

PERSONAL RESPONSE SYSTEM EVALUATION REPORT
Fall 2006

Executive Summary

Personal Response Systems have been used by faculty at Penn State for several years in an attempt to increase student interactions in large-enrollment classes without any formal assessment of their effectiveness. This study was the first comprehensive look at the use of these systems. Two systems were used primarily, the eIntelligent CPS (3%) and the Interwrite PRS systems (77%). Participants were six (6) faculty and 590 students from Astronomy (23%), Oceanography (36%), Engineering Mechanics (37%), and Human Development (3%) courses. Both students and faculty were surveyed about their experiences. Students participants were 61% male and 39% female, and the majority of the students were 26% freshmen, 47% sophomores , and 18% juniors.

The Student Survey

Students were surveyed about their experiences with the Personal Response Systems. Overall, the majority of the respondents agreed or strongly agreed that they received immediate feedback to their answers and they were better able to assess their understanding of the concepts because of the way the PRS was used in class. A slightly more than half of the respondents (51%) agreed or strongly agreed that they enjoyed the lectures, because of the way PRS used in class whereas 25% disagreed or strongly disagreed with this statement.

The majority of the respondents (total 76%) indicated the PRS made the course much more or somewhat more engaging. In terms of class rank, freshmen found the PRS significantly more useful than sophomores, juniors and seniors. The majority of the respondents agreed PRS was a way to enhance their learning experience. While some argued that clickers helped them to understand the concepts better, the overwhelming majority indicated that clickers helped them assess their understanding of the materials/concepts as well as their progress in the class.

When asked to indicate how they believed the clickers experience could be improved, comments focused on security, reducing the cost and integrating clickers better in terms of grading and course relevance. Students discussed having more control in using the PRS such as receiving feedback on their responses and seeing the log of responses. They also suggested that the questions might be sent to email accounts with the correct answers so that students can study more effectively. Furthermore, they discussed some problems

they experienced using clickers in class, (e.g: the clickers did not register their answers from time to time; it took time to access the class channel, the software were not working right at times, etc.). They also discussed that clickers should have ID and password protection so that people would not carry clickers for their friends who do not attend the class for attendance points.

The Faculty Survey

Faculty were surveyed about their use of clickers in class. When asked how they use the clickers, they responded:

- Multiple choice concept questions and class participation
- Review questions (preceding lecture), immediate questions after 15 minutes on topic and an opinion question
- In-class quizzes and tests
- Graded in class exercises
- Test preparation, and fun questions to break up the lecture.

Faculty seemed to have more problems with technical issues than students, but they indicated that only a few problems were never resolved.

Recommendations

General student recommendations included: (1) Better integrating of the clickers and clicker questions into the lecture period as well as the grading with points for right answers, (2) Identifying strategies for reducing the cost, (3) Identifying a need for ways to prevent students from carrying other students' units and answering for them, (4) Introducing best practices for faculty on how to use clicker questions more effectively.

Faculty recommendations were: (1) that the University should support only one system, but that (2) it should run equally well on Mac and PC platforms. They also agreed that (3) students should be able to sell back clickers.

THE STUDY

Introduction

The Personal Response System (also known as “clickers”) is one of many digital devices Penn State University has initiated using in large enrollment classrooms in recent years. The use of the PRS at Penn State is still in the evaluation stage, even after two years of implementing various systems in various courses by various faculty. This report summarizes the findings of student and faculty surveys related to the use of Personal Response System in six different undergraduate courses in the Fall 2006 semester.

Purpose

This Personal Response System evaluation, which is administered by Teaching and Learning with Technology Department, aims to measure the effectiveness of the Personal Response Systems (PRS), or clickers, on students' learning. Two separate online surveys were created to understand the experiences of students and faculty using clickers. The results of this assessment will provide data for recommending a common system for University use and support.

Methodology

Participants

Students from University Park campus who used clickers in their courses were invited to participate in the survey. Five hundred ninety (590) students (42.4% response rate) participated in the survey. Six (6) faculty members who integrated the clickers in their courses were also invited to participate in a faculty survey.

The distribution of the respondents by gender was 61% male and 39% female. Students who participated in the survey used clickers in Astronomy (Astro 010 and Astro 001), Oceanography (GeoSci 040 and GeoSci 020), Engineering Mechanics (EMech 11), and Human Development and Family Science (HDFS 315) courses. However, very small number of students from HDFS participated in the survey (3.1%); the remaining participants were from other three courses. In terms of class rank, majority of the students were 26% freshmen, 47% sophomores, and 18% juniors. The small number of remaining participants included seniors, super seniors and graduate students.

