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ARTICLE

Empowering or compelling reluctant participators using audience response systems

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ABSTRACT This article investigates the impact of an audience response system (ARS) on student engagement in undergraduate university courses. A survey was administered to students in a dozen courses piloting the ARS system. On 13 out of 14 measures the majority of students thought the system was helpful. Overall, students were more positive about the use of the ARS in courses that used the tool for formative feedback (empowering) rather than for grading or attendance purposes (compelling). The authors discuss the positive impact of the ARS on the engagement of 'reluctant participators' or students who reported that they are least likely to participate in class under normal conditions. Reluctant participators' perceptions of the helpfulness of the ARS were compared to those of non-reluctant participators. Finally, student comments were analyzed to determine why students with the most negative feelings about the ARS felt the way they did and which teaching practices using the ARS were perceived to have the greatest value by the students.

KEYWORDS: *audience response system, student engagement, technology integration, technology-mediated teaching*

Active participation in learning

The idea that students must be actively engaged in the learning process in order for it to be effective is not new. The roots for active learning reach back in the literature to John Dewey, who wrote that students learn by doing and that learning is an active process (Dewey, 1916). A diverse body

of educational research has shown that academic achievement is positively influenced by the amount of active participation of students in the learning process (Gardner et al., 1994; Narayan et al., 1990; Pratton and Hales, 1986; Stallings, 1980). Pratton and Hales (1986) defined active participation as 'the result of a deliberate and conscious attempt on the part of a teacher to cause students to participate overtly in a lesson' (1986: 211).

One measure of active participation that has been positively associated with gains in scholastic achievement is active student responding (Greenwood et al., 1984; Narayan et al., 1990). Hand raising is one of the most common methods that teachers employ to increase active student responding (Brophy and Good, 1986). Narayan et al. (1990) discuss some disadvantages of this method:

> Active student involvement, when it does occur during teacher-led whole class instruction, is often characterized by the teacher calling upon 1 student at a time to respond. Although this traditional method of having students raise their hands provides an opportunity for active response by the student who is called upon, all other students in the classroom are relegated to passive participation. (1990: 484)

When classes have limited opportunities for students to respond, participation can be unbalanced in favor of the most knowledgeable students who are most willing to respond in front of their peers. One approach to addressing this challenge has been the use of response cards in class (Marmolejo et al., 2004; Shabani and Carr, 2004). Response cards are 'cards or signs that are simultaneously held up by all students in a class to display an answer or other response to a teacher-delivered question' (Marmolejo et al., 2004: 405). Questions are typically multiple choice or true/false in nature. The use of these cards has been shown to increase participation, increase student performance in higher education classes (Kellum et al., 2001; Marmolejo et al., 2004), and provide important feedback to the instructors on their teaching (Cavanaugh et al., 1996; Christle and Schuster, 2003; Kellum et al., 2001; Maheady et al., 2002). Another approach to the challenge of active participation is the use of audience response systems (ARS), which are called by many names including personal response systems, classroom response systems, electronic response systems, or group response systems.

Introduction to audience response systems

An audience response system is a technology that allows students to respond electronically using a handheld device to questions that instructors pose in class. Instructors typically present multiple choice or true/false questions to the class using electronic presentation software such as PowerPoint. Each student responds to the instructor's questions using a transmitter (see Figure 1).

The transmitter sends a radio signal to a receiver that is connected to the instructor's computer. The computer records the individual student responses and the instructor has the option of immediately displaying a histogram or other information from the students' responses (see Figure 2). The instructor can also use the ARS to track individual student responses to questions.

During the past several years the use of audience response systems (ARS) in higher education has been on the rise. Large publishing companies are beginning to market ARSs to institutions as well as package the hardware with their textbooks. Although ARSs have been around since the 1960s (Judson and Sawada, 2002), it is only during the last half decade that they have become an off-the-shelf commodity that is easily integrated with other commonly used productivity tools and course management systems (e.g. PowerPoint, Excel, Blackboard, etc.). This has dramatically increased the adoption rate of the ARSs as an instructional tool at many institutions of higher education.

The use of ARSs in higher education

Criticism of the low student participation in traditional lecture formats in higher education has spurred interest in understanding pedagogical implications of ARSs (Benjamin, 1991; Robertson, 2000). Early research with

Figure 1 **Audience response hardware from TurningTechnologies: student transmitter (left) and instructor receiver (right)**

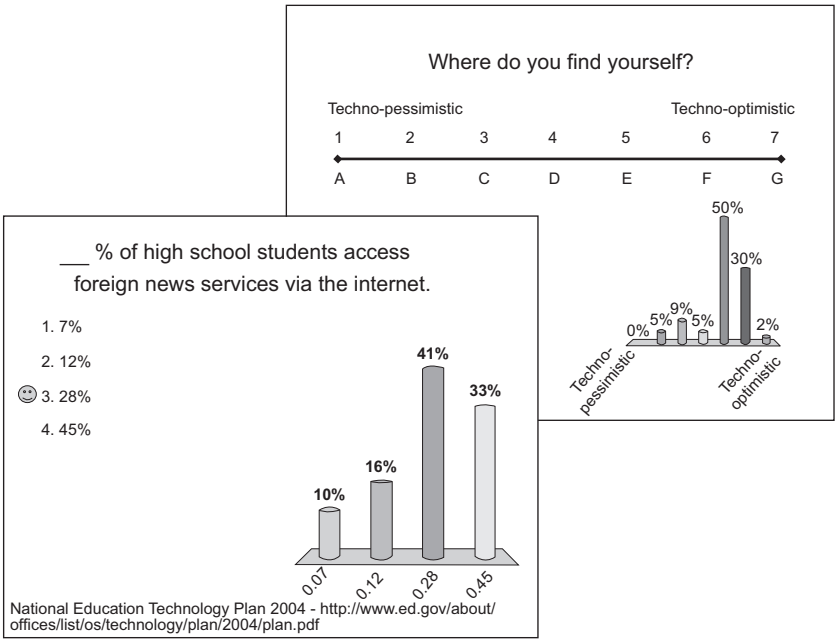

Figure 2 **Audience response system generates a histogram of class response to questions**

