paper FCME or the web version. All groups took the test in class, under instructor proctoring. There was no significant difference in total scores between the two treatments ($p>0.5$ for hypothesis testing).

Performing a Pearson χ^2 on individual items of the FCME found that seven items on the pre-test differed at the 0.05 level (where 2-3 items would be expected to differ by chance), but no items differed at that level on the post-test (one differed at the 0.1 level, well within random expectations).

The web version of the test seems to draw students away from certain popular alternative conceptions, mainly items with graphs. However, students did not perform any better; they simply shifted to different incorrect answers. It's possible that the layout influences those who have no clue, driving some of the distracter choices.

It should be okay to use the online FCME for regular classroom evaluation, but if you're using it to support a research item, be sure to report in your paper that you were using the online version. Subtle differences, especially dealing with distracters, may exist.

EA14: Mechanics Baseline Test Results and Analysis at West Point – Maj. Michael P. Schock, United States Military Academy, Michael.schock@usma.edu [It might be schrock, not schock; I have it written both ways.]

All cadets are required to take two semesters of introductory physics (Phys201/202), with about 1100 cadets involved. Better performers during freshman year are placed (whether they want it or not) in advanced versions of the courses (Phys251/252). There are no TAs, with lecture instructors also teaching the lab sections.

The MBT is given in 201/251 with a small incentive.

Science majors outperformed humanities majors, but economics majors did almost as well as the engineering majors. Environmental science majors did poorly. [I have a note saying "but env. sci well" that makes no sense now…I think he was making a distinction between a specific major within a grouping and that grouping.]

Students in Phys201 scored about 43% on post-test, while students in Phys251 scored about 65%. The Phys251 class had a broad spread of majors, including humanities, in part because placement was not based on student major or preferences, but simply on how well the cadet did in freshman classes.

Overall, the results generally compare well to the 1992 Harvard data.

GA: PER – Cognition and Problem Solving

GA01: Triangular Model of Concept Structure – Pavol Tarabek, Educational Publisher Didaktis, College of Applied Economic Studies (Slovakia), didaktis@t-zones.sk, http://www.didaktis.sk

[I have a full page of notes from this talk, but not a lot made sense. The speaker was trying to cram a 30 minute talk into 8 minutes, with a lot of diagrams that were like concept maps without actually being concept maps or structure maps or link maps.]

A concept triangle can be defined as a core idea, the sense of the idea (split into three levels, S1, S2 and S3) and the meaning. The meaning can be extended outside of the current boundaries of the concept.

A meaning triangle is similar, with the core C and a meaning M bounded by the concept, and an extension E outside of that boundary. Meaning is the union of elements M1, M2 and M3, hierarchical layers of meaning (M1 is referential, M2 is designated, M3 is something else I missed). The core includes various representations, such as verbal, symbolic and diagrammatic.

Excessively observation-based (WYSIWYG-type) students gain "developmental misconceptions". Also, textbooks often disagree on the details of things like orbital periods of the definition of a year (and there's more than one kind of year to define), leading to more confusion and misconceptions.

[There was a lot more after this, but I gave up trying to follow it.]

GA02: Novice Ontologies in Physics – Ayush Gupta, University of Maryland at College Park, ayush@umd.edu

Ontology is our sense of the nature of an entity. We need to decide on the relevant attributes of something. For instance, heat-as-substance and heat-as-agency have different relevant attributes.

Consider student ontologies regarding air and space. When asked if a vacuum bottle was more buoyant than one full of air, one student couldn't conceive of removing all the air from a bottle…because air IS space. Air can't fill things, it's that which gets filled.

When we discuss an entity, it's important to know if students' ontologies allow that entity to have the attributes we want to assign. We also need to know if the ontology in question is static or dynamic.

If an ontology is static, it can be determined and then instruction developed to replace it if incorrect. If dynamic, then context is important, and you need to determine the context that will guide students to a correct ontology.

Both experts and novices display frame-sensitive ontology, research is now looking into how both groups shift based on context. Experts are more likely to be aware of when and how they shift ontologies, this is a skill students need to learn.

GA03: The Specificity Effect: Implications for Transfer in Physics Learning – David T. Brookes, University of Illinois at Urbana-Champaign, dbrookes@uiuc.edu

Everyone, experts included, learns things attached to the content in which it is learned. Principled knowledge is content-bound. When a transfer task is more like the training content, we're more likely to cue on surface features (i.e. if trained on refraction in an equilateral prism and then presented with a strongly acute prism, we tend to treat it the same way, even if that gives an incorrect answer).

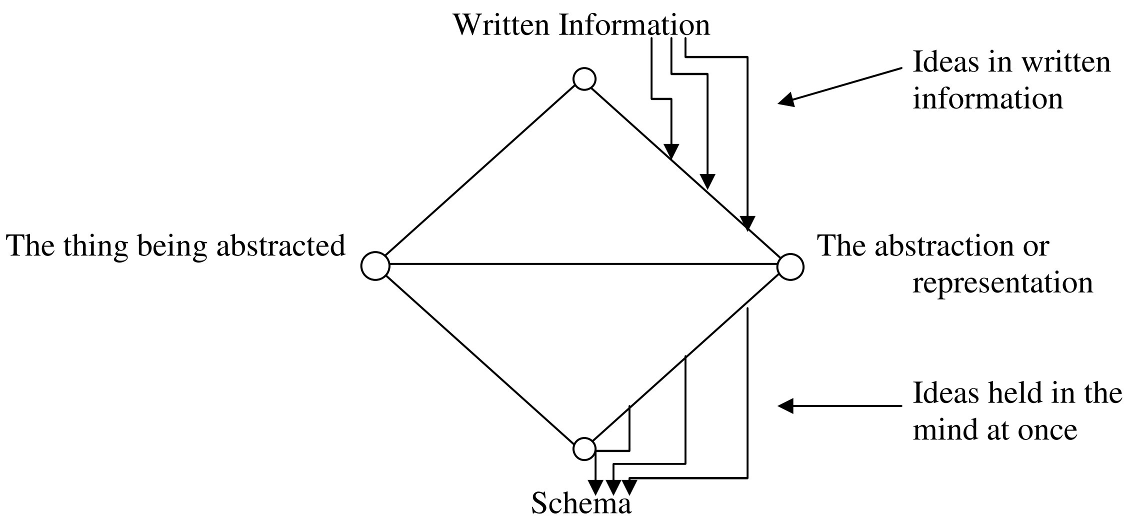
Experts have been trained in many ways, and so have a larger bank of "similar training content" to draw on, as well as more experience in picking the right similar task.

Metacognitive strategies can help students sidestep inappropriate specificity.

GA04: Towards an Operational Definition of Abstraction in Physics Education Research – Noah S. Podolefsky, University of Colorado at Boulder, noah.podolefsky@colorado.edu

What makes an EM wave abstract? We see light as colors, not as waves; real waves aren't confined or static as they're drawn on paper; waves don't actually wobble up and down, rather their intensity varies. So the usual intermeshed sine waves representation of an EM wave is very abstract. But how to define that abstraction?

Consider the following representation for abstraction:



The written information at the top of the diamond is a "community map". How many ideas need to be put together in order to understand a representation is a measure of the representations abstraction. Abstraction in this sense is a community measure.

Salience is based on the number of ideas you need to be able to hold in your head at the same time in order to understand the representation, and is an individual measure. Experts tend to clump the ideas together into chunks, reducing the salience of a given schema.

Learning takes place when a student's schema comes to resemble the community map. Analogies can help students modify their scheme, a sort of analogical scaffolding.

GA05: Identification of Specific Cognitive Processes Used for In-Depth Problem Solving – Wendy K. Adams, University of Colorado at Boulder, wendy.adams@colorado.edu

Problem Solving (PS) is the most important aspect of science education, according to educators, employers and alumni. According to Mayer (1992), PS is achieving a goal when no method is obvious…to the solver. What is and is not obvious is purely subjective.

The CAPS is the Colorado Assessment of Problem Solving. Students of broadly varied backgrounds were interviewed while working on the CAPS, to identify their strengths and weaknesses.

Component skills, processes and beliefs were examined. Anything that could affect PS ability. Assets from these categories included things like "addition skill", "creativity" and "wants to pass the test". These assets are split into three categories:

K – Knowledge, what you have.

P – Processes, what you do.

B – Beliefs, expectations and motivations.

A typical homework includes all three kinds of asset, although B may be limited to "want to get it done". Group work tends to bring in more P assets.

Being strong in one asset can compensate for weakness in another, but there are some things that you need to possess at least a little of. Also, some skills that we'd like students to acquire for their later lives are not always needed for doing homework problems (i.e. "visualize the problem" or "pick it up the first time").

A more complete list of assets is listed on the related poster. [I didn't take notes at any poster sessions, but I'm sure the presenter will email the poster files to anyone who wants them.]

