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SMALL GROUP TEST OF THE PERSONAL RESPONSE SYSTEM (PRS) IN A BEHAVIORAL SCIENCE GRADUATE RESEARCH METHODS COURSE

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Abstract

Personal response system (PRS) is an infrared frequency "clicker" system which promotes active, engaged learning in the classroom while collecting individual student responses to questions and statements electronically. The <u>purpose of this study</u> was to describe the use of the Personal Response System in a behavioral sciences graduate research methods course. The study explored how the use of PRS as game-based learning increases students' engagement. Qualitative and quantitative data are collected. The following elements are analyzed: engagement in research topics, participation, perceptions, opinions, and grades of 29 participants. The results are reported and discussed in the context of student engagement.

SMALL GROUP TEST OF THE PERSONAL RESPONSE SYSTEM (PRS) IN A BEHAVIORAL SCIENCE GRADUATE RESEARCH METHODS COURSE

Introduction

Personal response system (PRS) is an infrared frequency "clicker" system which promotes active, engaged learning in the classroom while collecting individual student responses to questions and statements electronically. Clickers have been used effectively in physics, chemistry, medical education, and mathematics classes to convey information to large groups of students (Burnstein & Lederman, 2001; Copeland, Hewson, Stoller, & Longworth, 1998; Hake, 1998; Wit, 2003). Application in courses in other disciplines is valuable for further study as "…active participation has become the dominant postulate of student learning" (Uhari, Renko, & Soini, 2003, para 1). In addition, the individual feedback afforded learners facilitates the systematic achievement of objectives for cognitive learning.

Central to graduate workforce education curriculum is coursework in behavioral science research methods. Research competencies include the acquisition of facts (i.e., basic elements), concepts (i.e., interrelationships among basic elements), and procedures (i.e., how-to steps) (Anderson & Krathwohl, 2001). Basic elements and concepts of research methods are foundational to the steps in designing and implementing research studies and the writing of proposals and reports. The <u>purpose of this study</u> was to describe the use of the Personal Response System (PRS) in a behavioral sciences graduate research methods course.

Review of Related Literature

PRS (Personal Response System) is an audience response system for electronically testing, polling, and surveying a group of people (*The InterWrite PRS User's Guide*, 2004). PRS system consists of receivers, transmitters (clickers), and the PRS software. A clicker or transmitter is a personal response keypad used for participating in an interactive class. Using the PRS system, the instructor asks questions to the students. The students respond to the questions projected on screen by using their

PRS clickers. They press a specific button on the clicker which sends an infrared signal to the receiver connected to a computer. Responses are projected on screen for immediate feedback and discussion. PRS is a way to promote active learning in the classroom through immediate feedback and a way to collect results electronically. The students are interactively engaged to answer questions or express their opinion about statements. The use of PRS system in a classroom actively engages students in the course and, thus, helps to assess student understanding, to increase student participation, and to increase student attendance (Fridgen, 2004). In fact, because of active engagement, students understand and participate more, and students are more eager to attend class. PRS system has been used essentially in Psychology, Computing Science, Philosophy, Biology and Mathematics (Wit, 2003).

According to Leidner and Jarvenpaa (1995), the use of technology enhances the effective application of learning models. Interactive engagement delivery methods can increase the effectiveness of a course compared to a traditional course. Hake's study (1998) surveying more than six-thousand students demonstrated that interactive engagement (IE) methods can allow more course-effectiveness than traditional course. Hake (1998) defined interactive engagement (IE) methods as methods:

> …designated at least in part to promote conceptual understanding through interactive engagement of students in heads-on (always) and hands-on (usually) activities which yield immediate feedback through discussion with peers and/or instructors. (p. 65)

Traditional lectures have different limitations; one of the most important is how to keep the students' attention. We know that students' attention diminishes rapidly during the first part of a session and that is the most challenging part for any instructor to try not to lose the students' attention. Duncan (2005) stated that active involvement of students increases consequently learning compared to traditional lectures. Furthermore, interactive sessions could increase interest and enjoyment toward a specific topic. Duncan (2005) specified also that students' attitudes toward the different topics taught should be evaluated and took into consideration. Indeed, the use of PRS provides several opportunities to collect data on different levels. According to Burnstein and Lederman (2001), the use of a personal system response offers the possibility to gather information related to attendance, grades, and effectiveness of the session. Besides, the flexibility of the system provides for the instructor a chance to present different varieties of questions for each topic studied.

