Application for 2005 University of California Larry L. Sautter Award for Innovation in Information Technology

Clickers: The Changing Face of Student Engagement

University of California Riverside
Computing and Communications
Faculty and Student Technical Services
Multimedia Technologies
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Project Highlights

- Facilitation of registration (clicker registration)
- Integration with Blackboard
- Campus learning management integration tool
- Expediting Bookstore transactions, Support
- Success is demonstrated by positive reactions of faculty and users
Project Summary

The 'tradition of teaching' mitigates against the restructuring of teaching in the classroom mainly because any system that has evolved over as many decades as our education system builds up complex social and administrative mechanisms that serve to maintain and support it. When instructional innovators attempt to change one part of the system, the system almost always works to change itself back again. What can we do to circumvent this self-correcting feedback in teaching?

Personal response systems ('clickers') represent a new level of interactivity in the classroom and make tedious tasks like taking role and giving quizzes in a large section a little easier. When integrated with classroom multimedia capabilities and learning management systems, this system enables the instructor to effectively engage students in the classroom synchronously. Clickers act as a change agent by stressing the pedagogy of its use rather that the technology itself.

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Testimonials

*What are 'clickers' – "…new low cost, incarnation of the older audience response systems that used to be very expensive, so I think what they are is a vehicle to get at information about a students knowledge and to make on the spot decisions about what you are actually presenting in class" -- Curt Burgess, Professor of Psychology*

*Use of statistical polling - "doing this verbal polling can be done verbally but the most common response is apathy- [audience response] might cause the student to actually take a physical action. - Force them to take an opinion on the issue and if they got it right they could feel good, if they got it wrong, they could worry." -- Robert Hanneman, Professor of Sociology*

*As a distraction to teaching style - " …it could be a distraction to my teaching style, but that’s a semantic issue. I had to change some things in my teaching style. I could consider that as a distraction, but I wouldn’t. Because whatever cost there is in using the clickers is very much offset by the additional information you get to use. Just in terms of where people’s [student] knowledge [resides]…" -- Curt Burgess, Professor of Psychology*

*Use during lecture – "It really does break up some of the lecture – it does energize the audience - the students learn better when there is some level of emotional arousal - the higher the energy, the greater the learning. These devices do seem to have that kind of positive effect on the energy of the room. The biggest problem you have is calming them down after having used the device, which is a greater problem than having to get them to pay attention." -- Robert Hanneman, Professor of Sociology*

"Resounding yes! They [students] are going to have to be able to work with it. One of the caveats is that you cannot teach them a concept and test them immediately- that doesn’t work with any system let alone clickers. They need time to digest it, you have to resist the urge to test immediately, unless there is some part of it that really is very straightforward, but I would definitely recommend it to all faculty to all sciences especially in these upper division courses, they are dry, dense- they’re full of material. It’s a really nice way to break up the lecture." – Morris Maduro, Assistant Professor of Biology

"My advice would be to seriously consider using it. It definitely engages the students. By definition, when you ask a class to give a show of hands for some particular reason, if you want to find out how much of a class understands something, has heard something before, you don’t get an accurate estimate for that, a lot of people don’t want to raise their hands. A lot of people are embarrassed to say or state their answers in front of other people. Everyone needs to respond because you are getting at least some minimal credit for doing so. And it’s anonymous, so my experience is that students love doing it." – Curt Burgess, Professor of Psychology
Any surprises – "The thing that surprised me the most was the way to get an instant survey of opinions, so much so that I devoted the very last lecture to non-credit, just show up and answer. It turned out to be the best-attended lecture. Only one student was missing and they all had their clickers." – Morris Maduro, Assistant Professor of Biology

"The engagement of the students was fantastic, in the beginning of the quarter; they were all a little leery about it. They didn’t like the idea of having this extra thing they had to buy- they had to use. But by the middle of the quarter, they were begging for more questions. I would ask the question they’d give the answer, they’d all go AH or OOH. They all respond. When I was finished, or started lecturing, sometimes they would yell out, could we have another question! So it was almost like a game, but it actually made them get involved in the class and think about the physics. And a couple times, I would do things where I knew most of them would get it wrong, and they actually enjoyed that. And they’d see they all got it wrong and I’d go explain it to them. Then I’d give them a real easy one and they’d think it was a trick question and it wasn’t. So it was kind of a game. But they seemed to really get engaged that way and it was better than it would have been. The enthusiasm of the class was raised by the clickers." – Jory Yarmoff, Professor of Physics
Introduction

Evaluation of the educational literature on classroom innovation has shown that it is difficult, if not impossible, to make important and lasting improvements in a system through gradual, piecemeal approaches. Rather, important improvements generally must come about through "quantum-leap" changes followed by gradual fine-tuning until desired results are reached.

