2004 National AAPT Meeting – Summer
Notes from August 2-5
Sacramento, CA

The following notes were taken by Dr. Van Domelen during the regular sessions of the 129th National Meeting of the American Association of Physics Teachers. Due to difficulties involving travel and accommodations, notes are a bit sparse on August 2. Only a few notes were taken during the PERC, on the grounds that the Proceedings would cover that part of the meeting.

Abbreviations: There are a few concepts that came up frequently enough in the talks I attended that I gave them their own abbreviations. (Not all will appear this time; I just pasted in the 2003 glossary and added to it as necessary.)

CSEM – Conceptual Survey of Electricity and Magnetism

ECR – Elicit, Confront, Resolve. The UWash 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.

ISLE – Investigative Science Learning Environment

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

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

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

PS – Problem-Solving

Monday, August 2, 2004

YPER Crackerbarrel

The big news at the start of this, before we went into the meat of the crackerbarrel, was that Physical Review Special Topics: PER had been approved as an online journal. More detail on this in my notes on PERC.

Sanjay Rebello was the "star" of the Crackerbarrel, and he was asked to discuss the CAREER grant process. A bunch of bullet points I noted down follow:

- CAREER crosses a lot of boundaries and can cover a broad range of topics.
- A CAREER grant should be based on something you've already started to do, and it's better if it is revolutionary rather than simply evolutionary.

- You need to establish at **least** a five year timeline, and show how you interweave teaching and research.
- Show how your planned work fits in with the department. As your department head writes a letter of recommendation for this grant, you should make sure you and the department head are on the same page!
- It's good to integrate research and education, but be careful not to double-count a single project under both headings.
- Curriculum development proposals have been pretty successful.
- Include the broad strokes in your proposal; the fine details aren't as important for the initial submissions.
- CAREER is a personal/professional development grant.
- It is very important to get at least two mentors on board for this process. You should have a teaching mentor at your institution, and a research mentor (who can be from another institution if you're the sole PER person there).
- If you are doing curriculum development, try very hard to get any new course you develop made part of your existing duties, rather than tacked on in addition to your regular teaching load. For that way lies madness.
- Budgets of $500K-$900K including overhead are generally okay.
- Collaboration (in addition to the mentors) is strongly encouraged.

The following comments came up during Q&A.

- An advisory committee is strongly recommended, they can help fill in gaps.
- Department of Undergraduate Education is generally the best fit for these proposals, MSP is not recommended.
- **Chat with the program directors, get advice from them on the content and appropriateness of your proposal.**
- Review panels will vary a lot in their expectations, both depending on where you submit the grant (i.e. DUE vs. MSP) and on just random chance. Try to sound out the panel who will be reviewing your proposal.
- It might be helpful to request a co-review with a related panel if you feel you're crossing boundaries, although NSF generally does that on its own.
- Deliberately cross-submitting to the Physics division might help change things a bit in our favor in the long run.

I did not remain for small group discussion, as I wanted to make it to the next session with some time to spare.

BP – Introductory Laboratories and Writing

BP01: Developing Scientific Evaluation Abilities in Students – Aaron Warren, Rutgers University.

The goal of this work was to help students reach the Evaluation level in Bloom's Taxonomy. Evaluation is crucial to helping students learn from their mistakes. Several methods were taught to the students in pursuit of this goal:

- Dimensional Analysis – do the units match up?
- Limiting case/Special case analysis – use limiting or special cases to compare a more complex idea to a simpler one. For instance, at infinite radius, circular motion becomes linear.
- Assumption Analysis – look carefully at the assumptions that are being made in order to predict something. Do the assumptions hold?

Self-evaluation makes it more likely that the student will develop expert-like knowledge. Therefore, evaluation tasks are worked into all parts of the course.

It was hoped that there would be context-independent high correlations between the evaluation tasks and other measurements of student ability, and this was borne out using Kendall's Tau (τ_b) for ordinal data.

BP02: Developing and Assessing Students' Ability to Design Experiments in a Large Enrollment Lab Class – Sahana Murthy, Rutgers University.

See http://paer.rutgers.edu/scientificabilities/ for more details.

Students were tasked with designing three different kinds of experiment:

- Observation Experiment – investigate some phenomenon
- Testing Experiment – test a hypothesis
- Application Experiment – solve a problem

These experiments all used the ISLE cycle and encouraged divergent thinking. The tasks were open-ended and deliberately ill-defined. A particular task might need multiple experiments of different types, and could be either qualitative or quantitative. They are intended to encourage several different scientific abilities.

(I missed some bits in the middle here because the speaker went through the slides too quickly to take notes.)

Student results were scored on a 0-3 integer rubric, and they hope to have students self-assess on this rubric in the future.

The tasks were broken into subtasks that were similar for all experiments.

Measured by Authentic Assessment, student performance improved.

BP03: Development and Assessment of Students' Skills in Designing and Conducting Introductory Physics Experiments Part 1 – Orion Davies, CSU Chico.

An ISLE cycle project.

Lab groups were formed with mixed majors and mixed ability levels, to try to make each group as diverse as possible. The labs themselves were of the three varieties noted in BP02: observation design, testing design and application design.

The speaker applied this process to his own work at an engineering firm that was testing water levels in dehydrated fruit using a low pass filter.

Using the Rutgers-style method means more work for the instructor before class, but less work during class. Students get more mentally involved.

BP04: Part 2 – Xueli Zou, CSU Chico.

The speaker of BP02 also contributed to the work in this talk.

ISLE in general has been found to generate higher gains on the CSEM. To this means of measurement, Prof. Zou has added the LVPI – Laboratory Program Variables Inventory.

The LVPI is a sorting task, in which students are given a large number of statements (generally on cards, but this can be done just on a sheet of paper) that may or may not describe the lab class accurately. They are asked to place the statements on a Likert-like scale that limits the number of selections at the extrema.

There are five choices varying from strong agreement to strong disagreement. The two strongest positions only allow two cards apiece, and most statements are expected to go in the neutral category. This forces students to place their responses along a bell curve, hopefully eliminating the garbage data one gets from a student who always picks the same response for all items (i.e. an apathetic student who picks all "neutral", or a disgruntled one who always picks "strongly disagree").

I was feeling very ill by this point, and didn't take much in the way of notes (most of the above is actually reconstructed from the PERC poster session), but I think the labs described in Part 1 got good results on the LVPI.

I left after this talk, my apologies.

BS - PER: Cognitive Issues in PER (Invited)

BS01: Problem-Solving, Scaffolding and Learning – Chandralekha Singh, University of Pittsburgh. (Rapid slideshow, apologies for somewhat scattered nature of these notes.)