Table 1. Distribution of respondents by gender

Total	590	100.0	100.00
Gender	Frequency	Percent	Valid Percent
Female	228	38.6	38.8
Male	360	61	61.2
Total	588	99.7	100.0
Missing	2	.3	

Table 2. . Distribution of respondents by course name

Course Name	Frequency	Percent	Valid Percent
Astronomy (Astro)	137	23.2	23.3
Engineering Mechanics (EMech)	220	37.3	37.4
Oceanography (GeoSci)	213	36.1	36.2
Human Development and Family Science (HDFS)	18	3.1	3.1
Total	588	99.7	100.0
Missing	2	.3	

Table 3. . Distribution of respondents by class rank

Class Rank	Frequency	Percent	Valid Percent
Freshman	150	25.4	26.0
Sophomore	272	46.1	47.1
Junior	103	17.5	17.9
Senior	37	6.3	6.4
Graduate student	5	.8	.9
Super senior	10	1.7	1.7
Total	577	97.8	100.0
Missing	13	2.2	

Survey Administration

The student survey had 10 questions and was mainly composed of open-ended and Likert scale items. Similarly, the faculty survey had 10 questions, mostly open-ended questions. The student class lists were submitted by the faculty. The students and faculty then were sent invitations using the online PSU.Itimate

Survey system. They were sent reminders a week later. The student survey response rate was 42.4% and faculty survey response rate was 100%.

Data Analysis

The quantitative data results were analyzed with the PSU.ultimate Survey reporting function and SPSS. The qualitative portion of the survey was analyzed through coding the responses and creating themes based on these codes.

Results

Brand of Personal Response System

Participants were asked what brand of Personal Response System they used in their class. Approximately 77 % of the respondents reported they used Interwrite PRS, while 19% did not know which brand they used. The remaining respondents reported they used eInstruction CPS (3.2%) and TurningPoint, (0.2%).

Table 4. Brand of Personal Response System

Brand Name	Frequency	Percent	Valid Percent
Interwrite PRS	456	77.3	77.4
eInstruction CPS	18	3.1	3.1
TurningPoint	1	.2	0.2
Don't know	114	19.3	19.4
Total	589	99.8	100.0
Missing	1	.2	

The Benefits of Personal Response System

Participants were asked their satisfaction level on some outcomes of using personal response system in their class. Overall, the majority of the respondents agreed or strongly agreed that they received immediate feedback to their answers and they were able to assess their understanding of the concepts better, because of the way the PRS was used in class.

Slightly more than half of the respondents (51%) agreed or strongly agreed that they enjoyed the lectures because of the way PRS used in class whereas 25% disagreed or strongly disagreed with this statement.

Table 5. Benefits of the personal response system

	Strongly agree	Somewhat agree	No opinion	Somewhat disagree	Strongly disagree	Not Applicable
Because of the way this course uses the student response system, I can see the results of my answers immediately.	69.8 %	21.8%	3.6%	2.7%	1.5%	0.5%
Because of the way this course uses the student response system, I can check how well I understand the concepts.	32.7%	43.7%	8.0%	9.8%	4.7%	0.5%
Because of the way this course uses the student response system, I enjoy the lectures for this course.	17.4%	33.6%	25.1%	13.1%	9.8%	0.9%

Female students had a significantly higher level of agreement on statement two and statement three than males ($F(1,583) = 32.327, p < .001$, $F(1,582) = 5.126, p < .01$, respectively).

In terms of class rank, freshman had a significantly higher level of agreement on statement two and statement three than sophomores and seniors, and similarly juniors had higher level of agreement than sophomores ($F(3, 555) = 20.158, p < .001$ (statement 2), $F(3,554) = 14.481, p < .001$ (statement 3)).

Students who registered for Engineering Mechanics had a significantly lower level of agreement on statement two and statement three than those who registered for Astronomy and Oceanography ($F(2,564) = 37.261, p < .001$ (statement 2), $F(2,563) = 17.151, p < .001$ (statement 3)).

