Engage Your Audience

Using audience response systems in SH&E training

By Julie A. LaRose

IN AN IDEAL WORLD, the learning objectives of an SH&E training session are carefully crafted by the instructor and clearly communicated to the audience. These objectives are perfectly matched to attendees' learning needs, and the instructor and attendees are completely engaged in the educational process. All information presented passes from working memory into long-term memory. The information is internalized by attendees and manifests itself in model behavior in the workplace. The ultimate goal of training is realized with greater awareness and lower injury and illness incidence rates.

In the real world, learning objectives may not be clearly defined. The learning needs of the audience may be unknown. Attendees may be disinterested, preoccupied, unmotivated or overwhelmed by the subject matter. The instructor may make false assumptions about the audience's level of retention and may not receive audience feedback until the presentation is finished.

Training initiatives can fail in many ways. The result is the failure to recognize any real benefit from the investment in training. The challenge remains for SH&E professionals to increase learning retention, improve learning outcomes and motivate safe behaviors. In pursuit of better learning outcomes, universities have invested tremendous resources to analyze the function of learning and methods to enhance the learning process. It is beneficial for industry trainers to study trends in higher education and employ strategies that have been proven effective.

One method that has been successfully employed in lecture halls is the use of audience response systems (ARS). The use of ARS to engage and interact with attendees on a real-time basis can significantly enhance the quality of SH&E training. To fully appreciate the utility of these systems, it is necessary to understand how they work; comprehend their benefits and limitations; and see meaningful, practical examples of their use.

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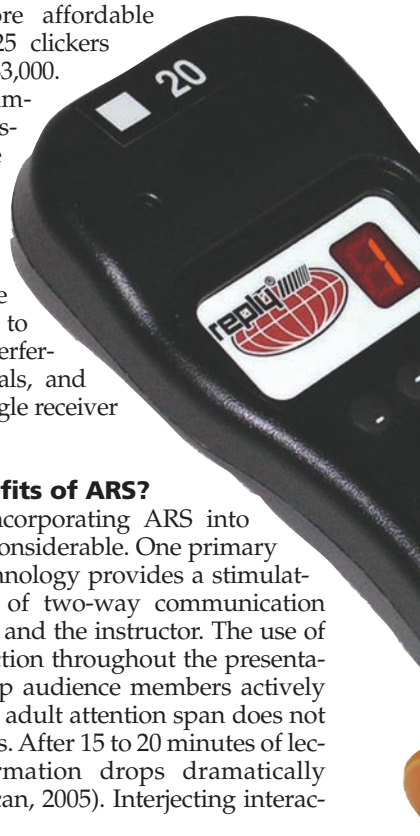
What Are Audience Response Systems?

ARS include four components: a handheld transmitter (often called a "clicker"), a receiver (plugged into the USB port of the presentation computer), the software on the presentation computer and a projection system. In an interactive presentation, the instructor poses a multiple-choice question to the audience, generally through a PowerPoint slide. Audience members submit their individual responses to the question by using their clickers. The clicker sends a radio frequency or infrared signal to the computer receiver (Photo 1). Software on the presentation computer compiles the audience responses and projects a summary of the responses (Photo 2, p. 69).

In recent years, the cost of ARS has dropped into a more affordable range. A system of 25 clickers now costs $2,500 to $3,000. With technology improvements, these systems have also become more robust and reliable. Radio frequency clicker technology is swiftly becoming the standard because these signals are not subject to the same types of interference as infrared signals, and they require only a single receiver (Caldwell, 2007).



What Are the Benefits of ARS?

The benefits of incorporating ARS into training sessions are considerable. One primary benefit is that the technology provides a stimulating and novel form of two-way communication between the audience and the instructor. The use of clickers fosters interaction throughout the presentation and helps to keep audience members actively engaged. The average adult attention span does not extend past 20 minutes. After 15 to 20 minutes of lecture, recall of information drops dramatically (Caldwell, 2007; Duncan, 2005). Interjecting interac-

tive questions at appropriate intervals engages audience members and sustains their attention. This technology builds on other techniques such as storytelling, small group discussion and workshops. The use of clickers provides another creative method that an instructor can employ to engage attendees.