Problem-Solving is defined as being in a novel situation and trying to reach a goal.

Students, however, see PS as "guessing plus plug-n-chug."

Cognitive research looks at the mechanics of how PS works. The working (short term) memory and long term memory have to work together on PS, and making more connections can help bridge between working and long term memory. Working memory acts as a buffer, able to hold 5-9 things at a time, so we need to be able to shuffle things into long term memory quickly and smoothly to free up the workspace.

We use hierarchical schema, from the fundamental to the specific.

"Chunking" information into small, meaningful pieces can help us get more out of our working memory. Experts are better at constructing these chunks and storing them in long term memory, then "loading" them into working memory via different representations. Experts use deep features (a la Mikki Chi's work) to sort these chunks.

Cognitive Load is a measure of how many resources are needed for a particular task. Metacognitive tools like chunking can reduce the load. Scaffolding is a tool for gaining these metacognitive tools.

Scaffolding provides support and guidance in reducing load. This is difficult to implement because cognitive load is very subjective.

Good metacognition and learning from experience can turn a "problem" into a mere "exercise".

Problem-solving heuristics are vital, we need to help students develop them.

Some important bullet points:

- Cognitive load is subjective.
- Learning is incremental.
- Learning requires effort.

Interactive video tutorials were developed to help with modeling, coaching and scaffolding up to PS heuristics (qualitative analysis, planning, implementation, assessment, reflection – what did I learn?).

Based on Van Heuvelen's 1991 problem worksheets, plus videos.

Students were given sub-problems to solve, intended to guide them along the right path. There were help sessions for each sub-problem, and students were required to run through things again after the tutorial help (similar material with no help given this time around). For instance, after a tutorial for N2L and N3L with a force applied to two blocks touching each other on a frictionless surface, the second run would involve three blocks, or involve blocks pulled with a rope rather than pushed.

The Vygotskian socio-cultural perspective (learning is social participation) was brought up, but time was expiring and the speaker was trying to cram another ten minutes of talk into two minutes. The remainder of the talk went by too fast to process.

BS02: How Might Cognitive Sciences Inform PER? – Robert Dufresne, University of Massachusetts at Amherst.

(Apologies to Prof. Dufresne if I misrepresent any points...the color choices for his slides were hard for me to read, and I may have made some incorrect inferences.)

In theory, Cognitive Sciences can do a LOT for PER. In the classroom, however, they seem to do very little.

Complex cognitive abilities:

- Cannot be reduced to component parts for teaching.
- Require coordination of different sources of information.
- Serve a meaning-making function.

Example: A young child who is falling behind in learning to read could be examined in many reductionist ways (look for just an organic cause, try just one pattern-based solution, etc) and reveal no problem at all. Yet the kid can't read at his age level. It's an irreducible problem.

The goal of cognitive science is to understand the human mind and intelligence. It treats the mind as a black box of sorts, trying to get an interaction matrix rather than worrying about the squooshy details (which are realllly hard anyway). It works at the level of symbolic representation, and seeks to find simple rules from which may emerge complex behaviors.

Meaningful details stick better than cosmetic ones. There's two main ways in which we construct meaningfulness for this purpose.

1. Semantic networks – branching, coordination. Go from general to specific along a shrub-like structure.

2. Schematic networks – lists of attributes and their values. Categorize things.

What you measure affects what you get, not unlike wave-particle duality. If you measure someone's semantic network, you will get branching results. Measure the same person along schema, and you get categories.

In looking at the question, "What is a scientific concept?", used the classic uneven tracks (which ball should arrive first for two tracks, one of which has a dip in it) as an example, and claimed that it's not the concepts or p-prims or what-have-you, it's the meaning-making that's important.

BS03: Resources, Framing and Transfer – David Hammer, University of Maryland at College Park.

Classically, Transfer is the ability to extend what has been learned in one context to new contexts. For instance, consider the old idea that studying Latin trains the mind to be more logical and structured.

As per Thorndyke's work, this sort of transfer is rare. BUT...

Maybe the classical definition of transfer is inadequate. After all, we always apply knowledge gained in other contexts, just not exactly or always correctly. It may even take precedence over simple recall, since we're often in situations that are not exactly like ones we have been in before.

(My own aside: it's kind of like the issue of bumblebee flight. For the longest time, we knew that they COULD fly, that was indisputable...but all our theories of aerodynamics said they shouldn't be able to fly. We know transfer must be happening, we just haven't cracked the "how" of it. And they did eventually solve the riddle of bumblebee flight (it involves vortices forming above and below the wings), so who's to say we can't solve the issue of how transfer flies?)

The original interest in transfer involved the question of whether the material learned in one place would be used elsewhere. Would X->Y for some specific, predetermined X and Y?

The current interest assumes it will happen, and is more interested in the how and why. Will X->something, and how?

Switching from "Transfer is X to Y" to "Transfer is X to something" certainly makes it more common an occurrence. The definition is further broadened to "Transfer has occurred if having X improves the chances of success in learning in a broad area Z, not just a specific topic Y."

Transfer is now being seen as a dynamic process, not just the forging of a static link.

At this point, the definition of transfer has been changed so much that it might not be a good idea to even use that word. Hammer advocates abandoning the term entirely and talking about "Activation of Resources" and "Framing" instead.

Activation – turning on a resource/tool/bit of knowledge.

Framing – activating a locally coherent set (such as the set of bits involved in looking through a window and interpreting what you see).

Reframing – switching from one set to another, often triggered by the failure of the old set to make sense. "Try explaining it to a 10 year old" is an example of deliberate reframing. (Aside: we should get posters made of the "Try explaining it to a 10 year old" thing, and put them in classrooms.)

Bad reframing can result in failing to follow your own advice. (Personal example: I'm always telling lab instructors they need to move around the classroom a lot, because students may have questions but be reluctant to draw too much attention to themselves, so they won't ask unless you're at arm's length. But the first time I taught in a large lecture class, I didn't move around at first, ignoring my own advice because I'd badly reframed for the situation.)

"Transfer transfers!"

There are three mechanisms of stability:

- Contextual – Stable within a single context, unstable outside of it.
- Metacognitive – Stable only if one is deliberately self-monitoring.
- Structural – A set of resources is self-stabilizing (even if it's a bad set, so beware!).

You want to get a feedback loop between theory building and instructional practice.

Use framing to see whether a particular instance of stability is good or bad.

