Student motivation and engagement in developing broader skills, e.g. problem-solving

Pedagogical Design:
e.g. ill-structured problems

Student motivation, beliefs about purpose of higher education, broader skills

Implementation:
cases, pslp, pathfinder, assessment
Student Motivation

- Attention
  - gain and keep the learner's attention,
    - Passion about skills, and/or scare them: job outsourced
- Relevance
  - Be explicit about the direct benefit to the student
    - Complex world, vital they develop/practice these skills
- Confidence
  - Support initial efforts, positive feedback on small-sized tasks,…
- Satisfaction
  - Provide a sense of achievement.
- Are we addressing all four?
  - First 2: be explicit. Last 2: scaffolding, ramp-up to larger tasks
Intellectual development of students (I)

- Core student-beliefs about what is knowledge/learning
  - Perry scheme and others

1. Duality
   - all problems are solvable
   - the student's task is to learn the right solutions

2. Multiplicity
   - attempts to account for diversity in human opinion
   - often becomes a new certainty of "we'll never know for sure,"
   - what is most important is one's own thinking.
   - arbitrary basis for determining what's right
     - hence an attitude of "do your own thing" or "anything goes"

Adapted from http://www.perrynetwork.org/schemeoverview.html
http://www.cse.buffalo.edu/~rapaport/perry.positions.html
3. Contextual Relativism

- Propose solutions and support these by reasons;
- Some solutions are better than others, depending on context.
- Student's task is to learn to evaluate solutions.

4. Commitment

- Develop and judge possible solutions using both intellectual and ethical considerations
- Consider choices in the face of legitimate alternatives
- Integrate knowledge learned via personal experience using reflection.
Question

Dualist, multiplicity, contextual relativism, commitment

- Estimate the average shift of positions a typical student has during his/her four years at college
  - e.g. from Duality (1) to Commitment (4) is a shift of 3
  - 1. average shift ~ 1, or less
  - 2. 1 < average shift < 2
  - 3. 2 < average shift < 3
Intellectual development + ill-structured PS

1. Duality
   - the student's task is to learn the right solutions

2. Multiplicity
   - arbitrary basis for determining what's right

3. Contextual Relativism
   - Propose solutions and support these by reasons;

4. Commitment
   - Integrate knowledge learned via personal experience using reflection.

When can students benefit from ill-structured tasks in courses?
- In freshman year so they kick-start their intellectual development?
- Takes time to develop these skills and to build integrated knowledge for ill-structured tasks
- Or is this too much a clash for “duality” students?
2008 National Survey of Student Engagement (NSSE)

Five clusters or benchmarks of effective educational practice established by NSSE:
1. Level of academic challenge
2. Active collaborative learning
3. Student-faculty interactions
4. Enriching educational experiences
5. Supportive campus environment

The benchmarks are expressed on a 100-point scale.

For each question in cluster, the best response =>100, worst response =0
Linear in between these two
Average is then calculated for all students, all questions in cluster
### Selected Student¹ and Faculty² Views of Level of Academic Challenge

<table>
<thead>
<tr>
<th>Task</th>
<th>Lower Division Students</th>
<th>Lower Division Faculty</th>
<th>Upper Division Students</th>
<th>Upper Division Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memorizing facts, ideas, or methods from your course and readings</td>
<td>61</td>
<td>56</td>
<td>61</td>
<td>56</td>
</tr>
<tr>
<td>Synthesizing and organizing ideas, information, or experiences</td>
<td>41</td>
<td>63</td>
<td>63</td>
<td>68</td>
</tr>
<tr>
<td>Applying theories or concepts to practical problems or in new situations</td>
<td>37</td>
<td>73</td>
<td>68</td>
<td>77</td>
</tr>
</tbody>
</table>

1. Percent of students who responded their coursework emphasized item "quite a bit" or "very much."
2. Percent of faculty who perceived students' coursework emphasized item "quite a bit" or "very much."

