

# Simple Technologies for Enhancing Interactivity and Effectiveness in Large First-Year Classes

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## The Challenge of being an Effective Teacher in a large first-year university course...

- A long-standing issue – now being seen in a “new light” because of:
  - ◆ Continuing increase of university enrollment
  - ◆ Reduction in faculty complement at many Canadian universities
  - ◆ Increased pressure from public & legislators to keep universities as places of quality Teaching (not just Research)
- New sources of help for faculty in the form of “Teaching & Learning Centres” or “Instructional Development Offices” at many Canadian Universities.

## In this talk, I will ...

- Illustrate a few “simple technologies” that can assist with this Challenge.
- Discuss my method of bringing these technology tools together in a (somewhat!) cohesive manner using my own experience with an introductory physics course (“Physics for the Life Sciences” at SMU).
- Attempt to Link each Technology with a particular “Interactivity Issue” faced by teachers of large classes

## The “Simple Technology” Tools:

### For use during Lectures:

- Personal Response System (PRS)
  - ◆ Active Learning through polling the audience ( “Who Wants to be a ... Physicist?!!” )
- Wireless cams: Making the tabletop big

### For use outside of Lectures:

- Individualized, web-based homework assignments (“CAPA”)
- An OnLine Resource Tool for Physics-Concept Demonstrations

## Interactivity Issue #1:

Asking questions...are the students understanding what you are talking about?

### Simple Technology Answer:

Poll the Audience ... "Who Wants to be a Physicist (or Chemist, or Historian, or Accountant...)?"



### The Personal Response System (PRS)

- Acquired at SMU summer 2001 (thanks to help from Dean of Science and ITSS)
- Used in Intro Physics PHY235.1/236.2, and in Intro Astronomy AST215.2 (Dr. Francine Marleau)

## What does PRS do?

- Allows instructors to post a **multiple-choice format question** on the front screen for the students.
- Each student in the class has their own **individual transmitter**, and can "vote" on their choice of answer (they will see their name on the screen, and a color change to let them know the answer has been received).
- Immediate feedback**: a display of the students' answers shown on screen (in anonymous histogram form).
- Permanent record** (potentially for grading/evaluation): instructor can extract individual student responses from stored spreadsheet.

## How do I use PRS for Introductory Physics?

- Ask a few (2-4) questions at the Beginning of Lecture based on material to be covered that day.
  - Find out if particular concepts are already understood by students.
  - Find out what the most common preconceived misperceptions are.
  - These findings can influence the direction of that day's lecture.
  - Responses **not "scored"** for grading.
    - "free chance" to respond
    - no worries about saying wrong answer in front of instructor / classmates.

## How do I use PRS? (continued)

- Ask **same questions** at end of Lecture
  - Find out if concept was transmitted!
  - Students find out how their understanding sits in relation to classmates (and expectations).
- End of Lecture responses** used for Grading (for me: 7% of course grade)
  - Provides incentive for students to come to class!
    - Average attendance** (# responders) for Fall 2001: **90%** (50 out of 56!)

## What equipment is it (how "simple"?)

- From Educue, Inc ([www.educue.com](http://www.educue.com))
- 1 "Lecture Pack" consists of:
  - Software (very simple!)
  - 50 transmitters
  - 2 "receivers" (hooked to PC)
  - Cost: \$2500(USD) ... ~ \$4000(CAN)

Try this year: sign out from Resource room in Library (\$70 Fine if not returned...)

### LOGISTICS for Using in 1 Room:

- Bought 2 Lecture Packs (100 tx's)
- Bookstore "sells" to students: \$70
  - Students get \$60 back upon return
- Let's see how a question looks ....**

Personal Response System - Copyright by AvanteX Manufacturing Ltd.

