

**Executive summary**

Audience Response Systems (ARS) - more commonly known by the term “clickers,” referencing the student handheld hardware for submitting feedback to the instructor - first appeared broadly on the ISU campus in 2004. In an attempt to minimize unstandardized technology confusion and decrease the debt burden on students, ISU standardized on the TurningPoint system by Turning Technologies in early 2007.

The current ARS system at ISU requires faculty to install software on their laptop and utilize a proprietary receiver that plugs into the faculty computer via USB port. Students using the current hardware response device are limited to 10 keys and multiple choice responses.

Now a new evolution of ARS technology exists, enabled by cloud-based technology, that promises to enable more pedagogical benefits and reduce technical issues encountered by faculty, students, and support staff. These newer technologies allow faculty the advantage of better development of in-class questions, as well as more efficient data management from any internet-connected device. For students, these newer systems allow for full keyboard responses and graphical interaction, all while helping turn their smartphones or other devices into response systems with licensing fees cheaper than the previous hardware clicker.

ISU’s current vendor plans to migrate their system to the cloud, although their current offering only provides cloud-based authentication, returning the user to a local software-based product that has cross-platform issues. Further, the current offering is integrated with Blackboard in a way that requires all faculty users to migrate simultaneously to the newer version, a logistical nightmare for faculty and support staff alike. While Turning Technologies has been responsive and is attempting to change the nature of the transition to ease ISU’s crossover burden, it is prudent for ISU to investigate various ARS options for consideration.

This paper contains an overview of clicker usage on campus, as well as a comparison of alternative products for the ISU campus community to consider. Central support staff who provide ARS support for ISU - staff in both the Center for Excellence in Learning & Teaching (CELT) and Information Technology Services (ITS) - recommend a pilot be conducted with several potential ARS cloud-based solutions during the Spring 2015 Semester. The ARS cloud-based solution options for this pilot test can be those recommended in this paper as well as any discovered during the Request for Information (RFI) process that will be conducted prior to pilot testing. If such a pilot is completed by spring break of 2015, central
services could have the time to move to the next version of ARS technology on campus by the Fall 2015 Semester, whether that be the new Turning Technologies solution or something different.

Introduction

Audience Response Systems (ARSs) have been around for decades and have found increasing use in institutions of higher learning since the mid-1990s. A basic ARS enables an instructor to ask questions of students who respond by selecting answer options with a handheld remote control. Early systems had limited functionality but later systems became quite reliable and sported more technical and pedagogical features. During the past five years the ARS market has undergone significant technological changes including a migration towards cloud-based solutions accessible through web browsers and mobile device applications, and a general improvement in user interfaces for students and instructors. Pedagogically, new question types such as short-answer and graphically-based questions have appeared. These changes promises significant advantages for faculty and students and the potential for a reduced support load for academic service staff compared to older hardware-based systems.

In 2007 Iowa State University standardized on the Turning Technologies ARS solution, which is comprised of a proprietary radio-frequency clicker device for students and a receiver device for instructors to use with the Turning Point software. IT Services and CELT partnered on the original pilot program and ultimate selection of TurningPoint, and continue to jointly offer this service to the ISU campus. As ARS use has increased on campus, faculty have started to explore the pedagogical and technical boundaries of this solution. This exploration has revealed certain issues with the current solution which prompted some faculty members to experiment with alternative systems from vendors such as Top Hat and PollEverywhere.

CELT and ITS have continually monitored the functionality of the TurningPoint solution on campus and the developments in the ARS market in general. Spurred by an upcoming comprehensive system update from Turning Technologies, which will be demanding on faculty and support staff to carry out, central technology support staff partnered to assess the current Turning Technologies ARS solution and to gain an overview of the current ARS market in an attempt to achieve the following goals:

1. Analyze the successes and challenges of the current ARS solution from Turning Technologies.
2. Describe faculty experiments with alternative ARS solutions and their rationale for seeking these solutions.
3. Survey the ARS landscape to identify solutions that could meet the current and future needs of ISU faculty, students and academic support staff.

