

# PROMOTING GAME-LIKE CLASSROOM ENVIRONMENT: THE USE OF CLICKERS IN TEACHING, LEARNING, AND ASSESSMENT

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## ABSTRACT

Recent studies show that students at all education levels learn best when classrooms promote participatory activities that re-enforce the material being presented by educators (Mayer & Johnson, 2010; Rieber & Noah, 2008; Wang, 2008). Activities such as quiz-game-like questioning or other game-like simulations engage students, make them more attentive during a class, and provide ways a teacher can gain valuable feedback for assessing student learning. Classroom response systems such as clickers are one way to promote teaching, learning, and assessment in an interactive environment. Clickers are becoming more and more popular in American colleges and universities. Some U.S. higher education institutions even require their students to purchase and carry their personal clickers between classes. This paper will discuss clicker technology and how it is being used in the classroom for teaching, learning, and assessment in the United States. The paper will review the research done on classroom response systems, its effectiveness as an instructional technology, how the teaching faculty and students view it, and direction for its future development. The targeted audience includes classroom faculty who are interested in enhancing their teaching by trying new instructional technologies. Clickers from TurningPoint will be used for examples.

## KEYWORDS

Clickers, Response cards, Classroom response systems, Assessment, Evaluation, Instructional technologies, Audience response systems

## INTRODUCTION

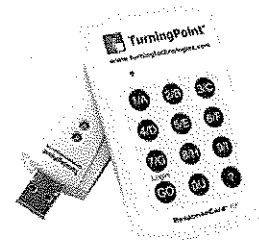
The use of classroom response systems is becoming a popular and successful educational tool to increase student attentiveness and participation. The technology enhances the classroom experience by using game-like activities to create an interactive environment that promotes student discussions with teachers and fellow students, and re-enforces the material presented, an environment in which students seem to learn best (Mayer & Johnson, 2010; Rieber & Noah, 2008; Wang 2008). In addition to promoting student engagement, the activities provide educators with immediate student feedback on how well material is being understood, enabling teachers to adjust their presentation to address the difficult learning areas. Student responses also enable educators to identify students who need additional help, and track student development over several classes.

There have been numerous studies of the effectiveness of classroom response systems. The majority of the studies show a marked improvement in student attentiveness, participation, enthusiasm, and achievement (Bunce, Flens & Neiles, 2010; Keller *et al.*, 2007). A few study results have raised questions concerning whether these learning levels are retained over time (Liu, Gettig & Fjortoft, 2010).

All classroom response systems are similar in their use and technology. This paper will focus on setting up and using the TurningPoint Technologies' clicker's response system first marketed in 2002. It is currently used by over 700 colleges and universities.

### **Clicker Technology**

A typical classroom response system includes three components: a clicker or respond card, a receiver or responder, and the proprietary software. A clicker looks like a TV remote control. The receiver goes into the USB port on the instructor's computer. See Figure 1 for a graph of a clicker and receiver. The software must be installed on the instructor's workstation as well.



**Figure 1. A Clicker and receiver.**

A clicker works in a similar way to a gaming system that most young students grew up using. Its buttons display numbers 1 to 9 and letters A to I. The numbers and letters represent choices that students click when answering questions. Each clicker has a unique hardware device number listed on its back. Pressing a button on clicker will send a signal to the receiver that plugs into the USB port on the instructor's computer. The clicker's unique number is broadcast along with the user's response which enables the receiver to identify which clicker is sending out data. The receiver will register the responses in the clicker software. In turn the clicker software will collect and store the answers that it receives and display the results in graphics on the screen of the instructor's computer. The software also tabulates the responses for statistical reporting and analysis that can be extracted later. If a classroom is equipped with a big projector screen, the whole class can see the responses instantly in graphical and percentage representations.

Each clicker is configured to use a particular channel which can be easily changed if there is an unexpected conflict. All the students in the same class and physical classroom must use the same channel, especially if other classrooms are nearby. Students in an adjacent classroom should use a different channel. If two clickers are on the same channel in two classrooms within 240 feet from each other, their signals may end up registering in the wrong receiver.

