Audience Response System Evaluation

2011 March 17

JC Gray Sawyer, OIT Academic Computing

Contents

Appendix

ARS Advisory Committee:

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Summary of Findings

Recommendation: The Advisory Committee recommends *i>clicker* as a possible replacement for the current eInstruction ("PRS") Audience Response System (ARS) on campus.

Compared with the current system, *i>clicker* would provide the campus with a reliable technology, simpler and more intuitive software and hardware, and superior customer support. Importantly, some members of the committee, pilot participants, and long-time users of PRS have said they will give up using the technology in their classrooms if we do not switch to a more reliable and stable system for the Fall 2011 semester.

In a feature comparison based on the Advisory Committee's research, the pilot participants experience, and feedback from peer institutions, i>clicker ranked as top preference in all categories (Pilot Tester Preference, Company Interests/Customer Support, Cost, Reliability, Usability, and Unique Features).

Feature Set

i>clicker offers a strong feature set that faculty identified as important in surveys and forums in an ARS:

- Hardware and software that are intuitive and stable
- Zero drop-rate for student transmission of votes
- Ability to ask for multiple choice, true/false, numeric, and/or alphanumeric responses
- Integration with learning management systems (SPARK, Moodle)
- Integration with homework management systems (OWL)
- Manual manipulation of student grades and data
- Demographic polling and data slicing
- Graphic display of polling results
- Visible countdown timer
- Supportive company relationship

Transitions & Long Term Potential

Because it was developed by professors at the University of Illinois for use in higher education, *i>clicker* is invested in maintaining simplicity and stability in a system developed for the pedagogical concerns of the higher education classroom.

The *i>clicker* hardware and software is similar enough to the current ARS (eInstruction PRS) to provide for a relatively easy and smooth transition. There will be a small investment in time for those instructors who are still using *eInstruction's* PowerPoint plug-in to incorporate questions into their slideshow. These instructors would face a similar issue even if we stayed with eInstruction, since they too are abandoning the PowerPoint plug-in model.

Over the Spring and Summer of 2011 Academic Computing will need to develop communications, documentation and training to assist the campus community in becoming familiar with the new system.

Additionally, Academic Computing and *i>clicker* will need to work with CESD to facilitate a smooth integration with OWL.

Systems Considered

OIT Academic Computing took over responsibility for PRS support in January 2009. Soon thereafter they received a high volume of calls regarding the audience response system's failings. By Fall 2010 issues escalated with poorly timed releases of bug-ridden software and failing receivers. Instructors began asking about other systems and began to meet with vendors themselves. In Spring 2011, OIT initiated an exploration of other vendors and verified instructor concerns through a *Survey of Current PRS Users* (see Appendix).

Four systems were considered during the evaluation process: *eInstruction, i>clicker*, *Turning Technologies* and *Qwizdom*. The *Qwizdom* option was reviewed early in the process and we determined that the company's business model (instructor fees for purchase of hardware and software) made it cost prohibitive to our campus. The *eInstruction* system is currently in use on campus and was reviewed fully along with the other options. The two options that were tested in the Spring 2011 Pilot were: *i>clicker* and *Turning Technologies*.

Standard Features of All Three Systems (*eInstruction, i>clicker*, and *Turning Technologies*):

- Floating Polling Bar that operates on top of any application
- Graphic Display of Polling Results
- Visible Countdown Timer
- Questions On-the-Fly
- Standard Business Model: where students purchase a clicker that can be used for any number of classes and instructors are provided with a gratis Instructor Kit (receiver, clicker, software).

Company Interests/Customer Support

Marketing Orientation

Although all three vendors market toward K-12, higher education and corporate training, i>clicker stands out as a company that seems primarily concerned, at least at this point, with the pedagogical concerns in the higher education setting.