Clicker utilization at ISU

Since 2007 the Turning Technologies ARS has been used to support a number of pedagogical interactions in ISU classrooms. Most commonly, clickers are employed to engage students in the subject matter and to encourage participation in large enrollment courses. Faculty have reported that clickers are valuable and motivating tools that support learning under the following conditions:
1. When clickers are used routinely to review course content in the form of short quizzes on assigned readings, which helps motivate student note-taking and reading of textbooks.

2. When clickers are used to ask high-interest, opinion-based questions related to the course content. This helps promote student engagement and electronic voicing of opinions, particularly among students who would otherwise hesitate to express their opinions publicly.

3. When clickers are used to probe into student comprehension, so that instructors are aware of common misconceptions and can address them on the spot, possibly modifying the flow of the course and its content in order to bring all students to the shared understanding of the subject matter.

When asked in informal conversations what kind of clicker-aided instruction is most beneficial for student learning, ISU instructors offered the following details:

1. Recalling information for basic facts, principles and concepts;
2. Understanding and interpreting what has been learned in the classroom by way of comparing, predicting, estimating, differentiating, recognizing and classifying.
4. Establishing the value of information by rating, comparing and appraising.

In addition, clickers have been used successfully in a variety of ways at ISU. For example, they can support Team-Based Learning (TBL) settings where one clicker device is shared across a team of students for making joint decisions in complicated application exercises that require a series of connected and meaningful interactive questions. Another example involves an ISU biology instructor who walks her large-size classroom through complex case studies in which clicker questions are used throughout for multiple purposes from developing the story line, probing into student preconceptions, assessing their current difficulties with the new material to encouraging students to act as experts. Another ISU instructor uses a similar methodology to engage her students in an alcohol metabolism clicker case study around saving a drunk student who is unable to metabolize consumed alcohol.

The academic use of clickers on campus is significant, with ISU being one of the more ARS-infused institutions in the country, spurred in part by TurningPoint’s local integration with ISU’s Blackboard Learning Management System (LMS). But non-academic uses exist as well. Two areas where clicker use is notable are in campus training and student organization functions (primarily for voting within the campus organization).

**Clicker implementation challenges**

Many ISU instructors take time and effort to craft meaningful clicker questions but face a steep and challenging learning curve before they are able to carry out a meaningful implementation of the Turning Technologies clicker solution in their classroom. The following challenges are often shared by ISU instructors:

1. The TurningPoint 5 software has a steep learning curve for first-time faculty users. At the start of class, instructors must complete a series of steps in the correct order, which is demanding for
instructors who need to be focusing on arriving students and other classroom preparations, all within the 10 minute class change period.

2. Many instructors complain about unreliable TurningPoint 5 software performance on Apple computers. Reports indicate problems with PowerPoint presentation crashes, random behavior of the response counter, and an inability to upload clicker scores from Apple computers to the campus LMS. Although Turning Technologies support staff is very helpful, many issues are hard to replicate and significant time is spent on investigating issues before ISU faculty members receive assistance.

3. The current proprietary hardware, the RF ResponseCard clicker device, can only be used to respond to a subset of available question types, leaving out numeric responses, short answers and essay questions. Although instructors can opt to allow students to use mobile devices as virtual clickers by using the Responseware application offered by Turning Technologies, many student responses do not display in a way that accommodates teaching and learning.

4. As the campus has seen a rise in use of virtual clickers, many students have complained of a very un-intuitive registration process for Responseware accounts, which require several steps to be completed. The requirement that students remember their log-in credentials for this system in addition to their ISU NetID and password adds unneeded complexity to classroom clicker implementation.

5. While the aforementioned mobile device software, Responseware (see bullet #3 immediately above), is used in some courses at ISU, it is not broadly deployable on campus without impact on student fees and debt. While a few instructors favor the Responseware software, students could be faced with a situation where another class discourages its use and instead directs a student to use the RF ResponseCard. This would result in some students needing to pay for two clicker technologies from the same company – the Responseware software license ($15-32 depending on duration of license), and the RF ResponseCard ($28-43, depending on new/used and specific model).