BS04: Using Learning Theories to Model Students' Conceptual Changes – Michael Wittman, University of Maine.

What is Conceptual Change (CC)?

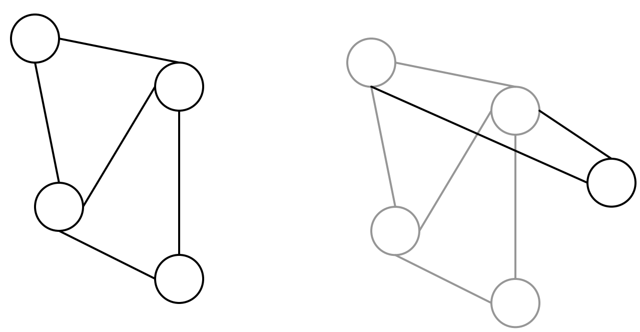
Some concepts are coordinated resources, ordered by coordination classes.

Resources are building blocks, which combine in link-note networks for form coordination classes. These are activated via readouts, which I **think** are essentially specific incidences of using a resource, applying it. Wittman was moving **very** quickly at this point, and I missed a lot of zoomed-past definitions.

If you trigger a resource, you get all of the other stuff that's linked to it. For instance, if you see the crest of a wave as being a specific object, then you may trigger all your "acts like an object" resources to use in the problem. If you cut open a resource, there are more resources inside, much like pomegranate seeds inside the fruit. Users rarely peek inside their own resources, though.

A Resource-Based Conceptual Change Model is offered, with four styles of CC.

1) Incremental – A becomes B slowly, as you change your mind.



As per the diagram to the right, you start with some set of resources and connections, then add in a new one. This process continues, possibly also including kicking resources out of the system, until you have reached a new understanding.

You get students to commit to a new resource, so that it sticks. It's a hard, slow process, and can contradict common sense. Good metacognition is necessary in order to correctly increase the span.

2) Dual Construction – Hold A and B simultaneously.

A single readout activates two networks at the same time. "Elby Pairs" are designed to induce such a dual activation, forcing two networks into action at the same time. Particle/Wave duality is an example of something that forces two networks ("Particles" and "Waves") into action at the same time. Sometimes the goal is to force the subject to abandon one of the two networks, sometimes not. Metacognition mediates in this case, helping pick the network that "wins". If you can teach the metacognition, the context is "easy".

3) Cascade – Domino effect of A becoming B.

You suddenly drop some resources from a network (because they've been disproved, usually). The network must rearrange **quickly** to plug the holes. Or a readout suddenly shifts you to another network.

A "better" network may now be in use as a primary activatee.

A "telling question" can shift students, even on unrelated topics (because you've kicked out some resource they need in another network).

4) Wholesale – A "jump cut" of sorts, where A is replaced by B so completely that you can't even recall what it was like to believe in the previous network.

The network collapses completely and is rebuilt.

Silence, babbling and absurdity can result during the collapse of the network.

Once the new network is constructed, the subject can no longer explain why the old one worked.

The Coordination Class model seems to be consistent with various CC theories, and may eventually predict new CC theories.

You need to allow time for a "confusion stage" in any case, while networks change.

Tuesday, August 3, 2004

CG – Interaction of Student Beliefs and Physics Learning

CG01: Student "Splits" Between Intuition and Scientist Answers – Tim McCaskey, University of Maryland.

A Split Task has subjects circle the answer (on, say, the FCME or FCI) that they **believe**, and then put a square around what they think is the **scientist answer**. Subjects may circle and square the same response if they wish. If they do not choose the same response for both, this is recorded as a split.

Split rates tended to be higher for lower-scoring subjects, and generally decreased after instruction.

Subjects do not necessarily disbelieve the scientist answer when they split, and give other reasons (such as following their intuition). It's possible that this resulted from ambiguous instructions.

A new Split Task was created with clarified instructions. The circled answer was now to be the one that agreed with the subjects' intuition. This new version resulted in fewer splits and smaller overall differences.

The new Split Task used "Elby Pairs", where both the correct answer and an attractive incorrect answer were supplied. Students in algebra-based electricity and magnetism were given the new Split Task.

Reform classes were both most likely to pick the correct scientist answer, and to circle that answer as well (called "right and reconciled"). Non-reform classes were most likely to pick the incorrect scientist answer. About the same number in both classes would pick the correct scientist answer, but circle something else (i.e. they had memorized the 'correct' answer, but it didn't make sense to them).

Future work will give a new Split Task to an algebra-based mechanics course in the fall, along with interviews and video.

CG02: Using the Colorado Learning Attitudes about Science Survey (CLASS) to Probe Students' Attitudes and Beliefs About Reality – Wendy Adams, University of Colorado, Boulder.

CLASS is based on the MPEX and VASS instruments. It is an attitude survey intended to be given as pretest and posttest, investigating shift between the two. It uses a 5-point Likert-like scale with 38 items.

CLASS is intended to work in a broad range of courses, not just physics, and takes about ten minutes to complete. It has been validated using interviews with both expert and novice subjects, and questions have been clarified based on the interview results.

The rest of the talk concerned analysis of the "Reality" questions on the CLASS, which seemed to be better split into two categories: Physics describes the real world (Real World Applications), and Physics matters to me personally (Personal Interest).

While both novices and experts rated about the same in Real World Applications, there was a strong difference between the groups on the Personal Interest items, and this was borne out by a Principal Component Analysis of the data.

A good Personal Interest attitude correlated highly with finishing the first semester (not dropping) and with going on to take a second semester of physics. This suggests that it would be helpful to get students believing that physics made a difference in their lives.

CG03: Luck versus Control: Does Introductory Physics Affect Student Beliefs? – Paul Knutson, University of Minnesota.

Motivation: student locus of control (LoC). Skill vs. Luck, internal LoC vs. external LoC. Do physics classes influence a student's locus of LoC, and does a student's LoC affect their achievement in physics classes?

LoC is normally measured by the Rotter I-E (Internal-External) test, and its Personal LoC section is most relevant to this sort of study. However, the Rotter I-E test was seen as intrusive by physics professors at Minnesota, as well as seeming to be irrelevant in many cases.

It was decided to write a less-intrusive physics-specific I-E test. This new test was calibrated against the Rotter I-E by mixing items from both on the same administration.

Each non-placebo item on the new I-E test has two choices, one representing an internal LoC and the other an external LoC. There are also two-choice items sprinkled throughout that have nothing to do with LoC, and are intended to keep the subject from seeing obvious patterns. All of the items have been written in a physics context.