Another benefit of ARS is that they enable the instructor to use real-time indicators to ascertain whether learning objectives are being achieved. Instructors tend to overestimate the amount of material students absorb (Duncan, 2005). With an ARS, an instructor can assess whether students have grasped key concepts before moving on to other material.

To incorporate ARS effectively, instructors should identify specific learning objectives and develop probing questions that periodically assess the audience's level of comprehension. Typically, the instructor receives this feedback at the conclusion of the session, when the opportunity to clarify or give another example is lost. An ARS allows an instructor to respond to the learning needs of the audience in real time. Such feedback also helps instructors to enhance their training content by evaluating which concepts need further elaboration or require better illustrative examples.

Another benefit for companies considering the use of ARS is that these systems have already been thoroughly evaluated and successfully implemented by numerous colleges and universities. Many higher education institutions have thoroughly reviewed and compared different ARS and have published or made their findings public (Barber & Njus, 2007; Lowery, 2006). These reviews serve as a consumer guide to companies that do not have the resources to extensively pilot these systems.

In addition, universities that have conducted surveys on the use of ARS have reported overall student and faculty satisfaction with the technology. The University of Wisconsin system evaluated the use of clickers across four of its campuses (Milwaukee, Eau Claire, Oshkosh and Whitewater). The evaluation spanned 28 courses, 19 disciplines and 2,684 students. Overall, faculty reported that "clicker systems afforded them opportunities to implement new pedagogical strategies and that they were helpful in introducing active learning into the classroom" (Kaleta & Joosten, 2007). In addition, students reported that "the use of clickers increased their engagement, involvement and interaction and helped them pay attention in class." Multiple studies have documented the positive influences of ARS in the classroom, including greater student engagement, greater student satisfaction and improved attention (Miller, Bimal & Getz, 2003; Caldwell, 2007; Silliman, Abbott, Clark, et al., 2005).

Another boon to corporate consumers is that the major players in the ARS field are constantly vying for market share by introducing new features and presentation capabilities. ARS software enables the presenter to upload participant lists beforehand or assign groups or teams at the beginning of a presentation. The software is designed to conserve training resources, streamline training documentation requirements and create more dynamic presentations. With constraints on SH&E training budgets, the ability to automatically track attendance and participation is a valuable feature. Attendance lists and attendee responses can be easily downloaded into an Excel spreadsheet and summarized in graphs and reports.

Because ARS involve an interactive, dynamic instructional style, it is simple to introduce a lively game-show quality to training sessions by requiring audience members to respond within a limited time frame using a countdown clock or by identifying the fastest correct responder. This is an effective, entertaining way to positively reinforce key safety concepts and safe behaviors.

Who Wants to Be a Millionaire and *Jeopardy* templates are available from some ARS providers. These formats enable the instructor to conduct question-driven instruction that keeps the audience engaged. As noted, teams can be assigned beforehand or at the beginning of the presentation. Team performance is based on knowledge of the company's safety and health program, a parameter over which the participants have direct control.

The interactive training format also creates an opportunity to redefine traditional training program benchmarks. Formative assessments of learning can be conducted throughout the presentation. In the past, attendance, posttest scores and speaker evaluations have been the only benchmarks employed to gauge training effectiveness. These measures are after-the-fact (lagging) indicators of the quality of the training program, and they are often not compiled or evaluated until days after the seminar has been conducted. It is becoming increasingly clear that sole reliance on lagging indicators (e.g., OSHA recordable rates) presents an incomplete picture and has significant limitations.

ARS provide an equal voice to all audience members. Discussion is not monopolized by a vocal minority.

Photo 1: In an audience response system, the clicker sends a radio frequency or infrared signal to the computer receiver.

Abstract: *The use of audience response system (ARS) technology can significantly improve the quality of SH&E training. This technology provides a stimulating and novel form of two-way communication that enables instructors to conduct real-time assessments of the learning needs of the audience and to determine whether students have mastered key concepts. This article explains how these systems work, reviews their benefits and limitations, and provides practical examples of their use. The SH&E field can capitalize on this technology to achieve better learning outcomes and motivate safe behaviors.*

Photo 2: After the audience responds, software on the presentation computer compiles the responses and projects a summary of the responses.