Another fundamental aspect of a personal response system is the principle of anonymity. The interactivity of students using clickers to answer a question projected on screen in complete anonymity reinforces the concept of the whole class participation/involvement. Anonymity motivates students to participate and express their knowledge without any fear of mistake (Wit, 2003). Furthermore, an instructor using PRS system helps students to be more active participants in their own learning progress. Through immediate feedback and the possibility to access the answers of the rest of the class, students can evaluate themselves and progress based on their self-evaluation.

Another benefit of the use of a personal response system is the possibility to stimulate discussion with peers and instructor. Discussion based on immediate feedback allows students to reason about a specific topic (Beatty, 2004). Consequently, the use of a personal response system is viewed as a tool facilitating learning progress and improving participation and student engagement.

Theoretical Framework and Research Questions

Student Engagement

The use of an audience response system or any technology opens questions related to students' engagement. Kearsley and Shneiderman (1999) described engagement theory as the following:

> Engagement theory is different from many older models of computer-based learning in which the emphasis was on individualized instruction and interactivity. Engagement theory does promote interaction but human interaction in the context of group activities, not individual interaction with an instructional program. (para 10)

Further, they stated that "…the difference between engagement and interactivity reflects the shift in thinking about computers in education as communication tool rather than some form of media delivery device" (para 10).

PRS can be viewed as a tool facilitating all aspects of engagement in the classroom and stimulating interaction between students and instructor. Indeed, Guthrie and Carlin (2004), in their research argued that the "PRS system … allows large group of students to individually engage instructional content real time in the classroom and get instant feedback about their individual responses as well as seeing how the class responded as a whole" (p. 1). The use of PRS seems to more easily stimulate the student's engagement through participation, instant feedback, and discussion.

Judson and Sawada (2002) demonstrated a correlation between interactive engagement and student's conceptual gain in physics. In addition, they found that the use of PRS can favor interactive engagement especially for large audiences. Furthermore, the use of PRS engages the students "by stimulating the recall of existing knowledge or attitudes" (Copeland, Hewson, Stoller, & Longworth, 1998, p. 233).

Hall, Thomas, Collier, and Hilgers (2005) showed that the use of a student response system also helps students to increase their level of engagement, their motivation, and learning. Another aspect of the use of PRS is the opportunity for students to "vote", to answer question anonymously and to have the opportunity of immediate feedback and discussions. According to Uhari, Renko, and Soini (2003), this practice of voting could increase participation in the classroom and interactivity between students and between students and instructor.

Consequently, the use of PRS facilitates participation, interaction between students and instructor; it allows also students to be more engaged in their learning process. However, it is important to take into consideration that the PRS system does not provide an interactive setting by itself. Indeed, the instructor should provide an interactive classroom environment based on his/her assumptions related to learning models and using PRS system as a tool facilitator of student's engagement (Judson & Sawada, 2002).

Research Questions

1. What are users' perceptions of a Personal Response System (PRS) in a graduate research course for the behavioral sciences?
2. To what extent did the Personal Response System (PRS) clicker enhance users' engagement in research topics?
3. To what extend did users' opinions regarding enjoyment and ease of using the Personal Response System (PRS) affect their engagement in a graduate research course for the behavioral sciences?

Method

Participants

Participants were a non-probability sample of graduate students (n = 29) enrolled in a graduate research course for the behavioral sciences. This included students enrolled in two sections in two consecutive semesters. All 29 students volunteered to use the Personal Response System (PRS) clicker technology as a means to complete classroom learning activities.

