2006-1675: INTERNET AND CLASSROOM-BASED AUTOMATED EVALUATION SYSTEMS

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Internet and Classroom-Based Automated Evaluation Systems

Abstract:

Many novel tools and techniques have been developed to enhance classroom teaching and learning. However, compared to the volume of material available for teaching enhancement, very little is available in the area of student assessment, especially automated student evaluations. Due to the nature of the subject content, engineering and its related fields are arguably the most difficult disciplines within which to utilize automated evaluation. Until recently, just a few small-scale evaluation tools were available, primarily from those individuals who developed them for their own courses. Currently however, several automated evaluation tools are available that are adaptable to various engineering applications. The most familiar of these are Blackboard and Web-CT, both of which are Internet-based evaluation, curriculum and course management tools.

A more recent automated evaluation tool has become available; know as a *Classroom Response System* (CRS) or Classroom Performance System. The CRS is a classroom based wireless-remote transmitter-receiver system. All students in a classroom have their own wireless transmitters that are used during class sessions to transmit information to the classroom-based CRS receiver. The CRS then evaluates and tabulates the student responses, and provides immediate feedback to the instructor and/or students from the system. This type of system is very useful as a classroom-based automated evaluation system. While the concept of evaluation typically implies testing, the CRS may additionally be used to gather and analyze other types of student responses as they occur within the classroom.

Because Internet-based systems such as Blackboard have become so common, this paper will emphasize the newer, and less widespread, CRS systems. The paper begins with a review of the purpose of CRS systems, followed by a review of students' attitudes toward using CRS systems in the classroom. Included in the paper is a description of implementing the CRS in a classroom, a review of the automated evaluation system, and a description of other features of the system. This paper also includes a side-by-side review of the classroom-based CRS in comparison to the Internet based Blackboard system, describing the advantages and disadvantages of both systems.

Introduction:

Automated evaluation systems have existed in various, but limited, forms for quite some time. The increasing popularity of on-line Internet-based systems such as Blackboard and Web-CT has greatly increased the use of automated evaluation. While there are many advantages to Internet-based systems, there are also many disadvantages. One of the biggest disadvantages regarding Internet-based automated evaluation exists because these systems are online-based, and therefore each student must have a dedicated computer during any evaluation session.

Recently, wireless classroom-based response systems (CRS) have been developed. These systems are locally based, requiring only one computer for any sized classroom, rather than one computer per student for on-line systems. These systems are inexpensive for students, typically free for instructors, easy to install, and easy to use. Student responses to questions are captured, recorded, and tabulated to provide meaningful statistical real-time feedback to both students and instructors.

CRS-based Automated Testing and Evaluation:

Testing can be accomplished during a class using two primary forms of testing. The first is a typical paper-based test, using the CRS system for automated grading of student responses to questions. Most of the CRS systems allow students in the same classroom to take multiple versions of the same test, each with automated grading. This testing method allows students to complete a test at their own pace. The second type of testing utilizes a projection of the CRS system within the classroom, and each student responds to questions as they are posed by the system for the entire class. With this method, all students must work at the same pace.

The types of testing available through automated systems are at times criticized for not being capable of testing conceptual topic information. However, there is very little difference between the types of questions capable on a CRS system, and the majority of questions on testing instruments such as the PSAT, SAT, LSAT, GRE, GMAT, etc.

According to research as discussed by Duncan[1], "When properly prepared, multiple-choice tests can generally be considered as good indicators of students' conceptual understanding. Such testing instruments are generally developed through research, which identifies students' most common misconceptions. The misconceptions are then used to create the detractors, or wrong answers, on the tests. Such tests work remarkably well in identifying whether students have learned important concepts."[1]

Improved Student Learning using CRS Technology:

CRS Systems have also been proven to enhance the classroom learning experience. Student understanding of concepts can be captured in real-time through anonymous responses to questions used to gauge the students' level of understanding. Instructors can reveal the existence of misconceptions or difficulty with the subject matter, and lectures can then be modified on the fly to depending on the immediate feedback provided by the students. The CRS system is also useful as a tool to involve those students who typically may not feel comfortable participating in

