

INTERACTIVE STUDENT RESPONSE SYSTEM: PILOT PROJECT

Report to the faculty in fulfillment of an STI grant

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Introduction

The goal of this project was to evaluate the in class use of an interactive student response system (known herein as clickers). The project was divided into the following three phases: 1) system selection, 2) pilot study, and 3) recommendations.

During phase one we gathered systems specifications, pricing data, and demonstration units from the three major vendors. Based on this information and pre-established evaluation criteria we chose a system from Turning Point.

Phase two occurred during the Fall 2004 semester, during which the clickers were used in 4 graduate level courses within the school. Student feedback on the use of clickers was gathered during the final class meeting.

Specific recommendations for the continued use of this technology are detailed below.

Background

Clickers are wireless transmitters that functions like a TV remote. They transmit data to a receiver that is directly linked to a computer. Students use clickers in the classroom to answer questions that the instructor poses, with the results appearing instantly on a screen. This technology has been around for some time, and has proven to achieve educational goals such as promoting interactive learning, supplying immediate feedback to students and to the instructor, increasing student interest, involvement and attendance, and improving the learning experience. [Citations?]

PHASE I: EVALUATION OF PERFORMANCE OF ALTERNATIVES

Evaluation Criteria

Prior to gathering data from vendors the following evaluation criteria were determined: 1) the selected system must integrate as seamlessly as possible with PowerPoint. 2) the system must be easy to use in general, both for creating response slides and using the technology during a classroom lecture. 3) the system must also be easy to use in terms of student registration. In order to determine who has responded and if desired record responses by student, each clicker must be registered in some way with the software used. 4) the system must be able to handle responses from at least 60 clickers (this represents the maximum size of graduate courses), 4) price – this project had a predetermined budget of XXX. Therefore, the chosen system must provide the necessary equipment to handle up to four classrooms simultaneously within the given budget. In addition, we considered the long term budget implications when choosing a system.

Systems specifications, pricing data, and demonstration units (including hardware and software) were gathered from the three major vendors – eInstruction, EduCue, and Turning Point. Table 1 shows a comparison of the three systems. A detailed report is given in the next pages.

	TurningPoint	eInstruction	EduCue
<u>Software:</u>			
<i>Compatibility with PPT</i>	Completely integrated into PPT	Not truly integrated into PPT	Still in Beta version
<i>Creating Question</i>	Toolbar within PPT	In separate CPS	

<i>slides</i>		software	
<i>Activating Question slides</i>	Automatically when PPT slide arrives	Manually by instructor (requires keyboard)	
<u>Pricing:</u>			
<i>Clicker price</i>	\$ 25 + Activation \$20 one time licensing OR \$12 annually	\$3 one time fee + \$15 per semester	\$25.5 one time fee
<i>Receivers</i>	\$ 119	\$250 per classroom (90 seats)	2 receivers per classroom (60seats): \$212.5 + \$195.5
<i>USB adaptors</i>	\$50	\$30	\$50

Hardware Comparison

The hardware of three vendors consists of response pads and receivers. However, depending on the signal speed of response pads, the requirement of the number of receivers for each classroom varies. At this point, Turning Point and eInstruction have better receivers, and it would be enough to set up one receiver for each classroom consisting of approximately 60 to 90 seats. On the other hand, the quality of receivers of EduCue requires 2 receivers for each classroom. EduCue's recommendation would be one receiver per 40 transmitters.

Keypads (Exhibit 1) from three vendors are evaluated by different dimensions, keypad layout and transmission speed. For most of the infrared products battery life and

range are very similar. And three keypads use infrared technology similar to a TV remote. It has proven to be reliable and operates on a "line of sight" so it will not interfere with radio frequency equipment or other systems in adjacent rooms.

Dimensions

Product	Dimensions	Weight w/o Batteries	Weight with Batteries
PRS	4.00" x 2.00" x 3/4"	2.0 oz.	2.9 oz.
CPS	4.25" x 2.25" x 1"	1.9 oz.	2.6 oz.
ResponseCard	3.50" x 2.50" x 1/4"	.9 oz.	1.2 oz.

The keypad for Turning Point ResponseCard is the smallest and lightest weight of the products we evaluated.

Keypad Layout

Product	Alphabetic Responses	Numeric Responses	Number of possible Responses
PRS	No	Yes	10
CPS	Yes	No	8
ResponseCard	Yes	Yes	10

Compared to the CPS and PRS, ResponseCard from Turning Point support both numeric and alphabetic answer choices.

