DELTAC

(Digitally Enhanced Learning and Testing Activity for the Classroom)

Death by PowerPoint Must Die

Integrating an Audience Response System (ARS) into IMI (Interactive Multi-media Instruction) to Enhance Learning Outcomes

Steve Huff, PhD
President
B&H Consulting Incorporated
steveh@einstruction.com / 720-261-2597

April, 2009

Executive Summary

DELTAC is an innovative digital learning and testing application that integrates and Audience Response System (ARS) with Interactive Multi-media Instruction (IMI) in a traditional instructor-led classroom learning environment. ARS handheld devices (either IR or RF) allow every student in class to send an input (answering a multiple-choice question) to a computer where the data are collected, scored, and tabulated in real time. Rather than utilizing static content (e.g., PowerPoint), DELTAC integrates ARS questions into IMI content such as video, avatar simulations, or Flash based applications.

Research suggests ARS can significantly improve learning when combined with a proper pedagogy (good question strategies), particularly for lower performing students (ref). However, the power of using ARS effectively is not so much in the "clicker" but rather in the timing and spacing of questions, the quality of the questions, how the data are used, as well as the interactive nature of the content that is delivered (refs). Most teachers who use ARS currently combine it with PowerPoint or other teaching media (internet, etc.). The instructional benefit of combining ARS with dynamic media such as video and simulations has only recently been explored.

The challenge with combining ARS with dynamic media is that instructors must be one part tech wizard (knowing when and where to pause the media and how to launch and run the ARS), one part instructional designer (designing the best questions to facilitate deep learning rather than simple knowledge recall), while still managing the learning in the classroom. With DELTAC (particularly with Level 2 and 3) the media automatically incorporates ARS, allowing the instructor to focus less on the technology and more on the learning in the classroom.

In this paper, three levels of DELTAC are described:

Level 1 requires the instructor to pause the media manually, launch the ARS, discuss the data, and then restart the video.

Level 2 automates the flow of instruction by "mashing up" the ARS questions with video, but still requires the instructor to know how to run the ARS system. Level 2 requires the use of special computer software to make the video pause and the instructional design ability to write effective questions inside the video.

Level 3 fully automates the experience in a "push play" type experience that allows the instructor to focus entirely on the classroom learning process with students. This level requires software developers to integrate ARS directly with the media that is being delivered.

Finally, this paper outlines a list of future capabilities that could be integrated into DELTAC for optimal learning, feedback and reinforcement of high level learning.

Conceptual Foundation

The innovation of DELTAC is to combine the immersive experience of IMI (e.g., videos and simulations) with ARS technology in a traditional instructor-led classroom. Simulations and other IMI content have been applied extensively in military, corporate and technical learning over the last decade (ref). However, these applications are almost exclusively delivered through a "one computer, one student" application. Unfortunately, when it comes to the traditional classroom environment, where a large percentage of our instruction is still delivered, too often the "death by PowerPoint" experience remains intact. DELTAC provides the possibility of significantly improving the quality of learning that occurs in these classroom environments.

Any type of content (e.g., technical, conceptual, procedural, etc.) can be delivered through DELTAC. However, the most compelling areas are ones that teach decision-making and behavioral fidelity to a model of action. First aid, use of force (police and military), scientific learning, management skills, OSHA Safety, etc. are some of the most obvious examples.

Although the specific elements of DELTAC are new (i.e., using an ARS integrated with dynamic media), the pedagogical framework started nearly ten years ago in both the entertainment industry and educational environments and has been growing ever since. In many respects, DELTAC is simply the next step in the evolution of the synergy of technology, learning, and human motivation.

Gaming Models

a. Multi-player gaming where each person has their own computer but operates in a shared space. Doom was one of the first successful games in this model; Second Life and others (such as Webkins and Club Penguin for younger learners) have broadened the application to social and even "21st Century Skills" applications. Multi-player gaming leverages both the competitive and the collaborative motivational aspects of human behavior and learning.

b. Game show experience where everyone in a one room is allowed to "weigh in" on the same question. The most obvious application is "poll the audience" from the "Who Wants to Be a Millionaire" TV show.

c. Wii and other gaming formats where multiple users (up to 4) are participating in the same experience in the same room but achieving a different score based on their individual performance. Rock Band (Guitar Hero) and Wii Sports (particularly Tennis) are examples of this model.