The Engagement Level of Course as a Result of Using Personal Response System

Participants were asked to rate whether or not the clickers made the course more or less engaging. The majority of the respondents (total 76%) indicated the clickers made the course much more engaging (25.9%) and somewhat more engaging (50.7%). Approximately 21% of the respondents found that the clickers did not make the course more or less engaging. Only very small number of respondents (total 2.7%) indicated the clickers made the course somewhat less engaging or much less engaging.

Table 6. The engagement level of course based on gender, course name, and class rank

Gender					
Engagement	\bar{x}	n	F	df	Sig
Male	4.14 (.660)	228	13.964	(1,586)	.000***
Female	3.88 (.875)	360			
Course Name					
Engagement	\bar{x}	n	F	df	Sig
Astro	3.99 (.853)	137	17.130	(2,567)	.000***
EMech	3.76 (.832)	220			
GeoSci	4.21 (.690)	213			
Class Rank					
Engagement	\bar{x}	n	F	df	Sig
Freshman	4.20 (0.811)	150	5.873	(3,558)	.001***
Sophomore	3.90 (.742)	272			
Junior	4.01 (.810)	103			
Senior	3.76 (.983)	37			

The results indicate that, on average, male students found the course significantly more engaging than female students [F (1, 588) = 13.964, p < .001].

Students in the Oceanography found the course significantly more engaging than those in Astronomy and Engineering Mechanics courses. Moreover, students in Astronomy course found the course significantly more engaging than those who are in Engineering Mechanics (the HDFS group was eliminated from the analysis due to the very small number of respondents).

In terms of class rank, freshmen found the course significantly more engaging than sophomores and juniors [$F(3, 562) = 5.873, p < .001$]. (Graduate students and super seniors were eliminated from the analysis because of very small number of participants)

The Results of Using Clicker Questions

Participants were asked for their agreement on some statements related to the use of clicker questions in class. The frequency of each statement agreed by students is below:

Table 7. Use of Clicker Questions

	Frequency	Percent
Questions helped me assess my own understanding	347	73.4
Questions started discussions.	182	38.5
Questions helped me be more prepared for tests.	173	36.6
Questions were busy work	74	15.6
Questions helped me apply concepts.	273	57.7
Questions were a way to get points in class.	384	81.2
Other comments	18	3.8

The Usefulness of Personal Response System as Learning Tool

Participants were asked to rate the usefulness of PRS as a learning tool. The majority of the respondents (81.4%) found PRS extremely (16.4%), very (30.8) or somewhat useful (34.2%). Total of 18.5% of the respondents did not find it very useful or not useful at all.

Table 8. The usefulness of PRS system by gender, course name, and class rank

Gender					
Usefulness	\bar{x}	n	F	df	Sig
Male	3.65 (1.069)	228	23.326	(1,586)	.000***
Female	3.21 (1.101)	360			
Course Name					
Usefulness	\bar{x}	n	F	df	Sig
Astro	3.42 (1.062)	137	44.471	(2,567)	.000***
EMech	2.93 (1.018)	220			
GeoSci	3.86 (1.018)	213			
Class Rank					
Usefulness	\bar{x}	n	F	df	Sig
Freshman	3.94 (0.884)	150	23.414	(3,558)	.000***
Sophomore	3.08 (1.040)	272			
Junior	3.48 (1.083)	103			
Senior	3.08 (1.362)	37			

The results indicate that, on average, male students found PRS significantly more useful than female students [F (1, 588) = 23.226, p < .001].

Students in Astronomy and Oceanography courses found PRS significantly more useful than those students in Engineering Mechanics. At the same time, Astronomy students found PRS more useful than those in Oceanography [F (2,570) = 44.471, p < .001].

In terms of class rank, freshmen found PRS significantly more useful than sophomores, juniors and seniors. Moreover, juniors found the PRS significantly more useful than sophomores. [F (3,562) = 23.414, p < .001].

Students Comments on the Ways the Clickers were Helpful as Learning Source

Participants further were asked in what ways the clickers were helpful as a learning tool. This question was in open-ended format and provided opportunity for participants to explain their experiences using clickers. While some students simply stated that the clickers helped or did not help learning at all, most students elaborated the reasons behind why they were or were not very helpful. There were many positive comments as well as negatives ones.

Learning

Replies from open ended questions indicate that majority of the respondents agreed PRS was a way to enhance learning experience. While some argue that clickers helped them to understand the concepts better, overwhelming majority indicated that clickers helped them assess understanding of the materials/concepts as well as their progress in the class.