electronic response systems in higher education reflected a 'stimulus-response pedagogic style' with a focus on students receiving immediate correct/incorrect feedback to their responses (Judson and Sawada, 2002). Recent research related to ARS use has accelerated – partially due to increased availability of inexpensive systems that provide opportunities for instructors to systematically collect and record feedback from students (d'Inverno et al., 2003). Current research has focused on the use of ARSs to promote collaborative discourse in the classroom with an emphasis on uncovering misconceptions and prompting small group discussion (Judson and Sawada, 2002; Nicol and Boyle, 2003). There have been many studies investigating the use of ARSs in a wide range of academic settings, including engineering education (Nicol and Boyle, 2003; Silliman et al., 2005; Silliman and McWilliams, 2004), continuing health professional education (Miller et al., 2003), physics (Burnstein and Lederman, 2001), philosophy (Stuart et al., 2004), psychology (Benjamin, 1991), political science (Damron and Mott, 2005), accounting (Beeks, 2006), computing science (Draper and Brown, 2004), and physical science (Fies, 2005).

Studies that explored *direct* measures of student learning with audience response systems have shown mixed results. Some studies outlined improved student achievement, while others described no significant

improvements in student performance (Fies, 2005; Judson and Sawada, 2002). Although these studies showed mixed results, most studies that looked at *indirect* measures of student learning (including levels of participation and engagement) found positive results. Researchers reported that students generally felt that ARSs improved their engagement in the class, made the class enjoyable, and helped the instructor attend to their needs.

A common rationale for using ARS technology has been to engage students who are shy or reluctant to take the risk of public failure (Fies, 2005). Fies (2005) cites Tannen's (2004) and Benckert's (2001) claim that female learners are particularly vulnerable to low participation because of the worry that they might appear to dominate discussion. Beeks (2006) notes that students from other cultures are often not used to responding instantaneously and are fearful of 'losing face' by answering incorrectly in class. This study refers to these students as 'reluctant participators'. Without exception in past studies, student engagement data were reported as whole class trends and did not isolated important subgroups within a class for analysis. Past research has not looked specifically at the impact of ARS use on the subgroup of reluctant participators in relationship to the whole class in order to determine if these reluctant participators feel differently about the helpfulness of the ARS than do other students.

This study investigated three subgroups of students who were at risk for low participation in order to understand how the use of the ARS impacted their engagement in class and their perceptions of the 'helpfulness' of the tool. The study also explored the pedagogical uses of the ARS that students find to be most helpful to their learning.

Methodology

This study focused on three broad questions (see Figure 3). The first two questions related to the impact of the ARS on student engagement in class

Question 1: How does using an audience response system impact student engagement?

Question 2: How does using an audience response system impact students who are least inclined to participate in class?

(a) those who want to know peers' opinions but are reluctant to share their own,
(b) those who are hesitant to ask questions or raise hands in class, and
(c) those who prefer classes with little participation.

Question 3: What pedagogical uses of the ARS did students perceive to have the greatest value?

Figure 3 **Research questions for the audience response system implementation study**

and the third question investigated the teaching practices and strategies that were most valued by students.

During winter semester 2006 the Center for Instructional Design (CID) at Brigham Young University (BYU) sponsored a campus wide pilot implementation of an ARS called TurningPoint. Faculty and students at BYU who were involved in the pilot were invited to participate in the study by completing surveys. The instructor survey focused on faculty purposes and strategies for using the ARS in class (see Appendix A for the instrument). The student survey focused on identifying students at risk for low participation in classes and then understanding their perceptions of how helpful the ARS was to their learning experience (see Appendix B for the instrument). The study included undergraduate courses in Chemistry, Biology, Physics, Psychology, Education, Statistics, and Marriage Family and Human Development (see Table 1).

Findings

Q1: General impact on student engagement

The overall reaction to the use of the ARS in the pilot was positive. Figure 4 shows how students across all ten courses responded to 14 questions relating to the helpfulness of the response devices. For all of the measures except one, a strong majority of the students 'agreed' or 'somewhat agreed' that the

Table 1 Information about the courses included in the research study

Class	*Faculty participants*	*Student participants*	*How often did you use TurningPoint in your class this semester?*	*What portion of class time do you spend using TurningPoint?*
CHEM A	1	67	Every class	Small portion only
CHEM B	1	51	Every class	Significant portion
EDUC	3*	82	a. Sporadically b. Once or twice c. Regularly (but not every class)	a. Entire class time b. Small portion only c. Small portion only
MFHD	1	136	Every class	Small portion only
BIO A	1	20	Once or twice	Small portion only
BIO B	1	108	Every class	Small portion only
PHYSICS	1	171	Every class	Significant portion
PSYCH	1	47	Every class	Small portion only
STATS	1	6	Regularly (but not every class)	Small portion only
Total	11	688		