Transmission Speed Results

Hardware Type	Transmission Speed (In Milliseconds – 1/1000 second – lower is faster & better)	Maximum Keypresses Per Second	TurningPoint Recommended Maximum Keypads Per Receiver
PRS	95.242	10.50	40
CPS	28.167	35.50	80-100
ResponseCard	27.641	36.18	80-100

As with any infrared device, a keypad receiver technically can only receive one response at a time. Thus, transmission speed is the main determinant of how many responses a single receiver can receive and how fast it can receive them. In short, the faster the transmission speed, the more reliable the solution. With all of the above infrared products tested, duplicate signals sent at exactly the same time will not be received by the receiver. When this happens, participants must respond by repeating their key press until the on-

screen grid displays confirmation to ensure their response is received. With the documented fastest transmission speed, Response Card will experience the least amount of signal clashes. From a signal reliability standpoint, that makes ResponseCard the best choice for many lecture environments.

The table below summarizes the comparison between three keypads from three vendors:

	TurningPoint	eInstruction	EduCue
Enclosure	Lightweight, compact, grey "credit card" format plastic case.	Lightweight, compact, blue plastic molded enclosure.	Lightweight, compact, gray plastic molded enclosure.
User Input	12 key (1(A) - 10(J), *, ?) user input.	8 key (A - H) user input.	10 key (1 - 10) user input.
Display	Red LED provides confirmation that response is being transmitted.		Green LED provides confirmation that response is being transmitted.
Power & Power Management	-Powered by two coin cell CR2032 (3.0V) Lithium Batteries -Very low standby power mode. -Batteries are powerful enough to provide typically over 12 months of keypad use	-Powered by two AAA (1.5V) Alkaline Batteries -Power will shut off when the unit is not in use for 15 minutes. -Batteries are powerful enough to provide typically over 12 months of keypad use	-Powered by two AAA (1.5V) Alkaline Batteries -Power will shut off when the unit is not in use for 15 minutes. -Batteries are powerful enough to provide up to 12 months of keypad use.
User Identification	Available in Programmable ID and Fixed ID (Bookstore Model Sales) versions	Keypads are programmed from 1 up to 256.	There are two types of PRS keypads, fixed and programmable. Each fixed ID keypads will be created with it own unique ID. Programmable keypads will be numbered from 1 to the number of keypads purchased. Keypads can be reprogrammed with an optional software utility.

Receivers:

	TurningPoint	eInstruction	EduCue
<i>Dimensions</i>	1.87" W x 2.5" L x .75" H.	2.36" W x 1.7" D x 4.8" H.	2.36" W x 1.7" D x 4.8" H.
<i>Unit Weight</i>	4.0 oz. (including 10' serial cable).	4.2 oz.	4.2 oz.
<i>Recommended keypads per receiver</i>	80 keypads	40 keypads	40 keypads

For all receivers, the range for one receiver is approximately 90 feet. This range can be increased by utilizing multiple receivers. This comparative information is provided by Turning Point since this company works with various vendors for hardware. However, eInstruction and EduCue claim the capacity of their receivers higher.

Software Comparison

Software by EduCue and eInstruction can only be used with their own product. TurningPoint software can be used with any type of hardware.

The compatibility with Power Point is a major issue that we took into consideration in this evaluation process. While Turning Point and eInstruction have integrated software with Power Point, EduCue has not released the Beta version of the software. We therefore could not evaluate EduCue's new software in time for Fall 04. Therefore, EduCue was quickly eliminated as a possibility for this project.

eInstruction: Software by eInstruction is complicated and not truly integrated into PowerPoint. Although power point slides can be uploaded to the software, all slides are run from inside eInstruction's software, called CPS. This means that the instructor must create the slides outside of PowerPoint, in an environment that is not user friendly. Furthermore, the question slides are not directly part of the PowerPoint presentation, and

the instructor has to click a special button to ask for the next question slide. This requires keyboard access! The questions typed by the instructor are hard to see, and the instructor has to be in charge all the time to control the timing (start and end).

TurningPoint Turning Point has the most advanced and user-friendly software. It is completely integrated into PowerPoint, with a special toolbar (see Exhibit 2), which the instructor uses to create question slides. During the presentation, when a question slide is reached it is automatically activated.

Pad Initialization Comparison

Pads by EduCue and TurningPoint are generally simpler to “initialize” than eInstruction.

eInstruction: The registration process of eInstruction is complicated since it requires registration of each response pad for each class and each semester. Both instructor and students are involved in the registration process. The instructor creates a CPSONline class on the eInstruction website, which is somewhat complicated. There is a synchronization phase during which the instructor needs to match the class roster with the section of the class so that the class roster is updated with new registrations. Once the online creation is completed, eInstruction provides a code, which students use to enroll into the class. Also, the response pad numbers are different than the serial number and are assigned on a ‘first-come, first-serve’ basis per class. Thus, students need three numbers for registration: their pad’s serial number, the “pad number” which is course-specific, and the password. In addition, the course-specific pad number requires students to remember their number for each class. Finally, the instructor has the option to create the class list by using the eInstruction software. While creating the list, the software assigns numbers for

each response pad. The question would be how to match numbers assigned by the instructor and those created by CPSONline.