Motivation/ Active Participation

Many participants discussed that PRS provided opportunities for active participation in large classrooms so that they were able to be involved in lectures more often and stay focused. Participants also pointed to increased motivation. They argued that PRS worked as an incentive to increase attendance and even motivated to attend the class.

Early Identification of Problems

Participants were happy that professors were able to identify the problems associated with the subject matter more promptly because of the way PRS used. Hence, they had an opportunity to clarify the common mistakes beforehand.

Grading

Grading the clickers' questions and using PRS for attendance points were very controversial issues. Some students were happy for receiving extra credit by answering clicker questions and earning attendance points. They found it very convenient for class participation. On the other hand, some other respondents believed that PRS was unfair way of grading students. They were not as happy using clickers for assessment purposes. There were several problems students discussed in their comments: Some brought the issue of forgetting clickers, which caused students to lose the attendance points even if they attend the class. They also felt that if the content had not yet been discussed in the class, they would not get the right answer and thus would not earn extra credit. Some

believed that most students did not know the right answers but mostly get it correct by simply asking the right answers from their friends. They further indicated that PRS *only* assisted to the faculty for grading and getting attendance points. Some felt that it was more of coercion than convenience [for those who come only for credit]. Time limitation (having short time to answer questions) and technological problems were other issues discussed by the participants.

Feedback/Interaction

Participants found PRS very useful because of its convenient feedback mechanism. PRS helped them compare their answers /knowledge with the rest of the class and provided immediate feedback. Some also indicated that PRS enhanced the learning experience by creating interaction with their peers.

Exam Practice

Some faculty used clickers for practice purposes for upcoming exams. Hence, students indicated that they found the opportunity to review similar questions and identify the areas they need to improve. To the contrary, some students felt that using similar/same questions in the exam forced them to memorize the questions and did not much contribute to overall learning.

Expense of PRS (High Cost vs. Low Benefit)

On the negative side, the major complaint of the participants was the high cost of the clickers. They felt that the benefits of using clickers do not actually outweigh the cost of the clickers device and those benefits could have been gained in other ways. Students argued that they could get the same effects by simply raising their hands and answering questions. They mentioned that the rare use of clickers did not justify the high cost. They further argued that the PRS was an expensive tool to use *only* for tracking participation and attendance.

Instructor-Related Comments

Some comments were directly related to the instructor use of the PRS. Participants felt that some instructors did not elaborate enough on the answers, indicated only wrong or right, and left students confused. Some professors used clickers as a way to grade students based on correct and incorrect answers and students got discouraged if they answered incorrectly. They also discussed that if most students had the right answer, professors just moved to another topic without having much discussion most of the time. Students who did not answer correctly were still disadvantaged and discouraged.

Student Comments on How to Improve the use of PRS

Participants asked about ways to improve the use of the PRS to help them learn better the course content. Most students were very satisfied with their use as it is.

Expense of Clickers

Participants suggested that the price of clickers should be reduced or distributed free to students. Some students made comments to balance the cost of the clickers. They suggested that:

- Frequency of using clickers in class should be increased.
- More questions should be integrated into each class session.
- Clickers should be used in more or all courses.

Grading

Participants suggested that clickers should not be used for attendance due to the fact that students who forget their devices get disadvantaged. Rather, only clickers' questions should be graded for extra credit points.

Technical Issues

Participants pointed to several technical/operational issues that needed to be resolved in order to increase the benefits of using PRS in their courses. They discussed that:

- they should have more control using PRS such as receiving feedback on their responses and seeing the log of responses.
- questions might be sent to email accounts with the correct answers so that students can study more effectively.
- some problems they experienced using clickers in class, e.g: the clickers did not register their answers time to time; it took time to access the class channel, the software were not working right at times.
- clickers should have ID and password protection so that people cannot carry clickers for attendance points for their friends who do not attend the class.

Training

Some students indicated that faculty needs to be trained on different uses of clickers and they should have a good understanding of the ways clickers could be used. A best practices web page may be in order here.

Alternative Uses of Clickers

Participants also suggested some alternative ways of using clickers. They indicated that the answers of take home assignments could be submitted using clickers. The clickers would be used in recitation sessions. They also suggested using clickers to take in class quizzes in order to save paper.

