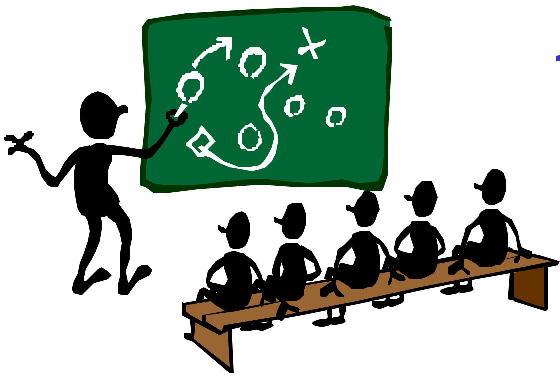
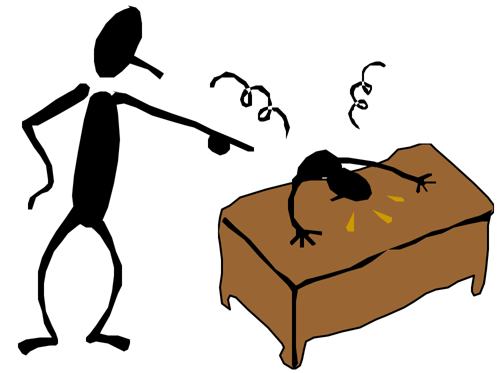
DE04: AAPT Summer 2001 Conference, Rochester, NY

Instructor's Beliefs and Values about Students Learning Problem Solving





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From Questions to Hypotheses

1: **Do physics professors have common beliefs about how students learn to solve problems in introductory physics?**

2: **How do instructor's ideas match with standard instructional paradigms?**

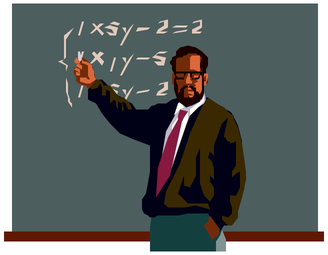
3: **What are the implications for curriculum developers?**

Calibration Sample

6 professors from a large state research university.

Known constraints and practices

Calibrate interview data with reality



Teaching Environment

- **3 lectures/wk – calculus-based intro physics class (200 students)**
- **Graduate TAs – recitation and lab –**
  - **Cooperative Group Problem Solving**
- **TAs grade tests**
- **1 meeting with TAs/wk.**
- **Physics Education Research Group exists – no direct contact**
  - **Cognitive Apprenticeship Instructional Models**