GA06: Group Learning Interviews to Facilitate Problem Solving Using Structure Maps – N. Sanjay Rebello, Kansas State University, srebello@phys.ksu.edu

Structure maps are a superset of concept maps. It is thought that students can use structure maps to help with PS. This study asked two questions about structure maps:

1) How do students use instructor-provided maps?
2) How do maps evolve in response to student feedback?

Group learning interviews met several times over the course of the semester for 50 minutes each time. In each interview, the students solved four progressively more difficult problems on material recently covered in class. They were provided with structure maps and taught how to use the maps.

The first map was fairly abstract and included no equations, just physical quantities and indications of which ones were related to which other ones. Students didn't really like it or use it, although a couple of them admitted that the maps might be useful.

Later maps responded to student feedback by adding more equations, and students liked these better. They prefer a "roadmap" style where they can use the structure map to explicitly guide them through picking equations and solving the problems. Once a sufficiently detailed map had been produced, it was pretty complicated, but students were able to figure it out and liked it. They don't like a map of just the physical quantities, or understand it.

Unfortunately, the final map was more of an algorithmic solution guide, reducing problems to exercises. It doesn't really help them learn to solve problems, it merely pandered to their preferred plug-and-chug style of working.

GA07: Text-Editing, Problem Posing, and Jeopardy Tasks in Introductory Physics – Fran Mateycik, Kansas State University, mateyf@phys.ksu.edu

Same project as GA06. In addition to the group interviews considered in that talk, the students also went through two sets of individual interviews, and this talk is looking at the second individual interview. Two questions were posed:

1) How does participation in group work help with individual work?
2) How do group workers compare to a control of students not engaged in the group interviews? (Short answer: no difference.)

11 students from the group interviews, plus 8 more students not involved in the group interviews but determined to be of the same "academic merit" as the group students, were individually interviewed. They were given one problem-posing task, one jeopardy problem, and two text-editing problems.

In the problem-posing tasks, students were given two required conditions (i.e. use the Bernoulli Equation and the Continuity Equation) and asked to create a problem that fit both. Most students only met one of the conditions, and some of those even admitted that they hadn't used the second. About a fifth of the time, students stalled out for lack of numerical givens, even when told they could make up their own numbers.

Jeopardy problems present a solution in variables and numbers, and the student is asked to create a problem that fits the solution. Most (17 out of 19) could recognize all the individual terms, but two were unable to tease the solution apart into pieces.

Text editing problems present a problem, and the students are asked if there is missing information, irrelevant information, or sufficient information to solve the problem (but they're not asked to actually solve the problem). All but one student could pick up on cases where there was missing information or sufficient information, but only three students were able to recognize irrelevant information. Of those three, two pointed out that such information was not provided in a similar textbook problem. The conclusion drawn from this is that red herrings tend to get past students.

GA08: Enhancing Cognitive Development Through Physics Problem Solving: A Taxonomy of Introductory Physics Problems [TIPP] – Raluca Teodorescu, George Washington University, rteodore@gwu.edu

Given the vast number of PER-based problems and activities out there, it would be a good thing to have a way to categorize them according to cognitive processes and knowledge domains. "Problem" is defined as per Mayer (1992).

The difficulty of a problem is a combination of its unfamiliarity to the student (time variant) and its cognitive complexity (time invariant).

TIPP analyzes and categorizes problems using Marzano's taxonomy of educational objectives. [The taxonomy was rushed through, along with a few other things. I pick up at the point where the speaker slowed down a bit.]

TIPP categorizes problems based on the highest level of cognitive process required, the number of cognitive processes required, and the knowledge needed to solve the problem.

GA09: Student Cognitive Development in a Thinking-Skills Physics Curriculum (Part I – Methodology) – Cornelius Bennhold, George Washington University, bennhold@gwu.edu [Presented by Gerald Feldman, George Washington University, Feldman@gwu.edu]

TIPP has been used as part of this work.

They would like to move from a focus on gathering information to a focus on cognitive processing. Physics is the STEM field that is best-suited to developing thinking skills and focusing on cognitive processing.

The course objectives are content, competencies and dispositions about science. A coherence among these objectives is sought, using a student-centered framework.

PS skills are improved by the use of problems that target specific cognitive processes (as determined by analysis in TIPP). Start with surface links, but as students get more comfortable with the material emphasize the deep structure more. Once they've gotten to that stage, start stretching into unfamiliar terrain.

For example, the case of a mass on a string at some angle starts with N2L (a=0) problems, then into N2L (a≠0), rotational N2L, and so forth.

The protocol taught to the students is called ACCESS, which stands for:

Assess the problem (classify, matching)
Create a drawing (symbolizing the information of the problem)
Conceptualize a strategy (integrate forward, filter)
Execute the solution (executing mental procedures)
Scrutinize results (analyze errors and check for reasonableness)
Sum up your learning (meta-learning)

The syllabus lays out both physics content and cognitive processes, they don't get all of ACCESS right away. Instead, elements are introduced one at a time over the course of the term.

GA10: Student Cognitive Development in a Thinking-Skills Physics Curriculum (Part II – Preliminary Results) – Gerald Feldman, George Washington University, Feldman@gwu.edu

Concepts were tested using the FCI, while paired exam problems were used to check for coherence. Student use of ACCESS was explicitly rated, and there were rubrics for measuring cognitive development. C-LASS was used to check affect.

When looking at their recitation quizzes (which used ACCESS) compared to their final score, there was a high correlation ($R^2 = 0.57$). Coherence (i.e. their symbolic and numerical versions of a problem matching up) was judged to be good.

The rubrics used to evaluate specific skills correlated these skills with course success well.

ISLE was one inspiration for the curriculum.

[Ran out of time]

GA11: Robust Assessment Instrument for Student Problem Solving – Jennifer L. Doktor, University of Minnesota, doctor@physics.umn.edu

There does not yet exist a reliable, valid and easy-to-use PS evaluation tool, and we need one. But we're "looking for a ruler, not an electron microscope." Broad usability is more important than precision.

The proposed instrument is a tabular rubric with five subskill spectra. The dimensions are meant to be fairly independent, and the smallest number of dimensions that will adequately span the space.

For each dimension, the student is scored either numerically on a scale of 0-4, rated "NA (solver)" or "NA (problem)". In the case of NA (solver), it means that the rater thinks the student is advanced enough that they no longer need to explicitly show a particular process or step, that it's been internalized. For NA (problem), the problem didn't require that process or step in the first place, or that process was already given in the problem.

Scorers were given training in using the rubric, with a lot of feedback. Before training, 77% of the time there was agreement within 1 between raters. After training this increased to 85% of the time. The NA(S) and NA(P) options did tend to confuse the raters, however.

Scorers had trouble disentangling some of the categories. For instance, if the physics content was poor, they had trouble seeing anything good about the work and rated the student too low on areas other than content.

The training materials have been revised and there will be a new round of training to try to deal with the scoring problems. The validity of the rubric still needs to be established.

GA12: Can Scientific Reasoning Ability and Epistemological Beliefs Limit Success in Introductory Physics? – Brian Pyper, Brigham Young University-Idaho, pyperb@byui.edu

Student performance on the Lawson Test was compared to their scores on the FCI, and low LT scores tended to limit FCI scores. However, the sample size is still too small to safely do any significant statistical analysis.

LT scores also limit the FMCE gain: an LT score of under 0.60 graphically correlates with an FCME gain of under 0.20.

The EBAPS and FCME were found to be uncorrelated to each other in this sample.

The preliminary conclusion from the work here is that reasoning skills are strongly correlated with conceptual understanding, so in our teaching we need to explicitly address reasoning.

GA13: Identifying Differences in Diagnostic Skills Between Physics Students Part 1: Developing A Rubric – Andrew Mason, University of Pittsburgh [no email given]

[This is based on the materials seen in WS-B of the 2007 PERC – Physics Learning in the Context of Scaffolded Diagnostic Tests.]

This part is concerned with methodology.

PS is often a missed learning opportunity, as students fail to reflect on their work. This can be addressed. If we **make** them diagnose their own work, how do they do?

Four groups were looked at, each with varying levels of support in self-diagnosis.

A: Control group, no support given at all.

B: Maximum support. Solutions were outlined for them, and they were given the rubric to use.

C: Medium support. A sample solution was provided in detail for them to compare their own work to, but no rubric.

D: Minimal support. Students were told to analyze their own work, and allowed to use the text and their notes.

The goal is to find a good rubric that will describe novice knowledge as well as map it onto expert/ideal knowledge. It must be versatile and valid. Their current rubric was shown in detail, and they believe it works pretty well at this point. [Ran out of time going into detail, contact Dr. Yerushalmi for a copy of the rubric and supporting materials.]

