The Method

(The How and Why)

Justification of a Different Method

Comment :

I dont know whether this stuff is appropriate or not, but thought it might ease the shock for those who come with pre-conceived notions about a physics class.

Effect of LECTURE STYLE on Student Achievement*

Professor	N	Pretest (%)	Posttest (%)
A	97	51	65
B	192	51	64
C	70	50	64
D	119	53	64

A Theoretician, conceptual structure, careful definitions, logical arguments.

B Many demonstrations, develops physical intuition, twice received awards for outstanding teaching.

C Emphasizes problem solving, teaches by example, solves many problems during lectures.

D Teaching for first time, follows book closely.

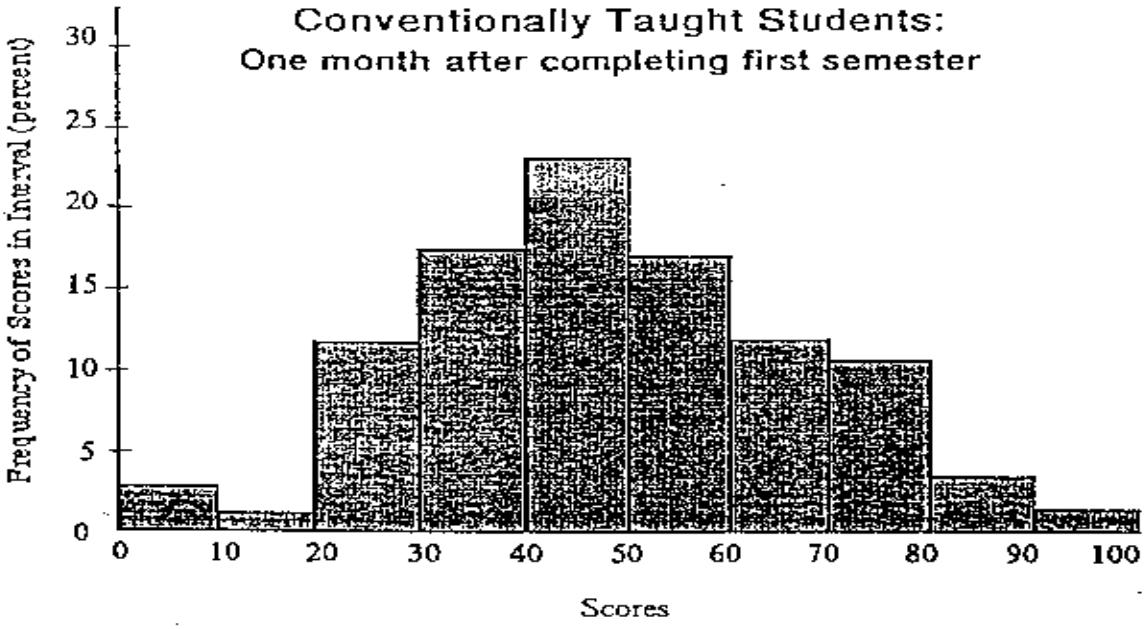
* Halloun and Hestenes, Am. J. Phys, 53, 1043 (1985).

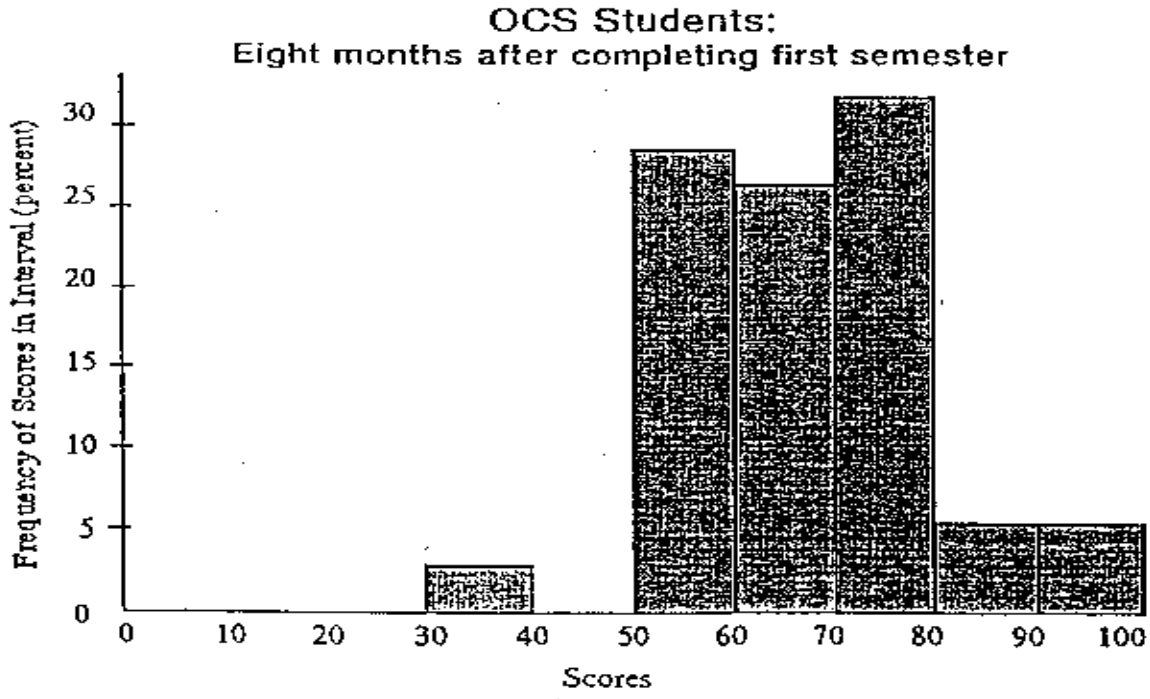
Calculus-Based Physics
New Jersey Institute of Technology