*Three different sections (a, b, c) represented

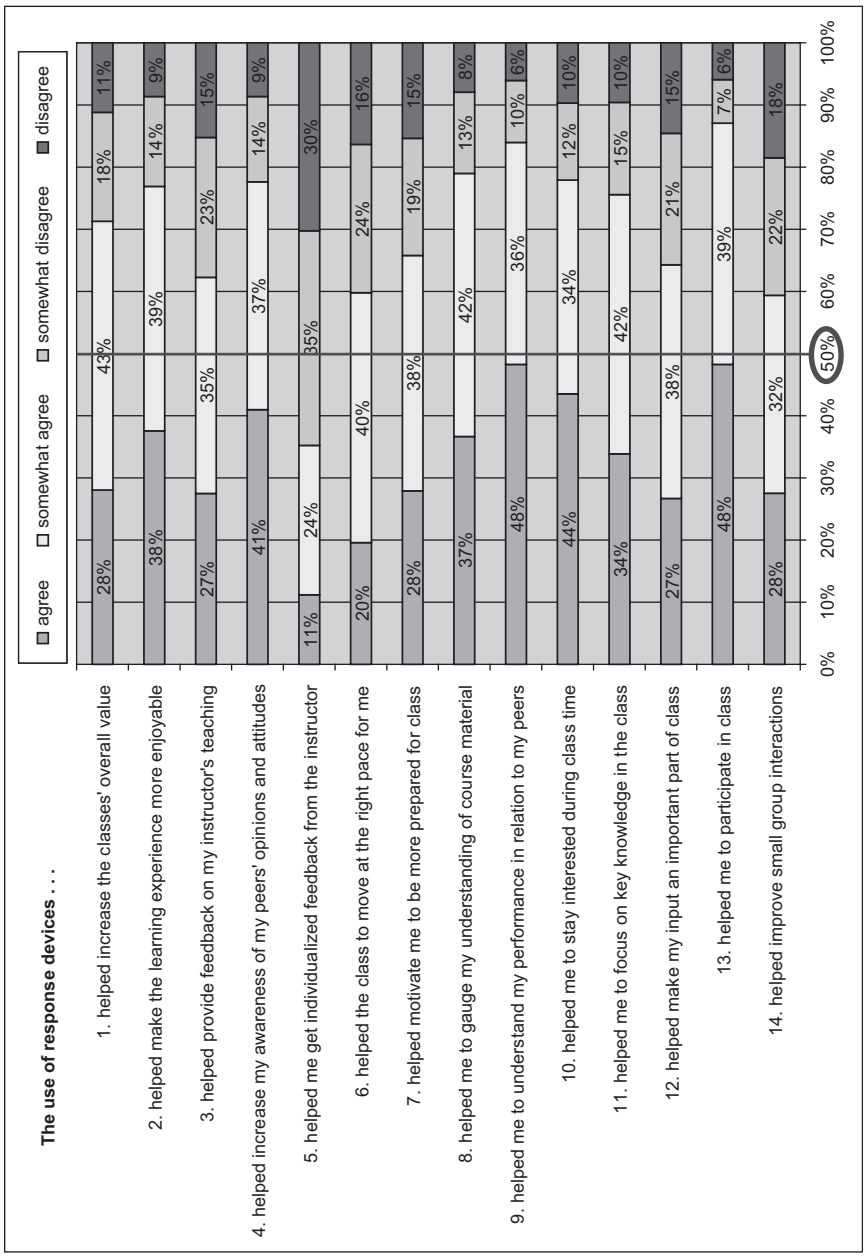

Figure 4 **Student survey feedback on impact of the audience response system (n = 688)**

ARS was helpful to them in their learning experience. The fact that most courses were not using the ARS as a mechanism to facilitate individualized feedback to the students accounts for the low rating on item #5.

Although the overall student response to the use of the ARS in class was positive, the aim was to understand why some students felt that the ARS was *not* helpful. In order to identify the students who felt most negative about the use of the ARS, all of the students that responded 'disagree' or 'somewhat disagree' to more than half of the 14 items listed in Figure 4 were selected. There were 116 out of the 688 student respondents (16.9%) in this group. A correlation analysis did not show any strong relationships ($>|0.2|$) between the group of students with negative feelings regarding the ARS and the individual student characteristics identified in the student survey (see Appendix B). For the 116 students, NVivo, a qualitative data analysis tool, was used to code their open ended responses to the questions: What did you like best and least about how the instructor used the response system in class? And what suggestions do you have for improving the use of the response devices in class?.

The four main themes related to negative feelings towards the use of the ARS that surfaced in the analysis were: (1) technical problems; (2) the cost of the device; (3) grading; and (4) mandatory attendance. Table 2 contains some representative student responses from each of these themes. Approximately one third of the respondents in this group mentioned technical problems with the use of the ARS. Most of the negative feelings about using the ARS for grading were coupled with technical problems and feelings that the grading tool was unreliable. For example one student commented,

> I think it's an unfair grading system. I think they're great, as long as grades aren't based on them. There are too many variables like battery failure, problems with being on the correct channel and so forth that interfere. These variables make it unfair to base grades on clicker quizzes.

Because the cost of the device to students was fairly high ($40 each), a significant number of students were critical of cost effectiveness. This feeling was particularly true in classes where students felt the response devices were not used frequently enough to justify the cost. Two of the courses avoided the issue of cost effectiveness from the student perspective by acquiring a class set of the transmitters to be loaned to the students.

Some faculty used the ARS as a way to encourage students to attend class and/or to come prepared to class. These instructors designed attendance quizzes on previously assigned reading, which were administered at the beginning of each class. The grades were based on the student making a response, even if the answer was incorrect. In these cases the ARS was used for assigning attendance points as well as providing a starting point for the discussion.

