

CLICKERS R US: A TECHNOLOGY APPROACH FOR ASSESSING ONLINE LEARNING IN THE CLASSROOM FOR BLENDED LEARNING COURSES

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ABSTRACT

Blended learning integrates online delivery of materials through web pages, discussion boards, and/or e-mail with traditional teaching methods including lectures, guided discussions, seminars, or tutorials. In blended learning, specific course material is outsourced to textbook or online learning. When students are "brought back" to the classroom to apply what they learned online, the instructor's immediate goals are to: (a) assess the individual gains of online learning, (b) review critical material, and (c) provide formative feedback. The paper explains how a classroom response system can provide an interactive classroom environment to accomplish these goals quickly and interactively. The authors present data from two courses where classroom response systems were effectively used for assessment, review, and feedback.

About the Authors

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Blended Learning Definitions

In 1989, the collapse of the Berlin Wall marked the end of the cold war and worldwide discord (Stokes, 1993); around the same time, the development and widespread deployment of the World Wide Web created a new community of information sharing. Academic enterprises have seen over two decades of Internet activity and witnessed a steady evolution of techniques designed to support and facilitate learning. The internet has transformed the traditional halls of ivy into an intricate maze of learning options that have thrown open the campus gates to an ever-increasing learning community. In the beginning, web-based learning or e-learning was focused primarily on off-campus students; however, online learning has breached the ivy walls producing new classroom concepts of hybrid learning, blended learning, and mixed-mode instruction. "The mere existence of so many names for what is essentially a single concept suggests that no dominant model has yet been accepted as a definition of standard practice" (Dziuban, Hartman, & Moskal, 2004, p. 2).

Blended learning is the combination of multiple approaches to pedagogy or teaching, usually characterized as an integration of e-learning (electronic) or m-learning (mobile) techniques with traditional teaching methods. Dziuban, Hartman, and Moskal (2004) define blended learning as courses that combine face-to-face classroom instruction with online learning and reduced classroom contact hours (reduced seat time). According to Singh (2003), the concept of blended learning is rooted in the idea that learning is not just a one-time event; learning is a continuous process. Singh lists three learning approaches that can be combined into blended learning: (a) synchronous physical formats – traditional classroom activity such as lectures, hands-on labs, workshops, field trips, etc.; (b) synchronous online formats (live e-learning) – real-time instructor-student interaction such as online meetings, virtual classrooms, web seminars, web broadcasts, coaching, instant messaging, conference calls, etc.; and (c) asynchronous online formats (self-paced e-learning) – online documents & web pages, web/computer-based training modules, assessments/tests, surveys, simulations, job aids, electronic performance support systems (EPSS), recorded live events, online learning communities, discussion forums, distributed and mobile learning, etc. Rossett, Douglass, and

Frazee (2003) list six possibilities of what can constitute a blended learning approach: (a) live face-to-face formal instruction (instructor-led classroom, workshops, coaching/mentoring, on-the-job training); (b) live face-to-face informal interactions (collegial connections, work teams, role modeling); (c) virtual collaboration synchronous learning (live e-learning classes, e-mentoring); (d) virtual collaboration asynchronous learning (e-mail, online bulletin boards, listservs, online communities); (e) self-paced learning (web learning modules, online resource links, simulations, scenarios, video and audio CD/DVDs, online self-assessments, workbooks); and (f) performance support (help systems, job aids, knowledge databases, documentation, performance/decision support tools).

Blended Learning Issues

Much research has been devoted to producing e-content and to constructing e-learning platforms; a more fertile research area is in discovering whether these e-learning initiatives actually improve the learning process. Derntl and Motschnig-Pitrik (2004) conducted evaluations by employing patterns in the context of blended, person-centered learning in technical subjects. They concluded that blended learning adds value, only if it is designed thoughtfully and is accompanied by high interpersonal skills of instructors.

Kupetz and Ziegenmeyer (2005) demonstrated that all learners do not approach e-learning the same way. They identified three types of learners: students who mainly create and apply experiences, students who mainly study the theoretical resources, and students who create with focused selection of resources.

