Interactive Teaching using Personal Response Systems
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How does PRS work?

Each participant responds privately to a question or prompt, all responses are collected, and the summary displayed for all to see.
With questions in a multiple-choice format, participants answer by pressing a number on their pocket-size wireless transmitter . The signals sent are processed by a portable receiver that in turn is connected to a central display via a PC. Each signal from a transmitter causes one of the boxes shown on the display to change color. That box shows the ID of the corresponding sender, confirming receipt of the response. The answer itself is not displayed. At the end of the question period, a statistical summary of the answers is shown on the display as a histogram.

There are two modes of operation selectable at the start of each PRS session.
- In the *Anonymous* mode, only statistical results are filed and no record is kept on individual responses.
- In the *Known* mode, each response (including the associated sender ID) is recorded on a data file. The cycle is repeated for each question until the end of the session, when the entire file is written onto the hard disk.

Application Notes

A) Active learning in the classroom –
PRS is a tool for effecting electronically immediate feedback and reinforcement for active learning by all students in the classroom.
Surveys of student users indicate that a majority of them consider the following features as valuable:
- answering in private;
- discussion with peers before answering; and
- knowing how their peers responded.

The faculty users consider the following as very useful:
- immediate assessment of students comprehension;
- automatic attendance check
- automatic recording of students answers;
- a polling option for surveying views and opinions; and
- gender-blind and color-blind responses.

In a comprehensive article published in the ***American Journal of Physics*** [Vol.66 (1998) pp.64-74], Richard R. Hake showed unequivocally that *the use of Interactive Engagement (IE) strategies in the classroom can increase mechanics-course effectiveness well beyond that obtained with traditional (T) methods.* The study was based on a survey of pre/post test data of about 6000 students in high schools, colleges, and universities using the Halloun-Hastenes Mechanics Diagnostic test or Force Concept Inventory. Defining the average normalized gain $<g>$ as the ratio of the actual average gain ($<post\%>$-'$\sim pre\%>$) to the maximum possible average gain (100-$<pre\%>$), Hake found $<g>$T-ave $= 0.23 \pm 0.04$ and $<g>$IE-ave $= 0.48 \pm 0.14$. The effectiveness of IF approaches over those of T is more than a

factor of 2 according to this measure!

The IE methods are those *designed at least in part to promote conceptual understanding through interactive engagement of students to heads-on (always) and hands-on (usually) activities which yield immediate feedback through discussion with peers and/or instructors.* For the practitioners of traditional lecture method, the approach of immediate feedback and reinforcement (IFR) using electronic devices is, perhaps, the easiest IF approach to adopt. Recent literatures on the use of the immediate feedback and re-inforcement approach include:

- Robert J. Dufresne, William J. Gerace, William J. Leonard, Jose P. Mestre and Laura Wenk, *"Classtalk:* A Classroom Communication System for Active Learning' in Journal of Computing in Higher Education, 7, 3-47, (1996). (or see http://www-perg. phast. umass. edu/UM PERG/papers/CT Paper/CT_Paper. html).
- Eric Mazur, "PEER INSTRUCTION - A Users Manual", 1997 (Prentice Hall). (or see http://galileo.harvard.edu/galileo/lgm/pi/details. html).

The *Known* or class mode of operation in which a record is kept on the answer of every student to every question permits monitoring of the progress made by every student in class. Some faculty members have used these records as a part of the course grade. Some even assigned relative scores to an answer; for example, 5/2/0 for Correct/Wrong/No-Submission. On the other hand, others prefer the use of informal assessments via the *Anonymous* or poll mode in which no individualized records are kept.

PRS facilitates both peer instruction and peer assessment in the classroom. Peer instruction has been found to be very effective in student learning. At Harvard, Eric Mazur practices peer instruction in a large lecture class by doing a Q&A two times in succession — the first time the students answer the question individually and, the second time, answers to the same question are solicited after the students have had discussions with their peers. The effects of peer instructions then are reflected by the differences in the two sets of answer results. Peer assessments of student project or homework presentations in class promote active learning.

C) Attaining the Reading and Arithmetic Standards.- Reading and arithmetic standards are increasingly imposed on school systems. Using **PRS** for feedback and reinforcement could add a new dimension to the drilling and problem solving exercises that are essential to the students' mastery of the requisite basic skills.

D) Non-academic applications of PRS:
- Training classes in language and other technical skills; used to ensure that a lesson is understood before proceeding to the next one and for monitoring the learning progress of trainees.
- In a convention or meeting to elect officers or vote on resolution; used to record votes and tabulate the results immediately.
- In marketing; used to obtain on-the-spot reactions of your audience to your product demonstration.
- In a contest to be judged by the audience; used to facilitate the scoring by the audience and to tabulate the results immediately.
- There are many other applications of PRS.