

The Interactive Classroom

The Newsletter for Interactive Classroom Teaching and Learning • Winter 2000

"WIRELESS" - at last!! ...

by LA, bE staff

For years, the most frequent question asked by anyone considering a Classtalk system has been,

"Can it be done without the *wires*?"

Now at last there is a positive answer, -

"Yes - there is the PRS!"

But, the PRS does not only solve the problem of wires. It also drastically lowers a plethora of other barriers to trying out the pedagogy and becoming comfortable with it.

First and foremost is price. Would you believe that the cost of "wireless" is LESS than you have been used to paying for a wired system. For example, compared to Classtalk, a PRS system costs about 50% less for the same size classroom. If students do not have their own calculators and your institution has to buy them, then the PRS will save you another 10 to 20%.

The next most important benefit is simplicity. Suppose your students do not have or need their own calculators, then the complexity of a graphing calculator is an unnecessary additional burden for you - the teacher - to overcome. This is also significant for students in those critical first few classes when technological difficulties can prejudice someone's attitude to the course for an entire semester. Another barrier is "logging in". For anyone who knows Classtalk, it's trivial. But for a new teacher and a lecture hall of several hun

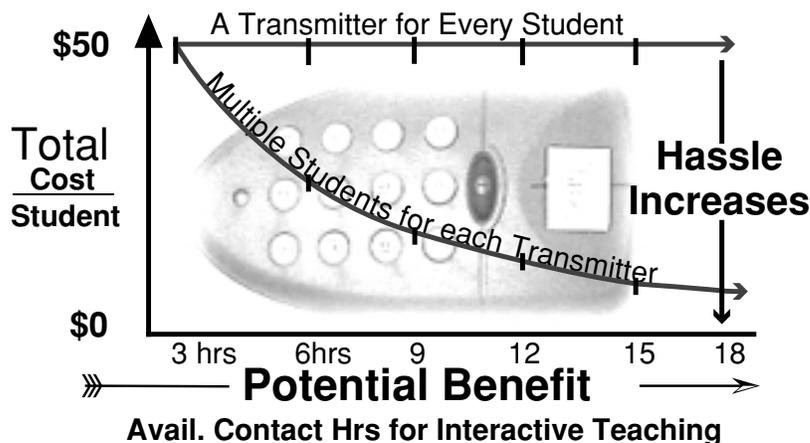
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Harvard B-School Goes System-wide with the PRS!

by MA, bE staff

Harvard Business School will be the first institution in the US to implement the PRS institution-wide. Students will be able to use the new wireless response system in virtually any class that they attend while completing the two year MBA program. Although HBS may have more money than most they did not spend it frivolously on this endeavour. By outfitting the great majority of classrooms with the inexpensive IR receivers HBS administrators ensured that the \$48 expense for each student transmitter, could be amortized over many classes. A system that required complex scheduling and a daily checking out and returning of transmitters would almost certainly discourage professors from using the PRS regularly. The maximum value will be obtained only when the potential benefit is maximized. HBS is betting that if the hassle factor is too great, this limit will not even be explored.



Although the cost per student can be decreased by having one transmitter serve many students, having one transmitter for every student reduces the "hassle" factor significantly and increases the chance that a greater benefit will actually be achieved.

Classtalk and the Learning Cycle

by Prof. Dean Zollman, Dept. of Physics Education, Kansas State University

Almost twenty years ago I developed a physics course for future elementary school teachers. In the development process. Because of financial constraints I needed to teach a large number of students in a single section. Yet, I wanted a highly interactive course based on the Learning Cycle. The idea was to provide some way for the students to perform Learning Cycles within a large class setting.

My students start each cycle with a "self-paced" exploration. Self-paced is in quotes because they schedule their own time to complete the exploration, but, if they do not turn it in before class starts, they do not

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CNU's Inadvertent Experiment

by Prof. Jane Webb, Dept. of Physics and Computer Science

Christopher Newport University was the alpha test site for the Classtalk system. Jane and George Webb have been using Classtalk in their Elementary Physics class since the very first version was developed. The version the Webbs have been using identifies the students by name. The professors are therefore able to track individual performance on a question by question basis, to pick up on pockets of weakness in the class as a whole, and to discover what exactly the students have failed to understand.

