

2006-2674: USING INTERACTIVE ASSESSMENT TOOLS IN THE CLASSROOM

Gary Moe, U.S. Air Force Academy

Lieutenant Colonel Gary P. Moe is an Assistant Professor at the United States Air Force Academy. Lt Col Moe received a B.S. degree from the University of California in 1976 and an M.S. degree in Aeronautical Engineering from the Air Force Institute of Technology in 1984.
gary.moe@usafa.af.mil

Using Interactive Assessment Tools in the Classroom

Abstract

Research continues to show the most common instructional technique, the lecture, is less effective in promoting student learning than student-active methods. Students tend not to retain the majority of material after the first 10-15 minutes of lecture. Actively involving students in the lesson has many benefits such as supervised practice, increased retention, and better understanding of concepts. In-class assessment is a useful tool that actively involves students, while providing valuable feedback to the instructor. Immediate feedback can be even more beneficial, because the instructor can modify the presentation “on the fly” depending on the students’ levels of understanding. One currently available tool, the GTCO CalComp™ “Personal Response System” (PRS), is designed to provide instructors assessment and immediate feedback to monitor student learning. The PRS is a computer-based, wireless system where students use individually coded transmitters to answer questions based on the lesson material. This paper will summarize the results of a study using the PRS in the United States Air Force Academy Engineering Division Fundamentals of Mechanics course. A class survey and focus group were used to determine the usefulness of PRS-based assessment for the course. The goal of the analysis was to use emerging technology to enhance the learning environment in engineering courses by increasing instructor-student interaction through assessment and real-time feedback.

Introduction

Student-active learning is an effective way to increase retention of lesson concepts. Involving the students tends to increase their attention, because they know they are an integral part of the lesson. The involvement also helps them better understand the main points of the lecture. Even though more student involvement is beneficial, without assessment the instructor cannot know how many of the students actually grasp the principle concepts. Using questions or activities to check student understanding not only involves the students, but provides the instructor with the needed feedback.

One currently available tool, the GTCO CalComp™ “Personal Response System” (PRS), is designed to provide instructors assessment and immediate feedback to monitor student learning. The PRS is a computer-based, wireless system where students use individually coded transmitters to answer questions based on the lesson material. The PRS was used to check understanding during lectures in the “Fundamentals of Mechanics” course at the United States Air Force Academy (USAFA). Questions posed ranged from those requiring simple true/false responses to simple work-out problems that illustrated the concepts being discussed.

Course Specifics

“Mechanics of Materials (EM-120)” is the first comprehensive engineering course cadets take at the USAFA. Material covered includes statics and mechanics of materials in a single-semester format. Students are exposed to many new concepts that require a greater degree of systematic detail than they have previously seen. Moreover, EM-120 is a core course each cadet must take, whether or not they are in a technical track. Typically, only 15-20 percent of EM-120 students have an interest in a technical major. As a result of the large percentage of non-technical students, a major challenge for the instructors is to make the course interesting and meaningful for all students. The audience and sheer volume of material to cover requires the instructors to be effective in presenting the lessons.

Using the Personal Response System

The GTCO CalComp™ PRS is a computer-based polling system that enables students to use individually coded, infra-red transmitters to answer concept questions during the lecture (Figure 1).

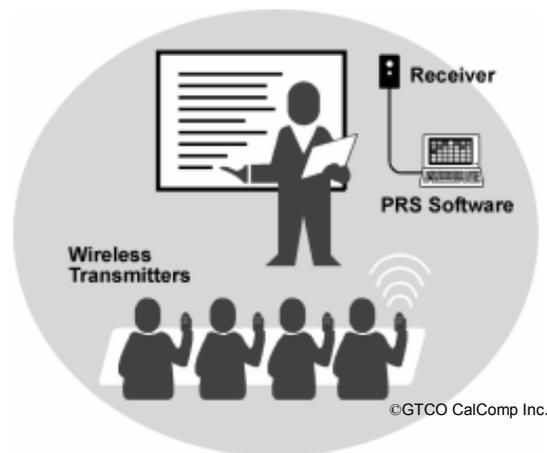


Figure 1: The Personal Response System

Lesson material is presented during the class using PowerPoint™ slides, with the concept questions incorporated into the lecture slides using PowerPoint Add-In software. The instructor can design the question and place it onto the PowerPoint slide (Figure 2). The slide can then be turned into a PRS question through a click of the computer mouse. Question options include number of answers, correct answer, number of attempts, and timing. The entire process of building the series of question slides takes only a few minutes to complete.