Suggestions for Instructors

Participants suggested some improvements on the ways instructors should use clickers. They discussed that professors/instructors should:

- provide more time to answer questions.
- spend more time to discuss right and wrong answers.
- use clickers to emphasize important concepts/ideas.
- plan lectures around clickers more.
- make clickers questions more difficult/comprehensive.
- make clickers questions simpler.
- ask more clicker questions.
- create a variety of types of questions.

The Faculty Survey

Faculty were asked what kind of training they gave their students to teach using PRS. All instructors only gave very basic, 5 to 10 minutes training at the beginning of their first class session and showed their students how to enter their user IDs into the clickers.

Faculty then asked how they described the purpose of using clickers in their classrooms. The summary of their responses were as follows:

- Assess students' understanding of course material.
- Poll students on various topics before they introduced them.
- Offer them immediate feedback on how their attitudes compared with the rest of the class.
- Offer instructor feedback on whether or not students understanding the concepts discussed.
- Offer students opportunities for extra credit.
- Determine class attendance and participation.
- Review questions for exams.
- Encourage students to attend class.

Instructors were asked how they used PRS in their classes. The summary of their responses were as follows:

- Multiple choice concept questions and class participation
- Review questions (preceding lecture), immediate questions after 15 minutes on topic and an opinion question
- In-class quizzes and tests
- Graded in class exercises
- Test preparation, and fun questions to break up the lecture.

Faculty was asked whether or not PRS was able to interact with ANGEL and the level of difficulty of working with it. Four of six instructors found it very easy to interact with ANGEL. They created an excel file with students' recorded responses and then uploaded it to the ANGEL. One instructor mentioned that s/he did not use ANGEL for this purpose. Only one instructor found it not very easy to use.

Faculty were asked if they had any problems with PRS. 83% of them indicated (5 out of 6) that they had problems with PRS. Only one instructor reported that s/he did not have any problems.

Faculty were asked to describe the problems they experienced and how they resolved them. Some of the problems they encountered during the classes are summarized as follows:

- Software collected responses but did not export them into grade book.
- One instructor could not leave and re-enter PPT presentation because of back-to-back lecture sessions and lost the second lecture results. The instructor shut down the computer and logged in again.
- Another instructor had a hardware problem in 121 Sparks and was unable to use student response system. S/he contacted Dave Test to fix it.
- Students turned on their remote and instead of seeing their PAD ID, they saw some other random number. The instructor contacted with tech person but their instructions were complicated and the issue never resolved. Second time, they forgot to reinstall the e-instruction software. So they were contacted again and they reinstalled the CPS software.

Faculty were asked whether or not they have additional comments on improving the system, and their suggestions were as follows:

- Students should be able to sell their clickers.
- Only one system should be used across the university and should be used in multiple classes so that students in downstream would already be familiar how to use them.
- When instructors upload the study guide it shouldn't be available all students. When results are available all students, including those who never took the assessment, this rewards students who did not come to class and answer the question.

- Instructors should have an option to choose Mac or windows and should be able to use clicker software on their preferred system.

Conclusion and Recommendations

The student and faculty PRS survey was conducted in six different undergraduate courses offered by University Park campus. The students in these courses used PRS during fall 2006 semester. Students and instructors were sent the surveys at the end of the semester. Most of these courses had large number of students. These courses were Engineering Mechanics, Oceanography, Astronomy and Human Development and Family Science. The majority of the participants were male, and freshman, sophomore or juniors. Most of the participants used Interwrite PRS brand.

Instructors employed different approaches when integrating clickers in their courses. In general, they mainly used clickers for grading and participation purposes. Other uses included providing immediate feedback to students, assessing students' understanding of the material, and motivating students to attend classes. Most common forms of using clickers were review questions, in-class quizzes and in-class exercises.

The survey results indicate that, in general, students were satisfied with the use of clickers in their classes. They reported that the clickers made the course more engaging and they found it very useful. When students asked for their specific comments on different uses of clickers, they indicated that clickers increased motivation, helped professor identify the problems, provided immediate feedback, helped them assess their understanding of concepts and earn extra credit and attendance points. The main disadvantage of using clickers reported by participants was related to expense of the device. The technical issues described by students were minimal.

Based on student and faculty survey results, we suggest that:

1. The price of clickers should be reduced or should be balanced offering more courses that uses clickers.
2. Instructors should be trained on different uses of clickers.
3. The clickers should keep the log of students' responses.
4. The clickers should have ID and password protection.
5. Grading seemed to be very sensitive issue among students and should be discussed between students and instructors at the beginning of the semester.

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