TurningPoint clicker software can be downloaded for free from the TurningPoint Web site (<http://www.turningtechnologies.com/>). There are two types of clicker software, one that works within Microsoft PowerPoint and one that works independently. The Microsoft PowerPoint software must first be installed before being used. The installing process contains on-screen directions that are easy to follow. An icon will be created on the desktop after the installation. Clicking on the icon will start Microsoft PowerPoint with the clicker program available as a tab on the top menu bar. Clicking on the tab will display the clicker menu. See Figure 2 for the clicker menu in PowerPoint. In either type of clicker programs, the instructor needs to inform the system of the type of participants that will be sending responses. A pull-down menu is accessible in the clicker software that displays choices such as "Auto", "Anonymous", or a participant list. See Figure 2 for a snapshot of the pull down menu with three participant modes. The numbers "18", "20" to "23" are participant lists with 18 to 23 students in each. The clicker program's Participant Wizard allows the instructor to create a participant list for any number of students with an assortment of customized fields.

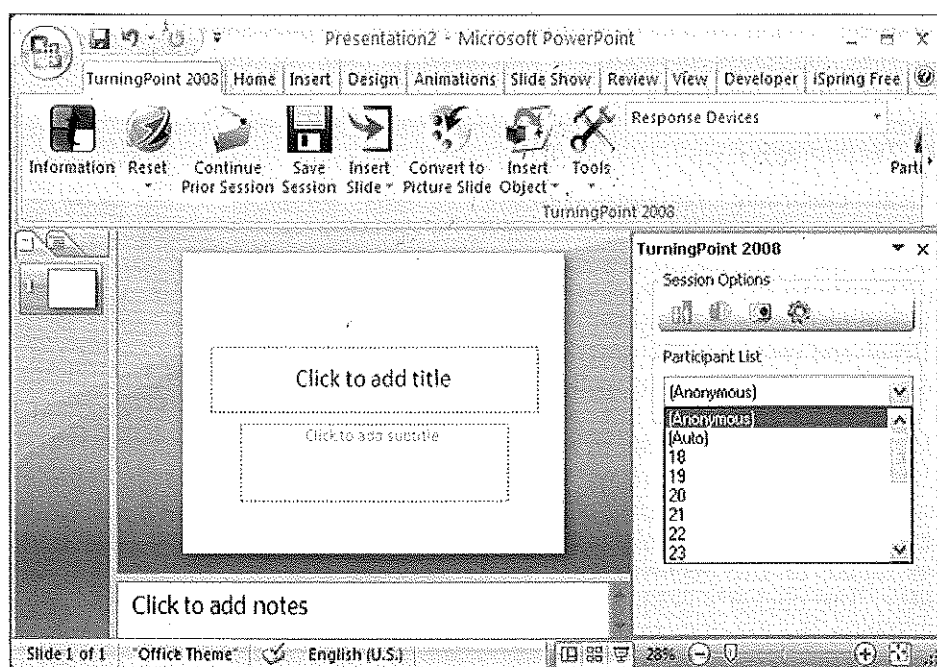


Figure 2. Clicker menu bar and response modes.

When "Auto" is chosen, the system will receive responses from a clicker together with its hardware device numbers. The instructor can trace the responses back to students by device numbers. If "Anonymous" is selected, the responses are received without the clicker's hardware device numbers. Responses cannot be traced back to a particular clicker, and the user remains anonymous. The third option, participant list, generally has information about a student such as their clicker device number, last name, first name, gender, major, and any other fields. In the participant list the clicker hardware device number must be present along with other information about the owner of this clicker. The instructor can add any data field wanted for use in data analysis. Once created, a participant list can be imported or exported into a file and moved to a Flash drive or other storage device. The hardware device number on a clicker is the key in identifying an individual student's responses and performance on tests. Participant lists are a good way to track a student's progress throughout a semester (Figure 3).