Test hypotheses with 24 additional interviews

State Universities, Private Colleges, Community Colleges

Analyze faculty interview

3 Artifacts are discussed

- Instructor solutions
- Student solutions
- Problem types

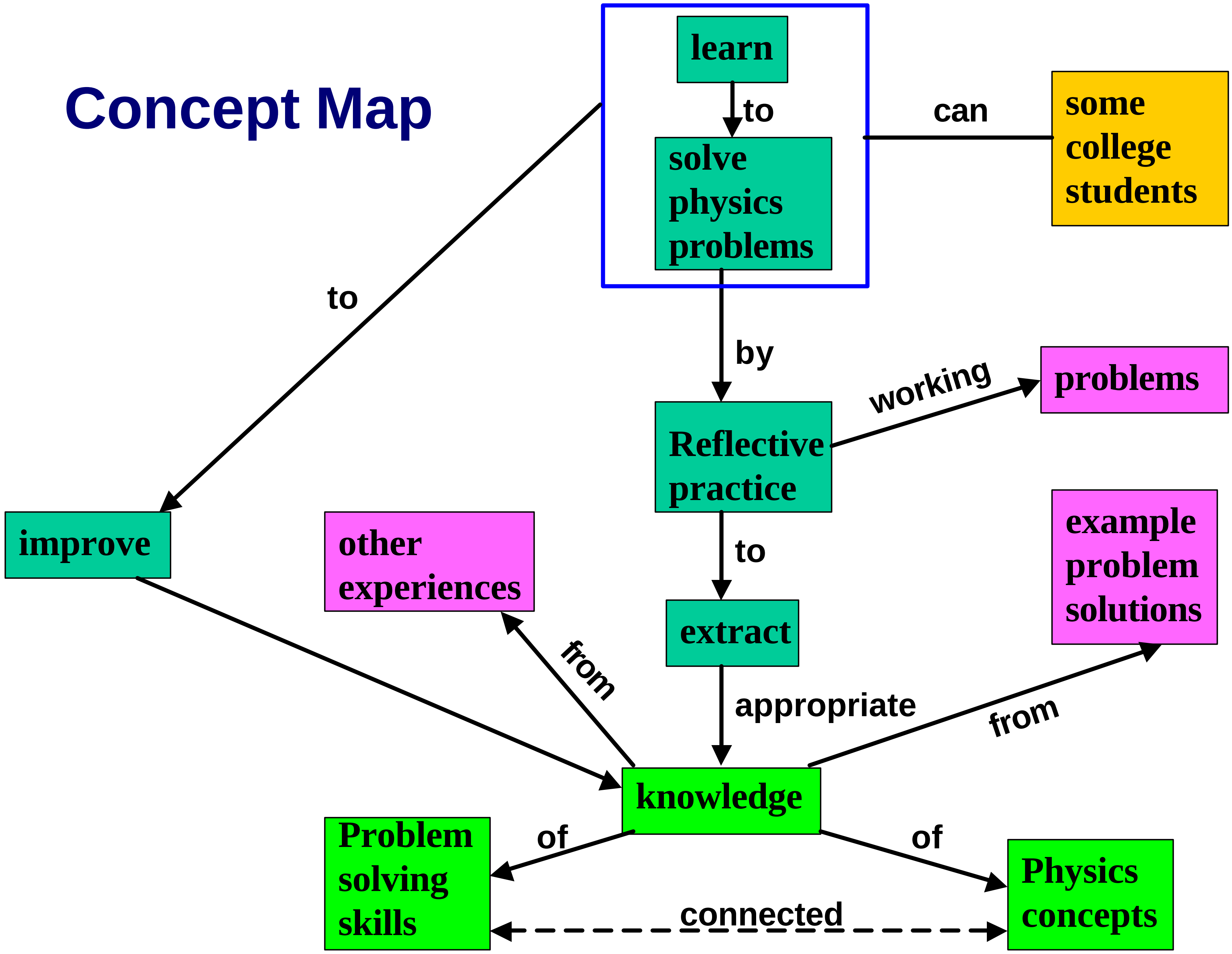
3 Concrete Tasks

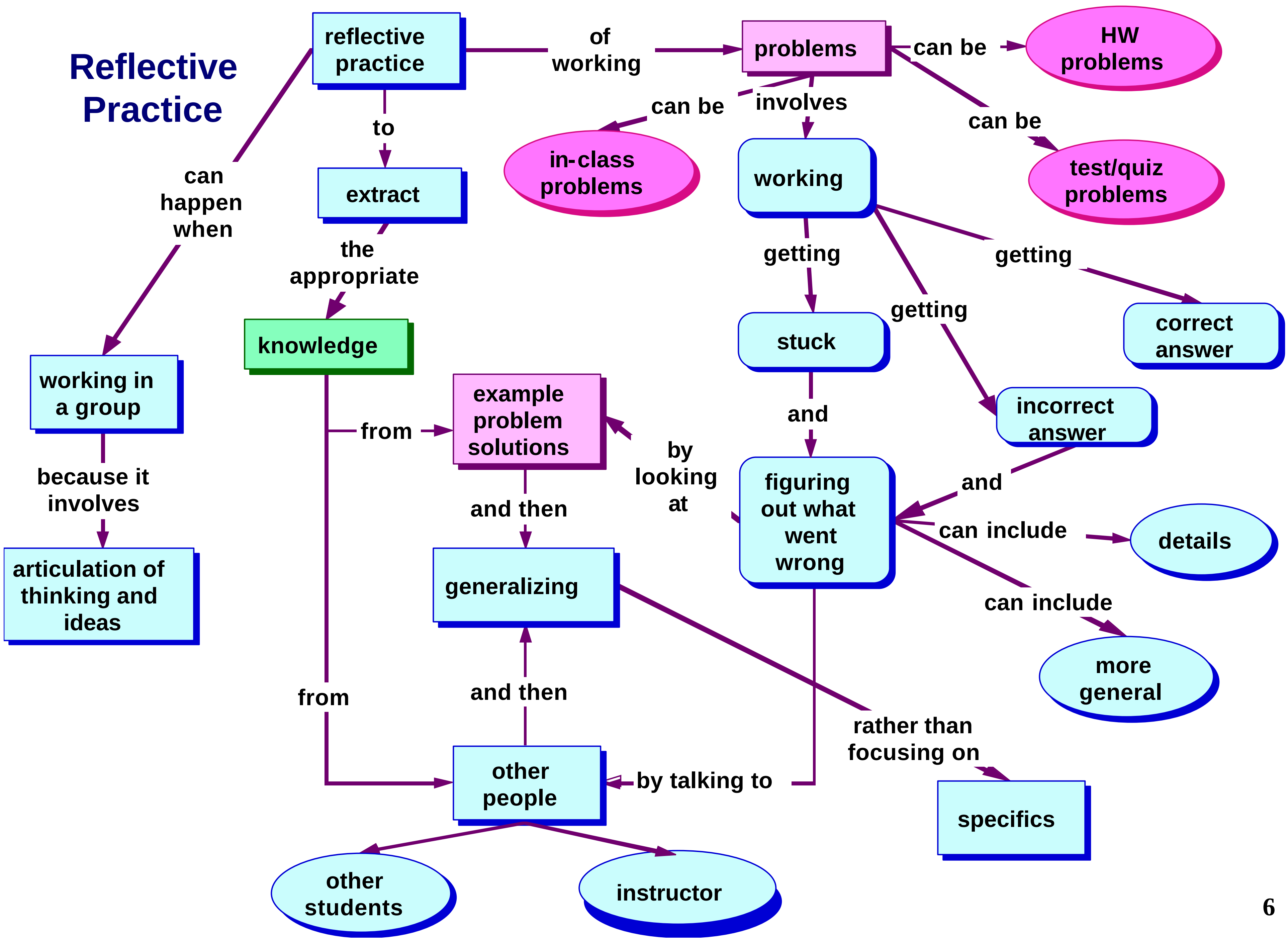
- Goals questionnaire (next talk)
- Grading student solutions (previous talk)
- Sorting statements about student problem solving