Principal Component Analysis of the I-E test revealed three main chunks tied to External LoC, which were identified as Academic, Good Luck and Bad Luck.

Academic – Grading issues, for the most part. Aspects of the course that were beyond the student's control. A student with an External LoC would agree with statements that suggested that grader variations had more to do with grades than actual subject knowledge.

Good luck – External LoC would credit luck/guessing with their successes.

Bad luck – External LoC would blame failures on bad luck.

Males and females had slightly different PCA, with female students adding a "lab" component (i.e. "I'm just bad at lab, so any course with a strong lab component is going to sink me.").

Preliminary results suggest that students experience a small shift towards Internal LoC after instruction, but much more work is needed.

CG04: Developing Instruments for Evaluating Anxiety Caused by Cognitive Conflict – Yeounsoo Kim, the Ohio State University.

The courses studied were Physics By Inquiry "Batteries and Bulbs" (phys 107 at OSU), and the cognitive conflict in question was of the ECR variety.

Conflicts can have both constructive and destructive outcomes, but it's not always obvious which one you get. Hence, an instrument is needed to determine this.

Phys107 students were examined, looking at the situations, feelings and anxiety related to cognitive conflicts. The instrument developed for this was the In-class Conflict and Anxiety Evaluation (ICAE). It measured:

- Types of conflict (vs. Experiment, vs. Group, vs. Instructor, vs. Self)
- Experiences (surprise, interest, attention)
- Type of anxiety (clinging to preconception, additional variables, low confidence, conflict with experience)
- How much anxiety (high vs. low)

Conflict with Experiment was the most commonly observed. Conflict with Instructor was almost non-existent, which is as it should be in a PBI course.

Experiences varied with the experiment, but there was a possible increase in Attention over the course of the observed experiments.

Anxiety type and level varied with no visible trends over time. High-anxiety students did significantly worse on tests.

Students did not resolve conflicts that arose regarding variables; it's possible that more instructor interaction is needed on that topic.

http://www.modelanalysis.net/ICAE for more.

CG05: Continuing the Debate: Experiences from the Fourth and Fifth Science and Mathematics Workshops for Tibetan Buddhist Monks – Mel Sabella, Chicago State.

This was more a progress report than a research report.

The Dalai Lama decided that it would be a good idea for his monks to have a better grasp of science, so set this program up in cooperation with Chicago State and a number of universities in India (which is where the actual workshops took place).

Physics By Inquiry was adapted for this program, with topics from the two volumes mixed together. The monks had minimal background, but strong work ethics.

Each day the monks studied math for 3 hours and science for 3 hours, with physics being part of the science curriculum. Many of the monks had been in the program from the beginning, but there was some roster change in every workshop.

While the 1st through 4th workshops used worksheets translated from the PBI workbooks, the 5th workshop used no written materials and added group-led presentations to the existing checkpoint structure. (Due to translation bottlenecks, the entire class would be checked off at the same time, rather than the normal PBI method of self-pacing for groups.)

The monks are getting more comfortable with model-building and relying more on experiment than dogma. They are very good at integrating group debate, since it's the sort of thing they do on a regular basis when discussing philosophy.

Video clips were shown that demonstrate the monks taking responsibility for their own learning (i.e. not just taking someone's word for things, debating in the classroom, etc).

DC – Student Concepts of Energy and Thermal Physics

DC01: Student Understanding of Gravitational Potential Energy and Moving Objects in a Gravitational Field – Michael Loverude, CSU Fullerton.

Very important lesson right at the start: if you use PowerPoint, be sure you know how to get it out of timed-advance mode in case it somehow decides to start advancing every few seconds on its own.

Context: general education physics courses (phys100).

Research question: To what extent can students apply gravitational energy and make correct predictions?

Used a ball in a bowl, where the ball was released from the lip of the bowl and students were asked where it would end up on the other side.

Different populations saw the ball-in-bowl problem the same way. Energy/Force conflation was common, as was Energy/Momentum conflation.

Experiment was repeated with a pendulum instead of the ball-in-bowl, and the same types of responses were given in roughly the same proportions.

When asked where the energy goes in a pendulum, two common responses were:

- It's just used up, like gas in an engine.
- Gravity steals energy, so U_g increases as the pendulum slows down.

Overall, instruction did not seem to help students learn to successfully apply the energy model to motion in a gravitational field. Students see U_g as being intrinsic to an object rather than being a function of position, etc.

DC02: Helping Students to Develop a Functional Understanding of Energy Conservation – Beth Lindsey, University of Washington.

While using Tutorials in Introductory Physics materials, a need was seen for a Tutorial on the subject of ΔU, change in potential energy.

They started with the Work-Energy Theorem and the idea that work is a change in kinetic energy. $W = \Delta K + \Delta U$ in general.

Force integration was seen to have serious limitations, and there was no provision in the Work-Energy Theorem for changes of internal energy (i.e. friction), which they called "ΔE_{other}" (and Van Heuvelen calls ΔU_{int}).

Students tend to treat all systems as closed, so the total change in energy is always zero. Once $W = \Delta K$ is introduced via the Work-Energy Theorem, it sticks way too well and is hard to dislodge.

DC03: Do We Say What We Mean? Misclassification of Physics Concepts and Students' Difficulties – David Brookes, Rutgers University.

Motivation: A previous study by David Meltzer showed that many students thought that the change of heat energy in a Carnot Cycle was zero, because you end at the same place on the P-V graph as where you begin.

It's possible that we don't use language in the same way that students do. Language is more a process than a static thing, so we can drift off in different directions.

Students need to decode the structure of the metaphors we use in order to construct their understanding. When we use a word, we have a specific meaning in mind, but that meaning depends on the context and the structure we're using at the time.

Brookes examined several textbooks and encoded all the sentences about heat in them, labeling "heat" as either a substance, a process or a state, depending on how the book was using it.

The idea that heat is a substance (like phlogiston) is wrong, but standard textbooks still overwhelmingly use the term as if heat WAS a substance, rather than a process or a state. In physics, "heat" is really only correctly used as a verb, the application of energy, but we still teach it as a noun, a thing that exists separately. (Serway & Beichner's textbook is much more careful in this regard, Brookes found).

Conclusion: we need to emphasize heat as a process, not as a thing.

DC04: Using the Thermal Concept Evaluation to Focus Instruction: A Critique – Paul Zitzewitz, University of Michigan at Dearborn.

The TCE can be found in TPT **39**, 496-504 (November 2001). It has 26 items.