Audience members who are typically content to observe and permit the extraverts in the group to respond are given the opportunity to voice their thoughts and opinions. The anonymity of responses provides a level of comfort, while enabling the instructor to access the views of the whole audience. This accommodates learners who do not wish to be in the spotlight but have valuable insight to share.

Finally, ARS allow the instructor to utilize peer instruction techniques. This teaching style can be incorporated into an ARS lecture by asking the audience a question, then displaying the results without revealing the answer. The audience members are then asked to turn to their neighbors to explain their responses and their rationale. The question is then asked again, and the results reliably demonstrate an improvement in responses after the benefit of discussion. This small group discussion is a valuable teaching tool—one particularly beneficial for learners who avoid the spotlight in large groups.

What Are the Limitations of ARS?

As universities embraced ARS technology, its limitations became apparent. Clickers can significantly enhance the quality of a training program, but if they are not used appropriately, they can become a liability. The literature abounds with lessons learned from instructors who have incorporated ARS technology into their classrooms. Instructors should be aware of certain administrative and methodological considerations in order to maximize the effectiveness of this technology.

Incorporating ARS technology into training involves a learning curve for the presenter and the audience. The presenter must feel comfortable with the software and keypads. It is recommended that the presenter arrange for a second pair of hands during initial presentations until a comfort level is achieved.

The presenter must also clearly explain to the audience how to use the technology, including directions to follow if a clicker seems to be defective. This is important because it can be disruptive if an audience member is experiencing problems or is uncertain whether responses are being received. It is also advisable to ask some sample starter questions so the audience becomes familiar with the technology and problems can be addressed early on. The clickers are as simple to operate as a remote, so there is generally little confusion with their operation. Before the presentation, the presenter should ensure that the batteries in the clickers are charged and that all clickers are communicating with the receiver. While this technology will initially require more preparation and lecture time, it is time well invested.

Another consideration is an overreliance on the technology or the temptation to introduce questions that do not serve a specific learning objective. Once the investment has been made to acquire and learn the technology, it is tempting to introduce all sorts of questions into a lecture without carefully considering the objective of each question. The technology is novel and, often, instructors feel compelled to show it off.

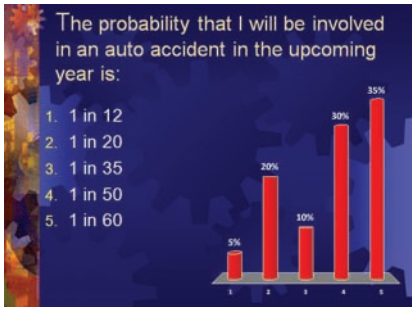
There is an art to crafting effective questions for interactive training seminars. Learning the technology is the easy part; designing effective questions is the challenge (Beatty, Gerace, Leonard, et al., 2005; Caldwell, 2007). An effective question "should address a specific learning goal, content goal, skill, or reinforce a specific belief about learning" (Beatty, et al., 2005).

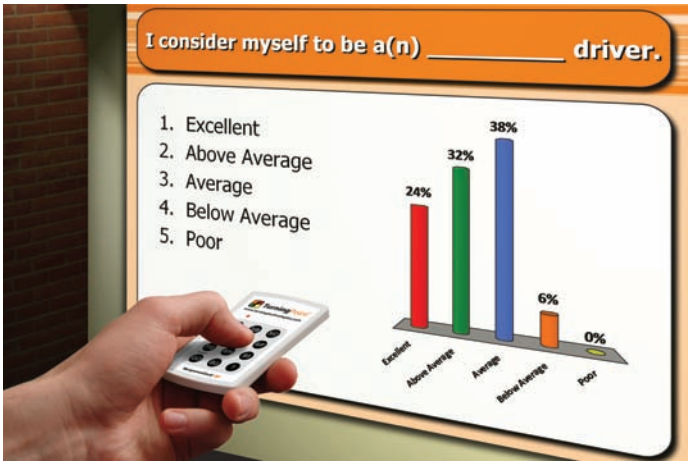
In developing these questions, it is beneficial to identify specific learning objectives that are based on core safety principles. These may include: raising overall awareness; recognizing unsafe behaviors and conditions; understanding the consequences of unsafe behaviors and conditions; illustrating common errors in reasoning; fostering the ability to develop corrective action; assessing safety attitudes; and developing positive associations with safety. These principles serve as a guideline for developing questions. In addition, learning objectives and questions should strive for a higher level of learning—one that moves beyond simple memory recall and attempts higher levels of learning such as evaluation, analysis and application.