Software Updates and Releases

eInstruction has repeatedly released software and firmware updates at times incompatible with the onset of semesters. Some of the institutions that we spoke with, such as Indiana University, expressed a similar concern with the timing of some the Turning Technologies software updates. According to other institutions that we spoke with, such as the University of Louisville, i>clicker software releases have been delivered with timing appropriate to the academic schedule.

Peer Institution Satisfaction

Many of the peer institutions that we looked at have made a switch away from eInstruction to either i>clicker or Turning Technologies due to their perceived limitations of the eInstruction system. The institutions that we spoke to that are using Turning Technologies were satisfied overall with the system (but did express concern over the timing of software releases). All the institutions that we spoke to that are using i>clicker are thoroughly satisfied with the system.

Customer Support

One of our main dissatisfactions with eInstruction has been their unreliable and inconsistent customer support.

The experience of our ARS Pilot participants has shown Turning Technologies to be somewhat inconsistent in their support. While quick to respond, their explanations have at times been unclear and not readily able to solve problems. Additionally, experienced misinformation as to what version of the software they should be using and how.

i>clicker has been overwhelmingly reliable, consistent and invested in solving any problems that arise. Other institutions, such as the University of Wisconsin, a have reflected similar experiences with i>clicker.

Cost

All three vendors have similar business models. There will not be any cost to the faculty or OIT for instructor kits, loaner kits, and support kits. i>clicker will offer the lowest shelf price to students at $45.50 (Turning Technologies would be $53.50, while eInstruction would remain at $52). See *Audience Response Systems Comparison Chart* in Appendix for details on the Textbook Annex's pricing on clicker buyback and used clicker resale.

Reliability

Operating Frequency

This past academic year has shown an increase in unreliability of the eInstruction hardware.

Our Networking specialists and eInstruction's technology specialists have determined that there is interference occurring with wireless technology on campus due to the operating frequency of the eInstruction devices.

Our pilot participants did not have similar experiences with the Turning Technology devices, but according to the Advisory Committee's research, they are running on a frequency that could present possible interference problems at some point. Our pilot participants have not had any issues with interference with the i>clicker devices, and because they operate on a separate frequency from wireless devices in common usage, our networking specialist do not anticipated any foreseeable conflicts.

See Turning Technologies' and i>clicker's *Interoperability Statements* attached.

Hardware

We are not aware of any known instability problems with the eInstruction or i>clicker hardware. One of our pilot participants did experience a number of malfunctioning devices from Turning Technologies.

Software

We have experienced failures with the eInstruction software, resulting in crashes, lost data, incompatibilities, slow system responsiveness. None of our pilot participants experienced any major level of software issues with either i>clicker or Turning Technologies.

We have experienced incompatibility issues with eInstruction's software: incompatibility with PowerPoint 2010, the floating polling bar doesn't function properly on Mac operating systems, and software installation inconsistencies on Mac operating systems.

Last summer, there was significant disruption among eInstruction users who upgraded their systems to the Windows 7 or the Mac Snow Leopard operating system. Our Turning Technology pilot participants experienced some limited incompatibility with the Windows 7 operating system. Our pilot participants did not experience any software incompatibilities with i>clicker.

With the latest versions of PowerPoint, eInstruction dropped support for their PowerPoint plug-in. Instructors have had to revert back to earlier versions of PowerPoint in order to continue using the plug-in. Neither Turning Technologies nor i>clicker integrate with PowerPoint. Plug-in integration with Windows software has proven problematic, and these companies have overstepped the issues by creating software that operates side-by-side instead of within Powerpoint.

Usability

Clickers

eInstruction and Turning Technologies use keypads. i>clicker uses button selection for multiple choice (A-E) and up/down, right/left buttons for alphanumeric and numeric entries.

See *Device Images* in Appendix.

Users found that the eInstruction and i>clicker remotes perform well. i>clicker is the only device of the three that does not require a screwdriver to replace the batteries. Pilot participants found the Turning Technologies remote to be difficult to use with large fingers, difficult to determine if a button worked or an answer was sent, and was inconsistent regarding when use of the *send* button is required.

