

# Challenging the Advanced First-Year Student's Learning Process through Student Presentations

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# We LIKE the Well-Prepared 1<sup>st</sup> Year Computing Students ...

They:

- Have completed lots of mathematics
- Have taken some data structures
- Can code circles around us
- Aced the AP exam (USA only)
- Like computing
- Are smart!
- Sign up for computing in their first year

# ...But the Well-Prepared 1<sup>st</sup> Year Computing Students Don't Like US

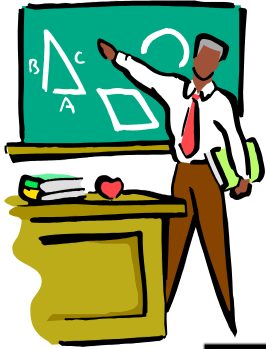
They:

- Study science, engineering, math, business, English, economics, history, etc.
- Lose interest quickly

The phenomenon is global

We may only have one term to retain them

# Outline



The promise of learning through teaching



The “capsules” experiment



Reactions, including pedagogical goals met and unmet



Implications for computing education

# Learning Through Teaching

(Dankel & Ohlich, 2007; Plimner & Amor, 2006; Ching et al., 2005)

## Approaches

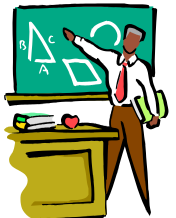
1. Peer teaching using graduate tutors
2. Research followed by peer teaching
3. Research, presentation & communication skills

## Benefits

1. Social bonding
2. Improved intrinsic motivation
3. Increased learning

## Caveats & Cautions

1. Upper division undergrads
2. Elective classes
3. “Soft” material seen as pointless
4. Significant structure is critical for success

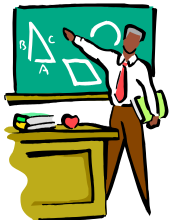


# Advanced 1<sup>st</sup>-Year Students

(Roberts, 2000; Carbone, 1997; Bruce, 1994)

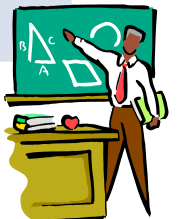
- Often like self-directed activities
- May prefer large, complex projects
- Enjoy and absorb highly advanced material

- 
- Sometimes are left out of pedagogical reform



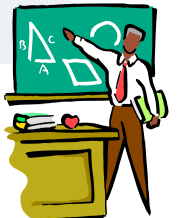
# Our Computing Honor Students

<b>Male</b>	<b>34</b>
<b>Female</b>	<b>1</b>
Freshman	30
Sophomore (by standing)	4
Junior (by standing)	1
<b>Computer Science</b>	<b>12</b>
<b>Software Engineering</b>	<b>3</b>
Computer Engineering	6
Mechanical Engineering	6
Electrical Engineering	3
Physics	2



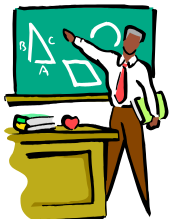
# Ambitious Weekly Topic Coverage

1	Environment – IDE, version control, unit testing, API, big-Oh,
2	UML, pair programming, inheritance, polymorphism, abstract classes, interfaces, debugging
3	Arrays and array lists, GUI design w/Swing, event-driven programming, applets
4	Introduce first large project: databases; exam 1; queries & SQL, searching algorithms, simple sorting algorithms, efficiency
5	Project work time; presentations of project screen layouts
6	Project work time; file I/O, advanced GUI topics
7	Introduce second large project: networks; threads, linked lists, project
8	Project work time; generics, stacks and queues, advanced linked lists
9	Student-selected topics (Graphics2D; animation; inner classes), exam 2
10	Status report presentations; project work time



# Our Pedagogical Goals

1. Improve skills
  - research
  - oral communication
  - teaming
2. Create self-directed learners
3. Deepen understanding of course material
4. Increase intrinsic motivation for computing