Table 2 **Reasons for negative feelings about the use of the ARS in class coded from open ended responses of students responding negatively to more than half of the survey items (n = 116)**

Theme	*Students*	*Representative student comments*
Technical problems	41 (35%)	'either use devices that work well, or don't use them at all'
		'I noticed that it was often a difficult thing to get them to work properly and the teacher found getting his program to work a challenge at times'
Cost of devices	21 (18%)	'don't use them, for how much money they told us it cost them to try them, its not worth the money from what I saw.'
		'they are too expensive. … DON'T USE THEM. They are a waste of money'
Grading	19 (16%)	'We were never tested on what we learned in class, but only on the reading from the night before. So I don't feel that it judged what we learned in class'
		'don't think they're necessary. They waste class time. Quizzes should be given other ways'
Mandatory attendance	11 (9%)	'I thought it was a poor excuse for a way to grade us on attendance in a class where attendance should not be mandatory'
		'I enjoyed the clicker's however I find that they become more of a babysitting device than a learning tool. I am of the feeling that we are all adults and don't need someone to hold our hand and walk us through a class. Clickers are great because certain students are scared and do not want to raise their hands but don't penalize someone who doesn't come to class'

Other faculty used the ARS as a way to assess student knowledge. In one class the instructor assigned a number of homework problems that the students were responsible for answering during the next class period. Then a brief in-class quiz was given where students had to answer only one of the assigned questions using the ARS. When the ARS was used primarily for grading there was a perception among some students that the benefits to the instructors, in terms of efficiency, were greater than the benefits of learning for the students. One student commented: '[The ARS] was used more to ease the grading of busywork for the professor more than it was used to benefit the understanding of the students'.

In order to probe the relationship between the use of the ARS as a grading tool and the students' perception of the helpfulness of the tool, courses

were identified where faculty claimed: (1) that the ARS was used every class; and (2) that the ARS was used minimally or heavily for grading. Table 3 compares the courses (MFHD and BIO B) that used the ARS primarily to provide formative (non-graded) feedback and the courses (CHEM B, PHYSICS, and PSYCH) that used the ARS for grading. Table 3 shows several items with the starkest difference between the two course groupings. With the exception of just a few items (such as number 7 'helped motivate me to be more prepared for class') students in classes where the ARS was not used for grading viewed the ARS to be a more helpful tool.

Q2: Impact on low-participators

Data for three subgroups of students at risk for low class participation were investigated.

- students who want to know their peers' opinions but are reluctant to share their own (see Figure 5);
- students who are hesitant to ask questions in class when they do not understand the material (see Figure 6); and
- students who prefer classes without student participation (see Figure 7).

Table 3 **Comparing five courses where response devices were used regularly either for grading (CHEM B, PHYSICS, PSYCH) or for non-grading purposes (MFHD, BIO B). The percentage of students that responded 'agree' to the following questions regarding the helpfulness of the response devices (n = 125)**

	Used ARS for grading				
	Not at all	*Once or twice*	*Every class*		*Regularly*
Use of the response devices . . .	*MFHD*	*BIO B*	*CHEM B*	*PHYSICS*	*PSYCH*
1. helped increase the course's overall value	47.0%	42.6%	7.8%	21.1%	14.9%
2. helped make the learning experience more enjoyable	62.1%	57.4%	10.0%	22.4%	21.3%
10. helped me to stay interested during class time	62.1%	64.8%	15.7%	29.2%	31.9%
12. helped make my input an important part of the class	45.5%	37.0%	7.8%	12.9%	6.4%

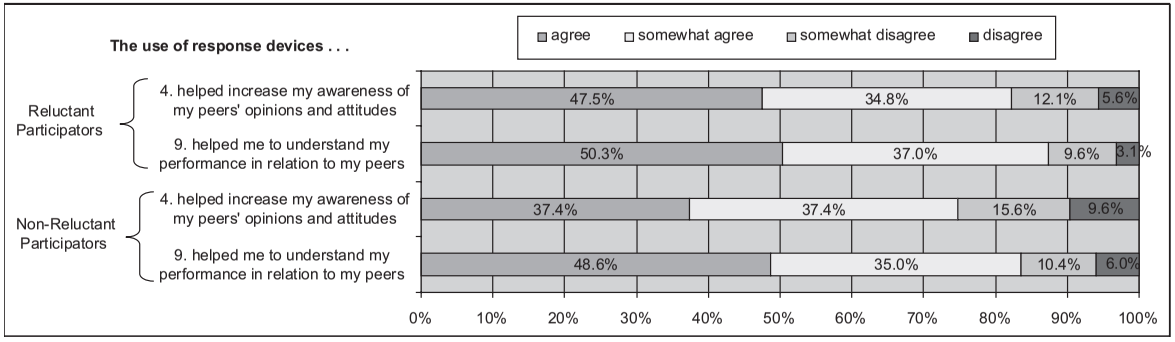

Figure 5 **Perceived helpfulness of the ARS**

Reluctant participators (n = 322) are students who want to know peers' opinions but are reluctant to share their own opinions (answered agree or somewhat agree to: 'I am interested in the opinions of my classmates' and 'I am reluctant to share my opinions in class'), and non-reluctant participators (n = 366) are all other respondents.