Analysis

- Link statements about how students learn to solve problems (30 pages of transcript/interview)
- Common pattern – composite concept map

Concept Map


learn
to
solve physics problems
can
some college students
to
improve
by
Reflective practice
working
problems
to
other experiences
extract
example problem solutions
from
appropriate
from
knowledge
of
of
Problem solving skills
Physics concepts
connected

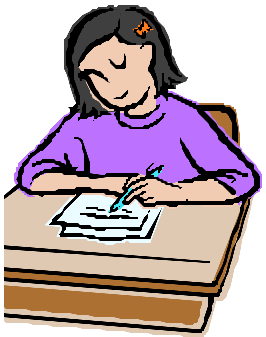


Reflective Practice
reflective practice
of working
problems
can be
HW problems
can be
in-class problems
involves
can be
test/quiz problems
to
extract
the appropriate
knowledge
can happen when
working in a group
because it involves
articulation of thinking and ideas
working
getting
stuck
getting
correct answer
getting
incorrect answer
and
figuring out what went wrong
and
can include
details
can include
more general
from
example problem solutions
by looking at
and then
generalizing
rather than focusing on
specifics
from
and then
other people
by talking to
other students
instructor

General Features

- **Students learn by doing**

  There is no set way for solving problems
  Problem solving is idiosyncratic



- **Students learn from others**

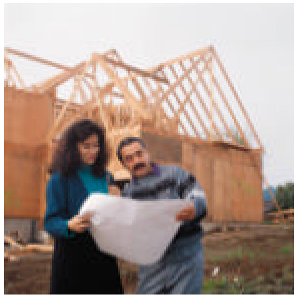
  Groups
  Other individuals
  Problem solutions

- **Learning requires metacognitive skills**

Some features of the cognitive apprenticeship model of instruction.