Probably the most important research question is whether blended learning has any advantages over traditional classroom instruction. Rossett, Douglis, and Frazee (2003) reported on three studies that demonstrated the advantages of blended learning:

A study by Peter Dean and his colleagues found that providing several linked options for learners, in addition to classroom training, increased what they learned. In 2002, Harvard Business School faculty, DeLaçey and Leonard, reported that students not only learned more when online sessions were added to traditional courses, but student interaction and satisfaction improved as well. Thomson and NETg released a 2003 white paper that

reported speedier performance on real world tasks by people who learned through a blended strategy—faster than those studying through e-learning alone. (p. 1)

A concern of blended learning is the design of the courses. Kerres and De Witt (2003) studied models for design of blended learning courses. They created a general framework that describes didactical design decisions regarding the elements of a blended learning arrangement (content, communication, and construction) and the choice of the delivery system. Ausburn (2004) researched course design elements most valued by adult learners in blended learning environments and determined that the preferred online course features supported the principles of adult learning, indicating that adults value course designs containing options, personalization, self-direction, variety, and a learning community.

Technology: Classroom Response Systems

Newer developments in technology are beginning to offer the potential for rich educational experiences. The challenge for educators and designers is one of understanding and exploring how best we might use these resources to support learning. It is clear that we need to incorporate technology into learning models; it doesn't make sense to exclude from schools, powerful technologies that are seen as a normal part of everyday life (Naismith, Lonsdale, Vavoula, & Sharples (2004).

One-on-one and in small classroom groups, most instructors naturally ask thought-provoking questions and continually probe students' needs, confusions, progress, and background knowledge, adjusting teaching behavior as needed (Beatty, 2004). These commendable techniques become impractical in larger blended learning classes, and even the most talented teachers resort to asking a few rhetorical questions or calling on the raised hand to determine whether the online material has been understood. The result is a mismatch between classroom practice and the instructional objectives instructors claim to value. Classroom response systems or classroom communication systems can provide vital feedback from every student and their conceptual understanding of the online material (Beatty).

Classroom response systems or classroom communication systems are technology products – combinations of hardware and software – designed to support communication and

interactivity in classes (Beatty, 2004). A classroom response system is technology that allows an instructor to present a question or problem to the class; allows students to enter their answers into some kind of device; and instantly aggregates and summarizes students' answers for the instructor (Beatty). Beatty lists eight ways that a classroom response system can provide support for specific student-active, question-driven, discussion-centered pedagogy:

1. Instantly constructing a histogram of class-wide answers for the instructor;
2. Displaying the histogram to students via overhead projector;
3. Managing rosters and student log ins;
4. Allowing an instructor to associate individual students with their answers;
5. Providing the instructor with a map of the classroom that displays student names and question answers by seat;
6. Allowing or requiring students to answer in small groups
7. Supporting integrated creation, management, display, and archiving of questions
8. Permitting question types other than multiple choice. (p. 2)

To realize the full benefits of a classroom response system, they must become an integral part of the learning environment. For example, online learning could expose students to new subject material in a blended learning class. Classroom time can then be devoted to classroom response system activities and discussions aimed at refining and extending students' understanding of the material (Beatty, 2004).

Fies (2005) investigated the impact of completely anonymous classroom response systems. Fies found that classroom response systems improved participation, and the students indicated greater interest in learning for understanding. Many researchers see the potential of wireless mobile learning devices to achieve large-scale impact on learning because of portability, low cost, and communications features (Roschelle, 2003). At the moment, wireless mobile technologies for education are incredibly diverse and discordant; to achieve compatibility, a strong vision will be needed to lead to standardization, overcoming the tendency for marketplace fragmentation (Roschelle).

This study employed a classroom response system manufactured by Hyper-Interactive Teaching Technology (H-ITT[®]). The system consisted of transmitters, receivers, and computer software for an inter-active classroom ("H-ITT[®] Classroom Response System," 2006). Each student used a hand-held transmitter, similar to a TV remote control, which had a unique ID. Using an LCD projector, the instructor presented multiple-choice questions through PowerPoint[®] presentations. Each student responded to the instructor's questions by aiming the remote control at a wall-mounted receiver. The receiver collected the signals and sent them to the PC through the USB port that was running the H-ITT[®] acquisition program. The student's two-way remote indicated with a green light if their transmission was successfully recorded. The H-ITT[®] acquisition program collected the responses, saved them to a file, and displayed a histogram of the results. The H-ITT[®] system can record 200 responses in less than 10 seconds. The transmitters use standard infra-red transmissions and will not interfere with wireless technology that uses radio frequency signals ("H-ITT[®] Classroom Response System," 2006).