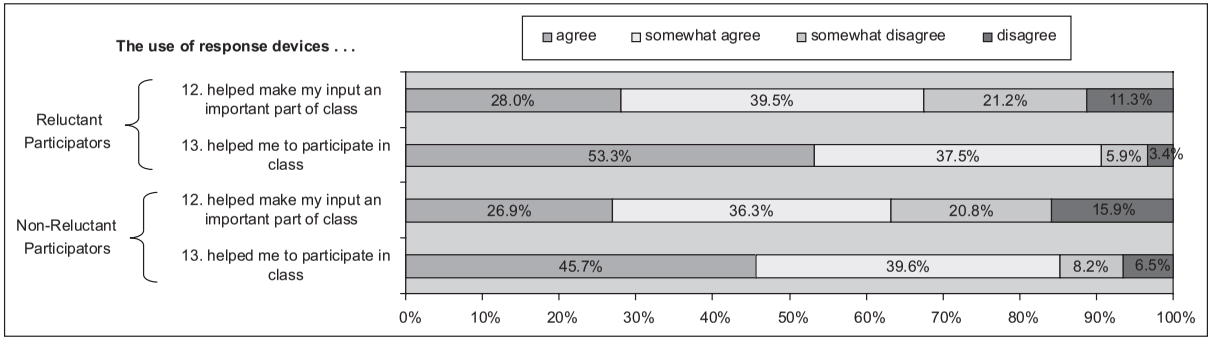

Figure 6 **Perceived helpfulness of the ARS**

Reluctant participators (n = 443) are students who are hesitant to ask a question in class when they don't understand the material (answered agree or somewhat agree to: 'I am hesitant to ask a questions when I don't understand the material') and non-reluctant participators (n = 245) are all other respondents.

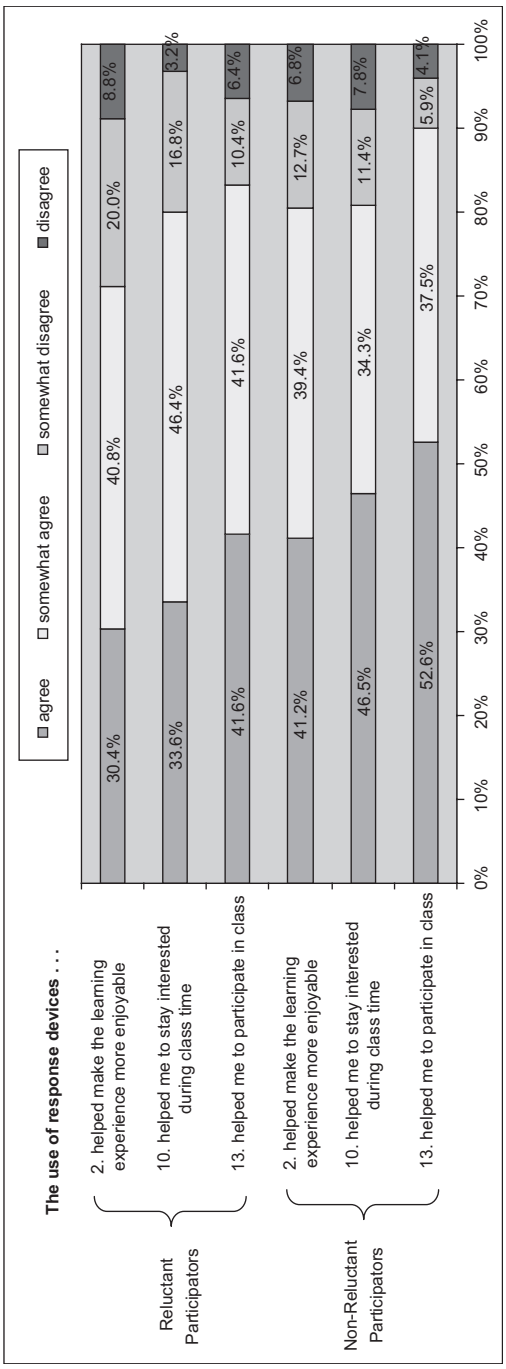

Figure 7 **Perceived helpfulness of the ARS**

Reluctant participators (n = 125) are students who do not prefer classes where they have the opportunity or are required to participate (answered disagree or somewhat disagree to: 'I prefer classes where I have the opportunity to participate' and answered agree or somewhat agree to: 'I like classes where I am not required to participate'), and non-reluctant participators (n = 561) are all other respondents.

The majority of students in each of these conditions reported that the use of the response devices was helpful. Forty-seven per cent (n = 322 out of 688) of the student responders reported wanting to know peers' opinions coupled with a reluctance to share their own opinions publicly in class. Of those, over 80 per cent felt that the response devices helped increase their awareness of peers' opinions and attitudes and allowed them to understand their own performance in relation to their peers (see Figure 5). Sixty-four per cent (n = 443 out of 688) reported that they were hesitant to ask questions in class when they feel uncertain about their understanding of the material. Of these hesitant responders, 90.8 per cent felt the response devices helped them to participate in class and 67.5 per cent felt that the ARS helped to make their input an important part of class (see Figure 6). Finally, a subgroup of students was identified (n = 125 or 18.2% of the respondents) who not only prefer classes where they are not *required* to participate but they prefer classes where students are not even given the *opportunity* to participate. For these students 83.2 per cent reported that the ARS helped them to participate in class, 71.2 per cent reported that it helped make the learning experience more enjoyable, and 80.0 per cent reported that it helped them to stay interested during class time (see Figure 7). When reluctant participator perceptions are compared with non-reluctant participators there is not a statistically significant difference at the $p = 0.01$ level (using the Mann-Whitney Test for non-parametric data) for the first two subgroups identified. Students in the third subgroup, who report that they do not prefer classes where they have the opportunity or are required to participate, were less enthusiastic than the other students regarding the helpfulness of the ARS. Eleven per cent fewer agreed that it made the learning experience more enjoyable ($p = 0.009$), five per cent fewer agreed that it helped them to stay interested during class time ($p = 0.005$), and eleven per cent fewer agreed that it helped them to participate in class ($p = 0.011$).