In evaluating the effectiveness of a question, instructors must determine whether the question serves a learning objective and how well it does so. Because designing questions is a challenge, instructors in higher education have developed pools of questions by topic area and share these questions within their field. It would be similarly beneficial for SH&E professionals to develop and share effective, probing questions. Other general guidelines for developing questions include: keeping questions short and simple to optimize legibility; limiting answer options to a maximum of five; and using consistent grammatical format for answer options (Robertson, 2000).

Instructors should edit or eliminate an interactive question if it does not effectively contribute to a learning objective. Although formulating quality questions requires additional work for the presenter, the seminar is significantly enhanced with thought-provoking questions. This process also encourages the instructor to specifically identify learning objectives and elevates the overall quality of the seminar.

Another consideration when incorporating this technology is the opportunity for formative assessment and "agile teaching" (Beatty, et al., 2005). It is more demanding for an instructor to present an engaging, interactive seminar than a traditional, passive lecture. The presenter must have the agility to respond to the needs of each audience. The formative assessment component involves using the information from the question responses to learn about the audience and enhance the lecture's quality. This involves anticipating how an audience may respond. Presenters not only must be prepared to comment on question results, but they also must be ready to provide additional illustrative examples on a topic that is unclear. This type of presentation style can be intimidating. When presenters invite two-way communica-





People often underestimate their probability of being involved in an auto crash (Photo 3, above), while they overestimate their abilities as drivers (Photo 4). This perception bias may help explain resistance to driver safety initiatives.

tion with the audience, they give up a certain degree of control. Questions may generate unexpected responses or results. As a result, the presenter must also be skilled at leading and directing discussion.

Lastly, presenters must develop a different presentation style for interactive lectures. The flow of the lecture must include time to reflect on audience responses and discuss their meaning. There may be a tendency to simply note the results and move on. This is a missed opportunity, and instructors can undermine the effectiveness of a question by not considering the meaning of the responses. When responses are unexpected or unclear, instructors can ask the audience additional questions to address misconceptions and to clarify.

Using ARS to Effectively Enhance SH&E Training

ARS can be effectively used to target specific learning objectives based on core safety principles. For example, the perception of risk can be illustrated through a series of questions. Human factors research has documented the tendency for people to overestimate low-probability events and underestimate high-probability events (Sanders & McCormick, 1993). This bias affects an individual's ability to perceive risk and, consequently, take appropriate action. For example, people typically underestimate their probability of being involved in an auto accident. People also typically overestimate their abilities as drivers. This can be reliably demonstrated by asking an audience the following questions (Photos 3 and 4):

The probability that I will be involved in an auto accident in the upcoming year is:

1) 1 in 12
2) 1 in 20
3) 1 in 50
4) 1 in 125
5) 1 in 256

The answer according to 2006 National Highway Transportation Safety Administration (NHTSA) data is 1 in 20, but most audience members will underestimate the risk and indicate answers 3 to 5. A follow-up question asks drivers to rate their own driving ability.

I consider myself to be a(n)_____ driver.

1) Excellent
2) Above average
3) Average
4) Below average
5) Poor

An overwhelming majority of audience members will rate themselves as average to excellent. Some researchers have actually identified a negative correlation between perceived driving ability and actual driving ability (Baldock, Mathias, McLean, et al., 2006). This phenomenon is a predictable perception bias. The bias may help explain resistance to driver safety initiatives. If drivers do not recognize their probability of being involved in an accident and rate themselves as above-average drivers, they do not recognize the need to become better drivers. This can impede efforts to change behavior.