File Audience-Kit 99 Chances Screen 59 Items 3 Choices Graph Options

Q1 00:40 0 New Session

76	70	90	71	65	83	94	78	35	84
Adebisi	Arnold	Ashu	Bartheaux	Boudreau	Browne	Burgess	Cameron	Card	Colson
41	43	50	72	59	89	93	44	39	42
Cooper	Cormier	Day	Doucette	Edmonds	Edwards	Emmerson	Gregory	Guan	Hachey
91	49	54	68	60	87	82	55	92	77
Holmes	(L)Howard	(S)Howard	Johnson	Kelley	Kelly	Kenny	Konesky	Landry	LeBlanc
88	64	53	67	52	38	57	34	85	86
Legacy	Livingston	MacFarlan	MacMullin	MacNeil	Markos	McGuire	McLean	Michaud	Morgan
61	46	63	73	66	51	81	47	75	95
Nowak	Paige	Perron	Power	Rahming	Selim-Onc	Singh	Skinner	Smith	Stoddard
99	98	97	45	80	96				
Stonehous	Trpp	Walker	Weber	Wheeler	Winters				

Q1. You face the end of a copper water pipe and throw a magnet through it, north pole first. Which way does positive charge flow in the tube (i.e., which direction does current flow)?

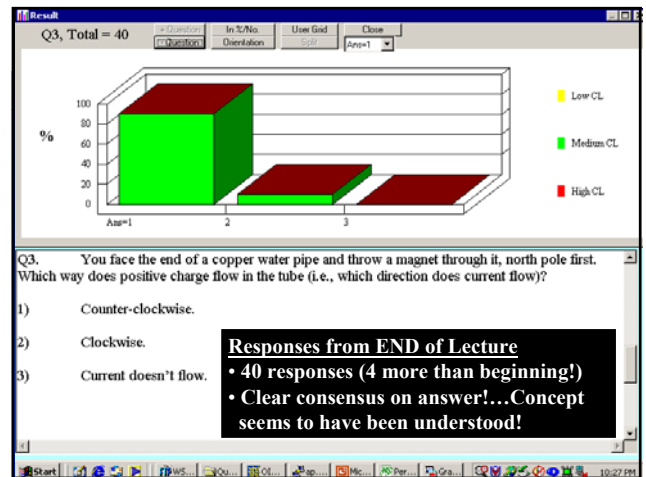
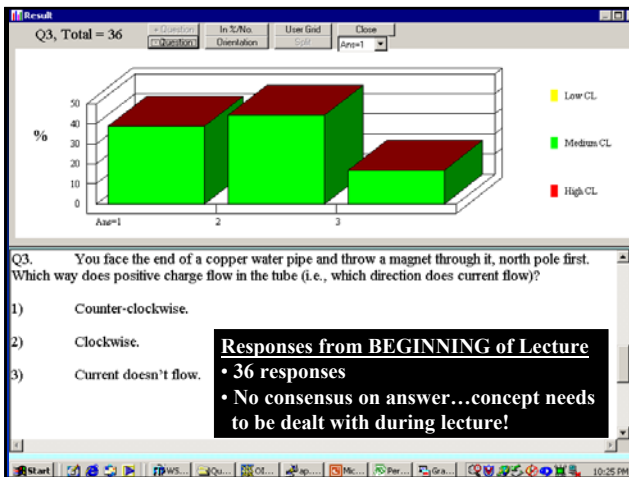
- Counter-clockwise.
- Clockwise.
- Current doesn't flow.

**Example Question (from last term):**

- PHY236.2 class list shown (with tx #'s)
- Response time set for 40 seconds

**Let's try this ourselves now!**

Showcase 2002



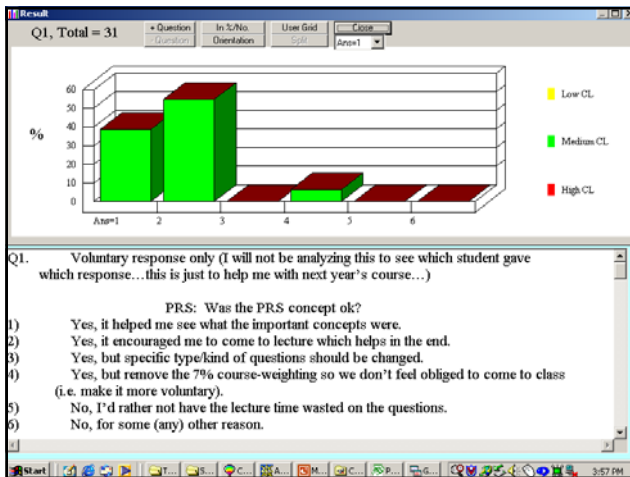
## Another feature of PRS: Confidence Level

- Further information (both for instructor and students) can be obtained on how well concepts are being learned ...
- Responders can indicate how confident they are in their answers (either "High" or "Low" or "Medium").
- Let's try this ourselves now, too!**

## Many Applications of PRS! (yes, I feel like an Educue sales-rep!)

In addition to providing an exciting Active Learning component to the Lecture portion of large classes...

