

Reflective problem solving skills are essential for learning, but it is not my job to teach them

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Goal of this Study

Students in introductory physics are expected to learn physics content through the process of solving problems.

- What learning skills do physics instructors believe students need in order to learn from problem solving?
- What learning skills do physics instructors believe students possess when they enter an introductory physics course?
- How do physics instructors believe they can help students to improve their learning skills during the introductory physics course.
- Why do they believe so?

This is one part of a larger study on physics faculty beliefs and values related to the teaching and learning of problem solving.

Data collection

Sample:

- 6 Physics Instructors at U of MN, Randomly Selected out of 23 that meet selection criteria: taught introductory calculus-based physics course in the last 5 years

Semi-Structured Interview Tool:

- Based on concrete instructional artifacts (problem statements, instructor solutions, grading)
- Interview questions: please describe how these artifacts are similar or different to yours. Please explain your reasons for having these artifacts the way you do

Interviews were videotaped and the audio portion transcribed:

~ 30 pages of text/interview

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Video- & audiotapes of interviews (~9 hrs)

Interview transcripts (~180 pages)

Statements (~2400)

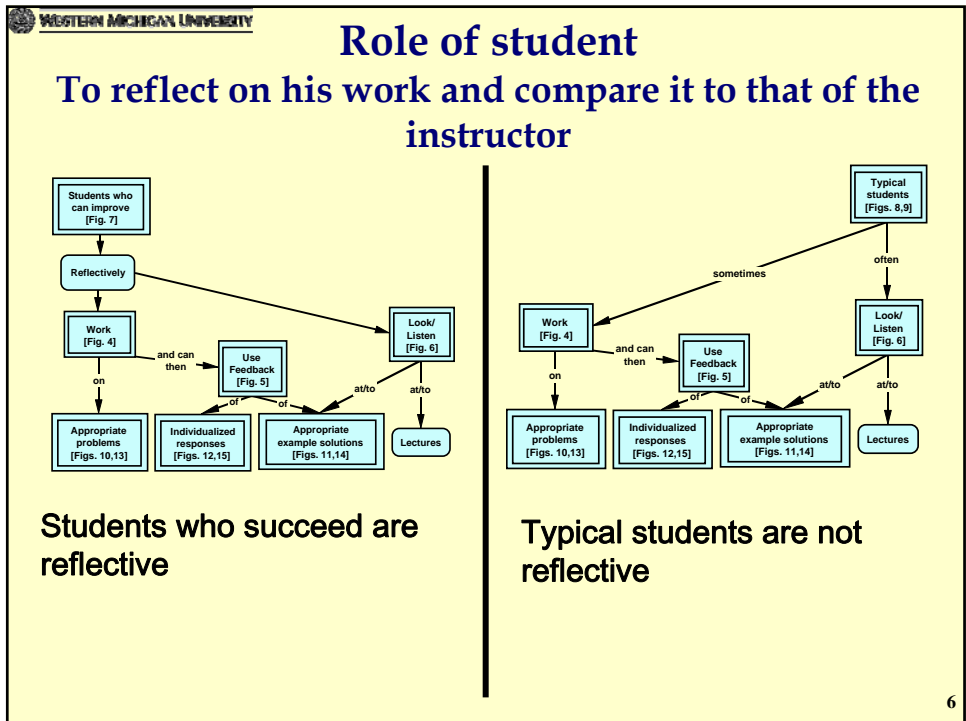
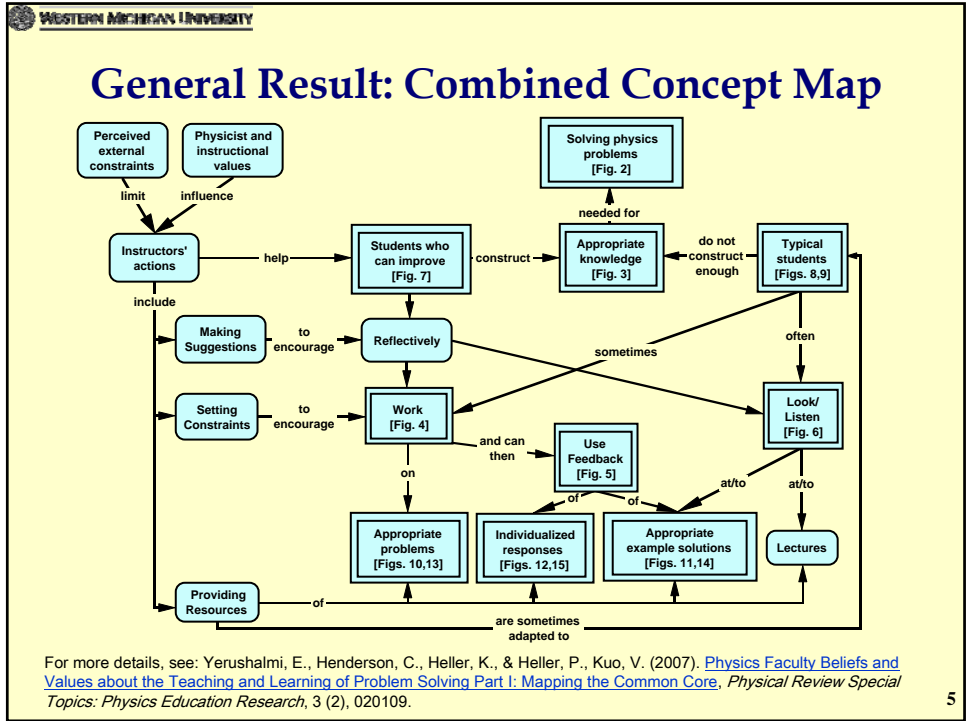
Concept Maps (15 x 6 = 90)