Demonstrating this phenomenon may increase awareness and foster better decision making. ARS can be used effectively to illustrate perception biases, thereby providing SH&E professionals with an interactive tool to help promote safety initiatives.

Another effective strategy is to present a picture with multiple safety violations and poll the audience about how many violations they can spot. This is a great opportunity to employ peer instruction. After presenting the responses, without revealing the answer, ask attendees to consult their neighbors and discuss their findings. Allow small group discussion for a few minutes, then repoll the audience. Inevitably, the audience gravitates toward the correct answer, and attendees usually manage to find violations not previously identified. This technique develops each attendee's ability to identify unsafe conditions in a real-life situation, a key learning objective.

Polling the audience to identify current practices is simple using clicker technology. At conferences attended by representatives from different companies or plants, it is extremely beneficial to come away with an overview of practices in other facilities. For example, an audience could be surveyed on the most successful incentive programs that are currently employed in their facilities. The results of the survey can be downloaded and shared with all participants. These data could be used to convince management to pursue a new incentive strategy. The survey results provide a summary of current practices and answer the familiar questions, what is everybody else doing? Do they think it's effective?

ARS technology provides instructors the opportunity to move beyond traditional lecture to create a superior learning experience. For example, it is critical for confined space entrants, attendants and supervisors to understand their gas detection equipment and the potential for hazardous atmospheres. Instead of presenting equipment specifications and expecting memorized recall, an instructor can pres-

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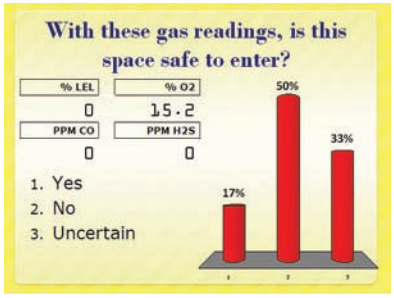

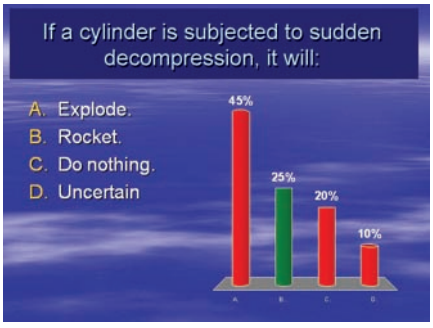

Training delivered using an ARS system requires attendees to use higher-level learning skills (Photo 5, top). An ARS also helps the instructor deliver more interactive training, which may lead to better results than a traditional lecture approach (Photo 6).

ent gas detection equipment readings and require attendees to make an entry/no entry assessment. The question can be posed: With these gas readings, is this space safe to enter? (Photo 5).

This exercise encourages attendees to employ higher level learning skills. Attendees can be further challenged to identify sources of oxygen deficiency in and around confined spaces. This learning experience fosters the ability of entrants, attendants and supervisors to recognize unsafe conditions in confined spaces.

Another productive use of ARS involves presenting an unsafe condition and asking attendees to predict an outcome. In laboratory environments, the failure to properly secure compressed gas cylinders is commonplace. To reinforce the importance of securing cylinders, attendees may be asked to envision the consequences of the sudden decompression of a compressed gas cylinder. If a cylinder is subjected to sudden decompression, it will: a) explode; b) rocket; c) do nothing; or d) uncertain (Photo 6).

Attendees can debate possible outcomes among themselves. To answer this question, the instructor can show a video of a compressed gas cylinder becoming a projectile and pictures of a lab heavily damaged by a rocketing cylinder. This interactive training technique may yield better results than a traditional lecture on the importance of gas cylinder safety.

ARS can enhance SH&E training in several ways. Uses of ARS include: documenting attendance and participation; conducting formative (real-time) assessments; conducting summative assessments (pretests and posttests); conducting discussion warm-ups; utilizing peer instruction; conducting surveys or polls; staging experiments; and illustrating misconceptions or myths.