Learning Models

a. Educational TV shows for pre-school children such as Dora the Explorer, Blues Clues, etc. and those designed for older kids such as CrashBox from HBO integrate multiple choice questions into the flow of the presentation to increase engagement. There is currently no direct way for viewers to actually answer the questions. However, with the integration of TVs and computers, this application is probably only 2-3 years away.

b. Museums and other public educational settings have included "interactive" kiosks and are now starting to build in keypads (ARS and other integrated devices) into presentations at natural history museums, planetariums, etc. to increase engagement and feedback.

c. Since 1998, student response technology has been growing exponentially in K-12, higher education, and adult learning settings (corporate, public sector, and military). Digital learners respond much better to the increased interaction, feedback, and games. Instructors benefit from having immediate access to data on learning gains.

The Relationship between Fun, Learning, and Assessment

The goal of DELTAC is to create an educational experience that is the best possible synergy of fun, learning and assessment. We call this "stealth learning" where students are learning, but they are largely unaware of the work they are doing because they are motivated, engaged and caught up in the process. If the experience is only fun, but does not effectively teach or test the student on a core content area, then we would define this as a game. In contrast, if the learning experience is too dry or linear (e.g., death by PowerPoint) then students may disengage with the process entirely. The goal is to balance these two elements effectively using IMI and ARS.

Heavy learning, light fun = poorly delivered classroom instruction (Image 1)
Heavy fun, light learning = mindless game (e.g., PacMan) (Image 2)
Balance of fun and learnign = DELTAC (Image 3)

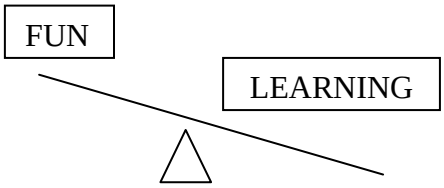


Image 1

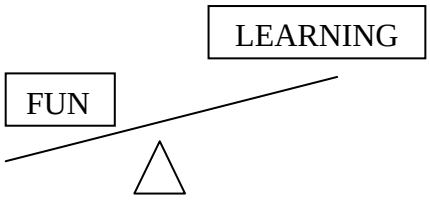


Image 2

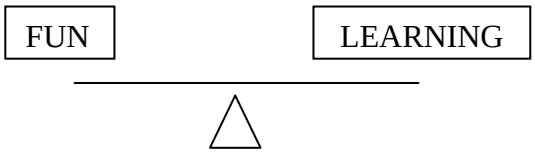


Image 3

Many simulation games get *close* to replicating the actual skill that is being taught, but are still too far away from reality to actually teach or test for the skill. For example, Guitar Hero is a lot of fun, but it does not teach someone how to play the guitar (exactly). It teaches SOME aspects of guitar playing (rhythm and timing), but it does not simulate the actual six strings, fingering of chords, etc. closely enough to assume that by playing the game you could play guitar. This is because learning the guitar is hard work… and simulating an actual guitar would be LESS FUN (that is, it would require too much WORK to feel like a game). It would "bog down" the fun factor. It would look like Image 2.

Games that are designed for learning have been criticized for not being able to demonstrate gains on specific learning objectives. Improvements in the pedagogical design of learning games are starting to increase the learning gains that can be measured (Stacy, Nelson, & Colonna-Romano, 2007). These "lessons learned" are a key feature in the design of DELTAC.

How to design a DELTAC

Level 1

DELTAC – Level 1 requires the instructor to *create* the dynamic interface between the media and the ARS. Here is one example:

The instructor delivers the following "knowledge" level question to students with an ARS:

The Law of Conservation of Mass states that in a chemical change matter can be…

a. Either created or destroyed
b. Neither created nor destroyed
c. Created, but not destroyed
d. Destroyed, but not created

The distribution of student data is show in Figure 1.

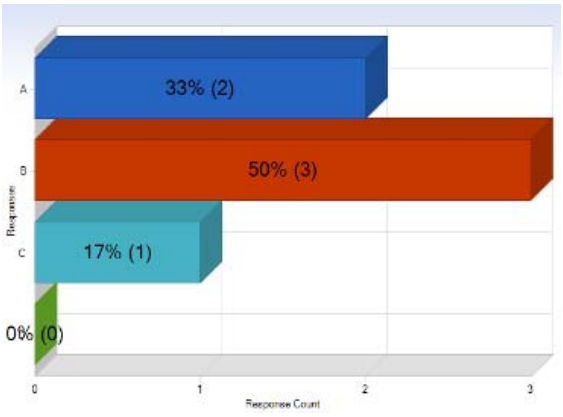
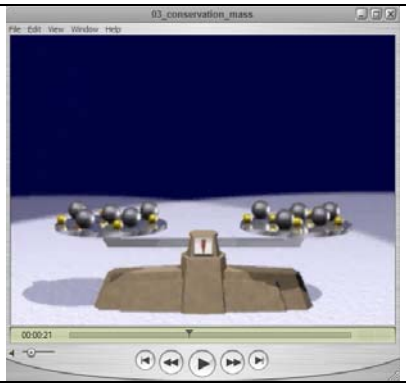
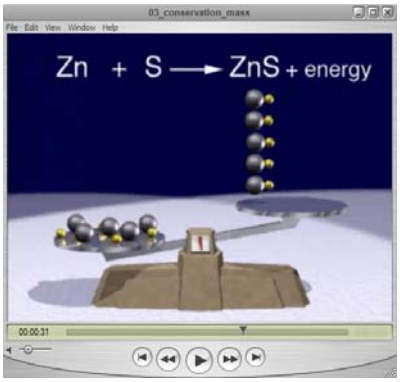