- For management ("organizational health") meetings ... already been used for this 3 times at SMU.
- For anonymous surveys of students/conference-attendees, etc
- For the instructor's own feedback survey's (so as not to rely solely on the Standard student evaluations)



**Interactivity Issue #2:**  
How do you say "Gather around the table so you can see what I'm doing here"? (important for subject like Physics where "demos" are useful...)

### Simple Technology Answer:

Use a portable, wireless camera to magnify and project tabletop to front screen



### The "X10" web-camera

- "cheap" (~\$150-\$200), easy
- See [www.X10.com](http://www.X10.com)

**DEMO related to last PRS question...**

**Interactivity Issue #3:**  
 How do you let students “take equipment home” to try the demos on their own later?

**“Simple” Technology Answer:**  
 Video-tape, and post to Web...

**Adobe Video-Editing software**

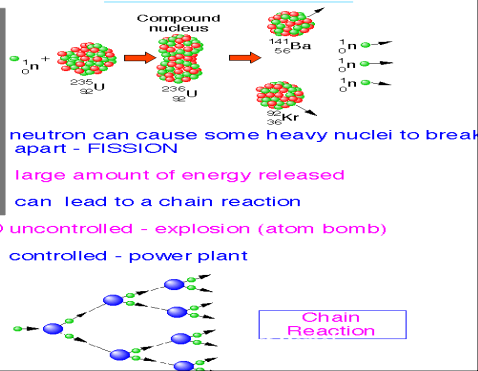
- At SMU, we started a project of developing an OnLine Resource Tool for Physics-Concept Demonstrations on May 1, 2002 – have 2 summer students and the assistance of the Department Technician
- Over 100 demos posted by August 1, 2002!

**Case Example:**  
**The SMU OnLine Resource Tool for Physics-Concept Demonstrations**

- Provide after-class access to all demonstrations seen in lectures.
- Include description of the equipment and assembly (no “hidden magic”!)
- Include discussion of theory describing the demonstration (using same language/equations as utilized in lecture).
- Provide video-clip of demo, including multiple-views and/or slow-motion where appropriate.
- To maximize “contact” with students, videos use identical equipment shown during lectures.

**An “in-class” demonstration video-taped for “after-class” viewing (via Web)...**  
**Nuclear chain-reaction modeled with mousetraps**

Let’s look at this demo on our web page .... Sorry, I didn’t bring my mousetraps today...



**Interactivity (Effectiveness?) Issue #4:**

How do you give every student their own individual homework assignment (in order to minimize direct student-to-student copying, and maximize learning benefit of the assignment) ... **without creating unmanageable work for the instructor?**

**“Simple” Technology Answer:**  
 Use existing software to provide web-based, individualized homework assignments.

**“CAPA”**

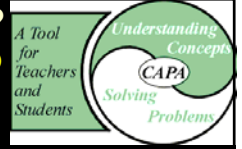
- Computer Assisted Personalized Approach

## Expanding on the "Issue" of Homework in Large Classes (caveat / restriction: Quantitative problems)

- **Conventional Assignments:**
  - ◆ One "correct" answer
  - ◆ One or two "paths" to the answer
  - ◆ So...copying very difficult to detect
- **Options for What to Do:**
  - ◆ Turn a Blind Eye
  - ◆ Eliminate Assignments (more tests)
  - ◆ Try something different – CAPA!
- I started using CAPA while on faculty at FSU, when Prof. H.-K. Ng introduced it in 1998 ...
- Prof. M. Butler and I brought it to SMU in Sept. 2001... **SO WHAT IS CAPA???**

## What is CAPA?

- Developed originally at MSU (1992)
- first used in a small (92 student) physics class – since been used by more than 100,000 students in astronomy, biochemistry, chemistry, mathematics, physics, botany, accelerator physics, human food and nutrition, family and child ecology, and computer science courses. (taken from CAPA homepage: <http://capa4.lite.msu.edu/>)



