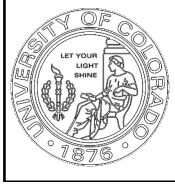
Physics 4460/5460-

Day 3: Digging into Theory

Theory without practice is empty;
practice without theory is blind
- adapted from Kant



Admin

- Good Work / Discussions
- Reading summaries [now explicit on website]
  - Moving to D2L
    (have available for class too (laptop, hard copy, etc)
- Fieldwork
  - / Sites - it's okay to swap & adapts
  - Fieldnotes… do 'em
- Always good to think about projects
  - But don't stress
  - Steady continual progress is what we seek

- ***It's mind-boggling how much research has been and continues to be done! It's a bit overwhelming; there's a lot to sort through!***

Today

- Really about Theory
- More on practical Thurs
  - Peer Instruction
  - Next week:
    - Just In Time Teaching
    - ILD
- Clarifying questions… ?

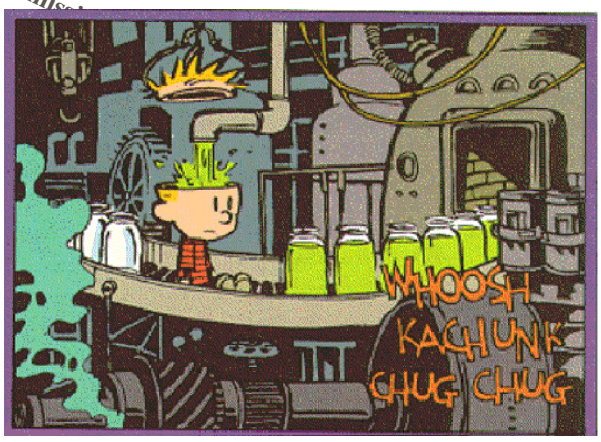
But my favorite JiTT

I thought Sagredo was a 'virtual colleague'(pg. 8). Now he's cropping up in more and more legitimate anecdotes. What's going on? Are the anecdotes made up by Redish to help him make a point? Or is Redish using the name Sagredo to protect real colleague's self esteem? Or is Redish going crazy?!

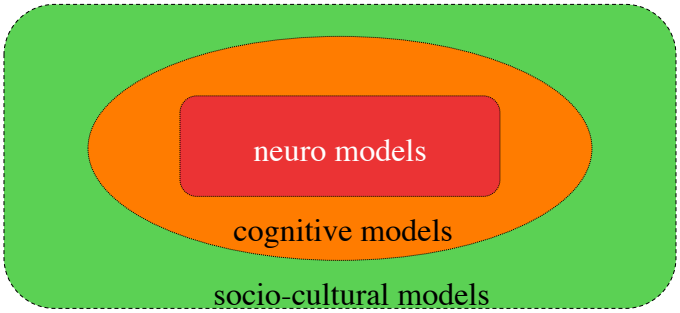
From: Edward Redish
Date: September 16, 2008 11:45:25 AM MDT
All of the above, Noah. All of the above.

Model of student learning?

Individual ← Instruction via transmission — Content (E/M)



Focus on models of cognition



Understanding Terms / ideas

comfortable with the following ideas?

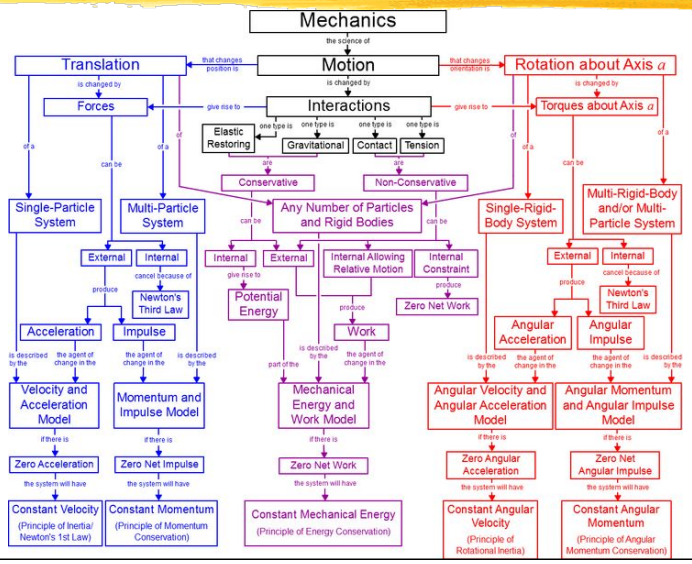
- instructionism vs. constructivism
- prior knowledge
- assimilation
- accommodation
- coaching, scaffolding,

It suggests that the ideas we're talking about are big ones (like special relativity or quantum mechanics), but I think the framework of central ideas & conceptual ecologies should apply just as well to small ideas

In groups:

- Consider the different grain-sizes, units of cognition. What are they?
  - Concepts
  - Theories
  - P-prims
  - Facets
  - Touchstone / Anchor problems
  - Schema
  - Central concepts
- Are these descriptions compatible?