The TCE was used in a teacher-training course sequence at Dearborn, a "Big Ideas" course model that cut across disciplines. Pre- and post-testing was administered, and an item analysis performed.

Students designed activities to probe areas that pre-testing showed were problematic. The gain was 0.56 overall, but some items resisted any improvement.

It was decided that the TCE was generally good in this case, but failed to separate misconceptions from simple lack of knowledge, and had confusing distracters. Better distracters are needed, along with a way to separate out the types of error.

DC05: Semi-Intuitive Thinking and Reasoning Inconsistencies in Calorimetry – Warren Christensen, Iowa State.

Investigating $Q=mc\Delta T$ in a calculus-based course.

Students tended to conflate change in temperature with change in energy, equilibrium with equal changes in temperature, etc. Some thought that temperature change was proportional to heat capacity.

About 60% of students showed correct understanding of Calorimetry, but it would be nice to increase that. Many students apparently thought heat transfers were unequal, but it was also possible this was just an artifact of exceptionally wordy multiple choice options.

The instrument was rewritten with more symbols and less words, but the results were the same. It was rewritten again, replacing "equilibrium" with "reaching a common final temperature," but there was still no real change.

During interviews of the students, math errors were very common.

DC06: Some Random Observations – Dave Van Domelen, Kansas State University.

Slides available on request.

Students filled out two online surveys on the nature of randomness. One was open-response, the other was multiple choice based on the results of the first survey.

In the first survey, students tended to use a lot of non-science definitions of randomness (i.e. unexpected, out of context) when simply asked what randomness was, but when given a specific context (dice), they strongly favored a definition that included unpredictability and lack of knowledge. The second survey reinforced this, as students were more likely to declare a situation random as the amount of information they had about it decreased.

In both surveys, the issue of patterns also came up. Randomness seems to have a sort of anti-pattern nature for many subjects (including graduate students and faculty), and a significant percentage of the subjects in all groups felt that it was not possible for random events to ever create patterns, meaningful or otherwise.

Wednesday, August 4, 2004

EF – Testing and Interpretation

EF01: Using Interview Data to Explore Transfer of Student Learning – Paula Engelhardt, Kansas State University (at the time of research).

This talk uses a basic definition of transfer, the use of prior experiences/ knowledge obtained in one situation and applied in another situation. Brought up the traditional vs. contemporary split on transfer (i.e. rare vs. ubiquitous).

Teaching experiments were used, including the operation of a bicycle, a circuits experiment and the workings of musical instruments.

Students bring in a mixture of knowledge and experiences: personal experiences, physics knowledge and knowledge from other academic coursework. They apply bits and pieces of these elements to new situations.

How students used their previous "bits" depended on the type of question asked. It was a dynamic process, with responses often constructed on the spot rather than picked out of recall.

Transfer was observed, but it happened more easily in cases where scaffolding was used to break it into smaller bites.

Paula may be contacted at engelhar@tntech.edu for more information.

EF02: Getting the Most from Multiple Choice Questions: Part 1

EF03: Part 2

- Robert Starr, Dakota Ridge High School (gave both talks, original presenter for EF02 was Uri Haber-Schaim of Science Curriculum Inc, but he was unable to attend.)

Just about every state has science standards, with Benchmarks/Outcomes/ Objectives/Etc. Basically, a list of what the students should learn. These Outcomes drive assessment and instruction.

There is a need for a meaningful feedback loop connecting Outcomes, Assessment and Instruction, mirroring University of Washington's classic triangle.

Criteria for a "good question" are:

- Is the science correct, or at least reasonable?
- Is it based on instruction, or at least on previous knowledge the students are presumed to have coming into the course?
- Is it clear and unambiguous?
- Does it avoid double jeopardy? In other words, does it avoid the situation where missing problem 3 automatically means you can't get problem 4 correct?
- Can it be answered without reading the multiple choice options?
- Is there diagnostic value to at least some of the distracters?

How and what we assess communicates what we value.

Software used for testing should:

- ...be flexible, and allow the use of teacher-made tests.
- ...not require special forms (such as Scantron sheets). If it does require forms, it should create them for instructors.
- ...perform data analysis, both for the class and per student.
- ...perform item analysis, both on difficulty and on the frequency of distracters.
- ...not require extra time on the part of the instructor. Any time it requires should be offset by a time savings elsewhere.

A number of sample items were presented, most of which violated one or more of the "good question" criteria.

EF04: Summary of the Effects of Question Order – Kara Gray, Kansas State University (at the time of research, now at Colorado State).

Pairs of related items were taken from the FCI and presented to students during interview tasks. The ordering was changed in different groups, and unrelated placebo questions were also inserted for some of the groups. The two pairs were the "car pushing truck" items, and two ballistic path items (bowling ball dropped from airplane, cannon shot from the top of a cliff).

In many cases, the order of presentation affected student responses, as well as student tendency to go back to a previous problem and correct their answer.

This work suggests that reordering your test items to create different versions of an instrument or exam (for instance, to deter cheating) may create instruments of different difficulties.

EF05: Is the Normalized Gain Valid? – Andrew Heckler, the Ohio State University.

As most who have worked with normalized gain know, it tends to be biased towards those with high pretest scores (i.e. if they get 29/30 on the pretest, their posttest will either have a gain of zero, or an integer value!).

We want a measure of improvement that is not dependent of the academic quality of incoming students, so that (for example) Ohio State can be compared meaningfully to Harvard or to Waukesha County Technical College.

A simple model was proposed: posttest = pretest + treatment. In other words, an absolute gain model. This was called the "tau model", as it was written as:

$$y = x + \tau$$

where y is posttest, x is pretest and τ is the absolute gain.

The tau model has a slope of 1 when comparing pretest to posttest. By contrast, for a normalized gain defined by $g = (y-x)/(N-x)$ where N is the perfect score, the formula for y isn't as simple. Assuming that g is not a function of x, then:

$$y = x + g\,(N-x) \quad \text{OR} \quad y = (1-g)x + gN$$

The "g model" does not have a slope of 1, the slope instead is 1-g. The g model also has the constraint that the graph must go through the point (N,N) in this analysis (although I've seen cases where a student had N on the pretest and N-1 in the posttest).

Scatterplots of real data do have regression lines that pass through (N,N), and their slopes seem to fit the g model. However, once you correct for the ceiling effect (you can't have $y>N$, and there's generally a wide spread of x values at $y=N$), the slopes fit the tau model very well and the g model very poorly.

High pretest scores generally mean that the ceiling effect is more pronounced, and the data is deformed to better fit the g model. There is also an effect of regression towards the mean (which happens whenever you test-retest and there's any random error in the results, such as guessing), and this tilts the slope as well. Higher pretest scores mean less guessing and less regression to the mean.