- That's the "history" ... to say what CAPA actually does – let me show a slide from Prof. Ng of FSU, shown at SMU during a Mini-Symposium on CAPA in July 2001:

## What is CAPA?

- 1992 CAPA (Understanding Concepts Solving Problems)
- 1993 MMP (Comprehensive networked system)
- 1997 LECTURE Online (allow students several opportunities to solve a problem)
- 2000 The Learning Network with CAPA (Communications with students on their performance)

- Individualized homework, quizzes and exams
- Comprehensive networked system
- provide immediate feedback on the student's submissions. ←
- allow students several opportunities to solve a problem. ←
- Emphasis on conceptual understanding
- Automatic grading and record keeping
- Online statistical analysis and feedback
- On-line discussion forum on the web
- Communications with students on their performance

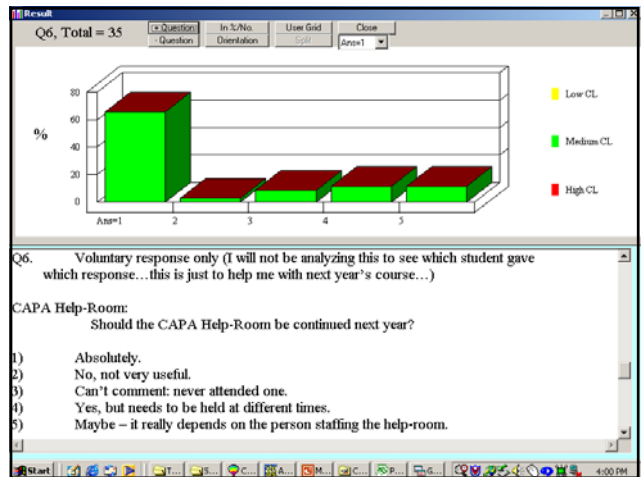
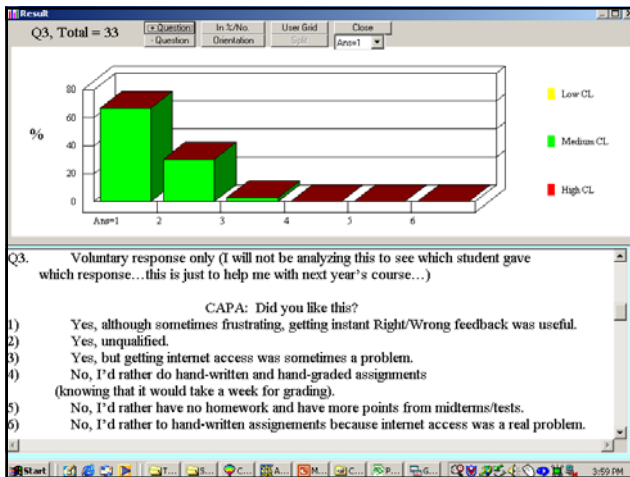
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## Observations

- 1992 CAPA (Understanding Concepts Solving Problems)
- 1993 MMP (Comprehensive networked system)
- 1997 LECTURE Online (allow students several opportunities to solve a problem)
- 2000 The Learning Network with CAPA (Communications with students on their performance)

- Majority of the students (>90%) like CAPA.
- Similar number says it helps them in their studies.
- Pain in ... but forces them to do their homework.
- Change in role of the instructor, from an examiner to tutor. ←
- Computer is the grader. ←
- Shift of staff time to interaction with students ←
- On-line feedback and analysis:
  - Pinpoint difficulties with current material
  - Monitor student progress to detect problems early
  - Objective assessment of overall student performance
- Communication with students – increase interactions w/ students
- Complete on-line up-to-date records

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**Summary:** Interactivity and Effectiveness in Large Classes can be Enhanced via:

- **PRS:** let students really answer your questions
- **Portable Web Cameras:** magnify and project tabletop demos and illustrations
- **Video-Taped clips on Web:** let students "try" demos at home; alternate resource during lectures.
- **Web-Based Individualized Homework (CAPA):** each student has unique assignment; allows tracking of students' efforts.

**Does it Work??**

AU Teaching Showcase 2002

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27

