The Impact of Personal Response Systems on Student Learning in Undergraduate Business Courses

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Abstract

This study investigated the growing body of research of how a personal response system (PRS) may make a positive impact on student learning outcomes. Results of the study provide insight into participants' use of PRSs within the classroom instruction. Although there are numerous stated benefits for both students and instructors, this study focused on student benefits. Consequently, an experiment was conducted with undergraduate business students using PRSs in varying business courses at Duquesne University. Comparisons were made between traditional and modified stand-up lectures that not only focused on, but also encouraged active student learning via the use of PRS facilitated question and answer feedback methods. The main objective of this study was to determine whether integrating PRSs into traditional lectures enhanced student achievement. Data were evaluated via descriptive and summary analyses. Results of the data analysis revealed that the implementation of a PRS did not result in statistically significant positive difference in student achievement when compared to students receiving the more traditional written and verbal response contingent feedback methods. The conclusions drawn from the results of this study show that PRSs may be a promising, developing technology for improving student achievement. However, continued research regarding the use of PRSs in undergraduate business classes is needed.

There has been some discussion in recent years suggesting that the way in which students learn has changed, and that sitting in a passive mode in large lecture halls is not the expectation (d'Inverno, Davis & White, 2003). Prensky (2001) explains that because of technology, today's students are different than those who the educational system was initially designed for because students "think and process information fundamentally differently from their predecessors" having grown up around computers, video games, and the Internet. Referred to as Net Generation (Net Geners) and Millennials, they represent the first generations to be completely surrounded by technology where email, instant messaging, and cell phones are integral parts of their lives.

The Net Geners and Millennials, who are now entering colleges and universities, have learning expectations, styles, and needs different from past students (Murphy & Smark, 2006; Skiba & Barton, 2006). Tapscott (1998) describes the Net Geners as assertive, self-reliant, and curious, who are entangled in an interactive culture that centers around ten central themes. These themes are indicative of how Net Geners have the ability to flourish in an environment filled with technology and experiential activities, which include fierce independence, emotional and intellectual openness, inclusion, free expression and strong views, innovation, preoccupation with maturity,

investigations, immediacy, sensitivity to corporate interest, and authentication and trust. Given these characteristics, it is apparent that the Net Geners and Millennials demand "a new learning paradigm" (Skiba & Barton, 2006).

There is a great deal of research into how students learn at the postsecondary level and it is apparent that technology has altered the undergraduate learning environment. Information technology (IT) can allow teaching and learning to be transformed, even when students do not interact with each other face-to-face. Some students who are silent and passive in face-to-face settings "find their voice" and become active participants in technology-mediated communication. Prior to integrating technology into the classroom, a key question in evaluating the impact of IT in education must be asked if technology-intensive approaches provide any advantage in student learning when compared with more traditional approaches (Hilton, 2002).

With all of the technical resources available today, instructors are able to do things that are not possible in a traditional classroom setting. "At the same time, technology does not replace the need for instructors, nor does it necessarily reduce interaction and communication with and between students" (Bates & Poole, 2003). Because there are infinite improvements in instructional technology, the process of engaging students in interactive feedback can be improved and personal response system (PRS) technology can enhance this technique. A PRS is an emerging technology, which allows students to take an active role in the learning process, making them more accountable for learning outcomes (Stein, Challman & Brueckner, 2006), and enhances the traditional lecture-based learning environment. PRS technology has been used with positive results in primary, secondary, post-secondary, and post-graduate institutions (Beatty, 2004; Beekes, 2006; Brewer, 2004; Conoley, 2005; d'Inverno et al., 2003; Paschal, 2002; Presby & Zakheim, 2006; Stein et al., 2006; Trapskin, Smith, Armitstead & Davis, 2005) by gauging classroom comprehension, assisting in recording attendance, and awarding classroom participation scores so professors can encourage students to participate in discussions.

College students need to be actively involved in their own learning (Angelo & Cross, 1993). Students, who are more engaged, will learn more, enjoy more, and possibly earn higher grades because they have a better understanding of the subject (Howorth, 2001) and an engaged student is more likely to be intrinsically motivated and feel like they are a part of the learning process (Bates & Poole, 2003). Newmann (1992) defines engagement as a student's "psychological investment" in learning. Ultimately, "engagement with material increases the chances that a student's learning of that material will continue after the course is technically over" (Bates & Poole, 2003).

A vast amount of perceived benefits are associated with the integration of PRSs in the classroom. It is commendable if an instructor, whose role is to help students learn, can motivate and engage students. Unfortunately, this may not be a simple task as the majority of college faculty still teach their classes in a traditional lecture mode. An alternative and/or supplement to the traditional lecture is to incorporate a formative assessment tool, such as PRSs, to create an environment that encourages active learning (Presby & Zakheim, 2006).

The following research question formed the basis of this study: Do students who receive feedback through a personal response system have statistically significant higher scores on final exams than those who receive feedback through non-technology based methods? This was conducted by evaluating cumulative final exam scores within each participating course. Students'

scores were collected from faculty teaching in the courses: Information Systems Management, Introduction to Marketing, and Quantitative Science.

This study presupposed that participating students will be amenable to using an innovative classroom technology. Without the subjects' cooperation, the experimental data could not be collected. Furthermore, the study also assumed successful technical functionality of the radio frequency (RF) receiver, ResponseCard® keypads, and software. If the technology did not function properly or failed completely, reliable comparisons could not be concluded between technology-based feedback methods and non-technology feedback methods.