The instructor is able to assess class understanding during the lesson presentation by using the PRS-formatted slides (Figure 3). At the appropriate time during the lesson, the instructor may introduce the question slide and prepare the students to give their inputs. The question grid appears on the slide, the timer is started, and the students use the transmitters make their choices.

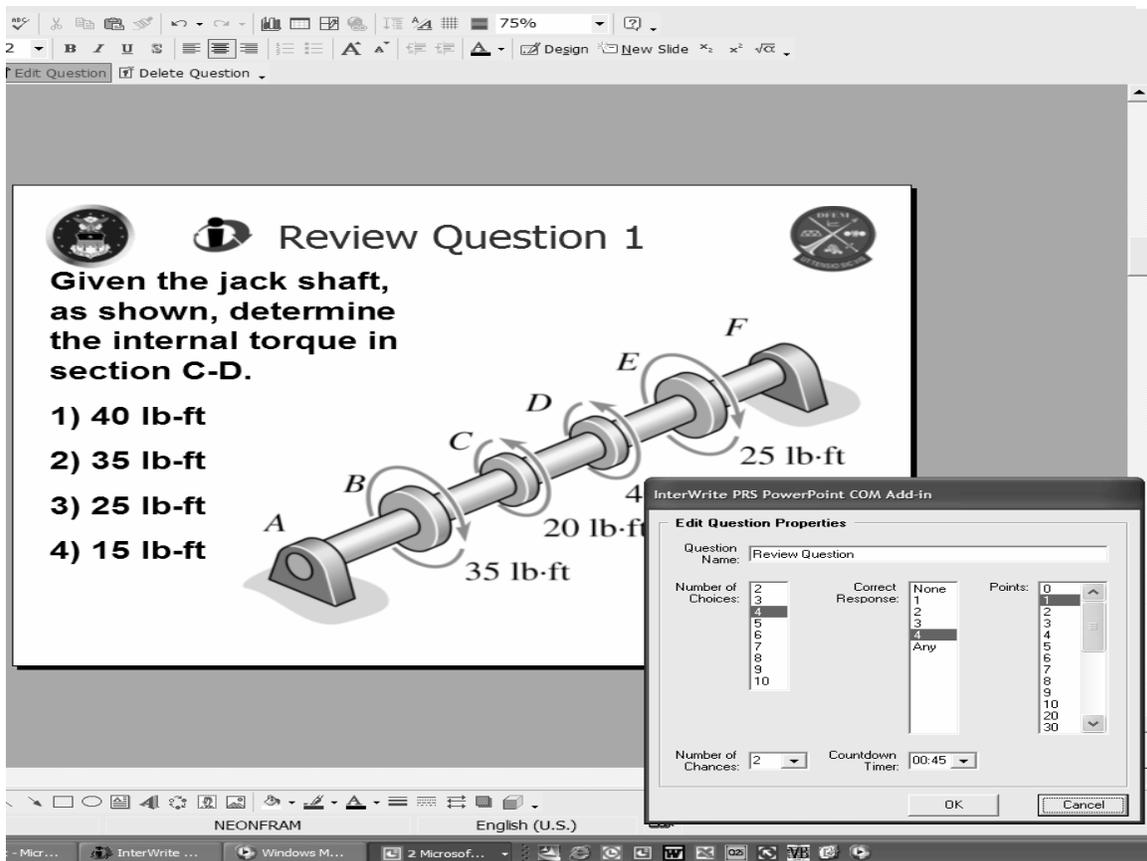


Figure 2: PRS Add-In to PowerPoint