When dealing with change in the instructional process, there is an important distinction that must be made between restructuring the curriculum and reforming. Reforming means making adjustments to improve the existing system, doing the same but more of it or doing the same but better. Restructuring, on the other hand, fundamentally alters the organization and its operating practices by designing and constructing a new process based on specifications and needs.

Educational research has demonstrated that a variety of instructional strategies can be used in order to achieve improvement via restructuring by including:

1. increased time-on task (the actual proportion of time that students are thoughtfully engaged in learning);
2. an increase in the amount and relevance of individual feedback to each student;
3. the adoption of a performance-based progression system, rather than a system where all students spend the same amount of time studying instructional material;
4. a pacing of instruction to the capabilities of the individual student, rather than to the class average; and
5. the utilization of cooperative learning strategies, peer tutoring, and diagnostic-prescriptive methods.

Most of the above strategies are difficult to implement under the present group-based, teacher-as-primary-source-of-instruction model, but restructuring of the current synchronous system can allow some of these strategies to be effectively put into place.

Specifically, the implementation of a synchronous participatory technology can successfully implement portions of the above strategies (1, 2, and 5). In the process of using the technology, the student achieves a self-realization of his or her own learning capacity and personal engagement with the content. To facilitate this the acquisition of data needs to be self-generated and immediate and transparent to both teacher and learner.

For all the reasons above, we have identified a specific technology, a personal response system, that meets the criteria of simple, transparent, familiar, cost-effective, easily implemented, and faculty-driven acceptance with the actual possibility of the technology acting as a change agent.
Enhancing Collaborative Learning

To bolster student engagement with course content, the UC Riverside campus is broadly weaving personal response systems into the fabric of the students learning experience. Today's educators are moving toward more student-driven models (active learning) where learners interact closely with one another as well as with the instructor by tapping into a pool of self-assessment information. This revolution in student engagement with their own education is enhancing learning but it also poses new challenges for IT staff. Educators need the ability to interact seamlessly with their students who are increasingly becoming more sophisticated consumers of information. Therein lies the challenge.

Improving Learning Inside and Outside the Classroom

Many educators are discovering that personal response systems are an ideal solution to deliver the information and knowledge assessment they need in the classroom, whenever and wherever they're needed. By providing ubiquitous access, you can enable students and faculty to engage in the highest levels of learning and collaboration. Via personal response, students participate in a dynamic learning experience, obtain immediate peer generated information, communicate freely and anonymously, and form ad hoc virtual scholastic and dynamic social intellectual bonding communities focused around a course.

Timeline and the technology utilized in the clickers project

In Spring 2004, a single faculty member approached Computing & Communications (C & C) about the possibility of outfitting a single classroom with a personal response system specifically H-iTT (http://www.h-itt.com). The instructor obtained the equipment on loan from the vendor and Multimedia Technologies wired a single room with the H-iTT system. The initial results were positive and the news of that single implementation spread to other interested faculty.

With many such systems available and the real possibility of Computing and Communications having to support several similar systems which were not compatible, several units of C & C meet during the Summer 2005 and researched what issues would be involved in a campus-wide implementation. Various systems and vendors were evaluated as to associated costs to the campus and as well as to the student with various costing models (one-time vs subscription) and differing technology (IR vs RF) investigated. By the end of summer 2004, the H-iTT system was identified as the system of choice for the initial implementation to the campus. During the summer discovery process, one additional room was out-fitted with the H-iTT system to accommodate instructor request.

In anticipation of additional requests, C & C identified 15 General Assignment classrooms as good candidates for the technology. Initial criteria for inclusion of a classroom in the implementation included: room capacity, existing technology (specifically a computer and network access) as well as location on the campus and faculty interest in using the system in Fall 2004. The result was that six rooms (from the
15 identified) were equipped with the H-iTT personal response systems. Four faculty ultimately used the system in instruction during Fall 2004.