Receivers

eInstruction and Turning Technologies both provide USB receivers that are similar in size to a "thumb drive." These receivers operate in the 2.4 GHz band and therefore are vulnerable to conflict with commonly used Radio Frequency technologies (including wireless networks, cellular telephones, Bluetooth devices, WLAN devices, wireless keyboards and mice, Zigbee devices, cordless telephones and microwave ovens). For the last two semesters, we have seen a dramatic increase in "dropped" students during sessions with the eInstruction system. The problem has been mitigated through the installation of 30'+ USB extension cables and wall-mounted receivers placed well away from classroom wireless access points.

The i>clicker system operates in the 900 MHz band to avoid potential conflict with commonly-used Radio Frequency technologies. Pilot participants did not experience any "dropped" students due to wireless interference with either Turning Technologies or i>clicker.

The i>clicker USB receiver is substantially larger than the other ARS receivers. This is due in part to its Radio Frequency and also to the inclusion of an LCD screen that provides the instructor with a sneak preview of the clicker responses as they are coming in. Instructors at other academic institutions have found this feature useful in modifying questions on-the-fly.

See *Device Images* in Appendix.

Channel Selection

eInstruction automatically selects a transmitting channel. Instructors must notify the audience of the broadcasting channel on-the-fly to have students key-in the channel or wait for an extended period of time (up to many minutes) for the student remotes to automatically find the channel. This semester we have had instructors reporting that sometimes the receiver does not broadcast a channel to the audience.

Turning Technologies and i>clicker offer manual selection of channels by the instructor. i>clickers channel selection is the most straightforward.

Polling Results Graph

Our pilot participants found Turning Technologies polling results graph to have some interface issues, particularly with sizing and correct answer determination. The graph is particularly limited when displaying open response alphanumeric answers.

Users have been satisfied with both eInstruction's and i>clickers polling results graph.

Additionally, i>clicker offers a unique option for instructors to utilize demographic polling and data slicing with their polling. There has been voiced desire of such a feature from our open PRS forums and pilot participants.

Grading Software

eInstruction provides limited types of data export and student data manipulation. Turning Technologies provides a fuller set of data exports. i>clicker offers a full set of data export options, is easy to use, and offers flexibility with selecting correct answers in all grading modes.

Data Output/Format

i>clicker stores polling results separately in CSV files. This keeps the data safe, is easy to manipulate, and can easily be used in other software programs.

Turning Technologies stores polling results separately in XML files; these need to be output to CSV files using their proprietary report generator. This is preferable to eInstruction's database, but less optimal than i>clicker's easy CSV format.

eInstruction stores polling results in a database within the same software that collects responses. This has proven to be less stable, leaving data open to corruption and causing the software to slow down as more data is collected.

LMS Integration

Both Turning Technologies and i>clicker offer LMS integration (Blackboard Vista, Moodle) for clicker registration, roster import, and grading. eInstruction requires faculty to do this independently through a complicated and often error-ridden process: our current process for exporting to an LMS requires instructors to convert data to an older version of the Response software before exporting to the LMS.

Clicker Device Entry

All three systems offer options for multiple choice, alphanumeric, and numeric answers. Our users found eInstruction's alphanumeric and numeric entry to be cumbersome (with the necessity of multiple buttons) and exacerbating to the database corruption and slowness issues.

eInstruction and Turning Technologies use character selection for alphanumeric and numeric entries.

i>clicker uses character selection for multiple choice answers and up/down, right/left arrow selection for alphanumeric and numeric entries. Instructors in the pilot and from peer institutions did not find this to be a limitation for students.

Based on our *PRS Survey* (see Appendix), a majority of respondents see numeric questions as a necessary option in their use of an audience response system in class. Both Turning Technologies and i>clicker offer easy to use numeric question responses.

Pilot Tester Preference

All of our pilot participants have expressed a preference for i>clicker. Our ARS users have a firm commitment to the pedagogical value of this technology. However, some have told us they will give up using the technology in their classrooms if we do not switch to a more reliable and stable system for the Fall 2011 semester.