Missing

Scaffolding instruction
Use of general heuristics

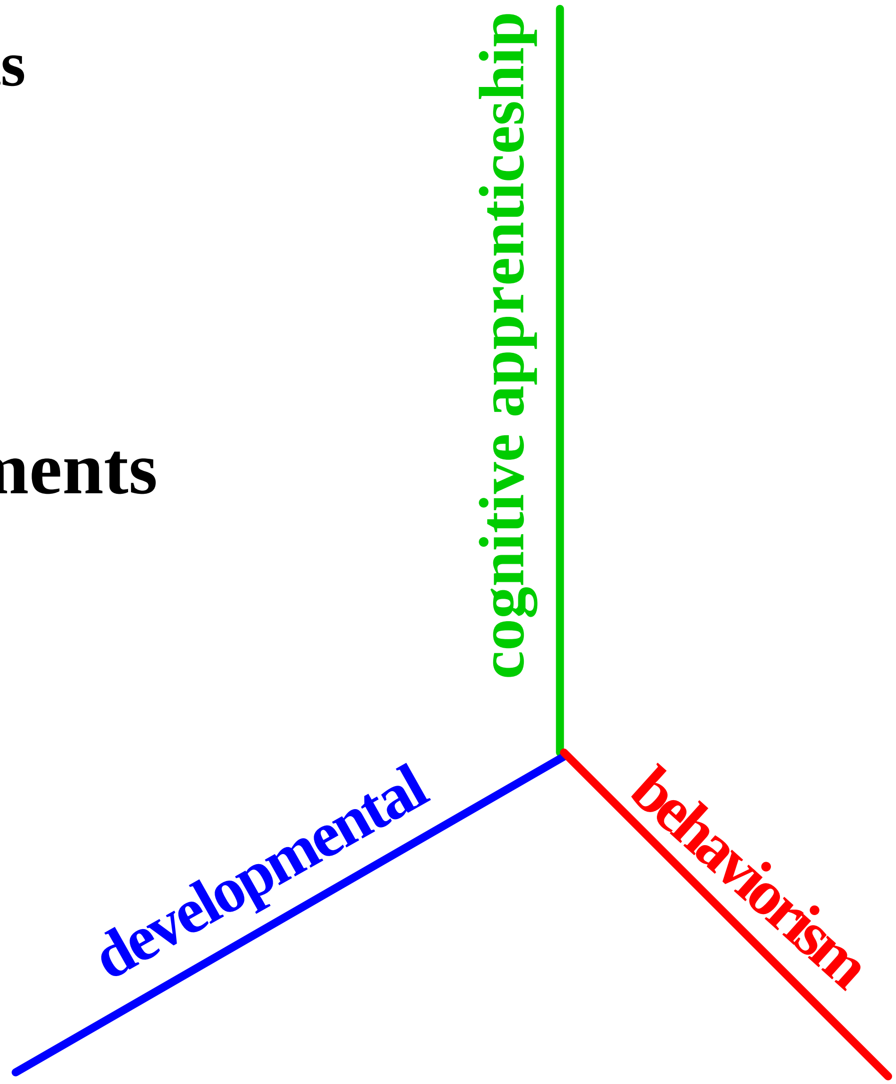


Instructional Paradigms

Rough check of concept map

Project faculty statements onto these axes

Classify individual statements and count.



Paradigm	Expert-Novice Difference	Instructional Mode	Teacher Actions
Behaviorist	amount of knowledge	incrementally add knowledge to the learner	provide the knowledge carefully broken down into essential components
Developmental	usefulness of thinking organization (schemata). Schemata are ‘universal” and must be developed in a sequential hierarchy. A new schemata replaces an old one.	confrontation with contradictions to existing schemata (disequilibrium). The learner constructs the new schemata	provides series of activities to create disequilibrium by confronting the known old schemata. Provides activities to guide the learner to build the desired new schemata.
Cognitive Apprenticeship	interconnections among pieces of knowledge and their organization. Interconnections depend on previous experiences and can be significantly different from individual to individual.	construction and reorganization of knowledge interconnection. New experience interacts with old experiences.	shows expectations in a context that connects to the learner’s experiences (modeling). The learner attempts a similar task with assistance (coaching). Help is slowly removed so the learner accomplishes tasks on their own (fading).