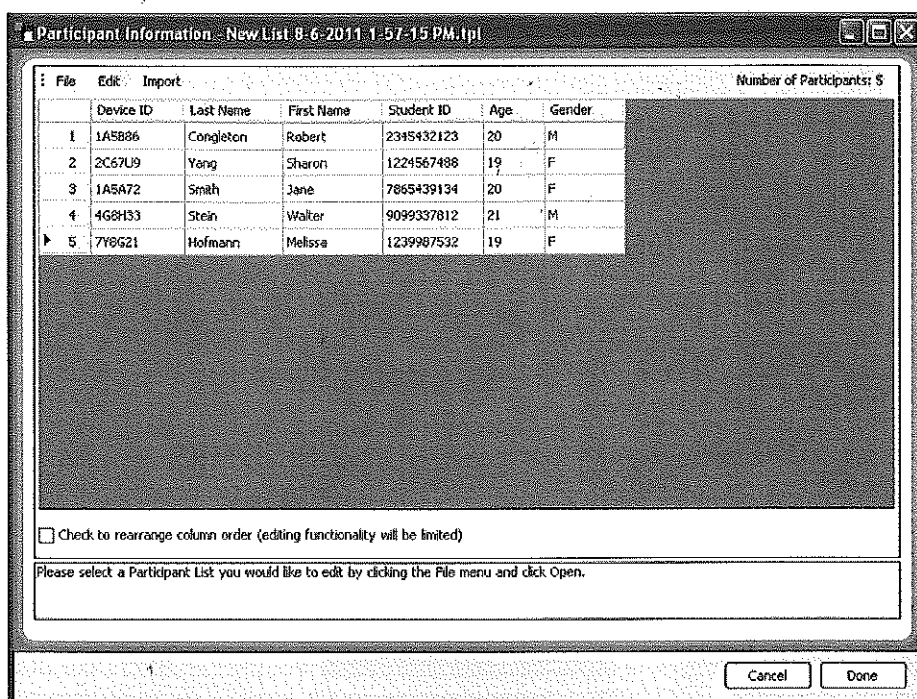


Figure 3. Creating participant lists.

The next step is to create a questionnaire. This can be done in the clicker software which resides either in Microsoft PowerPoint or outside PowerPoint on the desktop depending on the software you choose to download. For PowerPoint the clicker menu bar shown in Figure 2 is used to add a question slide, reset question slides and erase data from previous sessions, set up counters to count seconds and minutes for polling, choose a correct answer indicator, and link two question slides for comparison. Generally, question slides contain multiple choice response options rather than open-ended replies. The top heading of the slide contains the question. The multiple choice responses will be in the main body of the slide. If desired the correct answer can be indicated on a side panel. Once a correct answer is entered, the answers to the rest of the multiple choices automatically become incorrect. An unlimited number of questions can be created. See Figure 4 for a question slide that is ready for polling.

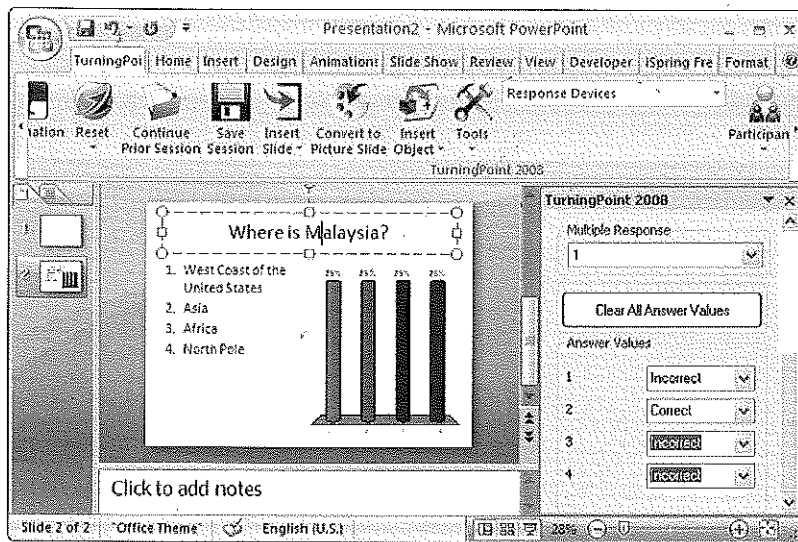


Figure 4. Creating a question slide.

Polling, or asking for users to respond, begins once the slide show starts. A mouse click on the question slide will stop the polling process. Polling can also take place in a timed manner with an indicator displaying how much time elapses before polling ends. Once the time is up, the polling automatically closes and the polling status indicator will turn red from green. The polling results will immediately show up as graphics, either a bar chart, pie, or broken pie, depending on what graphic has been selected for display. Figure 5 is an example of a question slide after polling is closed.