Conclusion

Training efforts often falter and fail to achieve desired results. By allowing instructors to interact with the audience and assess their learning needs, audience response technology can significantly improve the quality of SH&E training. The effective use of ARS depends on whether the instructor understands the technology's benefits and limitations.

ARS does not resolve every challenge involved in the development of a successful training program. It is one of many tools that can be used to enhance learning. ARS technology fosters a stimulating, dynamic instructional style that is responsive to the learning needs of the audience. Instructors can pursue higher levels of learning with the assurance that the audience is comprehending key concepts.

The technology also provides the opportunity to create new benchmarks to measure the success of training. These benchmarks are leading rather than lagging indicators of training program quality, and they provide a better indication of whether learning objectives are being met. The SH&E industry can capitalize on innovations in technology to significantly improve learning outcomes. It makes the ultimate goal of greater awareness and safe behaviors less of an ideal and more of a reality. ■

References

Baldock, M., Mathias, J., McLean, A., et al. (2006). Self-regulation of driving and its relationship to driving ability among older adults. *Accident Analysis and Prevention, 38*(5), 1038-1045.

Barber, M. & Njus, D. (2007). Clicker evolution: Seeking intelligent design. *CBE-Life Sciences Education, 6,* 1-8.

Beatty, I., Gerace, W., Leonard, W., et al. (2005). Designing effective questions for classroom response system teaching. *American Journal of Physics, 74*(1), 31-39.

Caldwell, J. (2007). Clickers in the classroom: Current research and best-practice tips. *CBE-Life Sciences Education, 6,* 9-20.

Duncan, D. (2005). *Clickers in the classroom: How to enhance science teaching using classroom response systems.* New York: Addison Wesley and Benjamin Cummings.

Kaleta, R. & Joosten, T. (2007). Student response systems: A University of Wisconsin System study of clickers. *EDUCAUSE Research Bulletin, 10,* 1-12.

Lowery, R. (2006). Clickers in the classroom: A comparison of interactive student-response keypad systems. *Proceedings for the National Technology and Social Science Conference, USA.*

Miller, R., Bimal, H. & Getz, K. (2003). Evaluation of an audience response system for the continuing education of health professionals. *The Journal of Continuing Education in the Health Professions, 23,* 109- 115.

National Highway Traffic Safety Administration. (2007) *Traffic safety facts report: 2006.* Washington, DC: U.S. DOT, Author.

Robertson, L. (2000). Twelve tips for using a computerized interactive audience response system. *Medical Teacher, 22*(3), 237-239.

Sanders, M. & McCormick, E. (1993). *Human factors in engineering and design.* New York: McGraw-Hill.

Silliman, S., Abbott, K., Clark, G., et al. (2005). Observations on benefits/limitations of an audience response system. *Proceedings of the American Society for Engineering Education Annual Conference & Exposition, USA.*

Resources

Audience Response System Providers

- ClassAct Student Response System (SRS): www.ljcreate.com; (800) 237-3482
- eInstruction: www.einstruction.com; (888) 707-6819
- Fleetwood Group: www.replysystems.com; (800) 257-6390
- Hyper-Interactive Teaching Technology (H-ITT): www.h-itt.com; (321) 576-0396
- iClicker: www.iclicker.com/dnn; (888) 938-8881
- IML Audience Response: www.imlaudienceresponse.com; (877) 646-2455
- iRespond: www.irespond.com/p/index.shtml; (888) 325-6565, ext. 17
- Meridia: www.meridiaars.com; (610) 260-6800
- Qwizdom: www.qwizdom.com; (877) 794-9366
- Turning Technologies: www.turningtechnologies.com; (866) 746-3015

Audience Response System Resellers—Rentals

- Audience Response Systems: www.audienceresponse.com; (800) 468-6583
- Audience Response Rentals: www.audience-response-rentals.com; (201) 266-6222
- Communications Technology International: www.comtec-ars.com; (888) 328-8683
- Padgett Communications: www.pcipro.com; (888) 233-4724
- PowerCom: www.powercomars.com; (212) 997-2000
- TCM Communications: www.tcminteractive.com/main.htm; (888) 233-4724