GA14: Identifying Differences in Diagnostic Skills Between Physics Students Part 2: Students' Self-Diagnostic Performance Given Alternative Scaffolding – Edit Yerushalmi, Weizmann Institute of Science, ntedit@wisemail.weizmann.ac.il

In classes of group B, TAs spend 15 minutes modeling and demonstrating the rubric. The students then take a quiz (about 20 minutes) and the TA coaches them on use of the rubric. Students are given credit for the diagnostic task. In groups C and D, students take the quiz and then perform the diagnostic task with lesser levels of support. This is only done once or twice during the semester, due to time constraints on the instructors. 100 students are in group A, about 30 in each of the other three groups.

Performance on the self-diagnostic is best in group B, worst in group D [not sure if group A got the diagnostic exercise at all], so the level of support does seem to matter. Group D comes the closest to how students normally work.

All three supported groups were better at identifying errors of invoking (i.e. picking the wrong concept) than identifying errors of application.

When looking at just the presentation of work (rather than correct content), group B was the best, but there was no significant difference between C and D.

It's easier to find content errors if you make a lot of them, but hard to find presentation issues if your work is rife with them.

GA15: Logistics of Modeling Instruction in an Algebra-Based Introductory Physics Class – Patricia E. Allen, Appalachian State University, allenpe@appstate.edu

Students considered here were taking a course that used modeling, but that faced numerous logistical hurdles (large class size, immovable desks, limited space to store equipment, disconnect between lecture and lab).

Solutions were targeted at three areas: activities and equipment, seating arrangements, and student presentations.

To deal with activities and equipment, the gear was stored in document boxes [the kind you can get at Wal-Mart for $10/10 boxes, and have to fold up into something 8.5"x11"x14"] that could either be kept at the edges of the room or easily brought into and out of class when needed. Inexpensive (and light) analog equipment was used wherever possible.

To get around the immovable desks, it helped that the room had more seating capacity than was necessary, so empty areas could be left between groups to give them room to work. Students self-selected into groups, but they were assigned locations, with layouts varying depending on the task at hand. For instance, if they needed to use the entire length of the tables for a kinematics experiment, the groups would alternate ends of rows, so each group got an entire row free. Students were expected to know their assigned locations, which minimized setup time.

In group presentations, with 12-20 groups and 5-15 minutes per presentation, it could get a bit cumbersome. There was a lot of redundancy in presentations, plus stage fright was an issue.

Initially, the presenters didn't have to identify themselves in any way, as a means of easing stage fright. Later on, they identified themselves by group number, and eventually were comfortable being identified by name.

Various means (such as putting up each group's whiteboard and voting on whether to hear more) were used to reduce the total number of presentations.

Once students get into the groove, instructor time is used much more efficiently. The student investment helps as well.

Conclusion: it can be done.

Wednesday, July 24, 2008

HC: Scientific Communication and Writing (Mixed Session)

HC01: (Invited) It's The Audience, Stupid! – Stephen G. Benka, Physics Today, sbenka@aip.org (Editor-in-Chief of Physics Today)

"How we reach an audience." We need to think about not just our information, but about the audience and how the information appears to them.

Make sure you speak the audience's language, both literally and figuratively.

Communication is a learned skill (as opposed to language, which may be inborn a la Chomsky). Listening is as important to communication as speaking is, there's a feedback cycle.

"Whenever you make a presentation, you present yourself." – James Garland, Physics Today, July 1991, p42.

Respect the audience. Here's how:

1) Know who they are, try to be the audience (put yourself in their place)
   - Are they expert, novice, or mixed with respect to your topic?
   - Are they scientists, laypeople, journalists, kids, etc?
   - What is their level of interest? Why are they present?
2) Know the parameters.
   - Allowed time (don't go over!)
   - Available technology (be ready for the possibility of speaking from just notes and no tech)
   - Size of screen and room (so your slides aren't unreadably small)
3) Interact with the audience.
   - Make eye contact
   - Ask questions of them
   - Speak up so everyone can hear you
4) Be "multilingual", speak different audience languages:
   - Expert-scientist
   - Novice-scientist (i.e. grad students, out-of-specialty faculty)
   - General Public
   - Children

NEVER exceed your allotted time.

Practice, accept criticism.

Provide appropriate context in your talks. The farther the audience is from experts, the more context will be needed.

Avoid clutter in your slides, pare things down.

Always start with the known (as far as the audience is concerned) and then lead them into the unknown. Funnel the audience into a "take home message".

Speak strongly, but not too quickly.

Never use arbitrary colors in slides, avoid low-contrast combinations. And test them out on an actual projector screen first, some things that look fine on the computer screen look bad on a projector. Bright gold and dark blue make a good high contrast pair that's less boring than black and white.

Some people never learn. Some people learn from their own mistakes. The really smart people learn from the mistakes (and successes) of others.

[During Q&A, there was a suggestion that the slides be put up on ComPADRE, so you might want to look for it there.]

HC02: (invited) Science Journalism, the Local Perspective – Keith Gerein, Edmonton Journal, kgerein@thejournal.canwest.com

Gerein mainly writes about post-secondary education, both general policy (Edmonton is the Provincial capital) and research results from the University of Alberta. He had originally planned to go into academia as a historian, but wasn't enjoying school or the polysyllabic horrors that infested the language of academia. He wandered into the student paper one day and found he liked being able to write "like a normal person."

Accessibility is a major goal of journalism. [Not to say that scientific writing strives to be inaccessible, but it comes back to a matter of audience as per HC01. Journalism needs to be accessible to a far less expert audience.]

What makes a pitch attractive to a science editor?

- Can it be explained in under a minute?
- Why should the readers care?
- Is there room in the paper that day?
- Are there people available to cover it?
- Various other "out of the control of the person making the pitch" elements.

The first two points represent the editorial barrier. You have to get those two points established in the affirmative before it matters what the answers to the other questions are. Of course, these are the main two that a pitching scientist has control over.

If you're trying to pitch a science story to the local paper, here's a few things you need to do:

- Keep it simple, and don't take offense at possible "dumbing down" that the editor suggests.
- Consider the "elevator rule" (i.e. if you had to explain it on an elevator ride with someone, could you do it?)
- Keep the pitch short! Journalists have short attention spans. Bullet point the important parts of the pitch.
- Avoid jargon in the pitch, and if you have to use any technical language, be sure to explain it clearly.
- Use real world analogies wherever possible. (Example: a beanstalk orbital elevator could be explained as working like the "round the world" yo-yo trick.)
- Personalize when possible, crank up the human interest angle.
- Tie it into things that people are already interested in.
- Include some history and process description. The process may be more interesting to the public than the result.

The definition of a slow news day: a story about a new species of moss makes it into the paper.

A pitch can include pictures, although the paper will usually want to get their own, since you're not likely to be providing professional photojournalist quality.

HC03: (invited) Writing: An Active Learning Tool in Physics and Engineering Education – Dan Budny, University of Pittsburgh (Engineering Department), budny@pitt.edu

Work in conjunction with Teresa Larkin of the Physics Department at UPitt.

They're using writing as a mechanism to improve retention in Engineering, and as a way to help teach content in Physics. Writing is an Active Learning tool, one that takes little to no space or resources. After all, every student should already have the tools to write…at most you need to provide online resources.

If considering such a program, be sure to get your librarians involved!

In the Engineering major, they replaced the university writing requirement with a component of ENGR0011, a computer programming course that covers Excel, MATLAB, Unix and HTML tagging. ENGR0012 goes into C programming. Along with these courses are taught ENGR0081 and ENGR0082, the Freshman Seminar sequence.

In addition to coding, ENGR0011 addresses communications in general, social and environmental issues, and library use. So it was a natural for adding a writing component. The new curriculum integrates all of the major's humanities requirements into the 0011/0012/0081/0082 courses, a change helped by the changes to ABET standards (moving from a "take this list of courses" set of standards to one that simply requires content be covered).

In 0011 there are four writing assignments, all of the "how I feel about this" variety, focusing on creative writing.

- Who I Am (i.e. a letter of recommendation for myself)
- What Engineering Is
- How I Fit Into Engineering
- Engineering and Society

Students, of course, hate this. They don't want to write. [Tough noogies.]

8 people from the Writing Center in the English Department grade the papers, and the Engineering Department funds those additional people. The English Department is generally happy with this state of affairs.

http://www.engr.pitt.edu/~eng11/ has writing templates, library orientation and other resources.

Lessons include how to determine whether something you find online is true, or if it's a case of "wikiality".

As a result of these writing exercises, students quickly learn what engineering really is, and if it's a good fit for them. 75% of students change their major or sub-major (i.e. from chemical engineering to civil engineering) once they're clearer on things, which improves retention in general because they don't spend so much time being frustrated by a major that's a poor fit. Also, writing skills improve.

In the Physics side of things, "Physics in the New Millennium" (PNM) simulates a professional conference, and students present papers on their chosen topics. It's all put together electronically, and should be easily adapted to other fields. The actual conference meets on the last day of the class, with a rigid presentation schedule to get everyone through it. There are about 16 papers, each given 15 minutes to present.