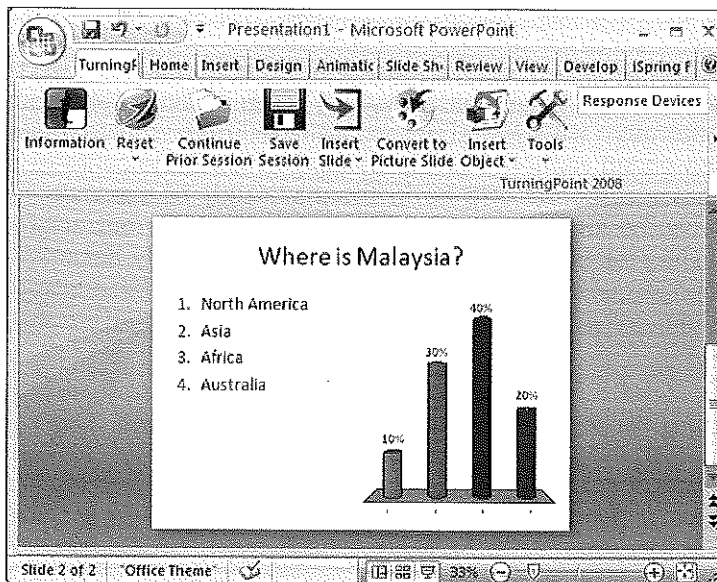


Figure 5. Displaying polling results.

In addition to a single slide, clicker software can compare data from two or more slides for assessment. The software can link two or more slides with identical or similar questions so that their responses can be compared. In a typical comparison scenario, students would answer a set of questions before the class starts and answer the same or similar questions when the class ends. The data from both sets of questions will be compared automatically by percentages and graphics. This function will provide a direct means to compare students' performance before and after the teaching session. See Figure 6 for a graph of an example of in-class assessment. The display is a comparison of pre- and post-class performance.

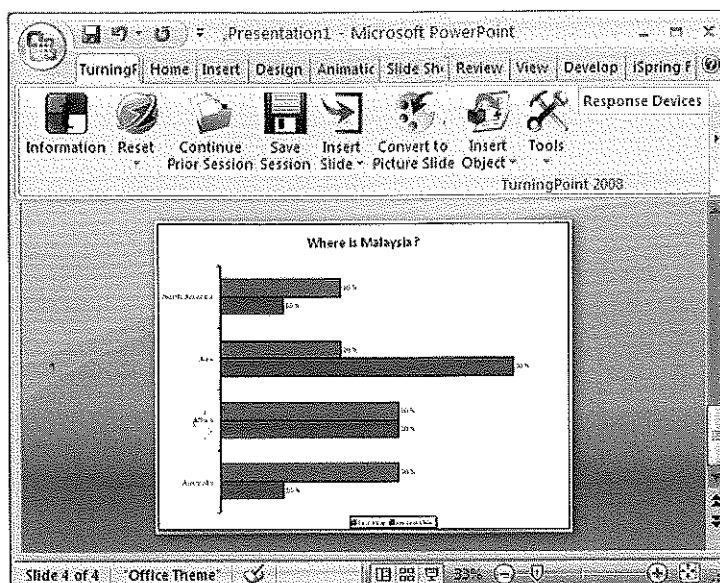


Figure 6. Comparison of pre- and post-class performance.

An alternate version of Clicker software can operate independent of Microsoft PowerPoint. The independent clicker software has similar functions as its Microsoft PowerPoint counterpart, but does contain slight variations. It offers more flexibility. The program can be downloaded and unzipped into a single executable file. The instructor can carry this file on the flash drive and use it anywhere as long as he or she has a computer. No installation is needed for the independent clicker software. The program displays as a floating menu bar on the desktop of the computer screen. See Figure 7 for an example of the clicker software as a floating bar on the desktop.

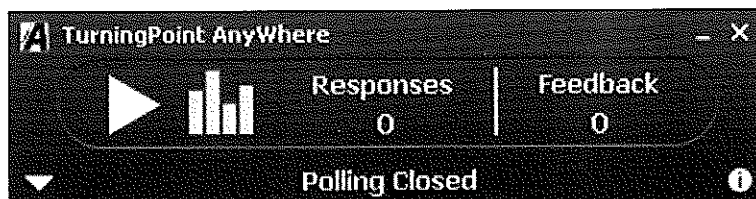


Figure 7. Clicker software as a floating bar.