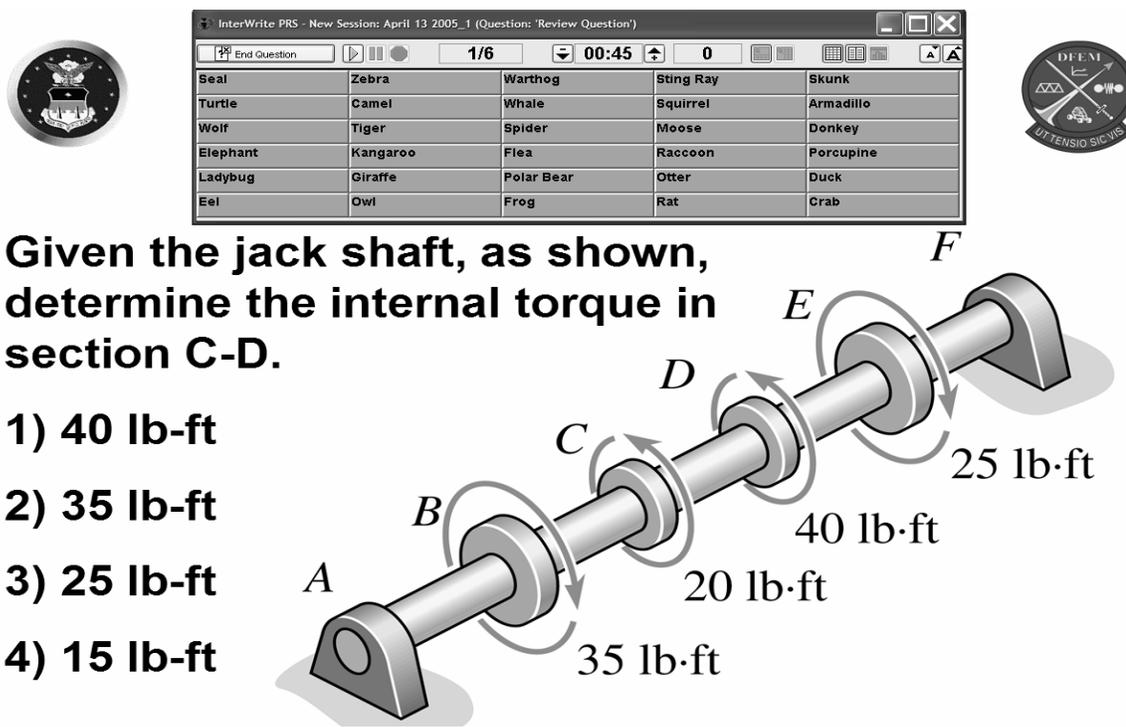


Figure 3: PRS Slide

After the question clock times out, no more attempts are allowed, and a graph recapping answers overlays the slide (Figure 4). The graph gives immediate feedback of concept understanding to both students and instructor. If the students understand the material, the instructor can continue the lecture. If the students require more instruction, the instructor can review the material to reinforce the learning.