Statement of the Problem

The authors of this paper define blended learning as any instructional delivery that is combined with traditional classroom activity where the non-classroom component independently provides new knowledge, skills, or abilities. Since learning requirements and learner preferences tend to be different, the various modes of instructional delivery should assure that every learner has reached the desired learning goal. Anecdotal evidence indicates that blended learning not only offers more choices but also is more effective (Singh, 2003). The classroom instructor needs more than anecdotal evidence if critical knowledge, skills, or abilities are to be outsourced to online learning methods. When students return to the classroom, the instructor's immediate goals are: (a) to assess the individual gains of online learning, (b) to review critical material that was covered by online delivery, and (c) to provide formative feedback to each student, regardless of class size. The instructor wants assurance that every student has fully grasped the essential online material before continuing with traditional classroom activity that requires the online knowledge, skills, or abilities. The authors demonstrate how a classroom response system; consisting of transmitters (Clickers), receivers, and computer software; can provide an inter-active

classroom environment to accomplish all three goals quickly and interactively with all students participating.

Research Design and Procedures

The authors used a classroom response system in two different classes to model blended learning feedback. They used an electronic teaching system manufactured by Hyper-Interactive Teaching Technology (H-ITT[®]) that included infrared student transmitters with unique identification numbers, an infrared receiver which collected the student responses, and computer software that displayed the responses and tallied them for grading purposes. The H-ITT[®] software was free; it runs on computers that use Windows, Mac, or Linux operating systems ("H-ITT[®] Classroom Response System," 2006).

The H-ITT[®] classroom response systems were used in two graduate courses (TMGT 630 – *Technical Management Information Systems [MIS]*) in the Master of Science in Technical Management (MSTM) program of Embry-Riddle Aeronautical University (Extended Campus Catalog, 2003–2004). MSTM students are adults, technically-trained employees working for large aviation/aerospace companies, preparing for advancement within their companies and for increased managerial responsibilities (MSTM, 2006). The classes were delivered on-site at two industry locations – Williams Gateway Airport in Mesa, AZ (13 students) and Lockheed-Martin Corporation in Goodyear, AZ (19 students). The courses met the author's definition of blended learning, because they were traditional classroom courses with several online learning components that independently provided new knowledge, skills, and abilities. These courses did not meet the blended learning definition of Dziuban, Hartman, and Moskal (2004), because the courses' online learning did not reduce classroom contact hours.

In each TMGT 630 class, students were given extensive reading assignments, covering required material that would not be covered in the classroom. In addition, each student was assigned an MIS topic to research and to present to the class. All students were responsible for knowing the reading assignments and for understanding every MIS topic presented by fellow students. Most of this learning occurred outside the classroom from the Laudon and Laudon (2006) textbook, the textbook's "Companion Website" (2006), and the author's Blackboard[®]

course-specific Web-site for students to look up course-related information (Smith, 2006). The H-ITT® classroom response systems were used in these classes to assess the individual learning, to review critical material that was covered by online delivery, and to provide formative feedback to each student. At the end of each course, students were given a 10 question survey to assess their perceptions about using clickers during the course.

Results

In each course, students used the H-ITT® classroom response system to answer 201 questions about course material that had been assigned from the textbook, assigned from online material, or presented by the instructor or fellow students. Table 1 displays the descriptive statistics from the individual assessments of online learning.

Table 1

Quiz Results from H-ITT® Classroom Response Systems

| | Lockheed-Martin | Williams Gateway Airport |
|--------------------|-----------------|--------------------------|
| Mean | 0.81 | 0.80 |
| Standard deviation | 0.09 | 0.09 |
| Minimum | 0.57 | 0.64 |
| Maximum | 0.94 | 0.94 |
| Count | 19 | 13 |

The quiz questions were chosen to review critical material that was covered by online delivery. After all students had responded to a question, a histogram of the students' responses was displayed, providing immediate formative feedback and allowing discussion and reinforcement. The quiz results between the two classes were almost identical, signifying there was no difference in the quiz scores and allowing the authors to consider the students as a single unit for analysis.