Figure 1

The data can be discussed as a group. Students can explain their reasons for various viewpoints.

The next step is to launch a simulation video that evaluates whether students can "apply" this principle to an actual situation by predicting an outcome. Since I cannot PLAY the video for you here, I have created a storyboard with screen shots and written out the audio portion of the video. At the appropriate place, the instructor will manually PAUSE the video and launch the ARS question.

Audio	Video
(Voice over on the video) The Law of Conservation of Mass states that in a chemical change matter is neither created nor destroyed, it is only rearranged. Reinforces the ARS question that was just delivered and discussed with students.	
For example, let's place five Zinc and five Sulfur atoms on the two sides of a pan balance. The two sides balance because the contents of each pan are identical.	
Consider the reaction of Zinc with Sulfur atoms on one side of the balance to form Zinc Sulfide (ZnS). Five Zinc atoms will react with five Sulfur atoms with a tremendous release of energy to form five Zinc Sulfide molecules.	

<table>
<tr><td>Video is paused by the instructor:
Instructor delivers this ARS question:
When the five Zinc Sulfide molecules are now put back on the pan balance, what will be the result?

The instructor could choose to either have students answer individually (without discussion) or with discussion (peer-to-peer).</td><td>A. The left side will be heavier
B. The right side will be heavier
C. Both sides will be equal</td></tr>
<tr><td colspan="2">The results from the ARS question are then displayed and discussed. The results can be discussed as a class where students are allowed to explain their thinking. The instructor could allow students to “reselect” an answer after the group discussion, or simply play the rest of the video to find the answer.</td></tr>
<tr><td>The instructor plays the rest of the video:
The two sides still exactly balance. The total number of Zinc and Sulfur atoms on each side are still identical, demonstrating the Law of Conservation of Mass.

The instructor would then allow students to discuss their thinking either in small teams or as whole group discussion.</td><td> 
</td></tr>
</table>

For this DELTAC – Level 1 example the instructor was required to:

1. Find the dynamic media (in this case a simulation) that teaches the concept.
2. Write the questions that would facilitate the proper level of learning. In this case, she opened with a “knowledge” level question, and then integrated an “application” question into the simulation.
3. Pause the video at the right time.
4. Launch the ARS software and collect and display the results.
5. Play the rest of the video.

This simple example in the area of science can be applied to any number of content areas where students are required to predict an outcome or apply a principle to a new situation. The video is of course not completely necessary. The instructor could have simply

"described" the experiment to students verbally, and then had them predict the outcome using the ARS system. However, the visual stimulation of the video is what creates the immersive experience for the students and embeds the learning in a much more effective manner.

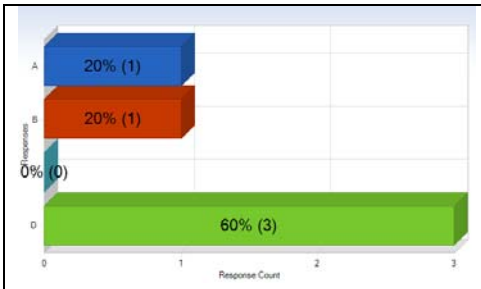
DELTAC – Level 1 applications are possible right now to any instructor with the proper software (video and ARS), hardware (ARS), and the know-how to develop the right type of ARS questions. Two white papers are available to teach instructors how to develop high level thinking questions with ARS systems (Huff, Thalheimer).