Data Collection Instrument

Data was collected using two types of instruments. First, research topic sessions during the course included sets of questions (8 – 15 per session) with three to six answer choices. A large majority (89.9 %) of the questions had a correct answer. For example, during the session on historical research students were asked to select from three possibilities the answer that completed the following statement related to their understanding of secondary sources of data: "Accounts of an event not witnessed by the writer are _____." The choice "I don't know" was included to reduce guessing and identify areas needing additional study and/or instruction (Wit, 2003). A portion of the questions (10.1 %) were designed to facilitate classroom discussion. For example, during the session introducing behavioral research students were asked to indicate their agreement or disagreement with the statement: "Applied research is more important than pure research in contributing to human welfare."

Second, participants' perceptions and opinions of the use of the Personal Response System (PRS) were collected using an adaptation of the instrument from (Guthrie& Carlin, 2004). Questions were both selection type (n=12) and open-ended response type (n=3). Examples of selection type questions included "Did you enjoy the

PRS activity?" "Do you feel that PRS activity increased interactivity between students?" and "Do you feel that PRS activity increased your participation and attention in class?" An example of an open-ended response was "What did you like the most/least with PRS system?"

Procedure for Data Collection and Analysis

During the course delivery, questions for each research topic were used to teach material and as a review activity. Questions were individually displayed using specialized software. Students used their individual infrared frequency PRS clicker to respond to the question projected on the screen. Then, students' responses were reported in aggregate, using a bar chart. Results allowed for clarification and further discussion. At the end of the course, data regarding participants' perceptions of the use of the Personal Response System (PRS) was collected using a paper-pencil instrument. Data was analyzed using descriptive statistics and Analysis of Variance (ANOVA).

Results and Discussion

Demographics[1]

Participants (n=29; male: 44.8%; female: 48.3%) ranged in age from early 20s to early 50s (26 to 35 years: 41.4%; 36 to 45 years: 24.1%). Ethnicity was reported as White (48.3%), African American (24.1%), Hispanic (3.4%), and Asian Pacific-Islander (3.4%). More than half of the participants were married (55.2%) and 34.5% reported being single. Socioeconomic status was reported in ranges. The highest number of students reported earning less than $20,000 (24.1%). The second highest number reported earning more than $70,000 (20.7%).

Perceptions of a Personal Response System (PRS)

PRS was used in eight of 16 class sessions (50%) over two semesters. Table 1 summarizes students' responses to questions with a correct answer for each behavioral research topic. During Semester One, students correctly responded to half or more of the question for which there was a correct response for five of eight sessions. Students in Semester Two correctly answered more than half of the questions during six of eight sessions.

Average session scores for correct responses varied from 24.4% to 71.1%. Scores from neither Semester One nor Semester Two participants varied in any predictable pattern, especially improving or increasing over time. Rather, scores seemed to depend on participants' understanding and complexity of the research topics. This is consistent with of the research of Beatty (2004) which suggested that students' use of PRS

Table 1
Average PRS Score by Research Topic

Topical Session	Semester One	Semester Two
	Percent Correct	Percent Correct
Fundamentals of Education Research	N/A[2]	71.1%
Preparing a Research Proposal/Report	24.4%	51.6%
Historical Research	54.7%	63.3%
Descriptive Research	33.3%	43.0%
Experimental and Quasi-Experimental Research	48.1%	37.8%
Single Subject Experimental Research	51.9%	57.8%
Qualitative Research	64.7%	N/A[3]
Methods and Tools of Research	64.7%	61.3%
Analyzing and Synthesizing the Literature	63.7%	57.1%

	Average Attendance	
	96.0%	98.8%

	Average Final Course Grade on a 4.0 Scale	
	3.93	3.73

Note. PRS scores include only those questions with a correct answer. Discussion and/or opinion questions are not included. N/A = data missing.