In ENGR0012, students research a topic from within their chosen subfield. Once they've picked the topic and spent about half the term working on it, they're told they will be presenting at a "Sustainability Conference" and need to adjust their papers to take the conference theme into account.

Since there's a lot more Engineering students than Physics, not everyone gets to do their own paper. Instead, students self-select into pairs (they also hate working in pairs [again, tough noogie]). The conference is held on a Saturday, with about 200 papers presented in 30 sessions on 10 parallel tracks over three time slots. Volunteers from industry chair the sessions.

http://www.engr.pitt.edu/freshman/academic/eng12/conference.html has the details of the conference.

Each session has a best paper award, with campus bookstore gift certificates given to the winners (they tried cash, but it messed with financial aid bookkeeping).

At the time, the students are impressed by the conference, but see no value in writing and still hate it. However, upperclassmen asked to look back at the experience see the benefit in it.

As a result of this revision of the curriculum (and of certain vagaries of the English Department), freshman engineering majors have to do more writing than freshman English majors!

In the wake of this revision, grades have gone up for engineering majors, and while just as many people leave engineering as before, they're more likely to move into a science major. Before, they'd simply drop out of college. So while major-retention is unchanged, university-retention has improved.

HC04: Using Summary Writing for Textbook Engagement and Student Class Preparation – Dedra Demaree, Oregon State University, dedra.demaree@gmail.com

The link between writing and content learning is unclear. PER results show less than expected benefits from textbook reading and cribsheet writing (Harper 2005, Podolefsky 2006). However, writing in conjunction with reading the textbook has been reported to help disadvantaged students (Kalman 2008).

A study was performed in early 2007 in conjunction with the University of Capetown (South Africa). Students summarized the chapters in writing before lecture over the same material, and were allowed to use their summaries during the exams. They had to summarize the chapters in one page.

Students found the summaries more useful as preparation than as actual cribsheets. Engagement and improved confidence resulted from the exercise, the summaries help students get through an "impenetrable thicket".

A coding scheme based on Waywood (1992) was used to look at the summaries. From least good to most good, the categories are:

- Recounting – essentially just recopying the material in condensed form.
- Summarizing – putting the material in one's own words.
- Dialoguing – sense-making during the process of writing.

The coding scheme was found to be valid and reliable, very easy to use. Instructors did tend to cue on global issues when ranking quality, although there's not enough data yet to be well-organized.

The students are essentially writing for an audience of one [and may not really know their audience that well!], so it's hard to correlate this with other measures of learning. A really good student may write bad summaries because they don't need the summaries, while a bad student may write excellent summaries because they know they need all the help they can get. So it's hard to compare the results.

HC05: Students Reflect on Understanding in Short Email to Instructor – Jim Stewart, Western Washington University, jstewart@physics.wwu.edu

Once per week, students send email to a dedicated account, reflecting on their problems with conceptual homework. They talk about what they found challenging, what they understood and what they still need to understand, identifying key ideas.

Students self-score out of 5 points (at 65 students, the load is too big for the instructor to grade), and are provided with a rubric.

Students are comparing their solutions to those in the instructor's manual, and the manual has errors in it. They need to be able to figure out whether they're right or the manual is right in cases where they contradict.

The rubric's coding scheme gets more formalized as the semester unfolds. Looking at student emails over the course of the term reveals no particular progress, although about half the students felt the exercise was worthwhile. Results suggest students need to work explicitly on metacognitive skills.

http://www.physics.wwu.edu/jstewart/email/emailproject.html for more info.

HC06: Physics Formula Recollection through a NEVER BEFORE SEEN Mnemonic Technique – Shannon A. Schunicht, M&W Inc., mnemonicmind@alpha1.net

Mr. Schunicht had to completely retrain his language skills after waking from a coma, and found he could use a mnemonic to turn equations into sentences. Arithmetic operators as vowels, variables as consonants.

[A very idiosyncratic method that made little sense in a five minute talk (he was late for his own timeslot). And, in any case, we don't want students memorizing formulas in the first place.]

IA: Crackerbarrel – Professional Concerns of PER Faculty

Otero: Concern about getting pigeonholed as a "teacher prep person". Noted that PER sessions were always opposite teacher prep sessions at Edmonton, making it harder for someone to try to wear both hats.

Replication Studies: Marx brought up the idea that as a field, we lack a robust tradition of replication studies. Instead, we tend to assume validity of reasonable claims after only one or two studies. For instance, "attitudes always get worse after instruction" has been accepted as true by most in the field, even though research has since shown it's not always true.

We may be building on sand by leaving out replication studies, but doing replication studies is often not possible because detailed methodology isn't published.

Brookes suggested we try to put out short papers more frequently to help with this, both methodology papers prior to final results and replications. This sort of paper is common in other fields, such as high energy papers where all they do is talk about the latest piece of their detector. It may not be as "sexy" as final results, but it's vital for helping people try to replicate your work.

Lindell agreed that we need to publish more methodology, and include better references to existing sources that describe the methods we use (i.e. "what is phenomenography?"). She noted that because TPT is generally research-light and AJP reviewers tend to dislike space spent on discussing methodology, this has shaped how we write papers, even when writing for other journals.

Otero flatly pointed out that replication studies are "lame" and that everyone wants to do something **new** for their PhD. This is related to the youth of the field, since there's so much new stuff out there to study that it seems a shame to "waste" effort on replication of someone else's work.

Hinrichs suggested we create a replication study poster session at some future AAPT meeting or PERC.

Meltzer said we do need to make all the bits (i.e. methodology) available somehow. If we can't get them into the paper itself due to editorial issues, then an online appendix would be a good option.

Engelhardt took Hinrichs's idea one step further, and proposed the idea of a replication-focused PERC.

Lindell noted that there's a generational difference between us and our students. Data from the 1980s and 1990s may not apply to the current students, even if it was valid in the first place.

According to Mayhew, we need to call each other out when we notice a lack of rigor, and not just keep our peace.

Hinrichs pointed out that PER used to be pretty much unrepresented in the ERIC system, which hurt us.

Meltzer countered that these days, Google Scholar is replacing ERIC and is a superior tool. And we **do** show up in Google Scholar.

Back to Engelhardt, we need to change the culture of PER so that replication studies are more acceptable. Otero suggested giving replication studies cool titles as a partially tongue-in-cheek suggestion to help with this cultural change.

PER at small schools: [I forget who brought us onto the new topic, might have been Hsu. I have a lot of unattributed statements here, in part because discussion moved more quickly, but also because a lot of the small schools people weren't people I knew and I couldn't always get a name quickly enough to write down.]

Hooking up with an external group is always good, but not always possible.

PER positions often ask for PhDs in Physics, but will take Science Education PhDs and other related degrees. However, there's two problems here: on the push side, SciEd people may be discouraged by the wording and not apply, while on the pull side, some schools are hamstrung by the wording of their ad…if they ask for a Physics PhD in the ad, the university will not let them hire someone with a SciEd degree.

Marx noted that small schools can do PER just fine, not all work needs large N.

Engelhardt added that SciEd degrees are good preparation for small N studies. Also, PER Central is starting to see use as a networking tool for "lone wolves" and other solo PER people.

Marx suggested tightly coupling your research to what you teach, although you need to be careful to avoid "teaching to the test" criticisms.

Lindell advocated doing what make you happy.

Brookes asked how we might sell ourselves to employers, and Lindell replied that three things were vital: evidence of ability to act independently, post-doctoral experience and being finished with the PhD work. [As some people have established, it's possible to be well into a post-doc without finishing one's PhD, oops.] Brookes then asked whether these things would help us sell ourselves to just the PER-interested people in the department, or to the whole department? [My notes for Lindell's reply are "same thing. Specialties can help too." I'm not sure anymore what that meant, and I may have miscopied what Brookes was asking.]

Marx pointed out that smaller departments may not be looking for PER specifically, but would be willing to take a PER person, especially if you can involve students in your research. But they want you to have existing "good teacher" credentials, not merely "shows potential".

Engelhardt warned that you shouldn't make it sound like you intend to come in and fix all their classes for them. They might want you to do that eventually, but the whole "outsider comes in and changes everything around" thing can rub a lot of people the wrong way.

Otero asserted that you should sell yourself as a researcher, not just a curriculum developer or teacher. She also suggested that you demand a SCALE-UP classroom in lieu of a lab [if it's the sort of institution where all new hires get lab space, as opposed to being expected to slot into some group's existing lab, I guess]. After all, classrooms are our research labs!

Funding: Singh brought up the point that funding is hard to get right now. Her proposals to CCLI keep getting shot down, despite her prior work in the research area. The Physics Division will fund her, but not at a high enough level to support any grad students.

Meltzer advocated persistence and a sort of shotgun approach…apply to everything, something will hit.