Thus, when the ceiling effect and regression effects are eliminated, the tau model fits the data very well, and the g model doesn't fit at all.

Conclusion: learning, as measured by tests like the FCI, is independent of pretest scores, at least to the first order. The normalized gain artificially boosts the measure of learning for students with a high pretest score.

(Note: this was a MUCH better presentation than his similarly-titled talk in 2003.)

EF06: Not attended due to time constraints, as I wanted to attend the plenary session being held in a different building.

Plenary Session III – Drilling for Life on Mars

Carol Stoker, NASA Ames Center.

(Note: I did not take comprehensive notes on this, just elements that struck my fancy. Also, the talk ran extremely long, and I had to leave in order to eat lunch before session FA, so there might have been some interesting bits I missed.)

In a nutshell, in preparation for a mission to Mars to look for present-day (not fossil) life, NASA is drilling in some weird and inhospitable locations on Earth, places that might have the sort of life that could survive on Mars. Drilling is important, because the conditions on the surface of Mars have been shown to "digest" organic material in a demonstrably non-living way.

It is known that there is an ice-rich subsurface layer on Mars, between the poles and about 60^o latitude on both ends. There's too much ice present to explain without the presence of aquifers. The theory is that under about 100m of dried out surface dirt and stone, there is an ice-saturated cryosphere from 1 to 5 km thick. Between the cryosphere and the nonporous basement rock, they predict a warm layer of liquid water (Mars does not have a liquid metal core of any significant size, but it does warm up as you go deeper).

Near the poles, the dry surface layer may be only a meter thick. What experiments have been performed suggest that the prediction of aquifers is reasonable, with water around 8 km below the surface. Also, the existence of what appear to be water runoff gullies at above 30^o latitude also suggests the presence of liquid water. These outflow gullies appear at cliffsides where the aquifer layer may be exposed, and some have not been filled in by dust yet, indicating relatively recent liquid water flow.

The mean temperature in the "wet" areas of Mars is significantly below the freezing point of pure water at 1 atm, but heavy brine concentrations would depress the freezing point, and high pressure in the aquifers could raise the temperature to the point where the brine is liquid. This salty liquid may harbor life.

A test run is looking for a subsurface biosphere at Rio Tinto, Spain. Life below the surface of this old (active since Roman times) pyrite mine would be based on chemoautotropy with a sulfur and iron metabolism. Data collection and analysis methods could be tested out on this biosphere before sending a drill rig to Mars.

Rio Tinto is VERY acidic, with a pH of 2.5. It's full of bacteria that eat sulfides and excrete sulfuric acid, in water that comes out of the remaining pyrite deposits. This chemosynthesis is possible in anaerobic conditions. There are two known species of bacteria that anaerobically eat iron and sulfur (Leptospril Ferroxidans, Acidithiobacillus Ferroxidans).

The H_2SO_4 waste products of these Ferroxidans can depress the freezing point at 1 atm to as low as -60^oC, which would allow for liquid (if very acidic) water on Mars.

The mineral Jarosite (an iron/sulfur compound) has been found both on Mars (by the current rovers) and at Rio Tinto. Jarosite requires a very low pH in order to form. Therefore, at some point there had to be an acidic, aqueous environment on Mars.

There exist several aphotic, anaerobic microbial ecosystems on Earth (all of them are methanogens, converting H_2 and CO_2 into CH_4 and H_2O) found in deep basaltic aquifers. Oxidation of the iron compounds in basalt creates H_2. Organisms capable of feeding themselves from compounds found in stone are called lithoautotrophs.

While Rio Tinto is a good trial bed, Earth and Mars do not share all of the same difficulties when it comes to drilling. On Earth you don't have the issues of hostile environment and extremely long distance transport and communications. On Mars, you don't have to worry about contamination by surface organisms, since there don't seem to BE any of those.

In both cases, however, bringing a sample up from a great depth may kill it, as it is not adapted for life at lower pressures.

After dealing with issues of contamination and pressure-kill, live bacteria were indeed found in the Rio Tinto deep cores. And they're conclusively anaerobic in the deep samples (samples nearer to the surface were often aerobic).

(I left at this point.)

FA – Student Conceptions of Atomic and Quantum Physics

FA01: Students' Perception of an Atom – Ridvan Unal, Afyon Kocatepe University (in Turkey). (Presented by Brian Adrian, Ridvan was unable to attend.)

Based on a 1995 study, which is available online. More information can be found at http://www.phys.ksu.edu/perg/papers/vqm/AtomModels.PDF

This study was administered to high school and freshman university students in Turkey. There were three kinds of high school: regular, a more selective English-speaking school, and a very selective science magnet school.

Three items were taken from the 1995 study and adapted to an open-ended format:

1) Describe an atom.

2) Can you get energy from an atom?

3) How can an atom be seen?

Item 3 was multiple choice, with students allowed to select more than one correct option.

Responses were categorized by several panels and individual researchers, with an 81% inter-rater reliability. Categories were extracted from the responses on the basis of distinguishability from other categories, and a response was assigned to a category only if it explicitly stated the relevant information.

The categories for item 1 were "Units of Matter", "Constituents of Atom" (i.e. they described an atom by invoking protons, electrons, etc) and "Supplied a Model" (such as the Bohr, Thompson or Dalton models...no students gave a probabilistic model). Most students had no model at all (83%).

For number 2, most replied "yes", generally citing atomic bombs rather than transitions between energy levels.

Further interviews are desired, contact runal@aku.edu.tr if you wish to help.

FA02: Conceptual Learning in a General Education Quantum Physics Course – Michael Wittman, University of Maine.

The New Model Course in Applied Quantum Physics (NMCiAQP) is designed for Sophomore and Junior standing engineering majors, but it attracted high school teachers. Intrigued by this, it was decided to adapt the materials to a math-light Physics 100 type of course (Rand Harrington designed the materials).

The course used tutorial labs on Tuesdays, lectures on MWF. There was a great deal of borrowing from University of Washington's tutorials and from NMCiAQP. The course had to fit in the existing scheduled times.

There was an emphasis on observation and analogy where possible, but in some cases it was necessary to resort to argument from authority. It's possible that topics were covered at too fast a pace.

Students "got" wave concepts pretty well after instruction.

They tried to cover quantum tunneling from first principles, but students didn't shake their tendency to confuse energy with probability amplitude.