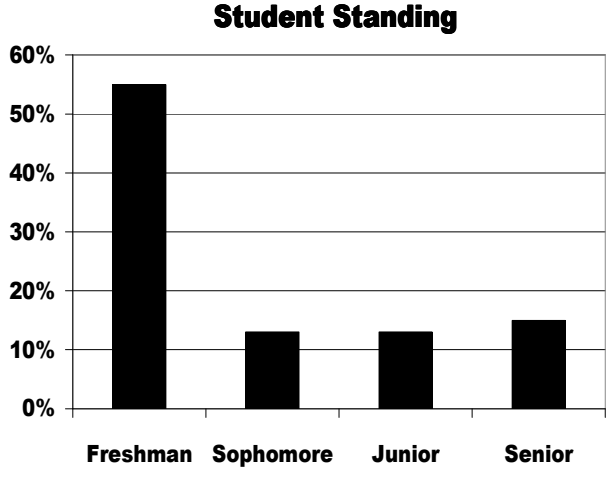
class. Interactive and student-centered learning is easier to accomplish with the use of CRS technology.

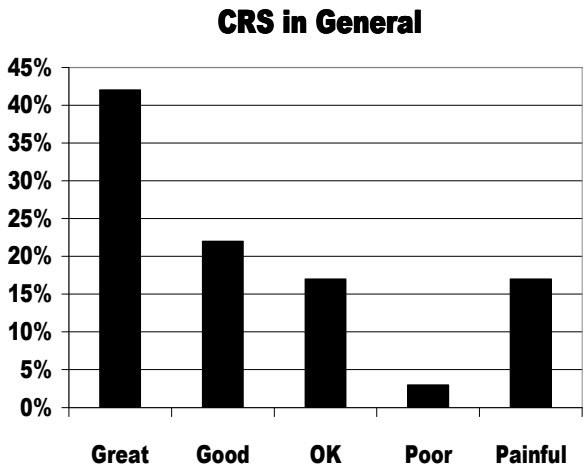
Further results of the research discussed by Duncan[1] indicates that;
Student attention diminishes rapidly within 20 minutes.

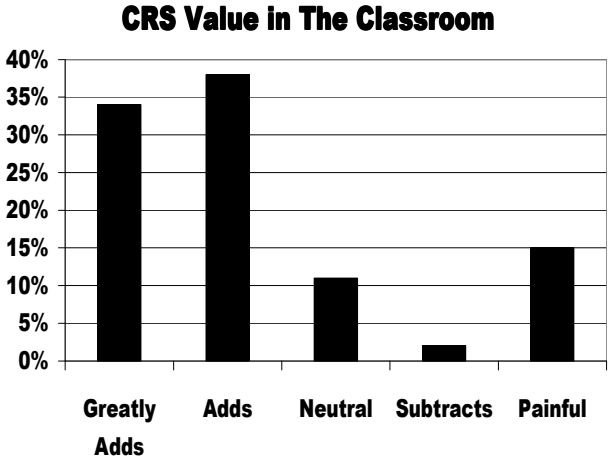
- The average number of students paying attention during a standard lecture is 47%.
- When a lecture is changed to a style in which the teacher actively engages students with questions, the attention average rises to 68%.
- In a typical class, 10–20% of the students dominate discussions.
- Studies in universities have documented that the "fade" in attention during a lecture is a universal phenomenon.
- Instructors can deal with inattention by using classroom response systems to fight the fade
- A large body of research shows that classroom methods that actively involve students, result in substantially greater learning than pure lecturing does.

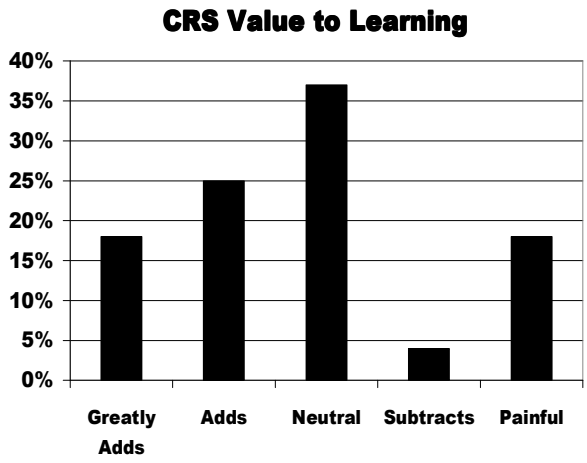
Research – Student Attitudes Toward CRS Systems