Appendix

Summarized from the ARS wiki at
https://wiki.oit.umass.edu:8443/display/clickers/Audience+Response+System+Evaluation+Project+-+Home

Evaluation Timeline

Audience Response Systems (ARS) are used on the UMass Amherst campus for courses that wish to initiate a greater level of interaction, dialog, and/or participation in large classrooms.

Here is the timeline for our proposed transition to a new ARS.

2010 September

Identified the ongoing and irreconcilable issue with the current ARS.

2010 October/November

Vendor demos from: i>clicker, Turning Technology, & Qwizdom vendor demos.

2010 December

Convened the ARS Advisory Committee.

2011 January

Initiated the ARS Pilot with four instructors using either i>clicker or Turning Technologies in their classes.

2011 mid-March

ARS Advisory Committee makes recommendation for future support for an audience response system on campus.

2011 late-March

Announce decision to campus community for the future direction of audience response systems on campus.

If a new audience response system is chosen:

2011 April

Begin working with UMass Textbook Annex to transition to new ARS.

2011 Spring

Develop documentation to support new audience response system.

2011 Summer

Training period to initiate familiarity of new audience response system.

2011 September

Implementation and support of new audience response system across campus.

Committee Mission

Here is the announcement Chief Information Officer, John Dubach, delivered to the campus community on November 29, 2010:

In the next few weeks, a new advisory committee will be meeting to develop recommendations on the future direction of OIT-supported Audience Response Systems ("clickers") on campus.

This advisory group is made up of faculty and staff and is charged with reviewing the available options and collecting input from the campus community.

"Clickers" are being utilized by more than sixty UMass Amherst faculty and approximately 5,000 students per semester. Due to substantial dissatisfaction with our current product, eInstruction's PRS, we have been exploring other systems and have identified a number of competitive options.

Our advisory committee will begin work immediately and provide recommendations by the middle of the Spring 2011 semester. Our goal is to have a decision in place soon enough to smoothly roll out a new audience response system for Fall 2011 if any of the available options is deemed superior to the current system.

There will be multiple opportunities for faculty to review our options and provide feedback. If you have thoughts on this issue and would like to submit them now, please add a comment below or email JC Sawyer at sawyer@oit.umass.edu.

Thank you for your attention to and input on this important matter.

Sincerely,
John Dubach
Chief Information Officer

ARS Committee Members

The committee at the core of this evaluation was a mix of faculty and instructional support staff from across campus. The campus community was invited to contribute to this discussion via open forums, blog comments, and email.

Faculty:

Beatrice Botch, Chemistry

Glenn Caffery, Resource Economics

Laurie Salame, Hospitality & Tourism Management

Support Staff:

Michael Dickson, OIT Network Systems and Services

Steve Pielock, OIT Academic Instructional Media Services

JC Gray Sawyer, OIT Academic Computing

Mei-Yau Shih, Office of Faculty Development

Kevin Skelly, OIT Software Support

Andrew Vernon, OIT Help Desk

Survey of Current PRS Users

In February 2011, as part of the ARS evaluation, we distributed a survey to the UMass Amherst audience response system (PRS) user community. We had 19% of our users respond to the survey (44 out of 230). Here is a summary of the results:

Course Size

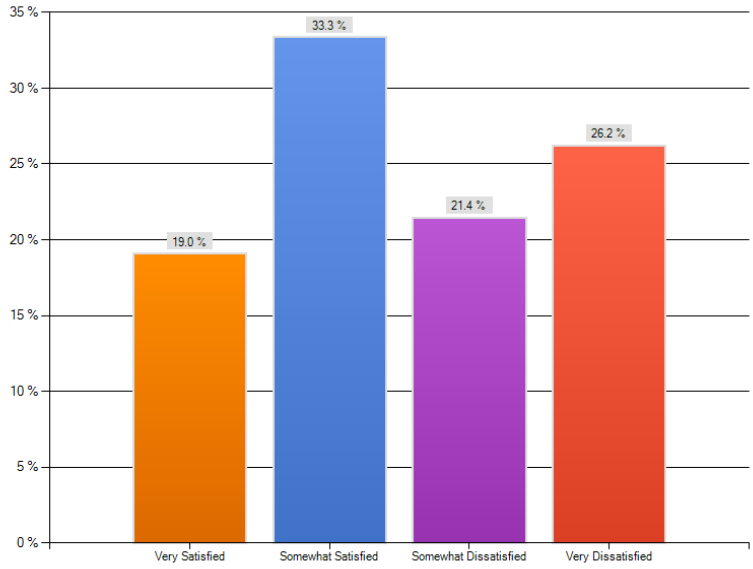
Faculty have an average of 222 students in each class/section that they teach using PRS, with 35 being the smallest number reported and 475 being the largest.

Operating System

77.3 % of faculty use Windows operating systems, 25% use Mac operating systems, and 2.3% use both.

Satisfaction

47.6% instructors reported being somewhat or very dissatisfied. This matches a similar level of dissatisfaction that we have seen among faculty who seek out support for PRS through the Instructional Media Lab and is what led us to evaluate other audience response systems.



Common Issues

Based on a list of possible issues that faculty experience with PRS, the largest number of respondents cited sometimes having problems with:

• Students unable to submit answers — 25

• The PRS software crashing/freezing during class — 23

• Issues with running PRS when multiple programs are open — 19

• Students reporting problems you can't track — 15

• Delays in opening the PRS software — 14

• The PRS software running exceedingly slow — 13

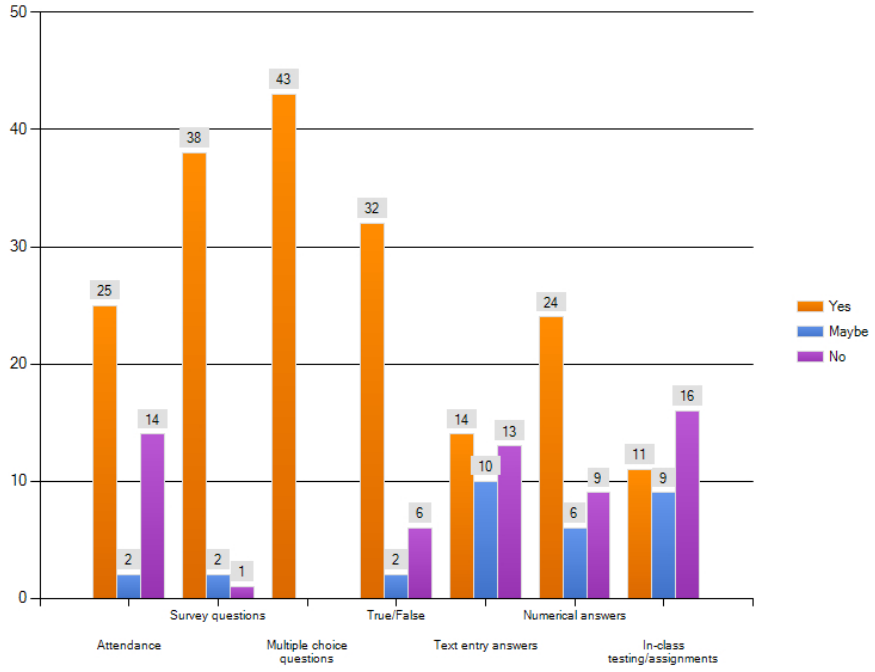
• Losing data from a PRS session —13

• Not being able to merge students/IDs — 12

It is significant that 25 of the 42 responses noted sometimes having students unable to submit answers, while 23 responses cited the PRS software crashing/freezing during class.