Q3: uses of the ARS that students perceived to have the greatest value

The data to answer the third research question were drawn from a qualitative evaluation of student responses to the open-ended question 'What did you like best and least about how the instructor used the response system in class?' Five hundred and fifty-nine students commented on what they liked best about the ARS. Their answers were categorized in Table 4 according to instructional purposes that were drawn from the literature and used in the instructor survey (see Appendix A). Two hundred and twenty-three students either left the open ended questions blank or did not mention anything about the value of the ARS.

Twenty five per cent of the students (n = 140 out of 559) who commented on what they liked best about the ARS mentioned student participation and

Table 4 **Coding of student open ended comments regarding the pedagogical uses of the ARS that they value (n = 559)**

Purpose for using ARS	*Students*	*Representative student comments*
Student participation: encourage students to participate in class	140 (25%)	'Clickers are great because certain students are scared and do not want to raise their hands' 'I liked the way we were all able to participate and put in our input towards the class'
Student self assessment: provide a way for students to get rapid formative feedback on their own knowledge and performance	139 (25%)	'It was nice to have an immediate response so I could know whether or not I was doing something right'
Mutual awareness building: increase student awareness of peers and their opinions, attitudes, etc.	114 (20%)	'It was interesting to see what other people in the class thought or what the percentages of the class voted'
Evaluate class understanding: gauge the class understanding of concepts presented	26 (5%)	'What I did like about the clickers was that our teacher could immediately see if we were understanding what he was teaching. Sometimes we did not grasp the concept, and so he went over it again. So that was nice'
Grading: simplify recording and grading of in-class quizzes	21 (4%)	'It was a lot easier to click a clicker than to have to turn in a piece of paper'
Student preparation: encourage students to come prepared to class	16 (3%)	'Every day when class started we had a quiz to see if we were reading the material and doing the homework. This helped motivate me to study and do the homework'
Group interaction: facilitate group interaction	15 (3%)	'I liked getting in groups to answer questions'
Pacing: adjust pacing to meet the needs of students	12 (2%)	'I also liked that when a fair number of the class didn't understand a concept (judging from the responses) he took time to further explain the concept'

(*Continued*)

Table 4 (*Continued*)

Purpose for using ARS	*Students*	*Representative student comments*
Initiates discussions: get students started on a discussion topic	10 (2%)	'I did, however, like the fast responses and the conversations that were generated from them'
Instructor formative assessment: get feedback on the effectiveness of my teaching	5 (1%)	'After a quiz, the instructor knows whether or not the topic was sufficiently explained'
Experiments: conduct in class experiments	1 (0.001%)	'I liked best when we used them to predict what we thought would happen in a particular experiment'
Exploration: explore the possibilities of a new technology	0	
Peer assessment: allow student to rate peers' work, presentation, performance, etc.	0	
Other: students mentioned something that did not fit one of the categories listed above	60 (11%)	'It made it more fun and exciting'
None: students provided a comment but did not mention something they liked about how the instructor used the ARS	132 (23.6%)	
Blank: students did not respond to the open ended questions	91	

self assessment. Students who mentioned participation typically enjoyed the opportunity for everyone in the class to participate, receiving points for their participation, and being able to participate anonymously. These students also reported that their interest and attention during class increased, and they had more motivation to attend the class. Students who commented about self assessment usually mentioned how the immediate feedback helped them

evaluate their knowledge or performance. For example, one student wrote, 'It was nice to have an immediate response so I could know whether or not I was doing something right'.

Another practice that students valued was mutual awareness. Twenty per cent of the students (n=114 out of 559) who commented about the value of the ARS mentioned that they liked seeing their peers' responses to the questions. A student wrote: 'It was interesting to see what other people in the class thought or what percentages of the class voted.'

Another student commented: 'The best part is that we could see the results of the surveys and what not instantly, and they were applicable to us in the class, not some foreign group of individuals. It brought the issues to life which we were discussing in class.'

Less frequent responses about the value of the ARS included evaluating class understanding, recording and grading quizzes, encouraging students to prepare for class, facilitating group interaction, adjusting the pace of the class to meet the students needs, initiating class discussion, and the ability for the instructor to receive formative feedback on the effectiveness of their teaching. Only one student mentioned the value of using the ARS for class experiments, and students did not mention peer assessment or exploration of a new technology as something they valued. Eleven per cent of the students (n = 60 out of 559) made comments about the value of the ARS which did not fit the categories. These comments were included in the Other category. The most typical comments in this category related to fun or novelty of using a new technology.

Discussion

The researchers in this study believe that the central concern of instructional technologists should be that of 'helping' learners (Inouye et al., 2005). Audience response systems are promoted on the idea that they will be *helpful* to the learners by permitting all students in a class to participate in an anonymous, non-threatening way. Past research has not looked at how helpful the ARS is from the reluctant participators perspective. The findings of this study suggest that the first two types of reluctant participators identified in the research (students reluctant to share opinions in class and hesitant ask questions in class) don't perceive the ARS to be any more or less helpful than their counterparts the non-reluctant participators. However, it is positive to note that these reluctant participators are *not* disproportionately represented in the small but significant group of students who do not view the use of the ARS as helpful.

The third group of reluctant participators identified represented those who do not prefer courses where there is student participation. This group

had significantly fewer students who viewed the ARS as being a helpful tool in the classroom. In the first two groups of reluctant participators, the ARS became an enabler for participation while the third group may have felt more coerced into a pedagogical strategy of participation that they did not like. The researchers noticed that the idea of 'mandatory participation' through grading or attendance quizzes was generally viewed as less helpful by the students (see Table 3). This trend was also seen in the open ended responses where two of the four negative themes that surfaced among students were pedagogical strategies using the ARS for grading and mandatory attendance.