The following charts provide information regarding research that was performed on a seminar class of 70 Engineering School - Computer Science majors in the Fall 2005 semester. The results were very positive indicating that students found the CRS system a useful tool in the classroom. In general, 81% of the students were neutral or positive. About 83% of the students were neutral or positive when asked if the CRS added to the classroom experience, and 80% were neutral or positive when asked if the CRS added to the learning experience. This is the first time the CRS system was used and there were a few glitches, hence several "painful" responses which should disappear next time around. Totals may not add up to 100% due to erroneous responses from students and/or due to rounding.









System Requirements:

Several vendors have CRS technology available, including H-ITT[2], eInstruction[3], InterWrite[4], and others. Each vendor has competing products, but in general, each of the various systems consist of similar hardware, software, and functionality. The examples shown are based on the H-ITT[2] system.

Each student purchases a hand-held wireless transmitter similar to a television remote control, as shown in Figure 1. Each transmitter has a unique identification (ID) number that distinguishes it from all other transmitters. The H-ITT transmitters consist of 13 keys, A-J or 0-9, and 3 special purpose keys. The transmitters utilize infrared (IR) technology, have a range of 90 feet, and operate on one 9-volt battery. Prices for students (from sampled vendors) range from $5 to $40 depending on bundling options, rebates, access fees, etc. The H-ITT system transmitters were priced at $5 if bundled with a textbook from a participating publisher (most major publishers participate), or $40 when not bundled.

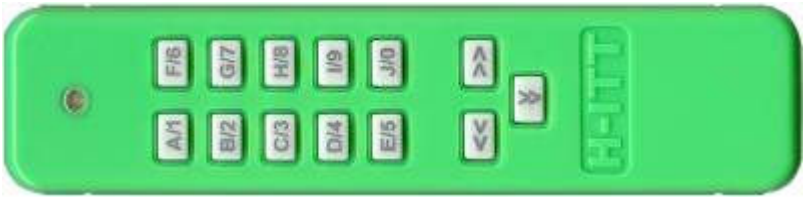


Figure 1: Wireless Transmitter (for student use)[2]

Figure 2 depicts a two-way base unit that is used to collect signals from the wireless transmitters and send the information to a PC via a USB port. One base unit is recommended for every 50 seats in the classroom. For rooms larger than 50 seats, multiple base units may be daisy-chained together. Typically, the software and receiver are provided without charge to the instructor of a

course in which students will be required to purchase transmitters. The value of the hardware is approximated at $500. The base unit used in the course described above, was provided free by H-ITT.

Figure 2: Base Unit attached to Notebook Computer via USB[2]

Data Acquisition:

To obtain student data, a question is posed to the students in the class in one of several options including printed-paper, verbal instructions, using an online system, or using a local system. The example shown in Figure 3 uses PowerPoint on a local CRS system.