How Instructors Would Like To Use PRS

If faculty were not limited by issues with the stability and flexibility of PRS, the types of questions they would use are as follows (Note: A significant 24 out of 43 responses cited the desire to have students enter numeric answers.):



We asked what instructors would like to do with PRS that is not currently possible. A sample of their responses:

• "The ability to integrate online, web-based submissions of answers by students who bring their laptops/smartphones but forget their clicker."

• "It would be interesting if it could be used for exam administration, but that would require a monumental leap in terms of stability and reliability (and authentication/verification/logging)."

• "Better text entry. Twitter-like responses would be very useful."

• “Being able to know the profile of the student answers, such as: freshman vs. sophomores; in my major vs. not in my major; prior experience in this topic vs. no experience; etc.”

• “I would use text entries more to foster communication than for assessment, so some innovative ways to process text entry (such as word clouds) would be great.”

Requirements for a Future ARS

From the survey results, support experience, instructor feedback, and open forums we developed the following requirements for a new ARS.

Requirements for Teaching

- Ability to ask varied question types: multiple choice, true/false, numeric, alphanumeric
- PC & Mac compatibility
- Dependable customer support
- Classroom stability and reliability
- Demographic polling and data slicing
- Integration with multiple software applications
- Simple & reliable student registration
- LMS integration (Blackboard & Moodle)
- Graphing of responses
- Manual editing of student data and scoring
- Data Export to Excel & LMS options
- Anonymous polling
- Web-based version of software for browser-based polling
- Accessibility

Requirements for the Transition

- Start-up documentation and trainings
- Owl integration

Technical Requirements

- Zero to minimal dropped students (reception)
- No interference from wireless devices

Business Models

i>clicker and Turning Technologies offer similar business models to our current ARS, eInstruction.

i>clicker

Equipment and Software:

Software

- i>clicker software solutions (polling and grading) will be provided free of charge.

Recievers

- i>clicker will provide receivers for all classrooms that instructors teach in.

Instructor Equipment

- i>clicker will provide each instructor who opts to utilize the i>clicker audience response system, in their classroom with an Instructor Kit (including the base station receiver, USB cord, flash drive with the software, and an instructor remote that features a built-in laser pointer). Kits retail for $200 but will be free to all UMass instructors.
- i>clicker will provide as many receivers as necessary to install directly in classrooms that are using the i>clicker audience response system.

Training and Support Kits

- i>clicker will provide two gratis support kits (each will include receiver base, instructor remote and 60 student remotes) to OIT Academic Computing for the purposes of training and events. More gratis support kits may be requested as needed.
- i>clicker will provide OIT Academic Computing with gratis loaner instructor kits for instructors who want to try the audience response system but haven't yet decided to require it.

Student Pricing

- i>clicker remotes will be $42.49 at the Textbook Annex. (The remotes are $33.99 net, but UMass will be offered $32.99 net—a $1 discount for centrally supporting the audience response system.)
- All UMass students who own a PRS device are eligible for an online $10 mail-in rebate when they purchase a new i>clicker device.
- i>clicker partners with a large number of textbook publishers to offer students discounts when an i>clicker is purchased with their textbook.

Returns & Handling of Defectives Devices

- i>clicker remotes come with a 1 year warranty. If a student buys a defective i>clicker, she just returns it to the bookstore and i>clicker will credit the bookstore. There is no limit to the number of remotes that can be returned to the i>clicker warehouse nor is there a restocking fee. Broken or defective base units (receivers) will be replaced free of charge via overnight shipping.

Reselling of Used Clickers

- It's up to the campus Textbook Annex if they choose to buy back used clicker devices from students and resell them. There is no extended warranty; each new remote has a 1 year warranty.

eInstruction PRS Clickers

- i>clicker will help dispose of old PRS devices in a green way.

