

Incorporating Active Learning into Medical Physics Education

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Introduction

“Education is the kindling of a flame,
not the filling of a vessel.”

- Socrates

Who Cares How We Teach?



Teaching Kindergarten

Course	Credit
TED 2250 Ethical Issues in School and Society	3
TED 2251 Becoming a Professional Educator	3
PSY 3440 Child Behavior & Development	3
EDP 5450 Child Psychology	3
TED 3550 Teaching and Research in Practice	5
TED 5790 Student Teaching and Conference	5
ELE 6080 Preprimary Goals and Practices	3
TED 5780 Directed Teaching and Conference	8
ELE 6020 Sem. in Early Childhood Education	3
ELE 6040 Role of Content Areas in Childhood Ed.	3
ELE 6070 Family, Community, Parent Partnerships	3
ELE 6340 Teaching Reading in Childhood Ed.	3

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Teaching Graduate Students



GTA Orientation

Orientation for new graduate teaching assistants.

Day 1: 1-5pm

Day 2: 8:30am-5:30pm

Day 3: 8:30am-1pm (International/Non-native English speakers ONLY)

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How Can I Become a Better Lecturer?



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How Did We Get Here?



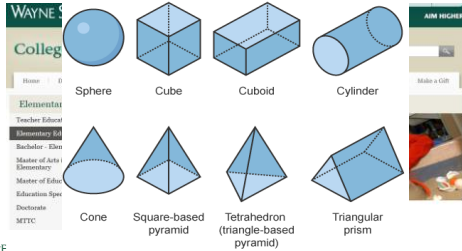
The "Tyranny of Common Sense"



State-of-the-art Teaching

- Here is some information you can read while I'm talking.
- In fact, why don't you write it down?
- This will give us the comfortable sense that we have successfully transferred some information.

How Do Students Learn?



Traditional University Education Format

- "Traditional" course format
- "Traditional" student behavior
- Prescriptive problem solving

Physics Education Reform

What do we know about how students learn?

What are we going to do about it?

How Students Learn

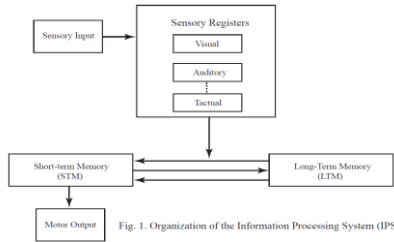


Fig. 1. Organization of the Information Processing System (IPS).

Hestenes, Phys. Teacher, 1979

How Students Learn

- 1) Information transfer
- 2) Assimilation of that information

“Flipping” the classroom

Types of Active Learning

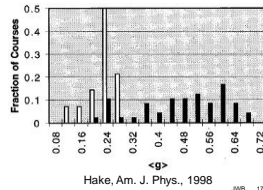
- Peer Instruction (Harvard)
- Class Wide Discussion (PERG)

Let's Look at Some Real Data

- Halloun and Hestenes create Mechanics Diagnostic test (and later Force Concept Inventory)
- Publish data showing two major conclusions...
 - Conventional instruction doesn't really change core beliefs
 - Knowledge gain is independent of instructor

Interactive Engagement vs Traditional

- Compared $\langle g \rangle$ using MD and FCI data
- N=6542 (HS, college, university)
- IE nearly 2 SD higher



'Peer Instruction' at Harvard

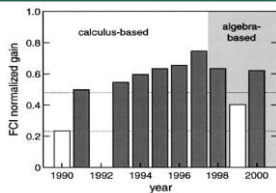


Fig. 2. Average Force Concept Inventory (Ref. 12) normalized gain (g) [Eq. (1)] for introductory calculus-based physics, Harvard University, Fall 1990–Fall 1997 (no data available for 1992), and for introductory algebra-based physics, Harvard University, Fall 1998–Fall 2000. Open bars indicate traditionally taught courses and filled bars indicate courses taught with PI.

What Are We Going to Do About It?

- Introduce active learning into “Introductory Radiological Physics”
- Why this course?
- What changes and why?

Each Class Period

- Reading (prior to class)
- Lecture audio/video (prior to class)
- 2 minute drill
- Abbreviated lecture
- Problems / Class Discussion
- Abbreviated video (after class)

Two minute drill

- Student randomly chosen
- 2 minute overview
- Chapter relevance within context of course
- No notes

RANDOM.ORG

What's this free about true randomness?

Perhaps you have considered how probable machines for computer randomness. In reality, these random numbers are not completely random and should not be used for security or a pseudo-random using a mathematical formula. This is for the many people, but it can be used for the non-predictable of your needs that do not have to be random.

RANDOM.ORG uses true random numbers to generate the Internet. The random numbers are generated using a quantum process. Please use RANDOM.ORG for random numbers, whether you need them for your game or for your work. The random numbers are not for sale. The service has existed since 1998 and was built by Dr. John D. Cook of the University of Toronto. Contact us at random@random.org or <http://www.random.org>.



Lecture Videos



Do students prefer video over instructor?

Not Really Peer Instruction

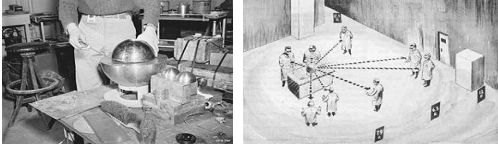
- PI typically short presentations followed by conceptual questions
- No pre- and post-discussion polling
- Discussion questions much more complex here

More Like “Class-Wide Discussion”

- Coined by Physics Education Research Group at U Mass
- Small group discussion of concept question
- Individual or group response
- Class-wide discussion facilitated by instructor

Class Wide Discussion

Example:



You are standing 1 meter from the source of radiation. Determine whether you will live.

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Class Wide Discussion

- Developing specific capabilities
 - Estimation, statistics
 - Dimensional analysis, reasonability
 - Specific conceptual topics

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Course Survey

Question	Mean score
I reviewed the course notes before class	4.3
I watched the video lectures before class	2.1
After reviewing notes and watching lecture, I felt prepared for class	3.9
Reviewing notes and video built a comfortable knowledge foundation for application problems	4.3
My curiosity was stimulated by questions asked in class	4.1
I reviewed lecture video after class for further clarification	3.6
Watching lecture videos was helpful with learning content	4.2
The amount of repetition in each class period cause me to get bored	1.4
1= Not True 2= Slightly True 3= Moderately True 4= Mostly True 5= Very True	

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Course Survey

Question	Mean score
After working on the material for a while, I was confident to pass the exam	3.5
Grading I received was fair compared to other students	4.7
The "2 minute drill" forced me to think more deeply about material and helped me get more from the class lecture	3.9
The addition of the "2 minute drill" helped me to learn the material	3.9
The application problems contributed to my understanding of the content	4.1
Completing the application problems gave me confidence that I had learned the content	3.3
I felt that the change in the use of class time was beneficial	4.1

1= Not True 2= Slightly True 3= Moderately True 4= Mostly True 5= Very True

Discussion



Conclusion

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Thanks for Your Attention



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