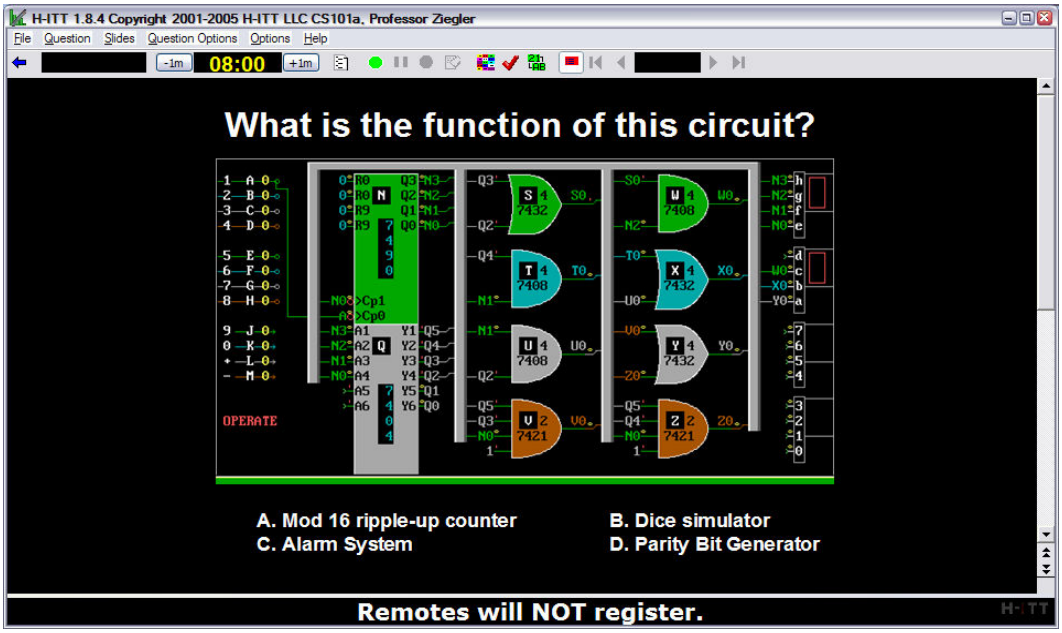


Figure 3: Posing questions to students using CRS and PowerPoint

Student Responses:

Using the wireless transmitters, each student responds to the instructor's questions by aiming the transmitter at the receiver(s) and pressing the desired button. As shown in Figure 4, the acquisition software displays a box on the computer screen for each student's remote. This allows both the students and the instructor to verify that each response has been recorded. The location of each box remains the same for the entire semester and the color of each box is determined by the last digit of the remote ID number.

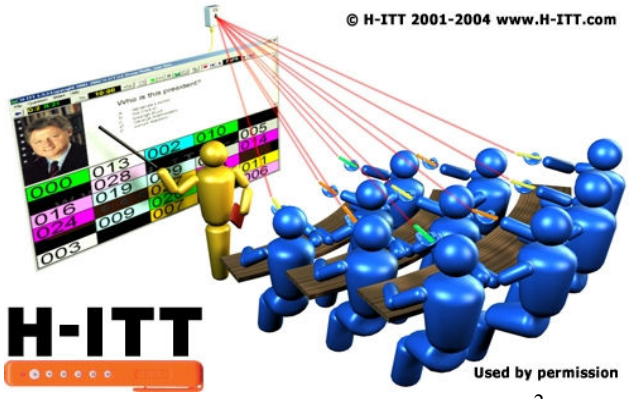


Figure 4: Students respond to questions[2]

Responses Tabulated

The receiver(s) collect the student responses and sends them to the host computer (Windows, Macintosh, or Linux). The software associates student names with the remote ID numbers and grades the responses instantly. The results are saved in a file and if desired, a histogram of the results is displayed as shown in Figures 5 and 6.

When used for instructional purposes (rather than testing), the instantaneous assessment of student comprehension enables the instructor to confidently move forward with the material or step back and review, closely tailoring the lecture to the students' needs.

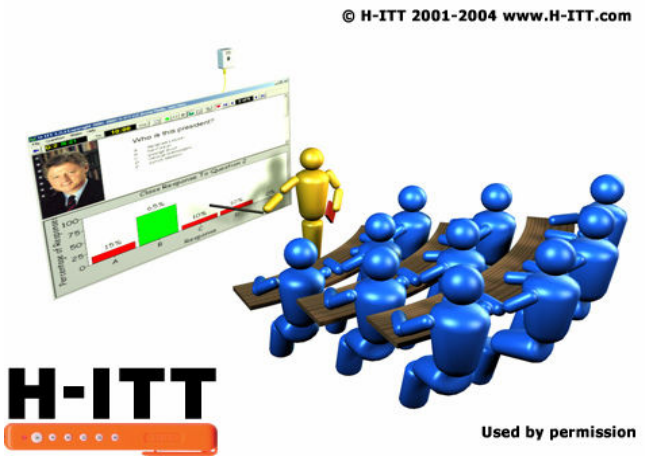


Figure 5: A histogram of the student responses may be displayed in real-time[2]