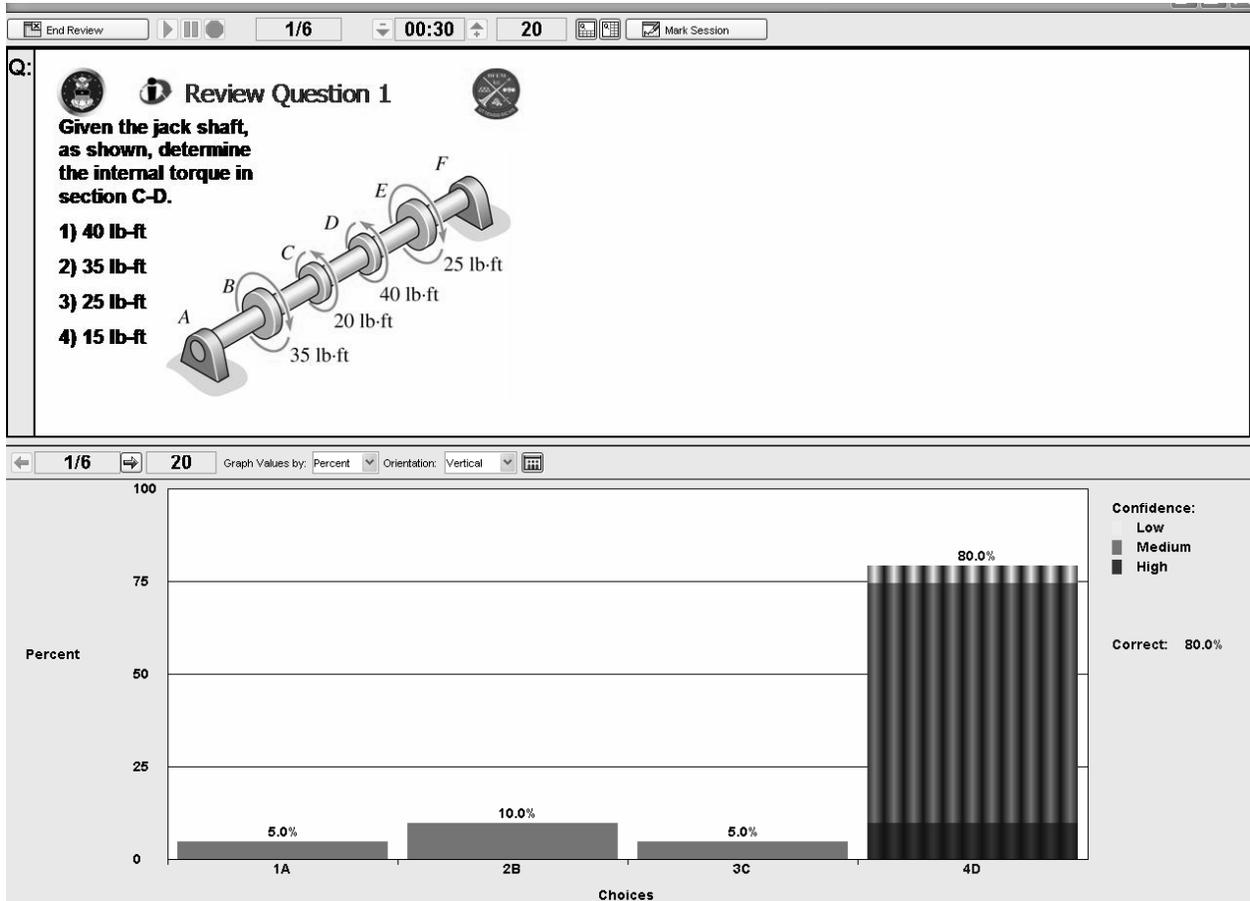


Figure 4: Assessment Feedback

Results

The goals of the study were two-fold;

1. To determine the usefulness of using the PRS to accomplish in-class assessment and
2. To determine the effectiveness of assessment and immediate concept review in a course with a comprehensive syllabus.

At mid-semester, an in-class survey was conducted to gauge the students' attitudes about using the PRS as an assessment tool in the classroom. Towards the end of the semester, the students also participated in a more in-depth focus group. In general, the students were open to using the technology and did not view the system as a distraction. More importantly, the students appreciated having the opportunity to review the concepts; especially when they knew they would be tested on the concepts as well as the application of those same concepts.

Personal Response System Effectiveness

The PRS units were generally accepted by the students (Figure 5, Question 1). They reported the system was easy to use. Even with a few start up challenges, the students did not find the PRS to be overly distracting (Figure 5, Question 2). In fact, using the PRS provided a useful way to break up the lecture and increase student attention. Cadets received about 15-20 minutes of lecture, then used the PRS to answer several concept questions. They listened to another five to ten minutes of lecture and finished the class with time to do a practice problem.