Students generally showed they had the ability to develop observation and logic skills, but "first principles" arguments were rough on them.

FA03: Students' Conceptions About Probability in the Double-Slit Experiment for Electrons – Pornrat Wattanakasiwich, Oregon State.

(Another runaway PowerPoint presentation, some slides could not be presented.)

The study considered issues of probability and indeterminacy, interviewing 12 students selected from 31 volunteers in an upper division course.

Subjects were asked to explain diffraction in terms of Heisenberg Indeterminacy. They had difficulty with this, as well as with localization and normalization concepts. Subjects never included the imaginary part of the wave function, only considering the real component.

FA04: Examining Student Understanding of Basic Topics in Quantum Mechanics – Andrew Crouse, University of Washington.

Looking at superposition of stationary states, students often attach time dependence to an eigenstate. The junior-level courses under consideration covered Quantum Mechanics, using tutorials. Superposition is gone over several times over the course of this curriculum.

Students tended to conflate expectation values with actual possible states. Many time-evolved a mixed state as if it were a pure state with energy equal to the expectation value of energy, <E>.

As far as many students are concerned, only pure states really exist:

- Superpositions are cases where we don't know **yet**, not actual "real" situations.
- Coefficients on mixed states tell us which pure state is more likely, but only one of the pure states is really there.
- Student backtrack if called on this, and try to bring up a "correct" answer, but interviews suggest they really only believe in the pure states.

In Q&A, Joe Redish opined that this situation may not actually be that bad. At least students are heading in the right direction, even if they haven't reached the end yet.

FA05: A Survey to Investigate Student Understanding of Quantum Tunneling – Jeffrey Morgan, University of Maine.

This work was part of an attempt to break the "energy == amplitude" link in many students' minds (as seen in FA02).

Upperclassmen and grad students were interviewed, and the results were used to develop a survey. Both the interview results and the survey results were used to help develop the course described in FA02.

In looking at tunneling, students get confused by the graphs that show both probability amplitude (Ψ) and energy of barriers on the same vertical axis. Common mistakes include drawing the amplitude oscillating around the energy of the particle, rather than around zero.

Students tend to see the reduced amplitude of a tunneling particle as indicative of a reduced energy, when it's really just a reduced probability. Classical analogies of crossing barriers also tend to get in the way (i.e. the wider the barrier, the more energy is lost).

The original survey was multiple choice, but it had too many options per question, so they switched to a short answer format, and expanded sketching tasks.

Students tend to correctly answer questions about probability, but consistently think energy is lost during tunneling.

FA06: Student Learning of Quantum Mechanics – Homerya Sadaghiani, the Ohio State University.

Looking at physical understanding of mathematical representations:

- Students tend to conflate $\langle x \rangle$ (expectation value) with $|\Psi(x)|^2$ (probability)
- Students have trouble going from physical description to mathematical formalism, and vice versa.

12 high-performing sophomores in a reformed 200-level physics course were interviewed (on classical probability), and all 61 students took online surveys (on the Stern-Gerlach experiment). In addition, the final exam was analyzed.

Survey responses were at the level of random guessing.

In general, students had trouble with abstractions, and performed better when given numbers to plug into an equation, or pictures to analyze. Transfer between their math courses and physics was rare, it's possible that the terminology tripped up the students and prevented them from making links.

In addition to the problems with transfer and abstractions, students did poorly on quantum probability.

FO – PER: Bridging Session: Transfer (invited)

FO01: Is Transfer Ubiquitous or Rare? New Paradigms for Studying Transfer – Jose Mestre, University of Massachusetts.

The talk opened with a recapitulation of the differences between classical transfer and what I'll call neo-transfer to keep things clear (see BS03 for more on that). Also, there were a LOT of bulleted lists in this talk, and not a lot of time to absorb them, so there will be things stuck into my notes that don't seem very connected. Sorry about that.

Neo-transfer is the "Ability to apply knowledge or procedures learned in one context to new contexts." (Mestre, 2003)

Traditional definitions are researcher-centered and blind to student processes.

Three dichotomies were presented to characterize an instance of transfer:

- Lateral or vertical (in level of complexity)
- Specific or non-specific (in context)
- Near or far (in similarity between current and old contexts)

The near/far scale breaks down along the following taxonomy:

- Knowledge Domain (type of subject)
- Physical Context (location of user)
- Temporal Context (now vs. later)
- Functional Context (how you use the understanding)
- Social Context (individual vs. group)
- Modality of Presentation (written, hands-on, listened to, etc)

The dimensions of assessment are as follows:

- Theory for assessment:
  - Empiricist – reductionism
  - Rationalist – structures
  - Sociocultural – cultural entity
- Level of assessment: how near or far from original task.
- Function of assessment: formative vs. summative.

The relationships between these dimensions are vital.

Classically, transfer is rare and generally just looked for at the near similarity.

Neo-transfer is broad, about dynamic activation of knowledge in response to a context. It focuses on student processes, thoughts, etc.

Examples of neo-transfer include:

- diSessa's "Knowledge in Pieces", with coordination classes, readouts (observe information from the world), causal nets (make inferences from the readouts) and concept projection (strategies for acting).
- Lobato's "actor-oriented model of transfer".

- Resources and Framing viewpoint (Hammer, Elby, Redish, Scherr, et al), with activation of resources, framing, unitary ontologies (big chunks) and manifold ontologies (small chunks).

Neo-transfer opens up new questions. Work with the two ball problem (one track has a valley in it) shows that expectations can make even fairly intelligent and well-trained people see things that are unphysical.

Neo-transfer is readouts interacting with expectations, and it is very chaotic, with strong dependence on alignment and on context. In this view, transfer stops when things **appear** to be correct, not necessarily when they **are** correct. It's inefficient, mediated by language.

Look for <u>Transfer of Learning from a Modern Multidisciplinary Perspective</u>, Information Age press (2005 projected).

FO02: Assessing Transfer of Conceptual Understanding – Karen Cummings, RPI/Southern Connecticut State

This talk sticks with the classical view of transfer. She makes the analogy that classical transfer is to neo-transfer as thermodynamics is to statistical mechanics. Observables versus guts & bolts.

Transfer = Apply "correct" knowledge gained in one setting in a <u>new, different setting</u>, or in a <u>new situation</u>. For example, a student learns F=ma in your class, and later applies it correctly in a subsequent course.

Claim: Understanding transfer is difficult.

Claim: Transfer generally doesn't happen.

Project: Measure transfer from basic math and physics classes into later engineering courses (using TESRI), assess attitudes, and see how teachers "teach for transfer". Try to find a good pedagogy to help with transfer. The project is supported by a CCLI grant at RPI.