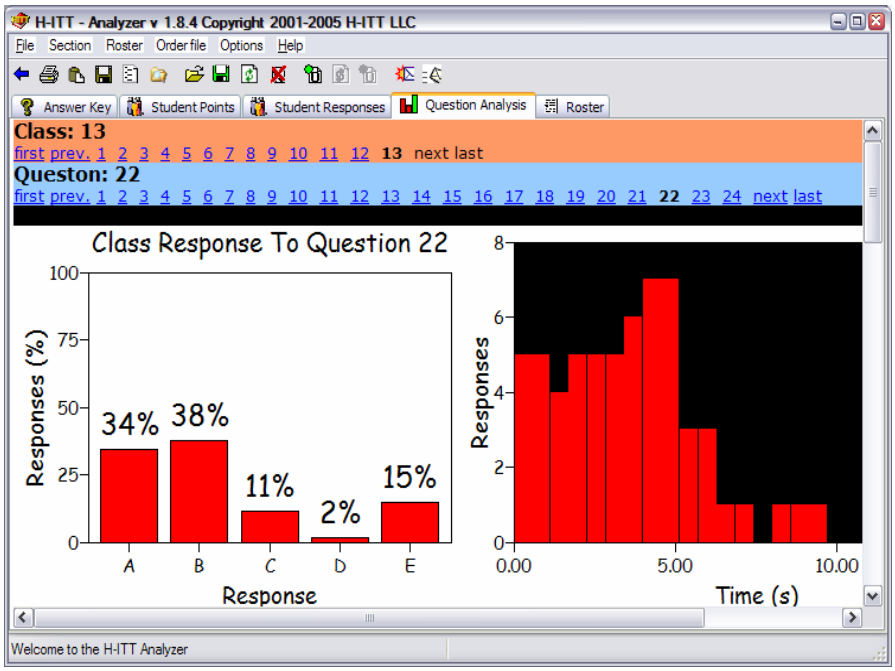


Figure 6: Further details of the histogram.

Reporting Tools and Response Analysis:

As shown in Figures 7 and 8, each CRS system is capable of producing reports of various response statistics including raw data, scores, averages, response times, etc.