In addition to the pedagogical challenges faced by faculty and students, software and hardware updates also pose a challenge for faculty and academic support staff. In 2015 the Turning Technologies vendor will require its clients to transition to a cloud-based software solution. This means that the usage of polling software will now be tied to a separate instructor account which is accessed through a cloud-based interface. The vendor promises that instructors can expect a simplified clicker registration process for student hardware-based and virtual (Responseware) clickers together with new student reporting features and Responseware functionality. Considering the previous, difficult experiences of support staff with updating Turning Technologies software, thorough testing must be conducted to verify these claims.

In 2013, ITS and CELT collaborated on a complex process to transition the ISU clicker community from a legacy version of the standardized clicker software to the current version. This process involved re-training of faculty and coordination with the ISU Blackboard Learn support staff to ensure successful integration of the new software version with the campus course management system. The transition had a profound impact on many ISU instructors and their students and placed a significant burden on
the academic support staff. Consequently, it is in everyone’s interest to find a solution that minimizes or eliminates this type of event.

**Clicker alternatives at ISU**

Citing many of the challenges outlined above, several ISU faculty have sought to experiment with alternative ARS solutions. One ISU instructor initiated an inter-college partnership to receive funding from the ISU Computer Advisory Committee (CAC) and conducted a pilot study of the cloud-based Top Hat ARS from fall 2012 to spring 2013 with over 2000 student participants. During the pilot study Top Hat question features such as numeric, word-answer, open-ended, multiple choice, review, and interactive demonstration were tested. The instructors involved reported satisfaction with the simplicity of designing a variety of questions in Top Hat and making them available to students before and after class; features which are unavailable in the TurningPoint 5 solution.

Another faculty user has praised the PollEverywhere tool for streaming live feedback and displaying student short responses as an engaging Wordle graphic. This solution also allowed the instructor to integrate polls into her PowerPoint and KeyNote presentations, thus making the teaching experience very comparable with TurningPoint 5.

In sum, the ISU instructors who piloted different ARS alternatives cited the following advantages:

1) The true cross-platform (Windows and OS X) nature of some alternative tools;
2) A greater variety of interactive questions ranging from open-ended to picture tagging;
3) A more pleasing visual design of interactive results, from streaming student responses to creating an impressive graphical representation of student feedback;
4) The ease of use of some alternative tools, including launching of the polling.

Amongst the challenges, the instructors reported dependence on the quality and speed of the Internet connection in the classroom and on instance of troubleshooting involving a student-owned device. (The issue of internet-connectivity in all ISU classrooms is being addressed in IT Services’ current wireless expansion project.) All instructors who piloted clicker alternatives relied on vendor-provided support for troubleshooting and reported being satisfied with the support they received.

**Alternative ARS solutions**

With the mandatory move to the TurningPoint cloud-based solution coming up in 2015, which appears to require an everyone-migrate-at-once approach, and ISU faculty members demanding a reliable, versatile and institutionally-supported ARS, central support staff decided to conduct a preliminary evaluation of the ARS market prior to sending out an RFI on this subject. The goal is to identify solutions that could meet the current and future needs of ISU faculty, students and academic support staff.

**ARS Evaluation Criteria**

The baseline criteria for evaluating the different ARS solutions were determined by central support staff based on experiences shared by faculty and college support staff. The criteria were divided into two categories: *Pedagogical Features* and *Administrative Features* which are listed below.
Reviewed Products
A wide variety of ARS products was sampled for this review. Some were products that the authors already knew or had heard of, others were ones that were found by conducting an online search for ‘audience response systems’, ‘student response systems’, and other similar search terms. Of the 13 products reviewed, some were removed from consideration early on due to various limitations. For example, Kahoot insists on a game-based pedagogy and requires instructors to include a picture with every quiz: If one is not added, the software will insert a random picture. This was deemed unacceptable. Other products, such as Shakespeak, require the instructor to use PowerPoint to administer quizzes. After comparison, six products were selected for additional analysis, and are compared in Tables 1 and 2. Note that the currently employed solution by Turning Technologies is included for comparison, as well.