The math side of the project is well underway, the physics side is still getting started. In order to set things up, they need examples of retention (zero-distance transfer), near transfer (tweak a problem) and far transfer (anything else). They have picked an intro physics course and the two engineering courses that have it as a prerequisite. One engineering course represents relatively near transfer, the other is clearly far transfer. The FCI is used in the introductory physics course to test retention.

TESRI, mentioned above, is the Transfer Environment and Student Readiness Instrument. It's similar in format to the RTOP, but covering transfer instead of interactivity.

Examples of measures of student attitude include:

- Learner Readiness – whether they see the curriculum as a unified whole or a bunch of scattered parts.
- Personal Capacity – how they think of inter-course connections.
- Positive Personal Outcomes – external motivations, such as grades.

- Intrinsic Motivations – desire to use the understanding elsewhere (an example was a PBI-Circuits student who fixed a power cord at home using ideas learned in class).
- Self-Efficacy – confidence in their own abilities and performance.

Attitudes and expectations are inseparable from transfer, and research has shown that improving attitudes and expectations is **very hard**. The MPEX results show that student attitudes often get worse after instruction, in fact.

On the topic of "teaching for transfer", it helps if instructors explicitly show examples of transfer. For instance, relating the above example about the power cord.

Encourage Metacognitive skills: think about your thinking, explain your reasoning, justify your answers, etc.

Give students opportunities to practice transfer!

Model transfer skills for the class. Make students explicitly aware of transfer and the need for it.

Teaching for transfer takes multiple academic terms, so multitasking is important.

FO03: Measuring the Transfer of Mathematical Skills – Manjula Sharma, University of Sydney.

Examined the following two main points:

- Transfer of high school math skills to college science classes.
- Training and professional development as the goal of a University education.

The workplace is demanding flexibility and an expert-like attitude (expertitude?), so both retention and transfer are vital.

Short-term, specialization-focused training can impede the ability of students to transfer their knowledge, or even to gain transferable skills later on.

Transfer takes effort, and if you push too hard the wrong way it may hurt motivation.

The high school math study involved exponentials and logarithms, topics that science-bound students should have studied in high school and will need for pretty much any science track in college. Freshmen were studied for three years, given a transfer test on these topics. Some items were context-rich, others were "naked" math.

The results were split into four groups by two dichotomous variables. The first was "Good/Bad" at the context-containing problems, the second was "Good/Bad" at the math-only problems. So, GG would be good at both types of problem, GB would be good at problems with a physics context but bad at the math-only problems, etc.

GB students may have lost specific mathematical knowledge or skills, but they are adaptive enough to make up for it when there's a context.

All students recognized the content ("I've seen that before"), even if they no longer remembered details.

Most students ranked the context-bearing tasks as more difficult. There was more to do, and they had to use multiple representations.

Students had varying expectations for the links between math and science, such as: it's just a tool, math is a link to the real world, math is the language of science, math IS reality, etc.

Topic shift.

Developing Adaptive Expertise – once automated, skilled responses are somewhat dependent on contextual clues for activation.

- Rule-based (provide rules) vs. Exemplar-based (provide examples)
- Try to avoid automation, instead disrupt patterns and force the student to think.
- Provide a greater contextual variety.
- Increase attentional effort during the exercise.
- Use self-assessment.
- Facilitate the development of rules and schema extraction.

Evaluation goals:

- Introduce unpredictability and variation.
- Use advance organizers (pre-made curricula)
- Practice should be spaced out, not massed.
- Faded feedback (hold back the feedback until after self-assessment).
- Errors as learning tools.
- Longer term follow-up and evaluation.

There was also a list of motivational points, but at this point the time limit was approaching, and with it the inevitable "flash through the slides as quickly as possible" race.

Draw from training literature to improve our transfer teaching. A mixed-method approach is best.

Thursday, August 5, 2004

PER Conference

As there will be a Proceedings for this, I did not take very extensive notes on this day, just a few things here and there that caught my interest.

First off, a note in case anyone involved in organizing the next PERC reads this: make sure the venue doesn't have cheap, badly made overhead projectors that aren't meant to be used in any room with a capacity of more than 20. The slides for one of the speakers at the invited session were totally unreadable because the projector supplied by CSUS's Union was incapable of actually focusing on more than about a fifth of the field of view at once. I ended up leaving the session with a headache.

In Daniel Schwartz's talk, he presented a two-dimensional plot of adaptiveness/ innovation versus efficiency, and how it related to training and education.

Novices are neither adaptive nor efficient. They can be turned into Routine Experts via Thorndykian drill, or into "Dreamers" via a method of pure discovery. The end goal of education, however, should be the Adaptive Expert, who is capable of both innovation when the need arises and simple efficiency during routine tasks.

Attempting to travel to Adaptive Expert via the Routine Expert step is very difficult, as drilling tends to stifle innovation. It's better to get novices into the Dreamer phase and then drill them in the basics once they have good solid habits of adaptiveness.

In diSessa's talk, he introduced three types of transfer: Type A, Type B, and Type C.

Type A – fully developed coordination classes transfer easily, but are hard to make. This is the type of transfer seen in common experience.

Type B – wasn't defined, or really ever mentioned again.

Type C – Little bits and pieces transfer all the time, but it's hard to measure this.

Workshop W-A, "Getting Articles into Journals" was run by Robert Beichner of North Carolina State University. It was roughly equal parts general writing/submission advice, reviewing technique, and Q&A about the upcoming Physics Review Special Topics: PER online journal (PhysRev STopPER?).

PRSTPER will only take submissions laid out in RevTeX, which is intended to keep the production costs low (since it's online, most of the production costs involve paying for editorial time). Submissions made before the end of 2004 will be free, with a slowly increasing page rate thereafter ($25/page in 2005, then boosted to $50 and eventually probably reaching the "industry standard" of $100/page). It is recommended that those writing grants include a publication budget so that later work can be put in the PRSTPER without taking a bite out of personal funds or other research money.

Reviewers are being actively sought. The goal is to have a one week review turnaround on articles. It is **strongly** recommended that you get someone to proofread your article before submitting it, so that reviewers don't need to waste time fixing your spelling and grammar. Speaking as someone who has done editing for friends, proofreading your own work isn't enough...everyone has blind spots, and many errors you make in the first place will also be errors you simply don't notice during proofreading.

Speaking of which, time to go over all the things Word says I did wrong and argue with it before mailing this document out. See (some of) you in Albuquerque!