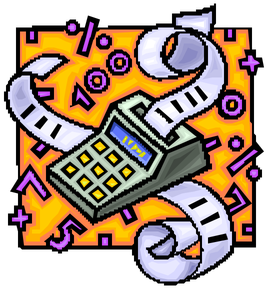
Sample statements

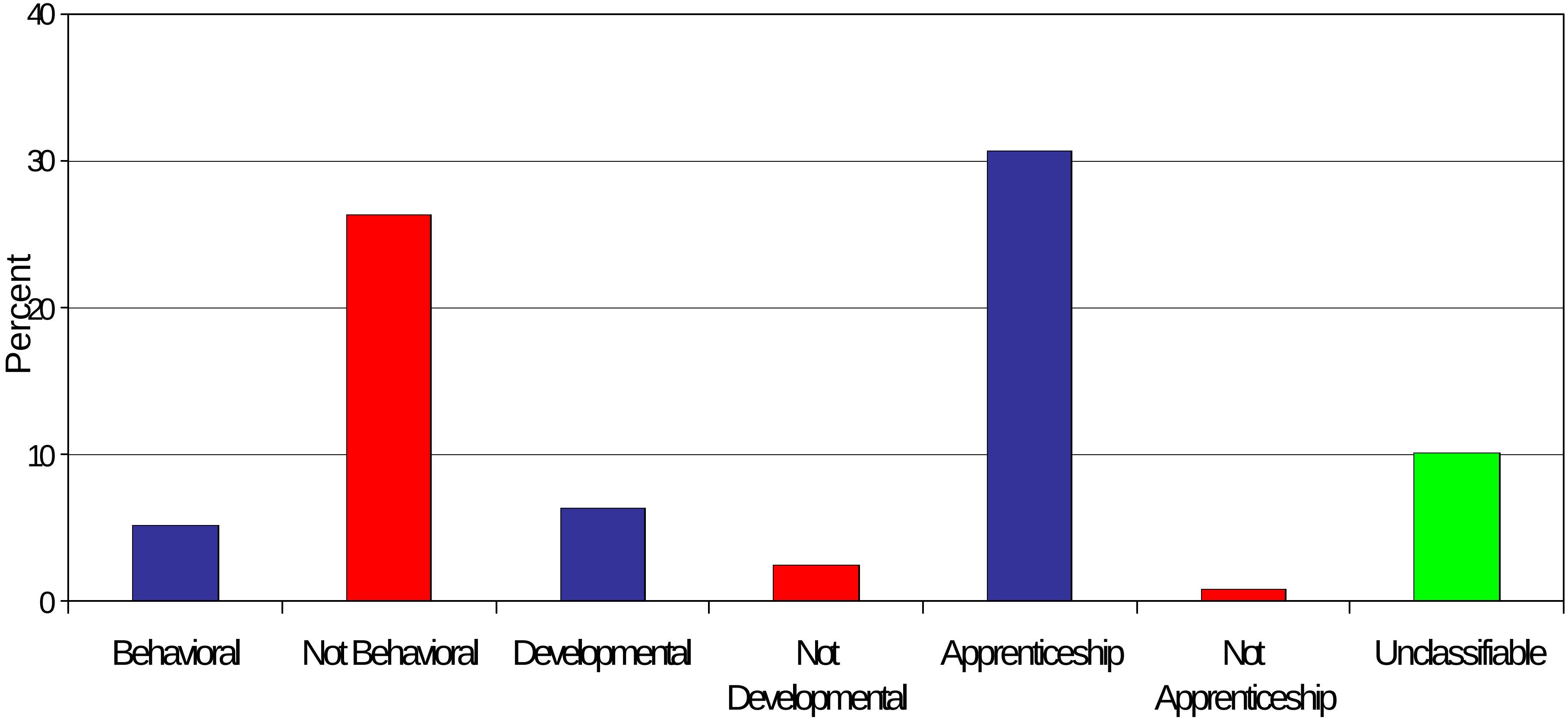
Behaviorist. **"These (UNDERSTANDING PHYSICS) are more "knowing the facts" and all that sort of stuff."** **(amount of knowledge)**

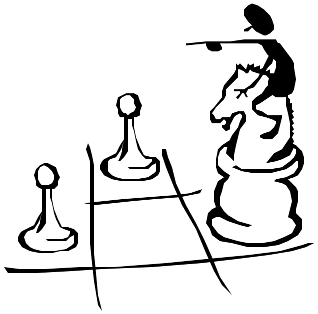
Developmental. **"Of course some of these (DIFFICULTIES) depend on people. Some people you won't get them to be systematic no matter how hard you try, they're just not that organized to do that."** **(organization of knowledge)**

Apprenticeship. **" To overcome difficulties, students have to solve problems without looking at solutions. And if they get stuck they should talk to someone specifically about what the next step would be, rather than looking at solutions, so they don't get too much help."** **(interconnection of knowledge, coaching)**

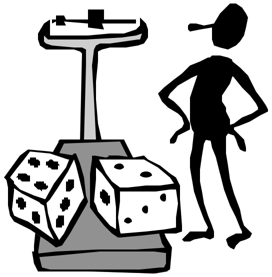
Statement Analysis







Preliminary Hypotheses



Physics faculty have common beliefs about how introductory physics students learn problem solving.

Faculty are closest to valuing an apprenticeship instructional model and furthest from a behavioral model.

Faculty believe metacognitive skills are necessary for students to learn problem solving.

To Be Continued

For more information,
visit our web site at:

http://www.physics.umn.edu/groups/physed/