Percent of initially-enrolled students receiving letter grade

Grade	Traditional Instruction (%)	OCS Instruction (%)
A	8	25
B	16	27
C	36	24
D	15	9
F	11	5
W	13	11
I	1	0

DISTRIBUTION OF SCORES ON MECHANICS DIAGNOSTIC TEST AT BEGINNING OF SECOND SEMESTER

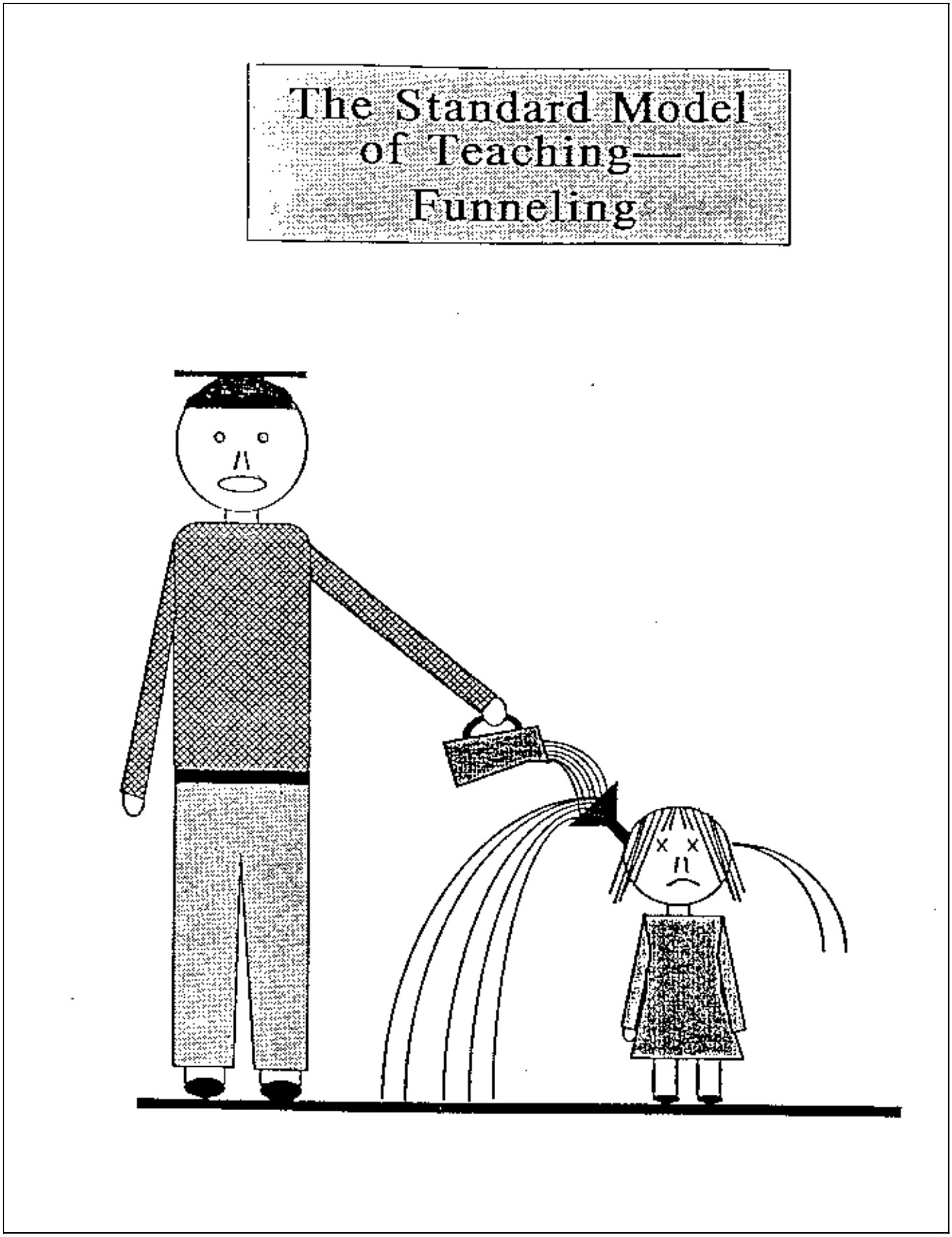




Characteristics of 10 Best-Schools-in-the-World Programs*

- Students are ACTIVE participants
- Students work in small groups—COOPERATIVE LEARNING
- Students CONSTRUCT their own conceptual models
- Use materials that MOTIVATE student interest

* Newsweek, December 2, 1991 (based on a classification of the characteristics of the programs in reading in New Zealand, math in the Netherlands, science in Japan, and the arts in Pittsburgh).


The Standard Model
of Teaching—
Funneling

PEDAGOGY

- Students form MENTAL IMAGES for physical quantities.
- Students are ACTIVE PARTICIPANTS in all parts of their instruction.
- Students help CONSTRUCT conceptual models.
- Provide EXPLICIT instruction.
- REPEATED EXPOSURE to concepts and analytical techniques.
- MOTIVATE INTEREST using relevant, interesting, and playful examples.

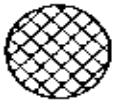
INSTRUCTIONAL STRATEGY

Overview - Qualitative Reasoning

- Learn to represent processes qualitatively using diagrams, graphs, sketches, ...
- In some cases, qualitatively construct basic principle while analyzing simple processes.
- Use the diagrams and principle to reason qualitatively about physical processes.

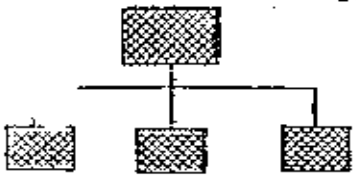
Exposition - Quantitative Reasoning

- Introduce math representation and practice changing representations.
- Use multiple-representation techniques to solve problems.



Case Studies

- Use integrated knowledge to solve more complex case study problems.



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A Few Words about Solving Problems

Novice Method™

Work backwards from goal to given.
Look for goal, look for given values.
Look for equation relating these, and solve for unknown. (Plug and Chug)

Problems with the Novice Method

Limits ones capabilities to one step problems.
Actually prevents one from learning concepts of physics.
Inhibits creative thinking.
Requires high cognitive processing capacity, (takes a lot of brain power).

Expert Method

Look for concepts involved, (try to put together a big picture).