Like the PowerPoint version, the independent clicker program has three data input modes, "Auto", Anonymous", and participant lists. The participant lists are interchangeable between two clicker software. An instructor can import and export the participants freely between the two clicker software. Likewise an instructor can import and load previously created questions into the program or create questions on

the fly during in the classroom. These questions can be edited, with additional information, after the class. The most frequently used questions are multiple choices, but the software also offers numerical and text options.

The arrow key on the left is a pull down menu for creating questions using the program's Question Editor. See Figure 8 for example of Question Editor. When polling begins, the floating bar will display the number of responses and indicate if polling is open or closed. The questions may be displayed on the screen or may be hidden. When the polling is closed, the statistics will be displayed as a bar chart.

The screenshot shows the 'Question Editor' window. It has a menu bar with 'Add Question', 'Delete Question', 'Import Question', 'Standard', and 'Save'. The main area is divided into three sections. The left section contains a list of questions, with the first one being '1. Where is Malaysia?'. The middle section displays the question 'Where is Malaysia?' with four answer choices: '1 North America' (Incorrect), '2 Asia' (Correct), '3 Africa' (Incorrect), and '4 Australia' (Incorrect). Each choice has a dropdown arrow and a delete 'X' button. Below the choices is an 'Add Answer Choice' button. The right section is titled 'Question Properties' and includes an 'Anonymous' checkbox, 'Correct Value' (1), 'Incorrect Value' (0), 'Presentation Properties' section with 'Display Correct Answer Indicator' and 'Display Countdown Timer' checkboxes, and a 'Seconds' input field set to 0.

Figure 8. Question Editor.

Using the independent software version enables an instructor to access a Word document, Excel Spreadsheet, or a Web site and then ask students to respond to questions about the contents on display. The clicker software will capture whatever is displayed on the instructor's workstation together with the students' responses. The instructor can retrieve a report containing the answers and all screens displayed in the class. The recorded session can then be revisited and reviewed. See Figure 9 for example of a report where students were asked a question about Malaysia while the instructor was displaying a Web site about Malaysia. Both the students' responses and the Web site are being captured in the report.

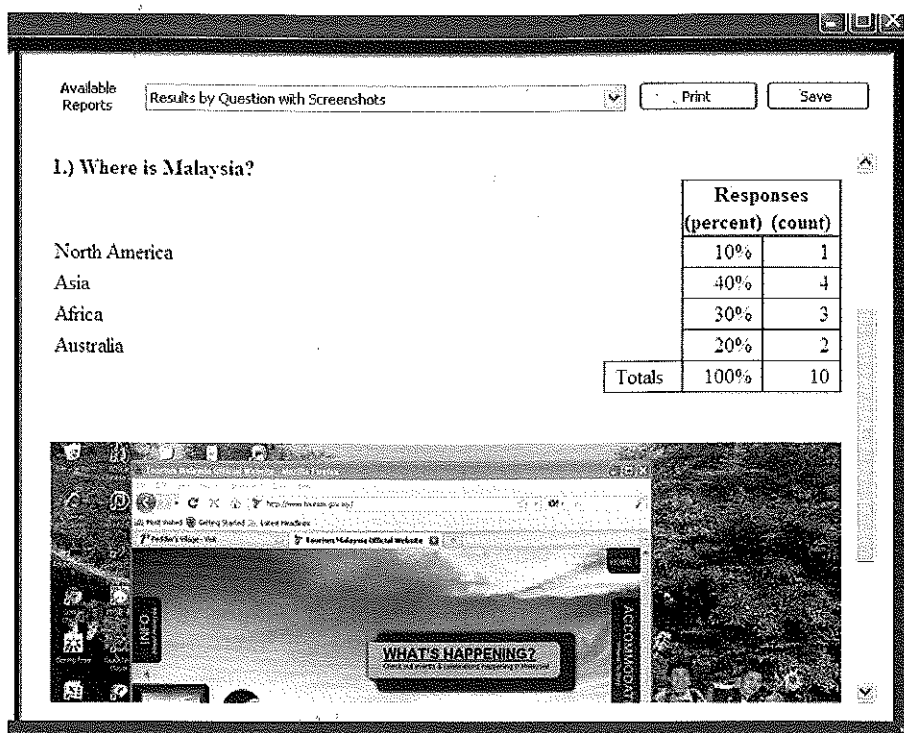


Figure 9. Clicker report with responses and screen captured.