# The Capsule Experiment

***The students...***

**Research content  
in advance**

**Prepare formal  
presentation**

**Demonstrate  
topic**



**Engage class  
in relevant activity**

**Receive  
evaluation**

**Assess peer  
learning**

# Instructor Modeling and Guidance

## *The instructor...*

- Leads discussion of capsule development
- Models several capsules
- Distributes a detailed grading rubric
- Debriefs on class progress weekly
- Provides detailed feedback to each team



# Data Collection

- Surveys to evaluate experience & perceptions
  - Pre-course demographics, expectations
  - Post-course impressions & perceptions of change
  - Focus on experience & comfort levels
- Peer evaluations for each capsule
- Instructor journals
  - Daily record of events, observations



# Results – Good News

Item	Background Survey	Post-course Survey
<b>Comfort working in a team*</b>	<b>2.86</b>	<b>3.28</b>
<b>Experience working in a team*</b>	<b>2.69</b>	<b>3.22</b>
Comfort teaching course content	2.66	3.00
<b>Experience teaching course content*</b>	<b>2.17</b>	<b>2.81</b>
<b>Comfort making oral presentations*</b>	<b>2.89</b>	<b>3.31</b>
<b>Experience making oral presentations*</b>	<b>2.89</b>	<b>3.25</b>
*Statistically significant, $p < .05$		



# Results – Not So Good News

Item	Background Survey	Post-course Survey
Comfort working in a team*	2.86	3.28
Experience working in a team*	2.69	3.22
Comfort teaching course content	2.66	3.00
Experience teaching course content*	2.17	2.81
Comfort making oral presentations*	2.89	3.31
Experience making oral presentations*	2.89	3.25
<b>Capsule enjoyment*</b>	<b>2.74</b>	<b>2.22</b>
<b>Computer Science enthusiasm*</b>	<b>3.41</b>	<b>2.94</b>
*Statistically significant, $p < .05$		



# Increased Learning but Resistance to Paradigm Change

*“I learned even more than I would have just on the student side”*

*“I would much rather have a professor teach...That is what I am paying ... for”*



# Lack of Trust in the Process

*“Really let us know what needs to be taught and that its [sic] correct”*

*“No one gets a perfect grade, meaning that some part of the teaching is not satisfactory without a professor teaching”*



# Increased Ownership as Learners

*“[A benefit of the capsule experience was] self-teaching ability”*

*“...by the end I was trying to find interesting ways to do things”*



# Instructor Journal Evaluations

- Sometimes we picked up on student perceptions
  - Workload worries
  - Improving content understanding
  - Improved presentation skills
  - Struggling students were quickly identified
- Sometimes we missed the boat
  - Instructors more optimistic, seeing improvements
  - Unaware of diminishing confidence, anxiety



# In Spite of Incredible Learning

- Why was there such intense resistance to change?
- Why didn't we fully recognize what was happening?
- What can we do better next time?



# Understanding Resistance to Change

(Howles, 2007; Loui, 2005; Allert, 2004; King & Kitchener, 1994)

- First year of college is a culture shock
- Academic maturity may exceed social maturity
- Traditional instruction has been good to these students
- (Perceived) lack of structure => anxiety
- Authority relationships inhibit full honesty

It is easy to forget these issues when exciting work is happening in the classroom!



# Leverage the Strengths, Address the Weaknesses and Move On!

- Increase the visibility of the instructor
  - Introduce, setup every class, all term
  - Model capsule development more explicitly
  - Periodically deliver “tricky” capsules
- Provide additional cognitive structure
  - 3 phase incremental capsule development
- Reduce the overall perceived risk
  - Fewer capsules, more time for each one



# Additional Strategies for Reducing Anxiety and Building Trust

- Increase perceptions of student control:
  - Phase 1: Choose topics based on interest
  - Phases 2 & 3: Choose teammates & topics
- Provide a break from social demands
  - Make some non-capsule projects individual
  - Allow them to choose team members & build supportive relationships



# Advanced 1<sup>st</sup> Year Students can learn by teaching

- ✓ Improved at research and communication
- ✓ Became self-directed learners
- ✓ Learned lots of material when they taught
- ✗ Decreased motivation for computing

## How to increase success and motivation?

- Provide lots of structure
- Ease them into it
- Design innovative pedagogy with affect in mind

We too can learn a lot from so-called “failure”

Questions?