Despite the significant technical difficulties experienced, the majority of students who responded to the survey felt that the use of the ARS was a valuable part of the class. The teaching methods used by instructors were a significant driver of student perceptions. Students seemed to be fairly good judges of when the technology was being used in pedagogically helpful ways versus superficial or more teacher-centered ways. In general students viewed the use of the ARS for formative feedback in a more positive light than for grading purposes (see Table 3). Interestingly, the majority of positive open ended comments had to do with pedagogical practices such as improving student participation in class, allowing students to immediately assess their own knowledge and performance, and proving a mechanism for increasing student awareness of peers' opinions and attitudes (see Table 4), while many of the negative comments related to non-pedagogical issues such as technical difficulties and the cost of the transmitters (see Table 2).

Practical implications for instructors

This section will highlight two practical implications for instructors who plan to use ARS technology in their classes: (1) empower rather than enforce; and (2) make sure the technology works.

Empower rather than enforce

The findings from this study suggest that pedagogical strategies have a greater impact on the perceived helpfulness of the ARS than do the dispositions that reluctant participators bring to the class. Students are agents who view as helpful strategies that empower them to participate in the learning but do not coerce or force them to participate. Pedagogical strategies that allow students to respond and get formative feedback on their own performance are viewed as more helpful than strategies that force participation and are used for grading purposes.

Make sure the technology works

Technical problems were the number one reason for negative feelings about use of the ARS (see Table 2). The pilot study highlighted how important

institutional support can be when a new technology is being implemented in the classroom. Increased availability of both *technical* and *pedagogical* support could have improved the experiences of both students and faculty involved in the pilot study. While the Center for Instructional Design (CID) provided some basic technical training in the use of the ARS there was not a concerted effort to ensure that technical problems faced in the classroom were quickly identified and resolved in a timely fashion. Some faculty just coped with the technical glitches all semester while others abandoned or limited their use of the ARS.

Limitations of the study

One limitation of the study was that there were some technical difficulties with the implementation of the TurningPoint system in almost every course piloting the system. Because of this problem, one course, not included in the study, discontinued the use of the ARS early in the semester. These technical difficulties undoubtedly had a moderating impact on both student and teacher perceptions of the value of the tool. A second limitation to the study findings is that the student response rates for the courses could have been greater. We were dependent on faculty and stakeholders in the Center for Instructional Design to administer the survey instruments to the students. There were a few courses where the instruments were distributed too close to the end of the semester when students had already turned their attention to final exams. Because of this, two courses with unacceptably low student response rates ($< 10\%$) were not included in the findings. Lastly, the study did not pay enough attention to differences in the specific pedagogical practices between courses. The study focused on the general fact that in every case the ARS was used to increase student participation. Differences in pedagogical practices with the ARS (such as using the ARS for grading vs. non-grading purposes as identified in Table 3) may have a larger effect on students' perception of its helpfulness than any of the psychological characteristics of the students. The link between student perceptions of helpfulness and pedagogical strategies was addressed in the qualitative analysis of the third research question (see Table 4) but not addressed directly in the quantitative analysis of the survey data. Future research could investigate a wider range of pedagogical strategies and the environments in which they are successful. A measure of the goodness of the strategies could be student and instructor perceptions of their helpfulness in the learning process.

Conclusion

This study investigated how helpful the use of an audience response system (ARS) was for students who identified themselves as reluctant participators

in traditional classroom settings. Three types of reluctant participators were identified. The overall helpfulness of the ARS was viewed as generally positive by all groups. However, students who did not prefer courses with student participation were significantly less positive about the ARS helpfulness. Four barriers to helpfulness were identified from student open-ended comments (see Table 2) and the pedagogical strategies using the ARS most valued by the students were also documented (see Table 4). In general, students perceived strategies that provided formative feedback and *empowered* them to evaluate their own performance as more helpful than strategies oriented towards grading and *compelling* participation.

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Appendix A

Faculty survey instrument

TurningPoint instructor survey

Thanks for your willingness to participate in this survey to help us better understand how TurningPoint is being used on BYU campus. A study information sheet can be found at the following URL: http://msed.byu.edu/ipt/graham/resweb/tp studyinfo.pdf. By completing the survey you consent to participate in the study.

Alternatively the survey can be accessed online at:
http://www.surveymonkey.com/s.asp?u=714581725188

1. **What course are you using the electronic response system in? _____**
2. **How many students were there in your class who used the response devices? _____**
3. **How many hours did it take you to learn the TurningPoint software and get your class set up? _____**
4. **How important were the following purposes in your decision to use the TurningPoint in-class response system:**

	Not important at all	Slightly important	Moderately important	Very important	Extremely important
Student Participation: encourage students to participate in class	☐	☐	☐	☐	☐
Student Preparation: encourage students to come prepared to class	☐	☐	☐	☐	☐
Gradings: simplify recording and grading of in-class quizzes	☐	☐	☐	☐	☐
Student Self Assessment: provide a way for students to get rapid formative feedback on their own knowledge and performance	☐	☐	☐	☐	☐
Instructor Formative Assessment: get feedback on the effectiveness of my teaching	☐	☐	☐	☐	☐
Evaluate Class Understanding: gauge the class understanding of concepts presented	☐	☐	☐	☐	☐
Pacing: adjust pacing to meet the needs of students	☐	☐	☐	☐	☐
Peer Assessment: allow students to rate peers, work, presentation, performance, etc.	☐	☐	☐	☐	☐
Mutal Awareness Building: increase student awareness of peers and their opnions, attitudes, etc.	☐	☐	☐	☐	☐
Initiate Discussions: get students started on a discussion topic	☐	☐	☐	☐	☐