For educators, the most valuable part of the classroom response system is its statistical reporting. The data gathered from students responses can be saved, stored, retrieved, and compiled into a variety of reports for statistical analysis. The instructor can retrieve it later and analyze the data to show students' demographical distribution such as age and gender, academic progress over time, ranked name list by performance, and comparative data for pre- and post- tests. The data can be used for a variety of research purposes.

There are disadvantages to using clicker technology. The handheld clickers are battery operated hardware that requires some maintenance. They are fragile and can break if not correctly handled. Vendors need to develop more robust hardware.

### *Clicker Use in Classroom*

Distributing clickers to be used in a classroom can be done in a variety of ways. The most common method is by distributing hand held clickers at the beginning of a class and then retrieving them when the class is finished. Another way is to require a student to purchase his or her own individual clicker and use it for all their courses. This way, a student will be using the same clicker throughout their education, as some higher education institutions require, and enable their clicker results to be tracked over their entire curriculum. Counselors and advisors can use this information to keep individual students on track for fulfilling degree requirements, or identifying individual learning problems and successes. Tracking also can help institutions assess the success or failure of their programs and identify ways to improve or revise the curriculum. However, tracking also raises privacy issues which many institutions have addressed by deleting information that can identify individual students once a student has graduated.



Instructors have found clickers to be very helpful in discovering the material students are having trouble learning. Appropriate questions placed in crucial parts of a lesson gives teachers instant feedback on how well the lesson is being understood. Based on the responses, the instructor could instantly adjust the lesson to give additional time to the material that generated the most incorrect responses. Displaying the response results could also be used as an opening for classroom discussion.

Clickers can also be used during student presentations. Students can be asked to comment on the presentation, with their comments collected using the anonymous input mode. The results could be displayed and the class then opened for more discussion. Alternately, the instructor could analyze the input in class and comment on the performance by the presenters. For each instance, classroom discussion of the results should be encouraged.

Studies have found that students are more enthused and alert when Clickers are used (Wolter *et al.*, 2011). The participatory activities provided by clickers enhance student learning experience by providing them with a game-like environment. Students display more interest in class materials. Some of this interest is derived from students being obligated to participate in the response activities. Such participation is the result of the clicker software display grid showing who has answered or not answered the questions. The display grid also ensures that no student will be left behind if they are unable to offer a response.

Teaching assessment is another area that clickers can be used. Compiling and charting the results of responses to a specific lecture or over the course of the whole semester lets an instructor analyse what students learned. Weak and strong points of a lecture, classroom activity, or the general curriculum can be identified and revised.

## **LATEST DEVELOPMENT OF CLICKERS**

Currently clicker technology is moving away from using only proprietary hand held devices. Technology has been developed that enable cell phones, laptops and desktop computers to be used as clicker devices. These new developments will do away with the need for students to purchase clicker devices or have instructors spend valuable class time distributing and retrieving proprietary clicker devices. The polling can take place not only in the classroom, but anywhere, on the bus, in the gym or on the street. There is no need for software installation on the instructor's desktop. The response data can be displayed directly on the Internet. Statistic reporting is also done on the Web. This makes clicker technology more flexible and powerful. These developments allow classroom response systems to be used in distant learning classes where students attend lectures while at their home or office via the internet.

A criticism of this new mobile technology concerns the instant feedback feature which some lecturers have found distracting as they talk to the class. This can be addressed by having the messages saved but not displayed.

## CONCLUSION

The growing use of classroom response systems has opened many avenues for enhancing a student's classroom experience. By encouraging and forcing classroom participation, the response systems have forced students to be more attentive in the classroom. Students have found that using clickers can be a fun experience similar to the interactive games they play outside of school. Student responses to using clickers have been overwhelmingly positive. Studies have shown remarkable increases in student enthusiasm, alertness, and participation in classroom activities with a related increase in student learning outcomes. In addition, teachers have found the reporting and assessment functions of the software to be very useful in identifying the weaknesses and strengths of individual students, classroom groups, faculty lectures and lessons, and the curriculum as a whole.

As classroom response systems move away from proprietary hand-held clicker devices and allow cell phones, laptops and other technology to act as responders, the use of this technology in classrooms will continue to grow. It is one example of software that has found an important niche in improving the learning and teaching assessment goals of education.

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