_____

[2] PRS use had not been approved by Human Subjects Committee at the time of the topic, "Fundamentals of Education Research."

[3] PRS was not used for the topic, "Qualitative Analysis" due to software-related technical difficulties.

stimulates discussion, reasoning powers, and self-evaluation of their learning progress. Attendance for both semesters was excellent. One student missed each of three sessions in Semester One, and one student missed one session in Semester Two. Further, the feedback provided through self -- evaluation seemed to identify knowledge gaps that students filled as their final grades were excellent (see Table 1).

At the end of the course, three-fourths (75.9%) of the users reported enjoying use of the PRS clickers. No students reported difficulty with use (86.2% - easy to use; 13.8% - moderately easy to use). Enjoyment of PRS is a measure of attitudes toward both the technology and its specific use with course material and content. Duncan (2005) directly

related positive attitude (i.e., enjoyment) to increased learning and thus, recommended that affective behavior toward PRS be evaluated and taken into consideration in planning classroom activities. In addition, the anonymity of responses where participants could express their knowledge without any fear of mistake (Wit, 2003) may have been another factor that contributed to enjoyment.

PRS use was associated with increased student engagement in the graduate behavioral research methods course. This research extends the findings of Wit (2003) who reported success with PRS in Psychology, Computing Science, Philosophy, Biology and Mathematics courses. Comprehension and learning of course material was almost always enhanced for 62.1% of the students; 24.1% reported that it increased to a considerable degree. Students reported that PRS use enhanced classroom discussion (65.5% - almost enhanced classroom discussion; 31.0% - to a considerable degree) and increased their participation and attention in class (86.2%). Users reported increased interactivity between instructor and students (69.0% - often; 31.0% sometimes) and between students (58.6% often; 37.9% sometimes). These findings support the notion (Fridgen, 2004; Uhari, Renko, & Soini, 2003) that this technology could increase participation in the classroom and interactivity between students and between students and instructor. Also, they could also be attributed to the immediate feedback that PRS provides (Beatty, 2004).

Participants commented about features they liked most about the system. Eleven of 29 students said that feedback was a benefit of PRS. This technology "…let me know if I had an understanding of material early." Another response was "I like the privacy of PRS if you got the answer wrong no one knew it but it also gave a chance to see why my answer was wrong via class discussion and participation." 89.7% reported that the PRS activities were more useful for learning than a paper-based set of review questions. When asked if they favored a course using the PRS system over a course not using the PRS system 82.8% of the students responded "yes". Almost all users (96.6%) reported that they would recommend a course using PRS to other students.

Users were also asked for suggestions to improve classroom use of PRS. Three students asked for "…more time to answer each question." One user commented that there should be fewer, more frequent sessions with PRS. Others preferred questions with a correct answer over opinions questions. For example, one student said "I know it opens conversation, but opinion questions are not good for PRS because it gives a specific answer and if the answer doesn't agree with the response I gave it makes me feel I did not understand the subject." Eleven users concluded that no improvements were needed with use of the PRS system in this behavioral science research methods course. All of these suggestions are part of the flexibility that the PRS system provides for the instructor and students, specifically timing of questions, types of information, and student evaluation protocol (*The InterWrite PRS User's Guide*, 2004).

Enhancing Student Engagement

PRS use was associated with increased student engagement in the course topics. Comprehension and learning of course material was almost always enhanced for 62.1% of the students; 24.1% reported that it increased to a considerable degree. Students reported that PRS use enhanced classroom discussion (65.5% - almost enhanced classroom discussion; 31.0% - to a considerable degree) and increased their participation and attention in class (86.2%). Users reported increased interactivity with the instructor (69.0% - often; 31.0% sometimes) and between students (58.6% often; 37.9% sometimes).

Participants' reports of engaged learning are related to the Kearsley and Shneiderman (1999) notion that engagement is "…human interaction in the context of group activities" (para 10) and that technology is a communication tool. Engagement in course content is indicated through enhanced discussion and increased participation and attention (Guthrie & Carlin, 2004). It also is effective for small groups in addition to large audiences (Judson & Sawada, 2002).