Combined Concept Map (15)

Concept Maps allow for:

- the **reduction** of complex data into visual representations
- **explicit connections** to be made between ideas that can then be tested
- Identification of **shared vs. idiosyncratic** features

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Role of student

Examples of reflective activities:

“Students would *analyze their test solution* and maybe my test solution to see where the *major differences* are, and then try to work on it.”

“you have to discipline yourself to say what, *why did I write this down.*”

“go through the *strategy part of the problem* saying ‘what do I need to know for this problem, and what are the parameters that are specified, and what are the things that I have to calculate.’”

“I try to get students to *think consciously about their general approach... not just sit and wait for lightning bolts to strike.*”

Examples of typical student activities:

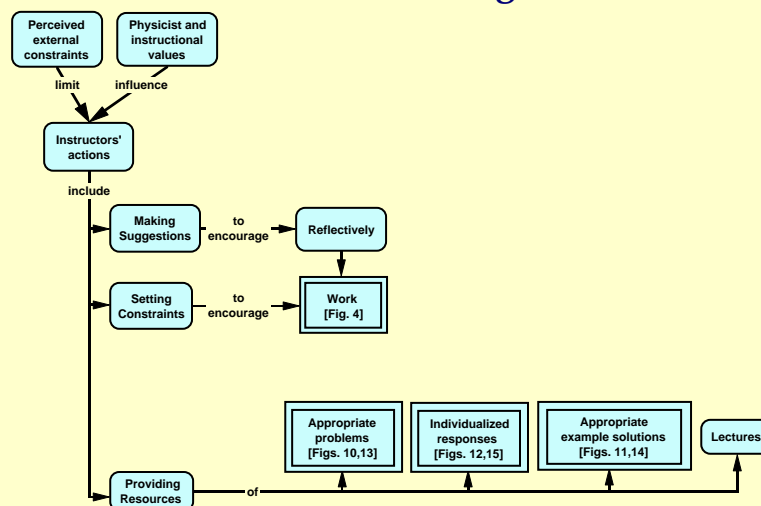
“When students do HW or solve problems it’s so tempting to just *look at solutions after working 2 minutes* if you don’t know what to do.”

“Students spend large numbers of hours just doing problems but *not doing them with a disciplined approach.*”

“There are many students who make a mistake on the quiz and say ‘*well, that was a mistake*’ and then they’re not interested anymore.”

Role of instructor

Instructors Suggest Reflectivity, but Require ‘Working’



Role of instructor

“I often tell students that if they are having difficulty that what they should do is look at a lot of problems, not necessarily work them, but look at the problems and then go through the strategy part of the problem saying to themselves ‘what do I need to know for this problem . . .’”

“What I often say is that they have to solve problems without looking at solutions, and if they get stuck, talk to someone specifically about what the next step would be, . . . so they don’t get . . . away without thinking on their own.”

Instructors are Aware of the Gap!

“Unfortunately, there is a big gap between what I would like students to do with solutions that I post and what I'm fairly sure they are doing with them... A large fraction of students are focusing too much on the very problem at hand ... as opposed to the structure of the problem.”