Training, Support & Documentation

- i>clicker will provide gratis on-site trainings and tech support (including students). i>clicker technical support is available for instructors, administrators, and students from 9:00 a..m. - 11:00 p.m. EST, Monday-Friday at 866-209-5698 (toll free) or support@iclicker.com.
- i>clicker will provide sales engineering support for faculty and staff related to integrating with the campus LMS, locally hosted registration and LDAP options, API/SDK support, and web>clicker support.
- i>clicker will provide editable documentation for their software and equipment for OIT Academic Computing to utilize in their training and support of faculty.

Turning Technologies

Equipment and Software

Software

- TurningPoint software solutions will be provided free of charge.

Receivers

- Turning Technologies will replace all existing elnstruction lnterwrite receivers currently owned and utilized at University of Massachusetts Amherst.
- Turning Technologies will offer up to 50 free receivers each year for the purpose of supporting growth on campus.

Instructor Equipment

- Turning Technologies will provide each instructor at University of Massachusetts Amherst that has opted to adopt clickers through the bookstore with 1 ResponseCard NXT, 1 Receiver, 1 PresenterCard and 1 Instruction Book.

Training and Support Kits

- Turning Technologies will provide 60 ResponseCard NXTs, 2 Receivers, and 2 cases free of charge for the purposes of training and development.

Student Pricing

- Turning Technologies will provide *Gold Level Pricing* to all University of Massachusetts Amherst bookstores and affiliates. Pricing for the ResponseCard NXT at Gold Level is $40.00 net.
- Students that purchase a new ResponseCard NXT during the 2011-2012 school year are eligible to receive a $10 mail-in-rebate off the purchase of their ResponseCard.
- With the cooperation of the bookstore, students that return a 'competitive device' in the 2011-2012 school year can receive $5 cash or bookstore credit. This offer will be valid for the period of 1 month at the beginning of each semester (September and January).
- Upon request, Turning Technologies can provide and online portal for students to purchase devices directly.
- Price per device in the online store will be $40 + Shipping and Handling.

Training and Support

Onsite Training

- Upon request, Turning Technologies will provide 1 on campus training per semester (Spring and Fall). This may serve as direct faculty training or 'train the trainer' type training.

Internship

- Turning Technologies will support 1 or 2 on-campus interns for the purpose of training, support, and growing usage on campus.
- Internship is paid ($10 per hour) and up to 20 hours a week (split between multiple interns).
- All interns will be provided comprehensive training by the Turning Technologies Implementation Specialist.

Master Certification Training

- Turning Technologies will offer 'Master Certification' training free of charge to anyone wishing to complete the program.

- Certification is available online through a Moodle course offered by Turning Technologies.

Product Improvement Roundtables

- Upon request, Turning Technologies will facilitate on campus 'round tables' with members of Turning Technologies Product Management team for users of our products to express their opinions about our solutions and ways to improve it.

Live Support

- Turning Technologies support personnel are available from 7am-9pm Monday through Friday to assist with support and troubleshooting for faculty and students.

Implementation Specialist

- The University of Massachusetts Amherst will be assigned an Implementation Specialist, Rob McMillen.
- Implementation Specialists work closely with all groups on campus to ensure that our products are performing to expectation and users are properly trained.

Distinguished Educator Event

- Upon request, Turning Technologies will sponsor 1 Distinguished Educator event on campus for the 2011-2012 school year.
- Distinguished Educators are teaching professionals that we feel to be exceptional in their fields and their use of the technology. Their purpose is to excite the faculty about the technology and expose them to new ways of using the technology.
- More Distinguished Educator events may be provided upon request.

Returns & Handling of Defectives Devices

See attached *Bookstore Return & Refund Policy.*

Feature Comparison

Audience Response Systems Comparison Chart

Pilot Tester Preference*

Pilot tester (brand tested)	eInstruction	Turning Technologies	i>clicker
Beatrice Botch (Turning Tecnologies)			Prefer
Nathalie Lavoie (Turning Technologies)			Prefer
Donna Spraggon (iClicker)			Strongly prefer
Cathy West (iClicker)			Strongly prefer

*see *Survey of Current PRS Users* in Appendix for feedback from current user experience of eInstruction