Enjoyment, Ease of Use, and Student Engagement

Analysis of Variance (ANOVA) was conducted using users' enjoyment of PRS and ease of use as independent variables and classroom outcomes related to student engagement -- comprehension, class discussion, interactivity between students and the instructor, interactivity among students, and participation and attention as independent variables. Results revealed that users' enjoyment of PRS and ease of use affected classroom outcomes. Enjoyment was significantly related to increased comprehension of research topics (m=1.28; p<.001) and students' participation and attention in class (m=1.14; p<.05). Ease of use was significantly related to increased interactivity between students and the instructor (m=1.31; p<.05) Other classroom outcomes were not significantly related to either users' enjoyment of PRS or ease of use.

Ease of use is one of PRS advantages related to classroom's involvement and participation (Siau, Sheng, & Fui-Hoon Nah, 2006). PRS disadvantages related to the ease of use seemed to be essentially technical issues. Indeed, the effectiveness of PRS can be affected by technical problems connected to the set-up of the system (Hall, Thomas, Collier, & Hilgers, 2005; Wit, 2003). Siau, Sheng and Fui-Hoon Nah (2006) also demonstrated in their research that the clickers or remote controls can be a source of problem if they do not work properly.

User' enjoyment can be expressed through different perspectives. For instance, preference for PRS courses over courses not using PRS system (Guthrie & Carlin, 2004), positive attitude toward PRS or SRS (Judson & Sawada, 2002), and students' appreciation of response system qualifies as "fun system to use" (Siau, Sheng & Fui-Hoon Nah, 2006).

Conclusions and Recommendations

The purpose of this study was to describe the use of the Personal Response System (PRS) in a behavioral sciences graduate research methods course. Use of the PRS in a small group of students enrolled was an effective method to engage students in acquiring the knowledge and skills needed to conduct research. Conclusions are based on the three research questions.

What are users' perceptions of a Personal Response System (PRS) in a graduate research course for the behavioral sciences? Students' attitudes and perceptions toward PRS were very positive. Indeed, students highlighted through their opinions that they enjoyed PRS activities. They will recommend and support the use of PRS system versus the traditional classroom setting. Besides, the easy use of PRS system was also specified by the students. The students expressed also that PRS activities helped them to enhance their learning process in the research course.

To what extent did the Personal Response System (PRS) clicker enhance users' engagement in research topics? The use of PRS activities promoted students' involvement that was expressed through enhanced participation, attention and discussion. The advantage of anonymity and immediate feedback of PRS system helped the students to be more engaged. The flexibility of PRS activities allowed also interactivity between students and between the instructor and students.

To what extend did users' opinions regarding enjoyment and ease of using the Personal Response System (PRS) affect their engagement in a graduate research course for the behavioral sciences? Students enjoyed the technology; it was easy to use and did not get in the way of discussion, comprehension, and learning. These outcomes were self reported and also reflected in the excellent final course grades for the small group of participants in this study. Reports of increased interactivity between students and instructor may be the result of students' definition of interactivity.

Further research could explore other uses of the Personal Response System (PRS). Other non-science subject areas could incorporate this technology in small or large classrooms. For example, use in the foreign languages could provide immediate feedback for grammar and pronunciation activities and enhance conversation and discussion in that language. In addition, an investigation of potential student-to-student interactions may identify new and additional ways to use the technology. Finally, an investigation of the nature of the enjoyment of this innovative technology may contribute to our understanding of the relationship between PRS technology and student engagement in topics in behavioral science research methods coursework, a central component to graduate workforce education curriculum.

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[1] Percents not equal 100 are due to missing data.

[2] PRS use had not been approved by Human Subjects Committee at the time of the topic, "Fundamentals of Educational Research."

[3] PRS was not used for the topic, "Qualitative Analysis" due to software-related technical difficulties.