Knowledge vs. Information



Redish: Constructivism & General Principles

- What are his principles and what's missing?

What are our goals?

- paraphrase

The constructivism principle

Principle 1: Individuals build their knowledge by making connections to existing knowledge; they use this knowledge by productively creating a response to the information they receive.

PER Theoretic Background

Individual ← Instruction via transmission → Content (E/M)

transmissionist

Individual (Prior knowledge) ↔ Construction constructivist → Content (E/M)

constructivist

Let's apply what we learned

- I want you to memorize the following number in order
- 3 7 3 2 3 7 1 9 4 5 5 3 0 0 1 7

G. Miller - magic number: 7 +/- 2

what was it?

- how many numbers did you get?
- 3 7 3 2 3 7 1 9 4 5 5 3 0 0 1 7

G. Miller - magic number: 7 +/- 2

This seems incredibly important to me. By being careful not to overload one side of the student's working memory, it seems one can nearly double the effectiveness of instruction.

7 +/- 2 is that it?

Now try the following:

1 7 76 1 8 6 5 1 9 4 5 2 0 1 5

How'd you do?

1 7 76 1 8 6 5 1 9 4 5 2 0 1 5

You all are brilliant!

what's the difference?

Does chunking work for anything?

d l s	c a t	t h e
k e l	d o g	b i g
t y u	t a g	d o g
x b m	g y m	r a n
j o r	o a r	t o o
o h k	l u g	f a r

Chunking

- it seems that he's saying your physics knowledge naturally forms into chunks the further into your education you get

Cognitive underpinnings of practices

How to deal with Prior Knowledge:

- elicit -confront-resolve -- not really a cognitive model -- but basis for practice
- bridging -- step from p.k. to scientific knowledge

Models of cognition

- Full blown concepts /mis-concepts--
  - Heavier objects fall faster
- Schema -- organized structures that give rise to concepts
- Phenomenological primitives -
  "phenomenological" = from experience
  "primitive" = basic / irreducible unit
  (neither correct nor wrong

Change Principle

Principle 3: It is reasonably easy to learn something that matches or extends an existing schema, but changing a well-established schema substantially is difficult.

- Corollary 3.1 — It's hard to learn something we don't almost already know.
- Corollary 3.2 — Much of our learning is done by analogy.
- Corollary 3.3 — "Touchstone" problems and examples are very important.
- Corollary: 3.4 — It is very difficult to change an established mental model.

Ponser

- Key: first instance of theoretical basis for learning COUPLED with mechanism
- Gives rise to the

  Elicit – Confront – Resolve model

Posner: Theory of Accommodation

- What are conditions for accommodation?
- What is a conceptual ecology?
- What is Einstein's epistemology and why does this matter?

Utility of elicit-confront-resolve

Tutorials based on this approach (partly)

Example?

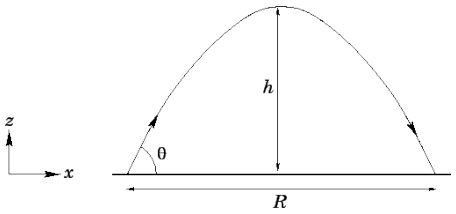
Consider 'Heavier Object Fall Faster than Light Objects"

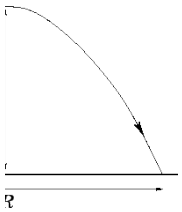
What is a way to confront?

P-Prims

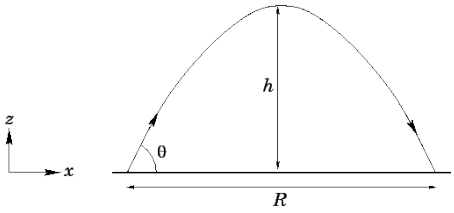
- What is Ohm's P-prim?
- What are others? Examples?