“When I do solutions on the board during class I hope that students just see how a professional thinks about these sorts of things. Of course I suspect in many cases they adopt the superficiality of it.”

How Do Instructors Explain Why They Do Not Impose Reflective Practice?

Three Perceived Constraints:

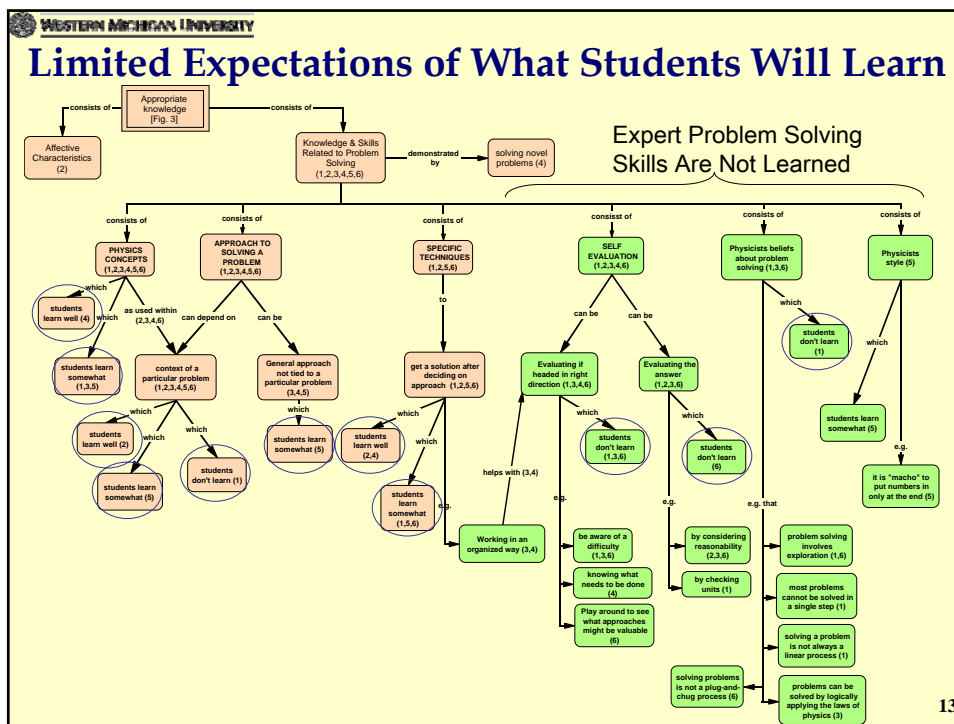
1. **Workload:** Instructors have limited time that they can commit to the course.
"I think engaging students and getting them to do something, no matter how wrong it might be, getting to do something on their own while you help them is, I think, the key. It's labor intensive though."
2. **Student Expectations:** Students might react negatively to requirements such as providing a reasoned approach to the solution.
"If I had given this a low score and the student came back and said 'but I got it right' I would tell them that they didn't show that they were using the right principles. I usually give them the benefit of the doubt when grading."
3. **Assessment considerations:** Instructors recognize that reflective practice is not assessed.
"There's nothing specifically that we test for that really brings these things [reflective problem-solving skills] out."

How do Instructors Resolve the Conflict?

Have Limited Expectations of What Students Will Learn

"The types of things in this stack [reflective problem solving skills] are not built up over one course ... I hope they learn some of it in the course, but it's not, these are things that aren't in the syllabus and that you hope over 4 years of a university education, that they cultivate."

Instructors don't expect students to develop reflective skills during the course. Yet, they believe that students without these skills will not succeed.



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Discussion

Instructors highly value reflective practice. They perceive it as necessary for success in the course. Yet, they do not impose it on students.

A possible explanation for this apparent conflict:

It is a norm in introductory physics courses that reflective practice is not assessed. Thus it is a lower priority and instructors are not committed to invest time (their own and in class) to constrain students to achieve it.

"If I had given this a low score and the student came back and said 'but I got it right' I would tell them that they didn't show that they were using the right principles. I usually give them the benefit of the doubt when grading."

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Implications

1. We don't have to invest effort to convince instructors of the need to develop reflective learning skills
2. A possible key for change – renewed assessment goals
 - Develop and suggest accessible assessment tools that assess reflective practice