The PRS system was “new” and different for the first few lectures, but the novelty quickly wore off. It soon became just another classroom tool, albeit a powerful tool. It gave the instructor and students the ability to immediately see the responses and check understanding. Depending on the percentage of correct responses, the lecture was continued or the misunderstood concepts were reviewed, then the lecture was continued. Using the PRS also gave the students a way to answer questions without feeling embarrassed by giving an incorrect answer. They could anonymously give it their “best shot.” It did not matter whether or not the answers were correct; the students would still get the needed information. During the focus group one student stated, “(The clickers) made you actually think about it (the concept) rather than just taking notes.”

Assessment Effectiveness

Angelo and Cross¹ have shown in-class assessment to be a very effective student-active method and useful tool to check student understanding of concepts. This was also the case for the EM-120 students involved with the study. Even though the PRS became an everyday tool, the act of breaking the flow of the lectures helped the students pay attention during the lessons. Moreover, the opportunity to review the concepts was well received by the students.

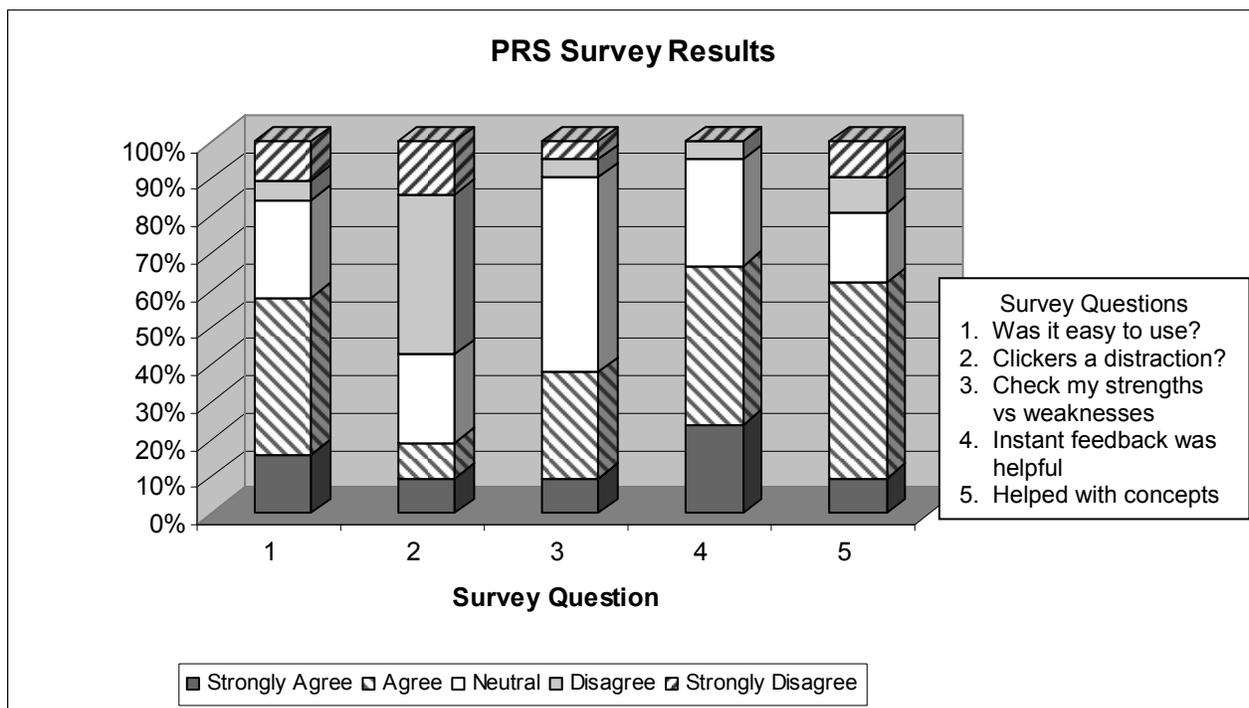


Figure 5: Graph of Survey Results

Student feedback (Figure 5, Question 4) indicated clarifying concepts was the greatest advantage of using the PRS to assess the class. There was so much course material to cover that the concepts had a tendency to get lost in the sheer volume of topics. It has been said, “Teach to one sentence².” That is, have the main concept, or “sentence,” as the focus for the lesson and come back to that sentence several times throughout the lecture. One way to refocus on the lesson concept is to assess, then review, the main points. This helps to fix the correct ideas in the students’ minds. One focus group attendee stated, “...I actually think it did help because it would explain the question and why we got it wrong.”