More on those p-prims





More on those p-prims



From p-prims:

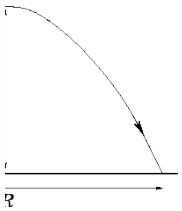
Ohm's law
Force as mover
Continuous force
Dying away
Dynamic balance
overcoming

From a (mis)conceptions views:

-impetus theory

Force given to object
overcomes gravity
dies away

- Should be consistent



How do we reconcile

- Posner
- DiSessa

It seems like the argument of this paper is that students' knowledge is neither coherent or fragmented, but maybe a bit of both.

… I also feel that maybe the two are necessarily mutually exclusive.

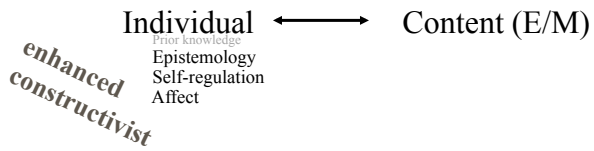
Is that it?

What's missing?

- Is there more than content & are these elements separable from content?
- What is the impact of elicit-confront-resolve epistemologically (belief about knowing)?
- Are concepts unitary?
- Does context matter and what is context?

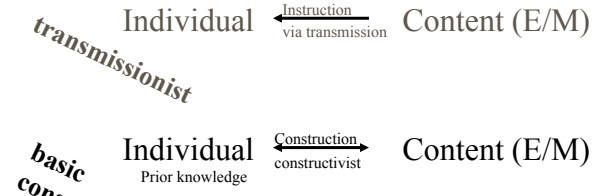
Where are we going

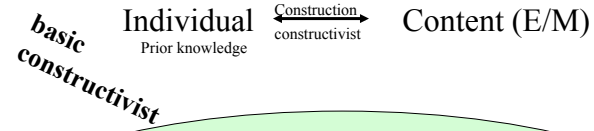
- Build back out …
- Realize there is more to education than "concepts"

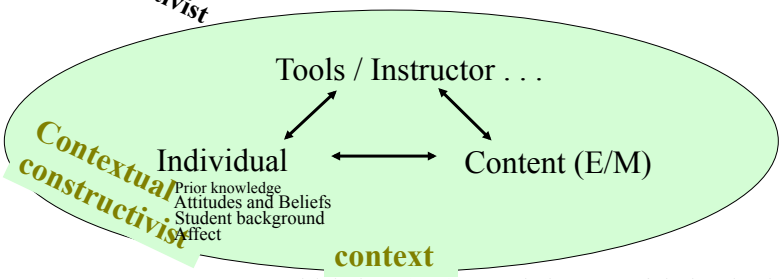


Paraphrase: students are tremendously affected by a positive attitude towards a topic.

PER Theoretic Background





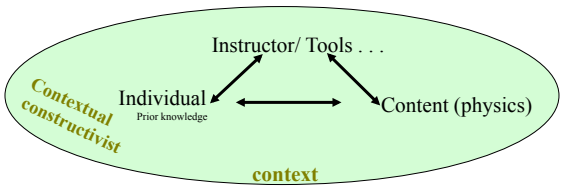


Finkelstein, N. (2005) Context in the Context of Physics Education, *IJSE*
Finkelstein, N. (2005-2011). NSF CAREER Grant: REC# 0448176

Theoretical Framework

Contextual Constructivism

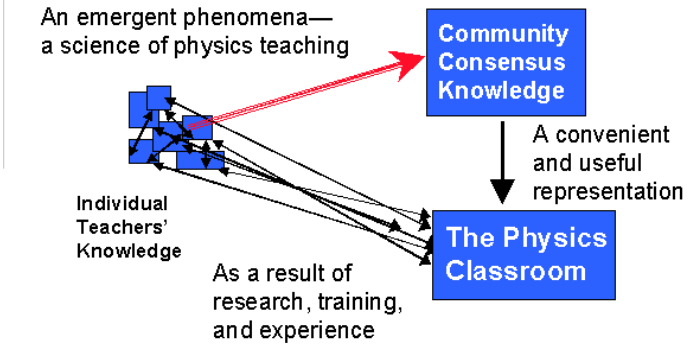
i. tools mediate our understanding / cognitive processes
ii. context shapes how we might use these tools



Finkelstein (2005), adapted from Cole, M. (1996), Cultural Psychology

Redish's community map

Building a community consensus map of physics education



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