Company Interests/Customer Support

	eInstruction	Turning Technologies	i>clicker
Market orientation	K-12, Higher Ed, Corporate	K-12, Higher Ed, Corporate	Higher Ed, K-12, Corporate
Customer/tech support	Inconsistent, Unreliable.	Inconsistent.	Excellent.
Official Availability of Desired Software	N/A	Software & hardware official release in June 2011.	Software & hardware official release in June 2011.
Software/Firmware Updates	Poorly timed with beginning of semesters.	Some reports from other institutions of being poorly timed with beginning of semesters.	Fine.
Interest in supporting transition	N/A	High.	High.
Satisfaction of other campus	Many peer institutions have switched to other systems.	Satisfied (some issues regarding clicker hardware and software updates from other institutions and pilot participants).	Very Satisfied (reports overwhelmingly positive from other institutions and pilot participants).

Cost

	eInstruction	Turning Technologies	i>clicker
Net/manufacture price to Textbook Annex	$39	$40	$33.99
New clicker cost to students	$52	$53.50 (w/additional $10 rebate = $43.50, plus return of old PRS device - $5 = **$38.50 Fall 2011**)	$45.50 (w/additional $10 rebate = **$35.50 Fall 2011**)
Used clicker cost to students	$39	$40.25	$34.25
Buyback from Textbook Annex	(50% of new clicker cost)	(50% of new clicker cost)	(50% of new clicker cost)

Reliability

	eInstruction	Turning Technologies	i>clicker
Operating Frequency	Unacceptable interference with other devices.	Uncertain (potential for interference; B. Botch observed students whose responses were not recorded even though clicker indicated it had been received).	Good (no interference with known devices; no drops observed in pilot).
Clicker Stability	No problems.	Some clickers broken. Some clickers shipped with faulty firmware.	No problems.
Software	Unacceptable (years of failures resulting in crashes, lost data, incompatibilities, unacceptable responsiveness.	No problems.	No problems.
Compatibility	Plug-in incompatibility with PPT2010. Software inconsistencies between Mac and PC operating systems.	Some current Win7 incompatibility.	None (Issue with eInstruction's Mobi Tablet is being resolved).

Usability

	eInstruction	Turning Technologies	iClicker
Clickers	Fine.	Hard to use with large fingers. Hard to tell if button worked; more buttons than necessary if just using multiple choice.	No need for screwdriver to change battery; click-thru system for alphanumeric entry; easy interface if just using multiple choice (other buttons deactivated).
Selecting Channel Frequencies	Self-selecting. Sometimes frequency doesn't transmit.	Less clear how to change frequencies than i>clicker.	Easiest: 3-step process.
Polling Results Graph	Fine.	Awkward sizing and labeling of correct answers.	Easy; can display bar chart with fixed # of digits/characters (e.g., "2.2" would include "2.22"; "sig" would include "significant").
Grading Software	Limited types of data export and student data manipulation.	Currently can only export one session at a time (new software will do multiple). Easy student data manipulation.	Very easy; can export multiple sessions at once; ease and flexibility with selecting correct answers in all modes; easy to import roster.
Data Output/Format	Stores results in a database that is corruptible and slows down as more sessions are accumulated.	Stored separately in XML files—need to output to CSV using report generator.	Stored separately in CSV files.
LMS Integration	none	Yes (registration, roster & grading)	Yes (registration, roster & grading)

Unique Features

	eInstruction	Turning Technologies	iClicker
Text Questions	Does not function well.	Does not display all responses, just top percentage.	Displays all responses.
Numeric Questions	Does not function well.	Fine.	Fine.
Demographic Polling & Data Slicing	No.	No.	Yes.

Device Images

eInstruction

eInstruction remote

eInstruction receiver

Penny (for visual reference)

i>clicker

i>clicker remote

i>clicker receiver

Penny (for visual reference)

Turning Technologies

Turning Technologies remote

Turning Technologies receiver

Penny (for visual reference)