In the fall of this year, 1999, the Webbs found themselves taking part in an inadvertent experiment as the result of an equipment failure. For the first time in a decade, Elementary Physics was taught as a traditional class. The Webbs tried to maintain an interactive atmosphere in the class, asking questions of the students, asking students to chat with each other, asking students to respond by a show of hands to multiple-choice answers. They were surprised to discover that students were reluctant to talk to one another. They were not surprised that the students didn't want to raise their hands when the time came to answer the questions.

As the semester wore on, additional evidence in the form of dropping student attendance and weak performance on the tests began to mount. In the final week of the semester, it is clear that the disappearance of Classtalk has had a profound effect on student achievement. Student attrition has been considerably higher than usual, and going into the final exam, student grades are significantly lower than in previous years.

The Webbs regard the following factors as having had a major impact on the class:

- the disappearance of the daily quiz has resulted in an absentee rate per class of about 20%, about double previous years;
- lack of the daily quiz has meant students do not inform the instructors of coming absences;
- disappearance of Classtalk has eliminated the students' discovering their own strengths and weaknesses in problem solving, so they go into tests with an undue assurance. A large number of students remaining in the course will surely fail and will be surprised by the failure;
- the anonymity given the students because there is no tool by which to identify them has apparently made students feel that the instructors have no idea who they are, what the quality of their work is, or whether they are regularly absent, turn in their work in a timely manner, and are in control of the material.

While the Webbs would never have entered an experiment of this type willingly, they do find it interesting to see exactly what the benefits of Classtalk have been. According to Jane Webb, "These students identify themselves as visual and aural learners. They don't like

to read. They come to us with poor study habits. Classtalk has given us an ability to hold their attention and to bring them gradually into the normal college environment." George Webb said, "Because of Classtalk, we've been able to maintain our expectations of the students at pretty much the same level over the past decade. Now we know why our colleagues have been complaining about the decline in performance of students." ♦

ACTIVE LEARNING IN THE PRE-MED CURRICULUM

by Prof. Judith Herzfeld, Biophysical Chemistry
- Brandeis University

The undergraduate pre-medical curriculum presents science faculty with an opportunity to play a significant role in shaping future physicians, and it seems desirable for our classroom goals to reflect that potential as much as possible. Of course, we need to teach the foundation science for medical training. However, it is also the case that our students will be better prepared,

- for understanding modern medicine if we encourage conceptual learning, rather than rote learning,
- for lifelong learning if we promote active learning, rather than passive learning, and

- for team work in patient care and research if we cultivate collaborative efforts, rather than solitary ones.

For these reasons (and, to be honest, to avoid the tedium of giving lectures that go over the same material as in the textbook, and to encourage friendly cooperation between otherwise cutthroat competitors), I have become a very avid user of peer instruction in general chemistry.

Since I use "ConcepTests" intensively (with lecturing only in the context of, or as lead-in to, specific questions), a major initial effort was required to develop an extensive set of "ConcepTests". This effort was supported by the Dreyfus Foundation and the evolving set of ConcepTests can be found at <http://stanley.feldberg.brandeis.edu/~herzfeld/conceptests.html>.

In our amphitheater setting, students originally answered ConcepTests with four-lettered and -colored signs (rather than show of hands) to minimize self-consciousness and allow "voting" for all choices at once. But now a Classtalk system (installed with support from the Howard Hughes Medical Institute) allows greater privacy in "voting" while allowing the instructor to record data on both individual and class-wide performance. The former allows the instructor to learn more about each student than is generally feasible in a large class format, and the latter helps in refining the design of the ConcepTests. Another important tool in active learning is a textbook that presents the material in such a fashion as to prepare students well for in class activities. This need is informing my development of a new adaptation of Segal's general chemistry textbook. ♦

"What *IS* Interactive Teaching?"

by Dr. Louis Abrahamson, bE staff

The first thing to realize about interactive teaching is that it is NOT something new or mysterious. If you are a teacher and you ask questions in class, assign and check homework, or hold class or group discussions, then you already teach interactively. In my book interactive teaching is just giving students something to do, getting back what they have done, and then assimilating it yourself, so that you can decide what would be best to do next.