Otero suggested teaming up with other disciplines on campus, NSF seems to like that sort of thing.

Brookes suggested going for an IES grant from the Department of Education. [I think he meant Institute of Educational Sciences.]

Kuck (long time AAPT member, first time national meeting attendee, significant experience in grants from the industrial side of things) said that anyone being turned down for a grant demand a face to face debriefing on why the grant wasn't funded, so you can ask what needs fixing. Seek partners in industry, and ask potential funders what sorts of ideas they'd like to see.

Engelhardt countered that NSF panels aren't stable like those in industry, and change from cycle to cycle. Addressing the concerns of this year's panel may not help with next year's panel.

Marx suggested becoming a grant reviewer in order to gain more insight into the process, and asked if anyone knew of a "master list" of groups funding PER.

Hinrichs pointed out that many colleges and universities have an office dedicated to helping faculty get grants, and we should take advantage of them. [To go back to the small school PER subject, and something I should have brought up at the crackerbarrel but didn't think of at the time…a smaller school's grant-aid office is likely to have personnel who see grants from all over the spectrum. If you're curious about granters outside of our usual suspects who would be willing to fund PER, the grant-aid officers at a smaller school are likely to have seen enough cross-disciplinary stuff to have useful suggestions.] Marx pointed out that not all small schools do have such an office, though.

Kuck claimed that getting non-NSF grants helps give you credibility with the NSF, and improves your odds next time you go back to the NSF for money.

Dissemination: Kuck asked why he hasn't seen any of this stuff [i.e. all the various PER session stuff] in use?

Marx pointed out there's resistance to dissemination, it's not just a lack of push from our end.

Otero brought up the fact that there's a couple of books currently being printed that are intended for dissemination to all physics departments around the country [world?]. They're meant as introductions to PER and how to teach better in general. They contain easily digestible materials for non-PER physics instructors.

Hsu suggested also checking ComPADRE and PER Central for materials. [We can push all way want, but others have to pull from their end for it to work.]

JA: PERC Bridging Session (invited)

JA01: Inequities in Physics Access and Enrollment in Urban High Schools – Angela Kelly, Lehman College (CUNY), ANGELA.KELLY@lehman.cuny.edu

New York City has about 300,000 high school students, characterized as "majority-minority" (i.e. mostly non-white) and low-income in general. Out of 316 high schools, 298 participated in this study: 180 small schools, 49 medium, 69 large.

High school physics is an important gateway to all science and engineering fields. Oakes (1990) said that access to advanced science is constrained by previous opportunities in math and science.

Nationwide, most high schools have physics classes, but generally only one or two sections. About a third of all high school students in the U.S. and in New York state take at least some high school physics. The research question was how NYC's schools compared to this.

Q1: Does NYC differ from the national average?

Q2: Do external school-level demographics influence access?

Q3: Do internal school-level variables (i.e. SAT or Regents scores, graduation rates) correlate to physics access?

Q4: What organizational or policy factors (magnet schools, AP classes, etc) contribute to disparities in physics access in NYC? While most physics classes in NYC are Regents classes (aimed at getting students to pass the state's high stakes physics test), not all are.

Data was obtained via surveys, contact with the school administrators and the NYC Department of Education annual reports.

A1: 55% of NYC public high schools offer no physics at all. Only about a fifth of NYC high school graduates have taken any physics, lower than state and national averages. About 75,000 students have no access to physics courses, but none of the schools without physics courses claimed that lack of instructors was the reason. Most claimed something along the lines of, "our kids can't do physics." The schools that did have physics courses tended to be richer, higher-achieving and whiter. The NYC high schools are overall about 91% black and Hispanic, but those with physics classes were only 72% black and Hispanic.

A2: School size, previous achievement, graduation rate, racial demographics and poverty levels were all strongly correlated with access to physics. The percent of graduates who were college-bound was moderately correlated.

A3: Small, restructured schools have difficulty offering physics, with only about ¼ of them doing so. When they do offer physics, though, 61% of graduating students took physics.

A4: A disproportionate number of NYC physics students are in larger magnet schools. There's a lot less pressure in the neighborhood schools to offer physics. Magnet schools also tend to be richer and whiter, with only 32% of students being black or Hispanic (Asian students count as non-minority in this case) and only 20% being in the free lunch program.

AP physics is only available in 20 NYC high schools, with the same sort of demographic skew as magnet schools. AP is mostly offered at larger schools (600 or more students).

The earlier students can take physics, the more of them who do take it. Where it's offered in the 9th grade, 33% take it. Where it's offered in 10th grade, only 14% take it. And if it's offered only in 11th or 12th grade, only 5% take physics.

The following recommendations have emerged from this study:

- K-8 science education in urban schools needs to be improved.
- The curricular limitations of small schools need to be addressed.
- Physics enrollment in neighborhood schools needs to be improved.
- Organizational structures that limit access need to be examined more closely. Find out who's saying, "No, you can't have a physics class," and deal with them.
- There needs to be transparent data reporting about access to physics.
- Racial and economic disparities in magnet schools need to be addressed.

[From Q&A] Schools may be too focused on just getting students graduated to spare much concern for "extras" like physics.

JA02 was unable to attend.

JA03: Impact of Chemistry Teachers' Knowledge and Practices on Student Achievement – Kathryn Scantlebury, University of Delaware, kscantle@UDel.edu

[Work done in concert with University of Miami in Ohio and PennSTI at University of Pennsylvania.]

About 2/3 of all U.S. high school students take chemistry. There's about 30,000 high school chemistry teachers, 88% of whom are certified (meaning they have at least the equivalent of freshman university chemistry), 93% of whom are white, 53% of whom are female. But in high-poverty schools, about 64% are teaching out-of-field (OOF), meaning they don't have at least a minor in chemistry. [Yes, you can be certified and still OOF.]

Teacher content knowledge correlates with student achievement, and OOF teachers are likely to just lecture because they're not comfortable enough with the material to do more than that.

Standards-based teaching helped African-American middle schoolers.

Changes in teaching practice require sustained (about 120 hours) professional development. Some professional development programs refuse to even make an attempt if they're not guaranteed at least 120 hours.

PennSTI is the Pennsylvania Science Teacher Initiative, and uses a cohort model for teacher training. There are 8 chemistry content courses and 2 chemistry education courses. These are split up over three summers (2 courses per summer) and two academic years (2 per year, held on weekends). The fact that many school districts are moving to shorten or even eliminate summer break is putting the squeeze on programs like PennSTI that rely on teachers having summer for professional development.

PennSTI is in danger of ending once the current cohort finishes.

As part of PennSTI, they developed the HSCCT – High School Chemistry Content Test. It has 13 multiple choice items and 8 open response, and has to be able to deal with a variety of district needs and curricula.

Men tend to outperform women on the HSCCT ($p<0.023$), but there's no significant difference based on ethnic group.

A teacher practices survey shows that teachers are starting to put more of these new lessons into practice once they're done with PennSTI. Not all of them are in a position to make changes, however, due to state mandates on things like assessment.

Student attitudes improved as the teachers improved. It's not a huge improvement, but it's statistically significant…and it's not a downward move!

Non-white students perceive experiencing less standards-based teaching than white students do. [I don't really remember what that meant, sorry.]

Teachers were recommended to use "cogens" (cogenerative dialogues) where students and teachers discuss shared teaching and learning experiences. These are increasingly important as teacher/student demographics diverge. [There's a lot more on cogens in the Dinner Talk next.]

[There was a Q&A session, but by this point my brain and arm were both tired, so I decided to pass on taking notes.]

PERC-DT: PERC Banquet Speaker

Pre-speaker note: next year's PERC theme will be "Multiple paradigms that PER borrows from elsewhere."

DT01: Fostering Science Learning in Diverse Urban Settings – Kenneth Tobin, Graduate Center of the City University of New York, ktobin@gc.cuny.edu, http://ken.tobinweb.net [Part of the same project as JA03.]

The light we generally "shine" on problems in PER has been Conceptual Change. Tobin proposes that we shine a different light on the topic and see if it reveals anything new.

When he tried teaching at City High School in Philadelphia, it was a real "deer in the headlights" experience for him. There was a total cultural mismatch, students gave him no respect, etc. There were no props for the old white guy, and it got somewhat scary at times.

Dialectual barriers can be as significant as full language differences. Sometimes they can be worse, since you think you're talking the same language. [Insert old aphorism about America and Britain being two nations separated by a common language.]

Respect is a vital currency. It's hard to earn and easy to lose, and if they don't respect you, you can't **make** them do anything. The hoodie goes up and they just ignore you.

The main sample class used for the rest of the talk is a 9th grade Health Science class at a "small school" in the Bronx, about 80% female enrollment. It was much more functional than Tobin's class in Philadelphia, and generally worked. A major reason it worked was cogenerative dialogue (cogens).