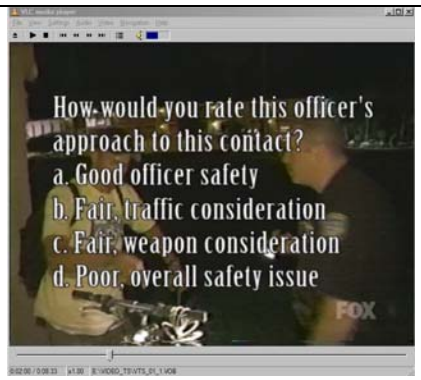
DELTAC - Level 2

DELTAC – Level 2 is built on the same basic principles of Level 1, but automates the integration of the video and ARS questions in a more dynamic manner. Here is one example:

In this example, a police academy is training cadets to apply proper procedures during a traffic stop of a suspected burglary suspect. The video is taken from the popular TV show COPS. The suspect is riding on a bike and carrying a backpack. The questions are embedded directly into the video and the video pauses automatically at the correct time giving the cadets the opportunity to input their answers with their ARS device.

<table>
<tr><th>Audio</th><th>Video</th></tr>
<tr><td>(Dialogue in the video)
Officer: Do you have any idea why I am stopping you?
Suspect: No, I got all my lights.
Officer: You got that one, but this one ain't working. The problem is that it needs to be 50 feet out in front of you.</td><td>  </td></tr>
<tr><td colspan="2">The video pauses at this point and the following ARS question automatically appears on the screen:</td></tr>
<tr><td>Students respond to the question with their ARS device and the distribution of data are then displayed.</td><td></td></tr>
</table>

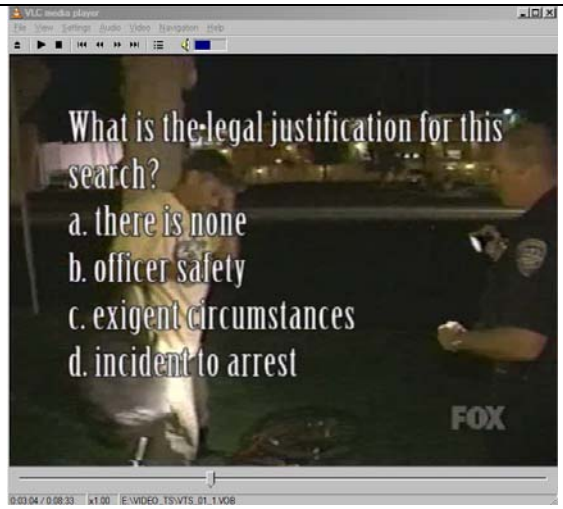




After class discussion the instructor hits PLAY on the video and the following dialogue occurs on the video:

(Dialogue in the video)
Officer: What's your name?
Suspect: Allen
Officer: Allen what?
Suspect: (deleted)
Officer: Do you have any ID on you?
Suspect: No, it got stolen like 3 weeks ago.
Officer: That's not good. What you been arrested for before?
Suspect: Ugh, drugs.
Officer: What kind? Speed?
Suspect: Yeah.
Officer: You don't have anything illegal in your backpack do you?
Suspect: Naw
Officer: You don't mind if I take a look do you?
Suspect: No
Officer: Why don't you go ahead and hand it to me?

The video pauses at this point and the following ARS question automatically appears on the screen:

Students respond with their ARS device and a 50/50 split is displayed. 	

The 12-minute video continues in this manner with embedded questions approximately every minute. Each question is designed specifically by the curriculum developer to highlight a common misconception that occurs as young cadets become more familiar with the law and proper police procedures. By embedding ARS questions directly into a "real life" situation, students are exposed to the actual sights and sounds that they will encounter on the street, making the learning experience much more effective than if the situation was merely "talked about" in the training.

For this DELTAC – Level 2 example the instructor was required to:

1. Find the dynamic media (in this case a video of COPS) that teaches the concept.
2. Write the questions that would facilitate the proper level of learning.
3. Use a software program that automatically pauses the video at the right time, and writes the question into the actual video.
4. Launch the ARS software and collect and display the results.

One of the main benefits of Level 2 is that, once it is created, it can easily be distributed among a large number of instructors who teach this class. For organizations who are delivering training with dozens of instructors, taking the time to "mash up" the video with questions that pause at the right time is a very effective use of limited resources.

DELTAC – Level 3

DELTAC – Level 3 requires a much more intensive development procedure on the part of software developers, content experts, and curriculum designers. At this level, the data from the ARS devices streams directly into the simulation. This requires having access to the SDK (Software Developer Kit) from the ARS Company. The simulation can then "branch" based on the MAJORITY vote of students, keep track of scores dynamically,

and allow for the group of students to move BACK through the simulation if incorrect decisions are discovered by the group.

Here is one example:
In this example, the proper First Aid procedures are being applied to a simulation of a car accident. There are two victims, one is unconscious (shown by the indication of a FLAT LINE screen next to Avatar B), and the other one has a pulse (Figure __).