Think of how these interrelate, (what formulas are possible?).
Begin finding unknowns that lead to the objective goal.

Major Benefits of Expert Method

Promotes understanding of concepts of physics.
Enables one to recognize opportunities to apply the concepts of physics to solve real live problems, (nearly all of which are open-ended, i.e. "what questions must I answer to solve this problem?)
Enables one to adapt to multi-step problems, even multi-level problems easily.
Forces ones mind to branch out into several methods of thinking at once, thus no single mental process receives a massive cognitive load.

In fact, a computer model has actually been written that proves the Expert Method requires much less effort that the Novice Method.

Supported by NSF Grant #DUE 9352046

The Bottom Line:

Expert Method is much more USEFUL, POWERFUL, and LOTS EASIER!

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Other Information

Another study found that while only 40 percent of students going into Physics thought of it as a boring Plug and Chug routine marathon, 68 percent thought so after taking it.

Worse yet, half of them came in with the correct approach to problem solving in mind, and left with a novice method in mind. In other words, albeit they did leave with a few new words added to their vocabulary, as far as being able to solve real life problems, they were worse off than they started!

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Group Roles, A Description

Manager:

Keeps group on task
Organizes tasks into subtasks
Manages sequence of steps to accomplish this, use phrases like:

We also need to consider ....
We need to move onto the next step...
Let's come back to that if we have time.

Skeptic:

Devil's advocate
Helps avoid quick agreement, (which can be disastrous)
asks questions that will lead to understanding
pushes members to explore all possibilities

to accomplish this, use phrases like:

...What else could we say about this?
Are there other possibilities here?
Before we agree, maybe we should consider...

Checker/Recorder:

Checks for consensus among group members
Obtains members consent upon completion of each step
Writes group solution
Turns in completed problem -- to accomplish this, use phrases like:

Can you explain how we got this?
Let's summarize what we have decided...
Does everyone agree?