Cogens:

- are about shared experiences.
- have representatives from all "stakeholder" groups (university, student researchers, teacher researchers, etc).
- bring data resources to sessions.
- reach agreement on changes to be made in class, school or social life.
- ask "What can we do, as a group, to make things better?"
- improve quality of learning and teaching.
- produce collective responsibility.
- respect others and interact in culturally adaptive ways.
- involve control **with** students, not control **over** students.

If successful, the results of a cogen transfer back into the classroom. An example was shown of a cogen in which a co-teaching plan emerged from the dialogue.

The rules for cogens include:

- Listen attentively.
- Try to understand others' contributions.
- Always show respect for participants.
- Address previous contributions.
- Maintain focus.
- Restrict time of utterance (i.e. don't let any one person dominate the conversation).
- Do not interrupt or be a "turn shark" (by jumping ahead of others).
- Strive for consensus…what have we agreed to?

The benefits of cogens include:

- Successful interaction across categories. Students will tend to self-segregate within the room at first (i.e. the students of Caribbean extraction will be in one clump, the Bronx-born Hispanics in another), but after enough cogens they will mix freely.
- Seedbeds for "hybridized" culture.
- Improvement in curriculum and the school in general.
- Changing student identities both in and out of school.
- Achievement gains.

Signs of cultural spread resulting from cogens:

- Teachers can get beyond the "stuff white standin'" style and fit in better with their students.
- The class changes as agreed to in the cogens.
- Collective responsibility increases.
- Coteaching happens, where students teach each other.
- There's higher levels of interaction in class, students are willing to speak up.
- Collective regulation of the class, students take more responsibility for keeping themselves and each other in line and on task.
- Signs of solidarity in terms of tuning in (students focusing on what's salient) increase, and shut-downs (tuning out the instructor) decrease.

Even if only a few students buy in at the cogens themselves, those students are the seeds of nucleation around which the entire class condenses. Sometimes the seeds need to be kept really small (i.e. one on one cogens) until the instructor gets the hang of the process.

Some high school seniors have started implementing cogens of their own with sophomores. It's become a part of student culture, not just something teachers impose.

We need to pay attention to:

- Social bonding
- Emotional valence and energy.
- Resonance sites for other fields.
    - Laughter (with versus at, chain reactions, disruptive versus goodwill…you can't stop it, so you might as well try using it.)
    - Prosody (variations within tone and volume of your voice, don't drone)
    - Communalism (oppositional subculture, work with the student culture not against it)
- Earning the right to be yourself. Adapt, but don't vanish…you can earn the right to change less of yourself while still fitting into the students' culture.

Thursday, July 24, 2008 - PER Conference

RT-1: Analyzing PSET for Content, Confidence and Comfort…So Why Don't You Want To Teach Physical Science?

Organizer: Laura Van Wormer, Hiram College, vanwormerla@hiram.edu

PSET is Physical Science and Everyday Thinking, and is related to PET (formerly Physics for Elementary Teachers, now Physics and Everyday Thinking), created for elementary education students by Fred Goldberg and others. It was beta tested in 2006 at Hiram College, a small (about 1000 students) private liberal arts college.

Physical Science courses tend to be survey courses, they may or may not include chemistry, astronomy and geology in addition to physics topics. PSET is mainly a mix of physics and chemistry topics aimed at preservice elementary education teachers.

Cited evidence is the "coin of the realm" in the course.

As part of the development, Goldberg et al created a content diagnostic test, an attitude survey and an "ideas about science" homework assignment.

The content knowledge definitely increased in both 2006 and 2007, with confidence in responses also improving. There were fewer "I guessed" responses on the confidence part of the diagnostic and more "very sure" responses.

The attitude survey was made specifically for PSET, but some states are trying to implement consistent attitude surveys statewide. For instance, the Assessment Center at Miami University of Ohio is involved in Ohio's statewide attitude survey efforts.

Attitudes either improved or showed no significant change in both years.

Students were assigned pseudonyms from a set of physicist trading cards, and those names were used to report data.

A specific bargain was made with students at the start of the course: "If you can tolerate the ambiguity at the start, the experiments will give you the evidence needed to BE sure at the end." Unfortunately, in the 2006 beta, sometimes the evidence wasn't there after all.

Some students take a scientific methods course before the PSET course, some after.

The "ideas about science" survey was developed by instructors as a homework assignment. In 2007, students found science to be less cookbook-ish after the course than they did at the start. The survey also allowed for open responses, which often mapped poorly to the student's response to the accompanying Likert-like scale item. This result justified their decision (based on the weakly ordinal nature of Likert data) to include the open response items. They may also add interviews next year, or switch to a Q-sort method.

The PSET course is equation-free, but graph-heavy.

Epistemologically, there's an issue with "what is a fact" to students. Post-instruction, they seem less likely to believe that facts even exist, perhaps the falsification criterion was pushed too hard. But emphasizing evidence is a good start in any case, even if it initially leads them into an epistemologically relativist stance. [The discussion veered into faith vs. science discussion for a while at this point, I didn't take notes on that.]

PSET builds in **operational** definitions rather than relying solely on nuanced definitions. The students need to start with blunter instruments and build their own nuance as they go.

Conclusions of the study so far, regarding PSET:

- Students do learn the material.
- Students are much more confident in their understanding.
- Students are more comfortable with physical science and scientific investigation in general.
- Students have a better understanding of the process of science and what it means to be a scientist.
- This is an excellent curriculum, both for preservice teachers and those simply looking for a general science credit. (Due to mixing of preservice and general education students, the gender balance did work out to be about 50-50.)

[There was a brief side discussion on the theory and practice of forming student groups, both to address gender issues and overall matters.]

In practice, PSET involves replication study as groups compare their results to each other, and the instructor encourages this practice. There isn't really any explicit "here's why replication is vital" instruction, but they're told to check, compare and redo if necessary. The roundtable audience advocated making this instruction explicit, however.

[Another side discussion on the matter of being penalized professionally for teaching in an inquiry style, since students initially hate it and will hammer you on the evaluations.]

PSET students hate inquiry style a little less strongly by the end of the course.

Hiram turns out very few graduates who can be certified to teach science. The state of Ohio is starting to look at whether elementary teachers are certified in science, with an eye towards possibly rearranging elementary school teaching by topic rather than by cohort (i.e. you don't have the same 4th grade teacher all day, rather a science teacher spends part of the day with each grade. [This isn't terribly radical as ideas go, my grade school did that sort of thing back in the 1970s. Of course, we also had to learn Base-5 math, so maybe we just had a holdover of the 1960s reform wave.])

In-service teachers are now resisting going to summer workshops, in part because summers are getting shorter. Ohio Department of Education will no longer find continuing education programs that have fewer than 120 hours in them, however, since absent intensive mentoring the shorter programs simply don't change teaching style.

IT: PERC Invited Talks

IT01: What Is Nepantla and How Might It Help Educational Researchers Conceptualize Knowledge for Teaching? – Rochelle Gutierrez, University of Illinois at Urbana-Champaign, rgutirrz@uiuc.edu

Nepantla is a Nahuatl term roughly translated as "coexistence of different points of view without sacrificing one of them," literally "place of water".

There is currently a tension between the dominant mathematics and critical mathematics. The dominant mathematics supports the status quo, includes both traditional math and much of the reform math being taught (reform is done within the paradigm, rather than moving outside the paradigm). The emphasis is on training people to access the power structure, to play the game. Critical mathematics, on the other hand, tries to do something about society, changing the game and moving away from the dominant Western paradigm. In general, any currently dominant mathematical system was at one time a critical mathematical system, but not all critical systems become dominant.

The tension arises because you have to know the game in order to have a shot at changing the game, but learning the game has a tendency to co-opt you into becoming a supporter of the status quo.

Equity is about power, but not just rearranging who is on the top of the heap. Rather, equity removes group-based biases from all groups, focusing attention on the individual. Ideally, it should be impossible to predict someone's ability based on the group to which they belong. Variation within each group should be much greater than any differences between groups, and this should be recognized.

It's a humanistic view. Math needs people more than people need math. [Some would argue that math does just fine without people, but that people are in deep trouble without math.] Different sorts of people will ask new questions and find new solutions that might not have occurred to the previous groups.

The focus of Gutierrez's work is on enabling "equity teaching practice". Teachers are brokers between students and society.

Knowledge is separate from beliefs and dispositions. Knowing something is not enough if you choose not to use that knowledge. We want to bring knowledge and attitude closer together.

Equity is made up of the following dimensions:

- Access – who gets to come to the table?
- Achievement – What happens at the table? What choices are made?
- Identity – Who are you when you're at the table? You shouldn't have to assimilate to succeed.
- Power – Who can talk at the table? Who has control of the curriculum?

This works out along two axes: the Dominant axis (Access and Achievement, play the game) and the Critical axis (Power and Identity, change the game).