But, almost all teachers do these things, so is there more to it? To answer this question, one has to step away from teaching and think about learning. Over the last twenty years, the field of cognitive science has taught us a lot about how people learn. A central principle that has been generally accepted is that everything we learn, we "construct" for ourselves. That is, any outside agent is essentially powerless to have a *direct* effect on what we learn. If our brain does not do it itself, - that is, take in information, look for connections, interpret and make sense of it, - no outside force will have any effect. This does not mean that the effort has to be expressly voluntary and conscious on our parts. Our brains take-in information and operate continuously on many kinds of levels, only some of which are consciously directed. But, conscious or not, the important thing to understand is that it is our brains that are doing the learning, and that this process is only indirectly related to the teacher and the teaching.

For example, even the most lucid and brilliant exposition of a subject by a teacher in a lecture, may result in limited learning if the students' brains do not do the necessary work to process it. There are several possible causes why students' learning may fall short of expectations in such a situation. They may,

- not understand a crucial concept partway into the lecture and so what follows is unintelligible,
- be missing prior information or not have a good understanding of what went before, so the conceptual structures on which the lecture is based are absent,
- lack the interest, motivation, or desire to expend the mental effort to follow the presentation, understand the arguments, make sense of the positions, and validate the inferences.

Whatever the cause, without interacting with the students (in the simplest case by asking questions), a teacher has no way of knowing if his efforts to explain the topic were successful.

This brings me to the first of what I believe are three distinct reasons for interactive teaching. It is an attempt to see what actually exists in the brains of your students. This is the "summative" aspect. It is the easiest aspect to understand and it is well described in the literature. But, it is far from being the only perspective! The second reason is "formative", where the teacher aims through the assigned task to direct students' mental processing along an appropriate path in "concept-space". The intent is that, as students think through the issues necessary in traversing the path, the resulting mental construction that is developed will possess those properties that the teacher is trying to teach. As Socrates discovered, a good question can accomplish this result better than, just telling the answer.

The third may be termed "motivational". Learning is hard work, and an injection of motivation at the right moment can make all the difference. One motivating factor provided by the interactive teacher is the requirement of a response to a live classroom task. This serves to jolt the student into action, to get his brain off the couch, so to speak. Additional more subtle and pleasant events follow immediately capitalizing on the momentum created by this initial burst. One of these is a result of our human social tendencies. When teachers ask students to work together in small groups to solve a problem, a discussion ensues that not only serves in itself to build more robust knowledge structures, but also to motivate. The anticipation of immediate feedback in the form of reaction from their peers, or from the teacher is a very strong motivator. If it is not embarrassing or threatening, students want to know desperately whether their understanding is progressing or just drifting aimlessly in concept space. Knowing that they are not allowed to drift too far off track provides tremendous energy to continue.

Classtalk and the Learning Cycle

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receive credit for it. They go into a room which has a number of experiments -- very similar to desktop experiments except in a laboratory environment. We work on a Monday/Wednesday/Friday schedule so the explorations are available after class on Monday and must be completed before class on Wednesday. Then, in class on Wednesday the whole group meets. We introduce a new concept, but we always start with questions related to what they observed and learned in the exploration.

In the early days I would just ask the questions in the large class setting. Sometimes I would ask open-ended questions to which some students responded; in other cases I asked for a show of hands. As is usually the case only a fraction of the students participated fully. I still start Wednesday's class with, "Any questions about the exploration?" Usually there are none, even though I know that the students should have some. So, I use Classtalk as the means of communication. I pose questions about the explorations. For example, when we first begin the study of interactions and momentum, I pose the questions:

What types of changes did you see in the exploration? Type in a word or two to describe the quantities that changed.

Was speed conserved in every interaction that you saw in the exploration?

- A. Yes
- B. No
- C. I think so but I am not sure
- D. I think not but I am not sure
- E. I don't know.

For open-ended questions such as the first one above, I have attempted to set up bins with the words that I expect. However, that approach does not work well for an exploration. The students do not have a physics vocabulary, so many interesting answers use words I am unable to anticipate. So, I scan the answers as they come in. I am looking for commonalities in what they observed. I can then base my discussion on those answers.