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**Lower division students:** Content is new, complex.

**Faculty:** baseline knowledge

**What would happen to student academic challenge, if faculty increased synthesizing, application tasks?**
Increase student motivation

- ARCS
  - Attention, Relevance, Confidence, Satisfaction

- Increase student sense of relevance, or buy-in to academic challenge
  - What set of skills am I trying to develop while at ISU?
  - How can I grow intellectually, professionally?
  - How can I use the challenges of each course to further my goals?

- Individual courses
  - Bring these implicit goals to the open, e.g. ill-structured problem-solving
Problem-Solving Beliefs in Sophomores/Phys 222

- Students asked to reflect and describe their preferred method of solving physics problems
  - At start of semester and at end of semester

- ~ 400 responses coded (blind to pre/post)
  - List known quantities
  - “match” between equation and known quantities “Roladex”
  - Find similar example in text
  - Diagram
  - Identify main concepts
  - Qualitative analysis
  - Identify sub-problems

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Listing Knowns

- The very first thing that I do is rewrite the information on the side so that it is easy to see and understand since it often gets confusing throughout a story problem.

- I write down the known facts and what I need to find. I assign variables to each fact--known or unknown alike. My biggest problem is finding information that isn't needed in the problem, and therefore, waste time.
Equation Matching/Roladex

- I read through the problem noting the information given. Then I look for a formula that involves these variables.

- My general approach to a physics problem is to write out the given information then try to match what we are given to an equation on the sheet. This is fairly efficient for simple problems, but much more troublesome with complex problems.

- I usually figure out what variables I have and what I need to find. Then, I look for a formula that contains all of those variables and solve for what I need.

- Despite your warning against it, I still go equation-hunting. Equations are basically models of concepts, and so it's the equivalent of looking for the right concept. However, most of all, it works.
Qualitative

- Also, I think it's very important to talk myself through it qualitatively before touching any numbers or equations. After using equations and getting an answer, I ask myself if it makes sense.

- One of the first things I like to do is draw a picture that represents the problem. This helps me better understand what I am dealing with and what I will be looking for. If, after this, the problem is still confusing, go through my head at what would make logical sense in solving the problem. Sometimes for it to make sense, I have to imagine myself in the situation and think about what would occur in this situation. Once I think I understand what is happening, I look for the formula(s) that relate to the problem.
More expansive strategies prevalent post-instruction

“Limited” strategies still mentioned post-instruction: robust because these work for simple problems
Systemic Change (I)

- CELT currently focused on faculty development => student learning
- How to get students to think about their own development
  - Partnership with GSB/CELT/Registration/Advising?
- Structured reflection for every student, start of each year
  - Peer review, so the audience is 2-3 other students who provide feedback/reaction, authentic audience
  - Done during registration?
  - [http://cpr.molsci.ucla.edu/](http://cpr.molsci.ucla.edu/) or eDOC
Systemic Change (II)

- How to get students to think about their own development (II)
- Student-owned “Alverno-style” or “ABET-style” broader skills
  - Matrix of broader skills, e.g. communication, group work, problem-solving
  - Each at different levels
  - Fill out which courses each semester helped you (or will help you) develop which skills
  - Registration, or as part of advising, or as part of course evaluation

……..
Summary

All three are important and perhaps necessary to achieve student growth.
Backup Slides
Selected Student\(^1\) and Faculty\(^2\) Views of Student Learning

- Learn something that changes the way students understand an issue or concept:
  - Lower Division Students: 56%
  - Lower Division Faculty: 51%
  - Upper Division Students: 47%
  - Upper Division Faculty: 55%

- Put together ideas or concepts from different courses:
  - Lower Division Students: 54%
  - Lower Division Faculty: 24%
  - Upper Division Students: 72%
  - Upper Division Faculty: 53%

\(^1\) Percent of students who responded they did item “often” or “very often” during current year.
\(^2\) Percent of faculty who reported they perceive students did item “often” or “very often” during current year.