At the end of the course, an on-the-spot survey was conducted using the H-ITT® classroom response system. Three students were absent when the survey was conducted. Ten

questions were asked, each prefaced by the statement, "Compared to other MSTM courses I have taken, in this course (TMGT 630): I" Before the survey, students were directed to consider the review of course materials, made available by the H-ITT® classroom response system, as the primary difference between this course and other MSTM courses. For each question, the possible responses were: 1) *Much Less*; 2) *A Bit Less*; 3) *About the Same*; 4) *A Bit More*; 5) *Much More*. Table 2 describes the results which approximate the likelihood that the H-ITT® classroom response system helped them to study and review the course materials.

Table 2

Results from Student Survey about the H-ITT® Classroom Response System (N = 29)

| Question | Mean | SD | Min | Max |
|---|------|------|-----|-----|
| <u>Compared to other MSTM courses I have taken, in this course (TMGT 630), I ...:</u> | | | | |
| read the textbook ... | 3.00 | 0.89 | 1 | 5 |
| used the textbook in class ... | 3.48 | 1.12 | 1 | 5 |
| studied by myself ... | 2.86 | 0.88 | 1 | 5 |
| studied with others ... | 3.17 | 0.93 | 1 | 5 |
| paid attention to the Professor's presentations ... | 3.45 | 1.09 | 1 | 5 |
| paid attention to Students' presentations ... | 3.45 | 0.63 | 3 | 5 |
| used the Blackboard® Web site ... | 3.59 | 0.82 | 2 | 5 |
| used the Publisher's Web site ... | 2.76 | 1.48 | 1 | 5 |
| enjoyed the course ... | 3.28 | 0.96 | 1 | 5 |
| learned ... | 3.17 | 1.20 | 1 | 5 |

In all but two questions, students indicated that the review, made available by the classroom response system, was a positive learning experience. Regarding blended learning, the primary gain was encouraging the students to focus on material that the instructor posted on the course Web site in Blackboard® (Smith, 2006). Since the Blackboard® material was adequate; the students did not focus on the publisher's Web site ("Companion Website," 2006). It appears that

the H-ITT[®] classroom response system made the course more enjoyable and even helped students to learn more. In a different student survey, monitored by the center administrative staff at the end of the course, one student wrote, "I liked how interactive the class was." Another student wrote, "The interaction in class really helped the time go by fast."

A Chi-Square was calculated to test the null hypothesis – There was no difference in students' opinions about the value of the H-ITT[®] classroom response system (survey response) based on their course achievement (quiz scores). Table 3 shows the results.

Table 3

Chi-Square Results for Comparison of Quiz Scores vs. Survey Responses

| | Below/above ¹ | Chi-square | p-value |
|--|--------------------------|------------|---------|
| <u>Compared to other MSTM courses I have taken, in this course (TMGT 630).</u> | | | |
| Q1) I read the textbook | 6/23 | 0.40 | 0.53 |
| Q2) I used the textbook in class | 3/26 | 0.18 | 0.67 |
| Q3) I studied by myself | 6/23 | 2.43 | 0.12 |
| Q4) I studied with others | 5/24 | 0.56 | 0.45 |
| Q5) I paid attention to the Professor's presentations | 3/26 | 0.65 | 0.42 |
| Q6) I paid attention to Students' presentations | 0/29 | 0.02 | 0.89 |
| Q7) I used the Blackboard [®] Web site | 2/27 | 0.02 | 0.88 |
| Q8) I used the Publisher's Web site | 12/17 | 0.22 | 0.64 |
| Q9) I enjoyed the course | 3/26 | 0.65 | 0.42 |
| Q10) I learned | 9/20 | 0.61 | 0.44 |
| OVERALL | | 0.61 | 0.44 |
| Critical chi-square | | 3.84 | |
| df | | 1 | |
| Hypothesized p value | | 0.05 | |

¹ Below = Number of survey scores below 3; Above = Number of survey scores of 3 or higher.