Napantla is a luminal space where multiple realities are viewed, shifting like water. A sort of dreamlands, where one can create the framing of the world. A crossroads of potential, a thirdspace.

Another term that is useful here is “conocimiento”, knowledge of a “connection with” sort. A form of the Spanish verb “conocer” (to know, be familiar with). Conocimiento is a tool for raising consciousness, giving empathy or sympathy.

“Nos/otras” is a Spanish pun, combining “nos” (us) with “otras” (others) into “nosotras” (we), deliberately using the feminine form. The slash maintains the separation between us and them, symbolizing that there’s no need to assimilate fully into nosotras. (Anzaldua, 1987 and 2000) Nos/otras is about experiential knowledge, even “outlawed” knowledge.

Desconocimiento is ignorance, distancing, safety. A refusal to know.

From the crossroads of Nepantla, you can go to either Nos or Nos/otras. Recognizing the otras can lead to new ideas.

UIUC is in a partnership with a Chicago high school, giving them opportunities to see high-performing Latino/a students using NSF-supported materials, building on strengths and resources. There are field trips and videos (both live and taped) used in the program. The organic nature of the partnership discourages the use of codified knowledge.

Similar points came up as seen in the Bridging Session talks, including the “they can’t do it” assertion by school administration. There were expectations of a poor proficiency math, but the videos taken of students showed that they CAN do it.

Who decides what’s appropriate in the curriculum? Grasping this question as being important is itself a sort of Nepantla. Reframing of curriculum happens through a process, it’s not a thing in itself. The goal is to find what works right now, not some hypothetical ideal that would work everywhere and everywhen. Conocimiento is always transient, not permanent.

Confusion can be good, a different stance from the resolution-focused “teachable moments”. There are no misconceptions, just conceptions.

IT02: A Variety of Diversity: Facing Higher Education’s Educational Challenges – Eric Dey, University of Michigan, dey@umich.edu

The ATLAS detector at CERN was the catalyst for this work.

We are fish in an aquarium that’s changing. There are five diversities we need to deal with: institutions, exposure, expectations, students and instructional approaches.

Institutions are becoming so complex that even categorization is getting hard to follow. For instance, the simple old “R1” sort of label hasn’t officially been in use for some time now, and the current sorting system fills a page just with labels.

Formal learning environments form a minority of the total educational exposure time…students are outside the classroom far more than they’re inside it.

We are being watched by many groups with differing expectations.

Student diversity has increased, but not enough. Also, ways of defining diversity have multiplied. Regardless of how you measure it, though, diversity of populations benefits us.

We are limited by our infrastructure…no matter how many computers you bring into the lecture hall, it’s still a lecture hall. This constrains our instructional diversity, but doesn’t totally bar change.

Recording lectures and putting the videos online can help tweak the balance of time use. However, this can be a more passive style of teaching, and also leads to employment concerns (i.e. “If I record a year’s worth of really good lectures, what’s to keep the university from firing me at the end of the year and just using my recordings from now on?”)

MScribe is a system in use at UMich that has a robot camera web-capturing lecture. One of the lecture hall seats is occupied by a robot camera with multiple lenses. An IR camera focuses on reflectors worn by the lecturer (the early ones were pretty blatant, but they’ve improved the looks) so that the close-up visible light camera can track the lecturer. A wide angle camera captures the chalkboard while this is going on.

Having a person on the screen, rather than just an audio track and the chalkboard, tends to improve attention. [Possibly a social effect related to one of the Invited Talks at the 2007 PERC.]

PowerPoint slides can be easily integrated into the output.

Various surveys, interviews and other data collection methods have been employed to track student usage patterns. 58% of survey participants claimed to use MScribe, although not everyone participated in the survey. Logging data shows that about 78% of MScribe users take advantage of the version running on the web, 15% download it as a podcast for later viewing, and 7% do both. About ¼ of the “do not use MScribe” respondents had technical issues that prevented them from using it.

The students who were in the “above average” group (but not the top 10%) were self-rated as the most likely group to use MScribe. ESL students are also heavy users of MScribe, rewatching lectures for comprehension.

Self-reported lecture attendance did drop, although faculty noticed no actual drop in attendance. It’s possible that students were simply more likely to report non-attendance after using MScribe. More students reported reviewing their in-class notes, and note-taking in general was reported to increase after MScribe was implemented. There were some preliminary performance benefits, but the system hasn’t been in place long enough to get much data in that respect.

Faculty workflow changes once MScribe is in place. It’s easier to assess prior lectures and adjust approaches for next semester, or even next week (there was a lot of “ego surfing” found in the logs). In subsequent semesters, if a lecture was satisfactory, an instructor can simply assign the previous lecture rather than giving it again in person.

Once the copyright issues are sorted out, this is expected to be a very good portable and open resource. They’re also working on improving the hardware and software, understanding the impact on students, improving teaching practices and learning outcomes. The system is giving feedback to the faculty.

[Lunch was a picnic outside, so there was no luncheon speaker, serious or silly.]

TP-E: Targeted Poster Session E – Applications of PER in Diverse Settings: Perspectives on Audience, Method and Implementation

Discussant: Angela Kelly

TPE01: Using Educational Reform as a Kernel for Growing Community at a Hispanic-Serving Institution – Eric Brewe, Florida International University (with Laird Kramer)

The goal was to pull together students and teachers at all levels. The program was set in a "community building" with a Physics Learning Center (PLC) that was used for various purposes. The project involved PhysTEC and QuarkNet.

The PLC forms a network with multiple faculty entry points and multiple outputs. The results are very student-driven.

It's hard to judge the success of the program yet, as there's a gap of a few years between participation and when the cohort would be likely to enroll in a physics program at Miami International University (MIU).

MIU is, perhaps unsurprisingly, majority Hispanic.

Modeling reform significantly improves conceptual understanding for both the traditionally represented student groups and the underrepresented groups [calling them "majority" and "minority" is misleading here, due to the nature of the population]. DFW rates drop in modeling classes, from about 70% prior to reform to less than 20% in reform classes. [I have a note "offensive to Trads" here, but I'm no longer sure what it means…instructors of traditional sections of physics were offended by this result, maybe?] However, there's so many reforms happening at once in the MIU classes that it's hard to tell what's causing the improvements.

C-LASS attitudes trend upwards in preliminary results, and students are now trying to get into the modeling sections because word of the low DFW rates has gotten around.

Students who took the modeling-based classes performed better in a non-modeling Modern Physics course than those who took the traditional sections of introductory physics. Students in the modeling sections were also more likely to take Modern Physics (4% versus 1% of students), which is considered the gateway to a Physics Major.

TPE02: Utilizing the Individual and Collective Resources of Urban University Students to Develop an Effective Institutional Environment – Mel Sabella, Chicago State University

Students in urban schools brought a different set of resources to class. Perhaps they were weak in a traditional sense, but they had plenty to work with nonetheless.

20-24 students per class, classes had large blocks of time to work with, including night classes. 7 hours a week split up various ways. Students rotated through various kinds of activities…a little lecture, then some lab, then some ranking tasks, etc.

Students have robust content understanding that can be invisible to standard testing. Triggering their knowledge can be difficult, and the students may be stuck in inappropriate frames.

The students in this population are willing to be part of a scientific community, they're comfortable with being incorrect on occasion, and they value group work. They're receptive to inquiry-style teaching, and want to be asked questions. They believe that active engagement helps.

Strong content knowledge is often used to resolve inconsistencies brought about by inappropriate frame-based activations.

They love arguing with group partners about the topic at hand.

TPE03: Acting in Our Own Self-Interest: Blending University and Community – Noah Finkelstein, University of Colorado at Boulder

The University of Colorado is very white…so how does one study diversity there? Well, you can go looking elsewhere and team up with a school that has a bit more variety.

They took advantage of the service mission of the university to go out into the community, co-opting the existing institutional structures in the name of good. While outreach is generally not very valued by tenure committees, a side effect of NCLB has been the slashing of science programs in public schools (to make room for more drilling on the high stakes test stuff) and therefore opening up a hole for outreach programs to exploit.

Develop youth intellectually by making use of the afterschool program structure. Create a new "space" between school, museum, home and community centers to get an informal science program running. This supports the university (students acting as instructors gain professional development experience), the community (kids learn science) and science as a field.

UColo partnered with housing centers to create a "Junior Science League" in Colorado and the "Fifth Dimension Afterschool Program" in California. Video links were used to keep the two groups connected.

Future teachers gain valuable experience, the kids learn science, and the science education community comes together.

Kids as young as 5 were involved. 8-year-olds made stop-motion movies on computers as part of studying 1-D motion.

The kids exceeded the "they can't do it" expectations, while the undergraduate teaching assistants improved in both skills and identity (of themselves as teachers). They gained a better understanding of both teaching and physics.