EduCue and TurningPoint: Students need only register their clicker serial number with the instructor. This can currently be achieved only manually (the TA or instructor must create a list of students and their clicker serial numbers). However, Turning Point's registration process uses Excel. Therefore, it is a fairly simple matter to download a class roster in Excel and assign clicker numbers sequentially (first person on the roster is clicker number 1, etc.).

Pricing Comparison

Both Turning Point and EduCue have a more flexible cost structure than eInstruction does. They require a one time flat fee for response pads, which cost at around \$20-25. Turning Point requires activation fee, which is \$20 one time licensing or \$12 annually (\$8 if more than 1000 students). On the other hand, the response pad of eInstruction costs \$3. However, each has a serial number on the back, and students have to activate their response pad for \$15 per semester. This price covers activation for one or more courses for the term. This registration and term fees make eInstruction's system burdensome. All vendors provide the option to resell the response pads back to the bookstore or to other students.

Receivers:

- **EduCue** requires two receivers in a 60-student room. The cost is \$212.5 (primary receiver) + \$195.5 (secondary receiver).
- **eInstruction** \$250 per room (90-student room).

- **TurningPoint:** \$119 (per class room)

USB Adaptors:

EduCue and eInstruction receivers use a serial port to connect to the computer. When using a laptop, this port is taken by the projector, and therefore there is a need for a USB adaptor. In both cases there is only one type of adaptor that works.

- **EduCue** uses an adaptor that costs \$50
- **eInstruction** uses an adaptor that costs \$25 and \$5 for shipping and handling
- **TurningPoint** (adaptor price included in receiver price)

Software+ hardware compatibility:

The big advantage of Turning Point is that they sell software and hardware separately. This option allows the flexibility of buying hardware from other companies since Turning Point's software is compatible with them.

Summary of the Evaluation Process:

After having evaluated the test kits of three vendors, we decided to eliminate eInstruction for the following reasons:

1. The software is not integrated with Power Point
2. There were some technical problems with receivers and technical support service was not quick in providing solutions.
3. And the prices were high compared to two other vendors.

In order to have a better grasp of the two other vendors' offers, below you can see the comparison table:

	Turning Point	EduCue
Hardware		
<i>Clickers</i>	<ul style="list-style-type: none"> ▪ No on/off button ▪ Special batteries (not practical) Powered by two coin cell CR2032 (3.0V) Lithium Batteries ▪ Faster, smaller, lighter 	<ul style="list-style-type: none"> ▪ On/off button ▪ Regular batteries (Powered by two AAA (1.5V) Alkaline Batteries)
<i>Receivers</i>	<ul style="list-style-type: none"> ▪ 1 receiver is enough ▪ The size is small 	2 receivers are necessary for each classroom and they have to be put together
Software	<ul style="list-style-type: none"> ▪ Requires only the numbers assigned to students ▪ Free download of software 	<ul style="list-style-type: none"> ▪ Requires serial numbers in grid (for 60 students it covers lots of space on the slide) ▪ No need for software to create slides ▪ Small toolbar
	The software is already in use.	It is the Beta version. Needs still to be tested.
*Cost		
<i>Clickers</i>	\$25	\$25
<i>Receivers</i>	\$119	\$400 (one time)
<i>Activation fee</i>	\$12/clicker (annual) or one-time \$20/clicker	\$0
<i>Other options</i>	30% off software and 20% off hardware if bundled with Thomson	Bundling with Thomson book so no need to pay for receivers

**By calculating the expenses we made the following assumptions:*

- *This software will be used in 10 classrooms (3 in DC campus, 1 in Shady Grove, 1 in Baltimore and 5 in College Park).*
- *In each classroom, there will be 60 students.*

In general, EduCue has some advantages over Turning Point:

- It is a local company, and they are in the education field for a long time. It gives UMD the opportunity to work with them closely.
- They have other products, which might be integrated in the long run to this system.
- Costs can be reduced significantly and there is no annual activation fee.

The main problem with EduCue at the time of this project was that their software was still in beta testing and would not be ready for the pilot study. Therefore, we decided to use a hardware and software package from Turning Point for this project.