Table 1: Alphabetical List of Reviewed Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echo360 LectureTools</td>
<td><a href="http://www.lecturetools.com/">http://www.lecturetools.com/</a></td>
</tr>
<tr>
<td>Every Slide</td>
<td><a href="https://www.everyslide.com/">https://www.everyslide.com/</a></td>
</tr>
<tr>
<td>Infuse Learning</td>
<td><a href="http://www.infuselearning.com/">http://www.infuselearning.com/</a></td>
</tr>
<tr>
<td>Kahoot</td>
<td><a href="https://getkahoot.com/">https://getkahoot.com/</a></td>
</tr>
<tr>
<td>Mentimeter</td>
<td><a href="https://www.mentimeter.com/">https://www.mentimeter.com/</a></td>
</tr>
<tr>
<td>Poll Everywhere</td>
<td><a href="http://www.polleverywhere.com/">http://www.polleverywhere.com/</a></td>
</tr>
<tr>
<td>Quizdom</td>
<td><a href="http://qwizdom.com/">http://qwizdom.com/</a></td>
</tr>
<tr>
<td>Quiz Socket</td>
<td><a href="http://www.quizsocket.com/">http://www.quizsocket.com/</a></td>
</tr>
<tr>
<td>Socrative</td>
<td><a href="http://www.socrative.com/">http://www.socrative.com/</a></td>
</tr>
<tr>
<td>Top Hat</td>
<td><a href="https://tophat.com/">https://tophat.com/</a></td>
</tr>
<tr>
<td>Turning Technologies</td>
<td><a href="http://www.turningtechnologies.com/">http://www.turningtechnologies.com/</a></td>
</tr>
<tr>
<td>ResponseWare</td>
<td></td>
</tr>
<tr>
<td>Verso</td>
<td><a href="http://versoapp.com/">http://versoapp.com/</a></td>
</tr>
<tr>
<td>ViaResponse</td>
<td><a href="http://viareponse.com/">http://viareponse.com/</a></td>
</tr>
</tbody>
</table>

Important Pedagogical Features
- Number of question types
- Support for asynchronous use
- Support for team-based learning and group work
  - Ability to track team-based learning and collaboration
- Answer confirmation
  - Confirms recording of student answer to question
- Quiz feedback
  - Option for instructor to let students know which quiz answers were right and wrong and ability to release correct answers

Important Administrative Features
- Integration with the campus LMS, Blackboard
- Cross-platform compatibility - should function equally well on both MACs and PCs
- Business model
  - License structure and recurring costs
- Hardware and software costs
- Impact on local support staff
- Viability of manufacturer’s business model (i.e. – will the company be around in five years?)
- Data storage solution – contract language needs to support FERPA and data security

ARS Recommendations
The results of our research are listed in tables 2 and 3. In each table a vertical line separates the products. Those on the left have all been used to a lesser extent by instructors at ISU while those on the right have not, to our knowledge, been used by any instructors on campus. Our findings indicate that in terms of pedagogical features Top Hat, Echo360 LectureTools and ViaResponse stand out. The reason is that they have a high or medium number of question types available, support asynchronous use, and provide answer confirmation. In terms of administrative features, Top Hat stands out as the most complete solution; it allows the institution to consider paying for student licenses, provides support for both faculty and students and integrates with both BlackBoard and other LMS alternatives. However, other options are also attractive from an administrative standpoint. These will be discussed below.

Table 2. Pedagogical Features

<table>
<thead>
<tr>
<th>ARS Product Criteria</th>
<th>Turning-Point Response-Ware</th>
<th>Top Hat Poll-Everywhere</th>
<th>Echo360 Lecture-Tools</th>
<th>Via-Response</th>
<th>Infuse Learning</th>
<th>Socrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of question types</td>
<td>10</td>
<td>10</td>
<td>4</td>
<td>6</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Support for asynchronous use</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Support for team-based learning and group work</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Answer confirmation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Table 3. Administrative Features