Participants for this study were undergraduate students – freshman, sophomore, and junior level – who were enrolled in the School of Business at Duquesne University, located in Pittsburgh, Pennsylvania, during the fall term of 2007. Two student groups were selected by randomly assigning classes to two different pedagogies; classes that integrated PRSs (the treatment group) and those that did not (the control group). Full-time business faculty members, representing either analytical or behavioral courses, acted as facilitators and data gatherers for the study. The research was conducted within a single term by including participants from the business program at Duquesne University. Class size was dependent upon enrollment for the term, and was not a factor for the study. Class sizes ranged from a low of 34 to a high of 37.

Students' technical skills were at an equal baseline. Prior to registering for business courses, students are required to take Research and Information Skills, facilitated through Duquesne University's Gumberg Library and part of the university's undergraduate core curriculum. This course offers an introduction to fundamental computer skills needed for using the Windows operating system, word processing, spreadsheet, presentation, and email software. In addition, students learn skills associated with information literacy—the ability to locate, evaluate, and use information for independent learning. The course's main objective focuses on basic skills needed by every student regardless of major, and examines selected ethical issues surrounding computing.

In following up on current antidotal evidence on the positive learning aspects of using the PRS, the primary aim of this study was to quantitatively access the affects of student achievement and two-sample t-tests were used for two analyses to assess whether an increase in student achievement has occurred. First, a two-sample t-test was used to determine if students in the treatment group have statistically significant higher scores on comprehensive final exams than those in the control group. Final exam percentage scores were provided by participating faculty at the conclusion of the study and the researcher used mean scores to determine this analysis.

The total number of participants whose data were used was 196. Of this number, 119 were male and 77 were female. Participants ranged in age from 19 to 25. A total of seven classes participated in the study, two in marketing, three in quantitative science, and two in information systems management. Of the seven classes, 196 students consented to participate in the study. Two students did not participate in the final inventory because of absence from class. Seven participants' grade point average were not available and five participants failed to indicate their racial background. Table 1 contains data on the participant demographics, including summary statistics (means, standard deviations, and proportions) for participants' GPA inventories, age, and race within the control and treatment group. The data indicate that there was a statistically significant difference between the control and treatment groups with respect to gender ($p < .05$) and no significant difference between the control and treatment groups with respect to the demographic variables observed including GPA, age, and race.

Table 1

Descriptive Statistics of Participant Demographics Including Gender, Grade Point Average, Age, and Race

			Control n=82	Treatment n=114	Total n=196
Gender*	Male	N	56	63	119
		%	68.29%	55.26%	60.71%
GPA	Mean ± SD		3.25 ± .45	3.18 ± .50	3.21 ± .48
Age	Mean ± SD		20.05 ± 1.04	19.92 ± .82	19.97 ± .92
Race	Caucasian	%	97.60%	90.40%	91.33%
	Other	%	7.32%	9.65%	8.67%
	International	%	2.40%	9.60%	8.10%

Notes. Gender % = Percent of total number of participants who are male; *p*-value = 0.032
GPA = Grade point average on a 4.0 scale; *p*-value = 0.854
Age = Years old; *p*-value = 0.821
Race % = Percent of total number of participants who are Caucasian; *p*-value between gender and race = .071
Other = Percent of total number of participants who are not Caucasian; this category includes those students who chose not to respond to this question
International = Percent of total number of participants who are international or foreign national students; this category includes Caucasian international students
*statistically significant at = .05

Table 2 shows summary statistics and includes mean, minimum, maximum, and standard deviations for the final exam scores by group types for final exam scores. This data were used to determine if students in the treatment group have statistically significant higher scores on comprehensive final exams than those in the control group. The results suggest that there was not a statistically significant increase in the mean final exam scores for all students who received instruction via PRS.

Table 2

Summarized Mean Final Exam Scores by Group Type

Group Type	N	Min.	Max.	Mean	SD
Control	81	43	100	79.36	11.80
Treatment	113	26	100	75.76	13.00

Notes. Estimate for difference = 3.60
95% upper bound for difference = 6.56
T-test of difference = 0 (vs. <), t-value = 2.01, p-value = 0.977, df = 181

Based upon the findings of this research we accept the null hypothesis. Results of the data analysis revealed that the implementation of a PRS in a post-secondary classroom environment did not

result in statistically significant positive difference in student achievement when compared to students receiving the more traditional written and verbal response contingent feedback methods.

These results support the conclusion that students remained about the same in regard to student achievement when using a PRS as a primary feedback method. This conclusion was reached based on the findings that students' final exam scores were not significantly higher on final exams when a PRS was integrated into the classroom.

The recommendations of this study were to continue researching and testing the use of PRSs in undergraduate business classes. Replications and further study of this technology should continue to investigate whether using a PRS improves student achievement and that the technology has a positive impact on the classroom environment. Because each professor in this study integrated this technology to their own liking, perhaps more structured implementation needs to be established to ensure that all participants are acquiring the same experience (e.g., similar type, level, and quantity of questions) regardless of which course they attend. Furthermore, including other students and classes from surrounding universities may aid in providing a broader range of academic ability and present an improved perspective of PRSs as a method of formative assessment.

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