(Continued)

(*Continued*)

	Not important at all	Slightly important	Moderately important	Very important	Extremely important
Group Interaction: facilitate group interaction	☐	☐	☐	☐	☐
Experiments: conduct in-class experiments	☐	☐	☐	☐	☐
Exploration: explore the possibilities of a new technology	☐	☐	☐	☐	☐

5. Were there other primary reasons for using the in-class response system? Please explain.

6. How often did you use TurningPoint in your class this semester? (Please mark one with an X)

_____ not at all
_____ once or twice
_____ sporadically
_____ regularly (but not every class)
_____ every class

7. What portion of class time do you spend using TurningPoint? (Please mark one with an X)

_____ I use it for a small portion of the class only.
_____ I use it for a significant portion of the class.
_____ I use it throughout the whole class time.
_____ I don't have a regular pattern of use.

8. Answer the following regarding your use of the in-class response system.

	Not at all	Once or twice	Regularly	Every class
How often do you use the in-class response system to track the knowledge or performance of individual students?	☐	☐	☐	☐
How often do you use data from the in-class response system to calculate student's grades?	☐	☐	☐	☐
How often do you use student performance data to provide individualized feedback or guidance to struggling students?	☐	☐	☐	☐
How often do you use the in-class response system to look at trends in whole class knowledge or performance?	☐	☐	☐	☐
How often do you make dynamic changes in your teaching based on student responses?	☐	☐	☐	☐
How often do you use the in-class response system to facilitate small group interaction?	☐	☐	☐	☐
How often do you use the TurningPoint team slides?	☐	☐	☐	☐

9. To what extent was it necessary to change the structure and organization of your course in order to implement the in-class response system? (Please mark one with an X)

_____ No changes were needed
_____ Hardly any changes were needed
_____ A fair amount of changes were needed
_____ Extensive changes were needed

10. To what extent did you change the kinds of questions you ask students during class time? (Please mark one with an X)

_____ No changes were made
_____ Hardly any changes were made
_____ A fair amount of changes were made
_____ Extensive changes were made

11. How important are the following types of question for assessing student understanding in your class?

	Not important at all	Slightly important	Moderately important	Very important	Extremely important
Recalling facts	☐	☐	☐	☐	☐
Applying concepts and principles	☐	☐	☐	☐	☐
Sharing opinions	☐	☐	☐	☐	☐

12. How effective was the TurningPoint response system in allowing you to ask the types of questions that you think are most important for assessing student understanding in your class?

	Not at all effective	Not very effective	Somewhat effective	Very effective
Recalling facts	☐	☐	☐	☐
Applying concepts and principles	☐	☐	☐	☐
Sharing opinions	☐	☐	☐	☐

13. How did using the in-class response system impact on your course compared to previous semesters without the in-class response system?

	Much worse	Worse	About the same	Improved	Much improved
Recalling facts	☐	☐	☐	☐	☐
Applying concepts and principles	☐	☐	☐	☐	☐
Sharing opinions	☐	☐	☐	☐	☐

14. Overall it was worth the effort to use the TurningPoint response system in class this semester. (Please mark one with an X)

_____Strongly Disagree
_____ Disagree
_____ Agree
_____ Strongly Agree

15. What factors would prevent you from using the in-class response system in the future? (e.g. ease of use, cost to students, overhead to get up and running, technological support, etc.)

16. What suggestions do you have for making the adoption of the in-class response systems easier for faculty?

Appendix B

Student Survey Instrument

TurningPoint student survey

Thank you for your willingness to participate in this survey to help us better understand how TurningPoint is being used on BYU campus. A study information sheet can be found at the following URL: http://msed.byu.edu/ipt/graham/resweb/tp_studyinfo.pdf. By completing the survey you consent to participate in the study.

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1. Please list the course and section in which you are participating in this survey

2. When responding to the following statements, think about your orientation towards classroom learning in general.

	agree	somewhat agree	somewhat disagree	disagree
I am hesitant to ask a question when I don't understand the material.				
I want my instructors to seek feedback from me.				
I am interested in the opinions of my classmates.				
I raise my hand in class when the instructor asks for a show of hands.				
I'm reluctant to share my opinions in class.				

(Continued)

(*Continued*)

I prefer classes where I have the opportunity to participate.				
I like classes where I am not required to participate.				
Gaining knowledge is more important to me than the grades I receive.				
I prepare more thoroughly when my participation is graded.				
Getting a good grade in a class is my first priority.				

3. When responding to the following statements, think about the specific class in which response devices were used:

	agree	somewhat agree	somewhat d isagree	disagree
helped increase the classes' overall value				
helped make the learning experience more enjoyable				
helped me to provide feedback on my instructor's teaching				
helped increase my awareness of my peers' opinions and attitudes				
helped me to get individualized feedback from the instructor				
helped the class to move at the right pace for me				
helped motivate me to be more prepared for class				
helped me to gauge my understanding of course material				
helped me to understand my performance in relation to my peers				
helped me to stay interested during class time				
helped me to focus on key knowledge in the class				
helped make my input an important part of class				
helped me to participate in class				
helped improve small group interactions				

4. What did you like best and least about how the instructor used the response system in class?

5. What suggestions do you have for improving the use of response devices in class?

6. If you would be willing to participate in a brief follow-up interview to provide feedback on your experience with the response devices, please provide us with your name and preferred contact information below.

First and Last Name_____
Telephone and/or email_____