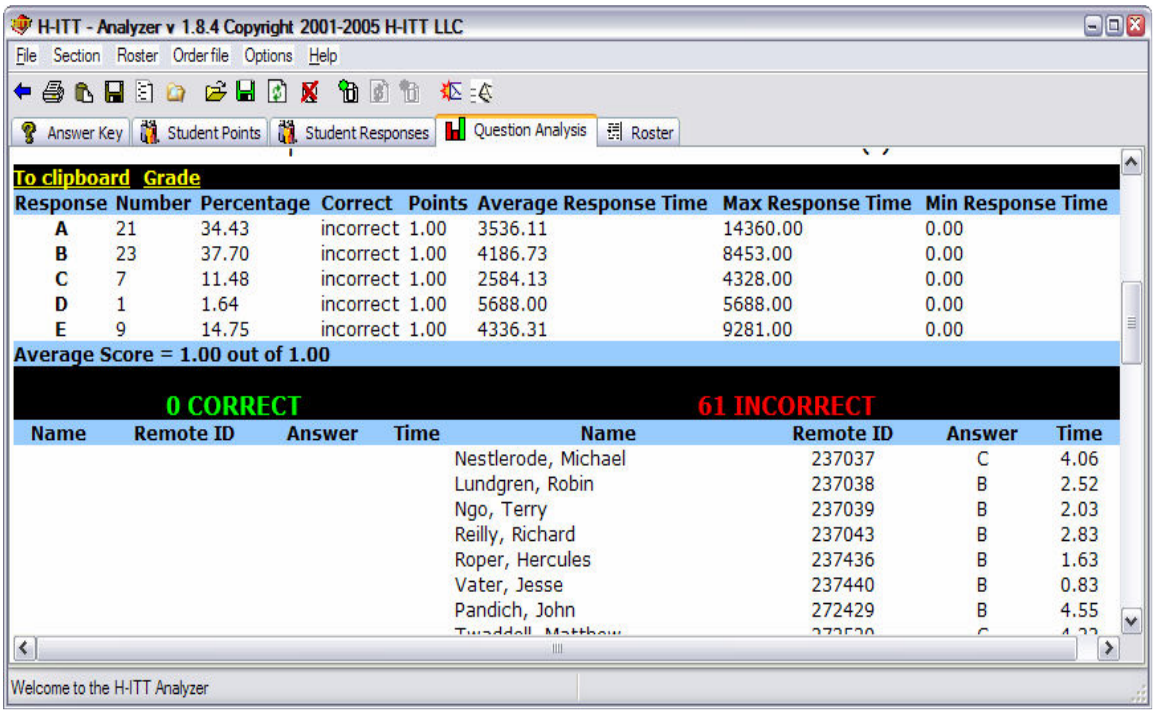
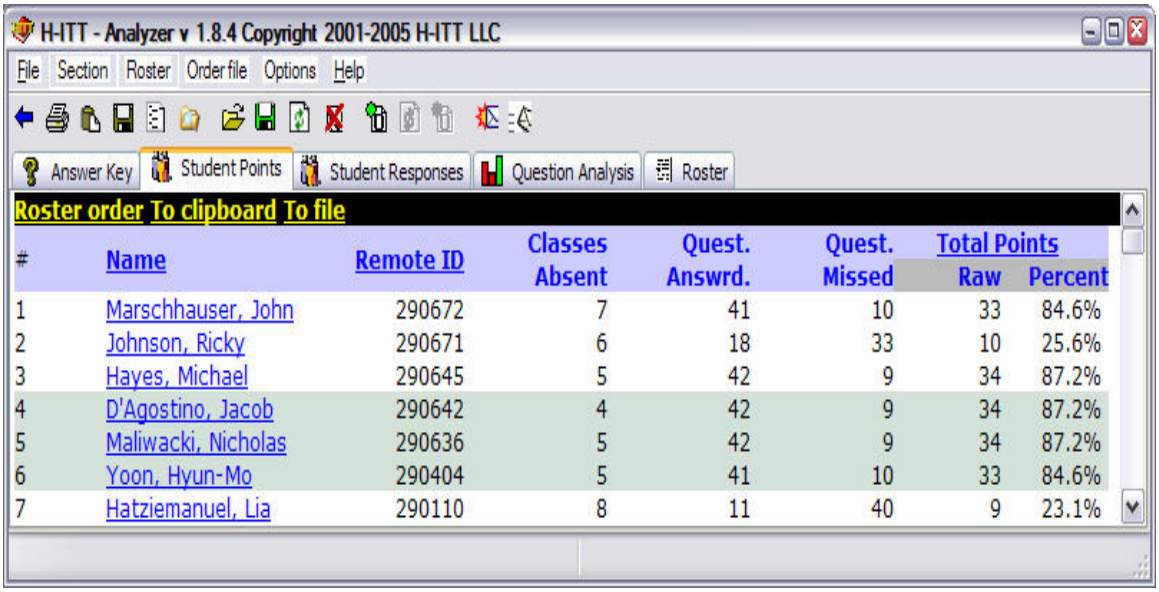


Figure 7: Statistical Report by question

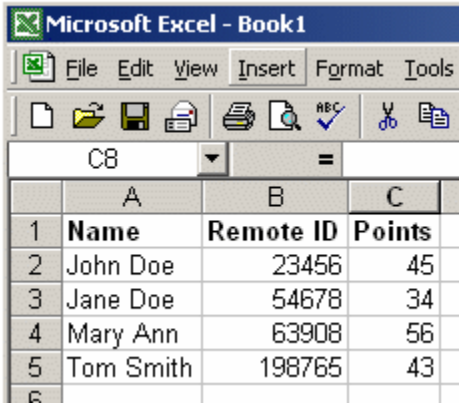


#	Name	Remote ID	Classes Absent	Quest. Answrd.	Quest. Missed	Total Points Raw	Percent
1	Marschhauser, John	290672	7	41	10	33	84.6%
2	Johnson, Ricky	290671	6	18	33	10	25.6%
3	Hayes, Michael	290645	5	42	9	34	87.2%
4	D'Agostino, Jacob	290642	4	42	9	34	87.2%
5	Maliwacki, Nicholas	290636	5	42	9	34	87.2%
6	Yoon, Hyun-Mo	290404	5	41	10	33	84.6%
7	Hatziemanuel, Lia	290110	8	11	40	9	23.1%

Figure 8: Statistical Report by student

Export Grades:

The software allows a list of student names with corresponding point totals to be exported into any spreadsheet program such as Microsoft Excel or Web-CT as shown in Figure 9.