Each response on the ten-question survey was separated into two categories: Below, meaning the response was: 1) *Much Less* or 2) *A Bit Less*; and Above, meaning the response was: 3) *About the same*, 4) *A Bit More*, or 5) *Much More*. Quiz scores were separated into two categories: Below, meaning their quiz score was below the mean; and Above, meaning their quiz score was equal to or above the mean. For each question, the Chi-Square test failed to reject the null hypothesis. Therefore, there was no difference in students' survey responses about the value of the H-ITT® classroom response system based on their achievement in quiz scores. For all questions, regardless of the quiz scores registered by the H-ITT® classroom response system, the outcomes generated by the system were perceived to be beneficial. Most notably, every student paid more attention to fellow students' presentations; they obviously felt a need to learn the presented material rather than to observe a demonstration of what somebody else had learned. Though not statistically significant, Question 3 showed that students who achieved higher quiz scores tended to study with others; while students who achieved lower quiz scores tended to study by themselves.

Conclusions

This study has a reinforcing message for blended learning. When critical course material is outsourced to the blended learning environment, it is possible to assess students' learning comprehensively and quickly when they return to the traditional classroom. A classroom response system can quickly achieve three goals: (a) an assessment of the individual gains from online learning, (b) a review of critical material that was covered by online delivery, and (c) formative feedback to each student, regardless of class size. Within minutes, the instructor will be able to assess how much of the essential online material each student understands, enabling the instructor to move forward confidently with the material or to step back and review the online material by closely tailoring the review to the students' needs ("H-ITT® Classroom Response System," 2006).

Besides using the H-ITT® classroom response system for quizzes, the authors demonstrated how it can be used to get immediate feedback from every student. Instructors often want feedback from the students' perspective about the online aspects of blended learning. The

Plus/Delta feedback tool (sometimes called Plus/Change) is a means of identifying what is going well and what needs to be changed. Plus/Delta is typically used at the end of a class period to gather information; however, it can also be used in the beginning of the class to ask students to focus on their online learning experience in the course. Using the classroom response system in the survey mode helps instructors to make mid-course corrections and helps students to think about what they should continue doing to learn (PLUS) and what they need to change for the course to improve for them (DELTA) ("Plus/Delta," 2006).

The classroom response system can help students to focus on the best information sources. In this study, students concentrated their online learning efforts on the material that the instructor posted on the course Web site in Blackboard® (Smith, 2006). Helping students manage their time for maximum gain is an important undertaking, especially for teachers of adults.

Adult learners do not like to be treated like children; certainly they do not want to spend their valuable time with toys, games, and playthings. In this study, it was clear that these adult students (professionals) treated the classroom response system as serious learning tools that helped them achieve their learning objectives. One student wrote, "I liked the clickers and the instant feedback. This is a realistic business practice as no one has all the right answers."

Other valuable uses for a classroom response system were not explored in this study. Most conferences tend to be speaker-focused with occasional interaction between the speaker and one participant at a time. A classroom response system can facilitate active participation by everyone in a conference session, even a very large audience. One speaker who used the H-ITT® classroom response system gave the following testimonial, "These results [200 responses collected in under 10 seconds] look very impressive" ("H-ITT® Classroom Response System," 2006).

The classroom response system is an ideal tool for teaching inter-rater reliability. The authors conducted a workshop for Standards Captains at a UK airline. They used the H-ITT® system to help these highly trained evaluators standardize their performance assessments on a 17-question instrument. The authors demonstrated the "gold standard" method and were instantly able to identify outliers and to facilitate improvement of their inter-rater reliability.

Blended learning, in its multiple approaches to pedagogy or teaching, has tremendous appeal to both teachers and students, particularly adult learners. It has become an integral part of the teaching process in several universities and organizations. The value of any learning model can only be determined by assessing the learning product in terms of student achievement.

Practitioners of blended learning should continually and comprehensively assess its added value to learning. Classroom response systems and other technologies can augment the interpersonal skills of instructors so hybrid learning, blended learning, and mixed-mode instruction can achieve these desired goals – to encourage students to take responsibility for their own learning, to make learning meaningful, and to support interactive knowledge assessment.

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