The second question above is more specific. However, I wish to emphasize that I am not "testing" them, but trying to find out what they observed. I could use the question template with a confidence rating for this, but I find that my students prefer the format above where "I don't know" is an explicit response.

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Classtalk and the Learning Cycle

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While the students are responding to the questions, I walk around the room. Frequently, students will ask me questions about the explorations as I walk by. They are unwilling to "look stupid" and ask the question aloud. I learn much about what I need to discuss from these one-on-one interactions during the feedback period.

The combination of the exploration experience and the feedback, creates a discussion atmosphere for the activities even though we're meeting in a room that holds 100 people. After the discussion and the introduction of new concepts we move on to a self-paced application which is due by class on Friday.

This class always starts with questions about the application. Again, the standard, "Do you have any questions?" almost never stimulates a question. So, I prepare more specific questions by watching the students complete the application. By seeing what is causing them difficulty, I compose questions that I can ask via Classtalk. For momentum conservation, one of the activities involves placing a spring-loaded cart against a pillar and releasing the spring. The question is:

Is momentum conserved in the activity where the cart interacted with the pillar?

- A. Yes
- B. No
- C. I think so but I am not sure
- D. I think not but I am not sure
- E. I don't know.

This question usually has a large number of "I think so ..." and "I don't know." So I then ask similar questions about a cart of small mass "exploding" away from a cart which has a mass that we increased during the application activity. This procedure helps students to connect the various parts of the application better than they have so far. Further, it gets them talking to each other about applying what they have learned.

When I teach smaller enrollment classes in the Learning Cycle mode, I can, of course, get discussion involving the whole class going much more easily. However, I still use Classtalk in a mode similar to the one discussed here. The technology assures me that everyone provides an answer and everyone is thinking about the topic at the same time.

References:

Robert Karplus, "Science Teaching and the Development of Reasoning," *Journal of Research in Science Teaching* 14, 169-175 (1977).

Dean Zollman, "Learning Cycles in a Large Enrollment Class," *The Physics Teacher* 28, 20-25 (1990). 2. Dean Zollman, "Preparing Future Science Teachers: The Physics Component of a New Programme", *Physics Education* 29, 271-275 (1994). ♦

Wireless - at last!!

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dred novice students, little things can cause headaches. On the PRS there is NO LOGIN required. Each keypad has a unique ID stored inside it, and when this is set to the student's school ID or social security number, it stays there. So - no logging in. When you come to the first question in class, just ask it, and the students answer, it's as simple as that!

Now, we did not mean to skip over or minimize the barrier of "wireless" itself. It is an incredible feeling, to just walk into a lecture hall, stick two little receivers onto the wall with velcro, and be ready to roll. After wiring more lecture halls than "Your's truly" cares to recall, I am at least one person who won't miss the three days of serious non-stop upper body exercise required to navigate under seat-rows, - reptile fashion. It's also not hard to quell the nostalgia for lying immersed in wrapping papers and empty Coke cans, with the view of table undersides pockmarked by chewing-gum wads curving gently out of sight on the horizon.

Of course, everything is not perfect - the PRS is limited. For example, questions can be multiple-choice, but that's all. No text, numeric, or algebraic. Also, no question sets - unless you step through them synchronously, one-question-at-a-time, with the whole class in lock step. And, there is no private screen for the teacher - the PRS has one screen and everything on it is public. Classtalk's elegant screens with little seat icons that change color to tell you about individual students, are sadly absent.

So, the PRS may not be for everybody, but it represents a dramatic lowering of the barriers for teachers considering interactive pedagogy, and a welcome addition to our family of interactive teaching tools. ♦

The Interactive Classroom

The Interactive Classroom Newsletter is published for the users of interactive classroom technology, educators and researchers who are committed to using interactive classroom technology to improve teaching and learning. If you have any questions, or wish to share your experiences using classroom technology, please submit them to: Editor, Interactive Classroom Newsletter, Better Education Inc., 4824 George Washington Hwy, Yorktown, VA 23692.

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