	A	B	C
1	Name	Remote ID	Points
2	John Doe	23456	45
3	Jane Doe	54678	34
4	Mary Ann	63908	56
5	Tom Smith	198765	43

Figure 9: Grades may be exported to spreadsheets[2]

Classroom-Based Systems versus Internet-Based Systems:

The use of Internet-based systems such as BlackBoard[5] and Web-CT[6] are becoming increasingly common. These systems are extremely useful for activities that take place outside of the classroom, unless each student has access to a computer during the class. Alternately, CRS systems are much more beneficial for in-class activities. Table 1 summarizes some of the key features and advantages/disadvantages of an Internet-based System (BlackBoard) versus a classroom-based system (H-ITT CRS).

TABLE 1: Features of Internet-based Blackboard and Classroom-based H-ITT Systems

FEATURE	BLACKBOARD	CRS (H-ITT)
Price	Subscription	As low as $5 per student (when bundled with a textbook)
Ease of use	Moderately easy	Moderately easy
Testing and assessment available	Yes	Yes
Other documents available for use (e.g. MS Office)	Yes	No
Surveys available	Yes	Yes
Types of Questions:	Multiple choice Fill in the blanks Matching 15 other styles such as essays (not all are auto-graded)	Multiple choice only (from 1 to 10 choices)
Confidence Levels available	No	Yes (3 levels)
Timed individual questions	No (full tests may be timed)	Yes
Analyzes Responses	No	Yes with Data and Graph
Points assigned by question	Yes (limited)	Yes (points may be set for: Correct, Incorrect, Blank, Confidence Levels (3))
Classroom Attendance capability	No	Yes with Analysis
In-Classroom Testing	No (unless all students have access to a computer during the test)	Yes
Out of Classroom Testing	Yes	No
Classroom Based	No (unless all students have access to a computer in the classroom)	Yes
Internet Based	Yes	No
Course Documents available	Yes	No
Assignments available	Yes	No
Student Accessible	Yes	No
Auto-Email to students	Yes	Yes
Grade notification by email	No	Yes
Security	Moderate	High

Conclusion

Classroom Response Systems are valuable tools for providing classroom based automated assessment, real-time classroom responses, and a move toward student-centered teaching and learning. Testing using CRS technology can be done very well as indicated by Duncan, "When properly prepared, multiple-choice tests can generally be considered as good indicators of students' conceptual understanding."[1] Duncan stated it well, that both content and presentation are important, "Although the main goal of instructors is for students to learn, student attitudes toward your subject should not be ignored. If we truly believe that learning is a lifelong process, we will be happier with a student who leaves a course thinking the subject matter was interesting and involving rather than one who leaves thinking it was irrelevant and boring. An explanation, even a good, clear one often fails to reach students who have misconceptions. Something more active is needed. Clickers [CRS systems] are useful in fighting the "fade" of attention that occurs during lectures.[1] Duncan's accumulated research also indicated that even the best traditional lecture courses produced only about a quarter of the possible learning gains. Furthermore, the difference between excellent lecturers and poor ones was surprisingly small. Even the worst of the more interactive classes did better than most of the lecture classes. These results certainly encourage clicker [CRS systems] use and argue strongly for introducing at least some active methods into lecture classes.[1]

Bibliography

1. Duncan, Douglas; *Clickers in the Classroom*, Benjamin Cummings, 2005
2. H-ITT; http://www.h-itt.com
3. eInstruction Corporation; http://www.einstruction.com
4. GTCO CalComp Inc.; http://www.gtcocalcomp.com/interwriteprs.htm
5. Blackboard; http://www.blackboard.com
6. Web-CT; http://www.webct.com