<table>
<thead>
<tr>
<th>Criteria</th>
<th>ARS Product</th>
<th>TurningPoint</th>
<th>Top Hat</th>
<th>PollEverywhere</th>
<th>Echo360 LectureTools</th>
<th>ViaResponse</th>
<th>Infuse Learning</th>
<th>Socrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration with Campus LMSs</td>
<td>BlackBoard, Moodle</td>
<td>BlackBoard, Moodle</td>
<td>No</td>
<td>BlackBoard</td>
<td>BlackBoard</td>
<td>BlackBoard</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Cross-platform compatibility</td>
<td>Yes</td>
<td>Yes – Web browser</td>
<td>Yes – Web browser</td>
<td>Yes - Web browser, iPad app</td>
<td>Yes – Web browser, apps for Android and iOS</td>
<td>Yes - Web browser, apps for Android, iOS and Windows Phone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business model</td>
<td>Students pay for app or clicker</td>
<td>Students or institution pays</td>
<td>Students or institution pays</td>
<td>Students or institution pays</td>
<td>Students or institution pays</td>
<td>Free</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>Vendor support</td>
<td>No student support</td>
<td>Student and faculty support</td>
<td>Student and faculty support</td>
<td>Faculty support</td>
<td>Student and faculty support</td>
<td>No*</td>
<td>No*</td>
<td></td>
</tr>
<tr>
<td>Data storage solution</td>
<td>Local</td>
<td>Cloud</td>
<td>Cloud</td>
<td>Cloud</td>
<td>Cloud</td>
<td>Cloud</td>
<td>Cloud</td>
<td>Cloud</td>
</tr>
<tr>
<td>Comments</td>
<td>Uses SSO. Many interesting question types. Has ‘homework’ feature that supports self-study and review</td>
<td>Question/comment features that allow students to answer each other’s questions.</td>
<td></td>
<td></td>
<td>Seems more aimed at K-12 schools.</td>
<td>Limited to 50 students at a time per class.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As mentioned earlier, different shortcomings of the currently used TurningPoint Responseware solution are part of what prompted this review of ARS options. Consequently, the products that offer features not covered in TurningPoint ResponseWare stand out. Nonetheless, they still need to offer important features such as integration with BlackBoard, cross-platform compatibility, good vendor support for faculty and students, and a business model that allows the university to consider paying for student licenses. Based on the results of our research we believe that several ARS solutions deserve a second look and more in-depth testing, along with any solutions identified during the RFI process. They compare well to our current solution from Turning Point ResponseWare and in some cases appear to offer more or better features. More specifically, Top Hat, Ech0360 LectureTools and ViaResponse stand out from a pedagogical perspective while also offering several attractive features and capabilities from an administrative point of view.

As is clear from the data in Tables 1 and 2, there are several solutions that fail to meet the desired criteria. Socrative, Infuse Learning and PollEverywhere all lack key features such as LMS integration and support for asynchronous use. In addition, Infuse Learning and Socrative offer no or very limited vendor support. Furthermore, the former is primarily aimed at the K-12 setting and the latter is limited to 50 students at a time per class.

Having made the above observations, it is important to note that further testing with faculty and students is necessary to determine the exact pedagogical strengths and weaknesses of each solution. Likewise, it will be necessary to discuss the exact ARS needs of the institution with the different vendors to determine how the different features they claim to offer are implemented in order to decide if they are satisfactory and if they are compatible with existing systems and procedures at ISU.

**Limitations**

The Research that was conducted into the different ARS products was careful and controlled and tried to take into consideration the most likely instructor and student needs and usage scenarios. However, it is impossible to predict all user needs or usage scenarios. In addition, our test protocol did not include live testing of features and capabilities with instructors and students because it was outside the scope of this report. It is also important to keep in mind that technology changes rapidly and that the tested software may gain or lose features in future revisions. In addition, any appealing products will need to be evaluated in depth with instructors and students before it is possible to determine if they meet all needs and requirements that would allow them to be considered viable candidates for campus implementation. For example, it would be necessary to evaluate the terms of use, privacy policy, FERPA and accessibility compliance, cost, availability and quality of technical and pedagogical support and user friendliness, just to name a few. Finally, the RFI process may reveal solutions that were unintentionally left out in the preparation of this paper, which will need to be given appropriate consideration.
Resources

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