Winter 2005 and Spring 2005 has seen an additional 5 classrooms equipped with the system with six instructors using the system in Winter 2005 and seven instructors using the systems in Spring 2005. Continuing faculty interest has moved us to do a broad implementation to all general assignment classrooms by the end of Summer 2005.

**Implementation**

When placing the H-iTT personal response system within a classroom, the mounting of receiver equipment and required cabling, especially in older classrooms, required innovative approaches to implementation to insure adequate coverage for the line of sight system at minimum cost. In addition, in our effort to make the system transparent and easy to use, computers were placed in rooms where computers did not exist before requiring additional modifications to existing hardware cabinets for computer placement and network access. We wanted to make the system easy to use such that the instructor would only have to start the Acquisition program to make it active and acquire student responses.

The Acquisition program that collects the responses from the students resides on the resident computer in the classroom. The program allows us to configure a course for each instructor so all they have to do is choose from a list their particular course. Once the course is chosen the system is immediately ready to acquire student responses. After all responses (and questions) have been given, the instructor need only close the Acquisition program and the response session is automatically emailed to the instructors' email account of choice as an email attachment. The instructor returns to his/her office accesses their email and the attachment is placed into a previously named folder to be opened by an Analyzer application.

**Student clicker registration**

Until student names are associated with the unique clicker ID, any responses originating from that particular clicker is only identified by the unique clicker ID. All responses originating from that clicker are stored under the clicker ID only. The instructor does not know to whom the clicker responses can be attributed. The instructor has the option to continue to use the clickers in an anonymous condition or require students to register the clicker to allow attribution of grades/scores/attendance.

Since each of the transmitters (clickers) has a unique identification number, we needed to support self-registration of the clickers by the students. We developed a self-registration web site ([http://clickers.ucr.edu](http://clickers.ucr.edu)) that allows the student to authenticate against our LDAP system and student information system (for registered courses) using their regular user names and passwords.
A student is presented with a web page with a choice of clicker styles as we had both older one-way and newer two way clickers with differing ID number schemes. Once the student identifies his/her clicker style, a subsequent form requests that the student enter the clicker ID twice before submission of the form. The numbers must match or they will be required to re-enter their ID numbers. Each registered clicker is now associated with that student and a course roster of all students with their unique IDs is created and made available to the instructor for download.

At the end of each quarter (end of finals), the clicker rosters are archived and the system purged of all clicker information and affiliations. This system reset allows students to sell, loan or give clickers to another student and have the same clicker ID attributed to another student in subsequent quarters. Students have the option to return clickers to the bookstore for a partial refund (functioning clickers only) that can be purchased by other students. Students are required to re-register their clicker each quarter if they have an instructor that is utilizing the personal response system in their instruction.

Analysis

The H-iTT system has two separate applications: one is the Acquisition application that resides in the classroom and an Analyzer application that usually resides on an instructor's machine of choice or the resident computer. To obtain a class roster of registered students and their clicker IDs, the instructor goes to a password secure portion of the clickers web site (http://clickers.ucr.edu/ci) and using drop down menus determines the quarter and the course within which they are using the HiTT system. The roster is downloaded as a specially formatted CSV file to the instructor's machine and the instructor places that file in an appropriately identified folder (usually the same folder that has the session data from the classroom). When the Analyzer program is started, the instructor indicates where that folder resides and the roster is created automatically and any session data is incorporated into the Analyzer application. All student responses are now available to the instructor for review. As additional response sessions are performed and emailed to the instructor, the attachments are simply placed into the folder and all subsequent openings of the Analyzer application automatically recognizes the added sessions, adding the scores to the appropriate accounts. Many additional features are available to the instructor in analyzing student response: correct/incorrect, cumulative score, attendance scores, student time to respond, etc.

If the instructor wishes to make this information available to their students, the scores can be exported out of the Analyzer program as a CSV file and placed into their corresponding Blackboard course site via the gradebook. We hope to make this step more integrated in the future and doing so would allow the students to immediately see their scores in their My Grades area of Blackboard.