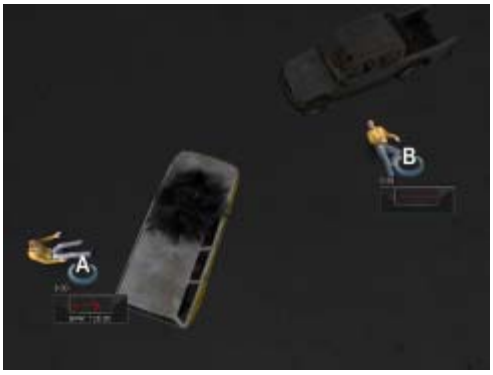


Figure __

Students must decide which victim to go to first. Some students will choose victim A because he has a pulse, thinking that, “Well, victim B is already dead.” However, an EMT would know to always go to an unconscious victim first to see if they can be revived using CPR. This simulation will “branch” based on the majority vote of the students.

If the students decide to go to victim B first, the following screen will appear (Figure __).

Figure __

Students now have the choice of what part of the body to evaluate first – (A) Upper body, (B) Lower body, (C) Assign status, (D) ask, “Can you hear me”, (G) Return to the other victim, or (H) go BACK one step.

The victim has a leg injury as indicated by the blood and bone protruding from the leg (not yet clear in this image). So, students must decide if they will bandage the leg first, or start CPR (the correct choice).

The simulation experience continues in this manner. Points are assigned for each student as they proceed and are displayed as a “top score” on the bottom right side of the screen (Figure ___).

Figure ___

The benefit of a Level 3 DELTAC is that the instructor has a truly “push play” experience where she can focus completely on the learning in the room, and less on the technology (i.e., when to pause, launching the ARS, etc.). The data are collected and can be reviewed after (or during) the simulation for discussion and debrief.

Instructional Design Considerations

The development of any level of DELTAC requires the combined efforts of people with three unique skill sets.

1. The content expert – this person must be extremely knowledgeable of the common misconceptions that novice students typically hold, the critical decisions that must be made, and the various contextual considerations that are faced in making those decisions.

2. The technical expert – this person must know how to integrate dynamic media (video or simulations) together with the ARS system. A basic level of skill must then be taught to the instructor in the room, or the session can be run as a team effort with an instructor and the technical expert.

3. The ARS question development expert – this person must know how to build high-level ARS questions that engage learners at the right level for the learning objectives.

In some situations, one person may have the skills of two of the above requirements. However, it is extremely rare that one person would have all three skills sets. Typically, DELTAC activities are the combined effort of a group of people who develop the activities as a team.

Future Applications of DELTAC

The three levels of DELTAC simply outline the level of integration of ARS with IMI. The most subtle pedagogical elements are waiting to be imagined, created and designed by future instructional designers. The follow is a list of the ideas that have started to emerge with our partners to consider the future of what is possible.

1. Graphing student evaluations during a streaming video or simulation

Imagine a four minute video or simulation where actors or avatars are playing out a scenario on the screen. Students would use the ARS system to "evaluate" particular elements during the simulation. In this application, the simulation or video would NOT stop to ask a question. It would play from beginning to end, and student could use the ARS to input a choice at any time. For example,

Indicate how you are feeling during the video/simulation:
   a. Calm – no pressure
   b. Mild tension – a little uncomfortable
   c. Moderate tension – uncomfortable
   d. High tension – very uncomfortable
   e. Extreme tension – I want to yell STOP!

Indicate the level of safety violation you observe
   a. No safety concern
   b. Mild safety concern
   c. Moderate safety concern
   d. Extreme safety concern

Indicate how well Joe (an actor) is applying the skill of leadership
   a. Joe is doing great
   b. Joe is making some minor mistakes

c. Joe is making some big mistakes

During the simulation/video, students would be using the ARS device to indicate their evaluation at any time. We could then "graph" the aggregate results in a rolling line graph, much like the polling results that have been used during political debates. However, we would NOT show the graph during the event.

We could then "play back" the simulation/video with the graph rolling. This would allow the student and instructor to see the specific points when the group indicated high or low level evaluations. We could also pick out specific students that were not evaluating the scene in the way that we expected (i.e., the outliers) and target them for remediation.

(Figure ___: Show an example of a graph below a video….)

2. Branching simulations

3. Have specific ARS devices assigned to different "roles" during the event (e.g., commander, soldier, etc.)

4. Give a pause in the IMI that asks the students to evaluate specific elements of what they see in the next period of time. Give the students a rubric on a piece of paper that asks them to track the experience. Use the ARS at the end to enter the data and then evaluate.

5. …..