Final Cost of Pilot Study

After negotiation with TurningPoint we purchased the following bundle for a one-time fee of \$7500:

- 300 ResponseCards (5 sets numbered 1-60)
- 5 ResponseCard Receivers
- 5 USB Adapters.
- 5 Annual TurningPoint 60 keypad software licenses.

This reduced price was based on the understanding that this is a pilot study which could potentially lead to wider adoption by the Smith School.

PHASE II: THE PILOT STUDY

The Turning Point system was used in the following classes during the Fall 2004 semester: BUSI 620 (2 sections in DC), BUDT 733, and BUSI 671. The software was run off of notebook computers, and the receivers were connected to these. Placement of the receivers was left up to the individual instructors. Instructors were not provided any set guidelines for how to use the clicker technology during class.

Student Feedback

At the end of each class the students were surveyed as to their perceptions on the use of clickers in the classroom. The results from those surveys appear below (note – the surveys were conducted using the clickers).

BUDT 733

1. Use of clickers improved my learning experience

Strongly Agree – 42%

Agree – 58%

2. I'd recommend using clickers in other classes

Strongly Agree – 50%

Agree – 33%

Disagree – 13%

Strongly Disagree – 4%

BUSI 620

1. Use of clickers increased my level of class participation

Strongly Agree – 29%

Agree – 57%

Neutral – 6%

Disagree – 9%

Strongly Disagree – 0%

2. I would recommend the use of clickers in other MBA courses

Strongly Agree – 29%

Agree – 43%

Neutral – 11%

Disagree – 11%

Strongly Disagree – 6%

BUSI 671

1. Use of clickers increased my level of class participation

Strongly Agree – 18%

Agree – 50%

Neutral – 18%

Disagree – 15%

Strongly Disagree – 0%

2. I would recommend the use of clickers in other MBA courses

Strongly Agree – 9%

Agree – 34%

Neutral – 34%

Disagree – 14%

Strongly Disagree – 9%

Instructor Feedback, Comments, and Suggestions

All instructors who used the technology during the Fall semester were very satisfied with it and are planning to use it again. The major reaction was “it is easy and fun”. The TP software was easily adopted by all instructors, who installed it, ran it during presentations, and created slides using it.

Clickers were used for:

- Stirring discussion
- Polling about student, team, and instructor performance
- Reinforcing analytical methods through computational questions
- Assessing the understanding of the class (immediate feedback to instructor)
- Improving class dynamics
- Improving and recording participation
- Grading team performance
- Evaluating satisfaction on different course components (guest lectures, quizzes)

The two technical problems that were encountered:

1. Placement of receiver in the classroom requires testing different locations.
In one classroom (DC01) this was a constant struggle.
2. Software installation on classroom PCs (rather than instructor laptops) was not straightforward because of the software licensing structure and our “image” system. Eventually the software was licensed per instructor.

PHASE III: RECOMMENDATIONS

From the experience gained during the pilot study we strongly recommend the adoption of this advanced teaching technology. The opportunity to use clickers in a course should be presented to all Smith School faculty and teaching adjuncts. This will improve the learning experience for students and the teaching experience for instructors and stress further our School’s commitment to technology.

There are several possible policies that would allow instructors to use the TP software and clickers in their courses. At this point we already have 5 receivers and 300 clickers. These are already used to capacity within the D&IT department. Additional hardware is therefore necessary if adoption occurs.

Our software license will expire at the end of the year. Software licensing must be renewed. The two options offered by TP are

1. Annual license at \$12-per-clicker (or \$8 if over 1000)
2. \$20 one-time fee per clicker (excludes software updates, tech support, maintenance)

Currently each instructor received one receiver and an amount of clickers according to the number of registered students. This model worked well for this group, but there are alternative policies to be considered when wider adoption takes place:

- Distribution of receivers:
 - Set infrastructure model – install systems in certain classrooms.
 - Instructor check out model – systems available for check out by instructor
 - Duxbury-TP relationship - Instructors receive free receiver if students purchase clickers through bundling with their Duxbury textbook.

- Purchase and distribution of clickers
 - Classroom use – clickers assigned to classrooms. Clickers can be used by multiple courses in the same classroom.
 - Course check-out - clickers distributed by instructor for the duration of the course.
 - Student purchases clicker – clickers go with each student (can be bundled with a Duxbury textbook or some course packet).
 - Nextel model -- School gives each student a clicker at start of MBA program.

Combinations of these models are also possible (e.g., clicker purchase in Core courses and checkout in electives; Receivers instructor-specific in VMH but classroom specific in DC campus).

EXHIBIT 1:

Turning Point: Response Card



eInstruction: CPS



EduCue: PRS



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