The students’ appreciation of their strengths and weaknesses seemed to grow during the semester. Earlier in the semester they were less interested to “know what they don’t know,” that is, to identify not only their strengths, but also their weaknesses. They responded somewhat coolly to the survey question, “Using the ‘clickers’ helped me assess my strengths and weaknesses (Figure 5, Question 3).” Later in the semester the focus group responses showed the students thought this use of the PRS was, in fact, beneficial. One cadet stated, “The immediate feedback is really nice because if you have an aspect of the problem that you are not understanding, but you don’t know you don’t understand it, it (the review) corrects that immediately, so you don’t have it (the incorrect concept) ingrained in your mind...”

The students were more receptive to reviewing the theory since they knew they would be tested on their knowledge of conceptual material (Figure 5, Question 5). Being required to know concepts as well as how to apply them made the students more receptive to in-class reviews. This should go without saying. However, even the best technology can be coolly received if it is seen to have limited immediate value.

Personal Response System Strengths and Challenges

The PRS can be very useful in the classroom to increase student-instructor interaction through polling and non-threatening assessment. The system lends itself to a more permanent set up because it has a number of peripheral components, such as cables power supply, and infra-red receivers. However, a portable laptop computer can still be used with the system if the cables are brought into the classroom.

The major strength of the PRS is the ability to use the system with PowerPoint™ (PPT) slide shows. The PPT add-in program made it very easy to turn questions on the PPT slides into PRS questions. In fact, questions from other PPT slides could be copied and turned into a series of PRS question slides in a matter of minutes.

One point to consider when importing questions from other slides is to turn off all slide animation. Any animation on the question slide can be very distracting for both students and the instructor. The distractions can range from upsetting question timing to preventing any logging of answers.

Another system strength is the ability to instantly check results of the question poll and to use the results to guide follow-on discussions of the misunderstood concepts. When the PRS slide comes up in the lesson, the question timing starts with a mouse click. As soon as the question times out, the answers are presented on a graph that shows both correct and incorrect responses.

If the graph shows overwhelming concept understanding, the lesson can continue. If there are several incorrect answers, the concepts can be reviewed to increase the students' understanding.

One of the most significant early challenges was adapting the PRS presentation window to work with the in-class projection systems. There were several times when the PRS response control bar was truncated or totally disappeared from the viewing window because the projected image proportions were different than those used on the laptop computer. The situation was corrected when the control bar was located at the top-center of the image. After making that correction, images could be displayed using resolutions of up to 1280x1024 pixels.

One system idiosyncrasy became evident because the PRS was used with a laptop computer that was moved between the office and classroom. There were times when the communications port, that allowed the computer to “talk” with the receivers, shut down. It was distracting to the students to take time to go into the software and re-open the communications port. The situation was caused by the instructor using the PRS program in the office and setting the computer to “standby” when leaving to teach class. When the computer operation was resumed in the different environment, the communication port shut down. The situation was corrected by closing the PRS program before moving the computer from the office to the classroom. Upon starting the program in the classroom, the software automatically opened the communications port and the system worked as expected.

Conclusion

Overall, the personal Response System was a very useful tool for the classroom and provided a method to increase instructor-student interaction. By using the PRS to assess understanding of lesson material, student-active learning was increased. The instantaneous feedback and concept review can increase concept retention and was favorably received by the students. Once the startup challenges were overcome, the PRS became a powerful addition to each presentation.

Bibliography

1. Angelo, Thomas A. and Patricia M. Cross, “Classroom Assessment Techniques: a Handbook for College Teachers.” Second Edition. Jossey-Bass, 1993.
2. Gray, Tara, “Be All You Can Be – Teach!” Presentation at Boot Camp for Profs, Leadville, Colorado, 2004.