TPE04: Challenge Faced by a (White) Idealist Teaching Science in a Public High School in Harlem – Richard Steinberg, City College of New York

Standardized testing undermines everything!

Steinberg worked at a school that required students take physics, but didn't require that they pass it. So half the class was mentally "checked out" from the word go. The principal was very test-focused, which hindered learning.

Steinberg managed to click with one of his classes (they even wrote him a glossary of slang), but not with the rest.

It can be difficult to use PER-based instruction in these classes. For instance, there's a fairly standard centripetal acceleration exercise where students try to get a bowling ball to go in a circle by tapping it with a mallet. The goal is for them to realize they need to tap the ball at a right angle to its direction of motion. One student got frustrated, threw the mallet, kicked the ball and cursed the ball out. Such discipline issues are fairly common.

Test-driven classes made the students try to become drones, since they thought that's what they had to do in order to pass the high stakes tests. When put in a frame of "ignore the testing stuff," they generally did better. Not only are thinking and engaging not tested for in these high stakes exams, they're actually selected against.

The students trained Steinberg via negative reinforcement, both overt and subtle, both passive-aggressive and outright aggressive. While he was trying to teach them to care, they were trying to teach him to not care…and they outnumbered him.

He was not allowed to set aside the Regents Exam stuff, no matter how much it seemed to hurt actual learning. And despite being a pretty good school overall, he ended up flunking ¾ of the class.

A toxic school culture robs students of 4 years of their lives and gives them nothing in return. Success is possible, but strongly selected against, with the Regents curriculum handcuffing teachers.

Discussion: [Things moved pretty freely here, I only got names for a fraction of the comments, and some are syntheses of multiple peoples' views.]

A common theme of all four posters was the power differential and how it shifts (individual and institutional power). Power is ownership of education and control of framing.

We need to create spaces where students have power, whether a physical space like the PLC or a virtual space like Colorado's video links.

An outreach program can be used to give teaching experience to grad students who go straight to research money and never act as regular GTAs. It's good for 'em.

Giving power to the students is scary to both the teacher and the students. At the teacher's end, it helps to have colleagues for mutual support.

TPE03 may have been the only one to do so explicitly, but all four projects found ways to twist the system to shift power.

Aubrecht – Schools are toxic systems designed to squash curiosity and pigeonhole people as losers. We can't change it enough on our own with these little tweaks.

We need to link content to pedagogy better.

There's a vicious cycle where high schools try to prepare students for bad college teaching, thereby making the students less able to handle good college teaching and reinforcing bad teaching.

Change needs to come from the top, the bottom AND sideways.

It really starts in elementary school, high school may not be as intrinsically toxic as some suggest.

There do exist models of success.

The university can have an influence, since it trains those who work in the K-3, 4-6 and 7-12 arenas. As is bent the twig, so grows the branch. Unfortunately, it's a slow process.

Consider teachers as skilled practitioners and **ask them** for information, rather than assuming they're incompetent and trying to work around them.

Hestenes – Community-building is the mechanism most likely to bring change. It's a common element of all successful programs.

Zollman – Change what you can change rather than wasting time on what you can't. Incremental erosion is the key…what couldn't be changed a few years ago may be changeable now that you've changed what could be changed.

Brewe – Show you can make one thing work first, before tackling all things.

Ed Price – If you have an idea to do something, document it.

(a high school teacher) – High school teachers don't like it when things are imposed on them from above. They've been burned too many times by forced participation in educational fads that then burned out. You need to convince them your reform isn't another fad.

TP-D: Targeted Poster Session D – It Works There, Will It Work Here?

Discussant: Angela Kelly [yes, again…purely coincidental on my part.]

The "Zeroth Law of Curriculum" is that if it worked there, it should work here. If it didn't work here, it's our fault.

TPD01: Lessons From the Adaptation and Implementation of a Non-Traditional Introductory Physics Course – Charles De Leone, CSU San Marcos [presented by Ed Price, CSU San Marcos]

The course being adapted is a large-enrollment introductory calculus-based physics course for biology majors at UC Davis. It is being adapted for use by a similar population of students at CSU San Marcos, but in an algebra-based course.

The content sequence has been altered to match the differing catalogs (one school is on semesters, the other on quarters). The course time allotment had to shift, there were fewer TAs and more control by the primary instructor. They also had to delink from UC Davis's updates, since those would not necessarily work in their setting.

Porting the class over has been successful at improving student outcomes (FCI, CSEM, C-LASS, behavior observations), institutionalization of the course (it has survived past the original innovators and is now well-accepted) and fidelity to the key elements of the original.

TPD02: Curriculum Design for the Algebra-Based Course: Just Change The d's to Δ's? – Michael Loverude, CSU Fullerton, Steve Kanim, New Mexico State Unversity.

They're trying to move between calculus-based courses and algebra-based courses in tutorial use. The algebra-based course skews older than the calculus-based course and shows a more diverse population in general.

Students in the calculus-based course do not outperform the algebra-based course on all items. They're better at the concept of slope, kinematics graphs and proportional reasoning. But they're mixed on tension problems, possibly because the calculus-based students are easier to distract with a complicated setup.

Even reformed algebra-based classes underperform on the topics mentioned above, but the types of errors made in the reform courses were a bit more sophisticated.

Proportional reasoning items from the Lawson Test correlate well with final exam scores in the study. They've also been redesigning the Lawson items to be less tied to a science context.

TPD03: Adaptations of the Physics By Inquiry Curriculum Part I – Tips for Successful Implementation and Conceptual Learning Outcomes – Karen Cummings, Southern Connecticut State University, cummingsk2@southernct.edu

When graphing conceptual gains against Lawson Test scores, there's a limiting factor. For Lawson scores below a certain threshold, gains simply don't rise very high, and the curve is pretty flat below that threshold. Above that point, gains spread out and rise up. [Reference to Pyper's talk, GA12.]

The adaptations here were performed by a collaboration between Baltimore City Community College, Southern Connecticut State University and the remedial college of the University of Minnesota. They had no access to GTAs as well as enrollments on the large side, both elements that prevented "right out of the box" use of PbI. Still, all groups did well in conceptual and affective gains.

PbI is the right material for this population. It develops scientific reasoning ability as well as content knowledge. The small step size between questions may frustrate more advanced students, but it's good for "stalled" students.

If you're too scientifically naïve, it's hard to benefit from Peer Instruction or ILDs. PbI is better for the naïve.

The Lawson test is perhaps too crude or roughly focused to show improvement in scientific reasoning among students in PbI. It may not be able to resolve down to a one-year shift, so Lawson may need some tweaking.

Conceptual gains were strong in all three implementations.

TPD04: Adaptations of the Physics By Inquiry Curriculum Part II – Assessing Shifts in Student Attitudes – Leon Hsu, University of Minnesota, Twin Cities

The C-LASS was used to test attitudes at all three institutions. Attitudes generally improved, it was comparable to the effects seen for PET/PSET courses.

Cooperative group techniques were used. Specific C-LASS-based heterogeneous grouping was done (i.e. a good attitude with a bad attitude), groups were changed periodically (using exam scores to help put high performers with low performers), group questions were intentionally too difficult for individuals to solve, and there was a bonus if all members of the group did well on individual tasks.

Undergraduate TAs who had taken PbI previously were used as assistants. Some were paid, others got academic credit.

There was a 5-10% drop after the first day of class, as students left to find a lecture course more to their liking.

The Minnesota remedial population has not been well-served by traditional education, so they're more willing to try something new.

UTAs initially needed a script, but were slowly weaned off it or internalized it. They tend to last about three semesters before burning out on the class.

It may be necessary to have an attendance policy and group contracts to avoid students blowing things off.

C-LASS gains seem to depend on the inclusion or exclusion of certain modules. A change in just two weeks' worth of materials is enough to affect C-LASS scores significantly.

Discussion: [Okay, this time I didn't get the names of anyone in the discussion, sorry. Definitely showing signs of being mentally worn out at this point. ☺]

There was some scaling up in these examples, but never more than doubling in size. TPD01 was "scaling sideways".

The challenges went beyond mere size. The new environments were simply different, not necessarily harder or easier per se.

Question: How big is too big? How much reform effort is carried by TAs or adjunct faculty (who may not be much better than TAs, especially since you can't give marching orders to an adjunct like you can to a TA)?

Superficial "reform" (i.e. toss clickers into an otherwise traditional class) can be worse than no reform. How do you get a deeper buy-in? It's more challenging at a large university.

It might help to have a table of data from successful implementations to see if you have the resources to pull it off. Also, having a clear list of requirements can be helpful in getting support.

Populations really matter, so know your population!

Several weeks of trial and error and error and error can be really bad for morale.

Differences in institutions are very idiosyncratic.

[I did not attend the wrap-up session, as my brain was full.]

And so ends another installment of my AAPT meeting notes. I may be at the Chicago meeting; finances permitting…otherwise see you all in Ann Arbor!

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