



Evidence for teaching practice: The impact of clickers in a large classroom environment

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SUMMARY

As the number of nursing students increases, the ability to actively engage all students in a large classroom is challenging and increasingly difficult. Clickers, or student response systems (SRS), are a relatively new technology in nursing education that use wireless technology and enable students to select individual responses to questions posed to them during class.

The study design was a quasi-experimental comparison with one section of an adult medical–surgical course using the SRS and one receiving standard teaching. No significant differences between groups on any measure of performance were found. Focus groups were conducted to describe student perceptions of SRS. Three themes emerged: Being able to respond anonymously, validating an answer while providing immediate feedback, and providing an interactive and engaging environment. Although the clickers did not improve learning outcomes as measured by objective testing, perceptions shared by students indicated an increased degree of classroom engagement. Future research needs to examine other potential outcome variables.

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Introduction

Enrollments in schools of nursing in the United States have increased substantially in the last few years (American Association of Colleges in Nursing, 2008), from class sizes of 20–30 to incoming classes of 150–200 students. As the number of nursing students increases, the ability to actively engage all students in large lecture style classrooms is challenging and increasingly more difficult. Active strategies and discussion are often limited by the physical structure of the room, inability to hear student responses, and the dominance of responses from a small percentage of students (Herreid, 2006). Examination of the efficacy of alternative interactive teaching and learning strategies is necessary for the establishment and support of best teaching practices.

One approach to engaging students in classrooms maybe the use of a student response system (SRS) (audience response systems (ARS) or ‘clickers’). It is a relatively new technology in nursing education that uses wireless technology and enables students to select individual responses to questions posed to them by a faculty member during the class (Fies and Marshall, 2006; Skiba, 2006). The wireless response systems may elicit feedback from a small or large group. These small, computerized devices transmit individual

responses back to the faculty’s computer that instantly tabulates the data. The class then reviews the displayed data. Multiple applications for SRS exist, such as, recording of attendance, question and answer sessions, opinion polls, voting, quizzes, tests, and group decision making activities (Duncan, 2005; Fies and Marshall, 2006).

Educators have recognized the use of technology and its additional value to the classroom experience in elementary and higher education for many years (Banks, 2006). The National Research Council (Donovan et al., 1999) states that classroom response systems and the related pedagogy have great potential to transform classrooms to be more learner-knowledge and assessment-oriented. The current literature in higher education on the topic is primarily found in the professional schools of medicine, dentistry, physical and occupational health as well as in schools of business and sciences such as physics (Bruff, 2006; Draper and Brown, 2004; Schackow et al., 2004; Trapskin et al., 2005). With the increased sizes of nursing classes, the use of SRS may be an important tool to increase student interaction and engagement while also improving objective student outcomes. Further empirical investigation seemed warranted.

Literature review

Student response systems (SRS) have been in existence for over three decades (Sawada, 2002). These systems have been used in a variety of different contexts, professional continuing education to undergraduate classes. In a review of the educational literature

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on student response systems, Fies and Marshall (2006) have noted that much of the existing literature is anecdotal and there is a need for rigorous exploration of this technology across diverse populations and pedagogies. These authors noted that there seems to be a general agreement that SRSs “promote learning when coupled with appropriate pedagogical methodologies” (Fies and Marshall, 2006, p. 106). Findings from several studies involving SRS have reported positive student perceptions about learning (Guthrie and Carlin, 2004), increased student participation (Latessa and Mouw, 2005), greater positive emotion (Stowell and Nelson, 2007), and facilitation of student achievement (Uhari et al., 2003). Despite generally positive reviews, several authors reported limitations of SRSs: reliability of the system, cost, technical knowledge, and interruption in flow of class (Knight and Wood, 2005; Zhu, 2007).

The findings with respect to objective test scores and perceptions of SRSs have been mixed. One study in the nursing literature (Stein et al., 2006) examined the use of a student response system for pre-test reviews in an anatomy and physiology class. While no significant improvement in examination scores was found, students demonstrated positive attitudes and a perceived benefit with the use of the technology. Morling et al. (2008) used clickers with four sections of an introductory psychology course ($N = 1290$). The results supported a small positive effect on exam scores. Students in their study did not report feeling significantly more engaged in class. Similarly, in another large sample ($N = 1221$) experimental study, Hall et al. (2005) reported a significant improvement in test scores from previous years in undergraduate chemistry lecture courses. Their students perceived the classes with SRSs to be “more engaging, motivational, and increased learning” (Hall et al. 2005, p. 1). Yourstone et al. (2008) found a positive impact on learning on test scores with undergraduate operations management students ($N = 190$). They compared entrance examination scores with a final examination. The authors cautioned that the clickers may not have been the reason for improvement in test scores and further research is necessary.

Participant knowledge scores did not improve significantly when a SRS was used in a continuing medical education program for physicians and health care professionals (Miller et al., 2003). However, participants rated the speaker and presentation quality more favorably when the SRSs were used. Learning outcomes and student attitudes were outcome variables in a study by Fies (2005). She video-recorded classroom discussions for evidence of participation and use of SRSs. There was no improvement from pre-test to post-test scores; however, students indicated an increase to understand as opposed to lecture style delivery of content.

With a dearth of research examining learning outcomes and SRSs with nursing students, the primary purpose of this study was to evaluate the effectiveness of a teaching intervention using a SRS in the classroom setting with junior baccalaureate nursing students. A second purpose of this study was to describe students' perceptions of using a SRS in the classroom. The research questions follow:

1. What is the difference in test scores for students who use a student response system during class when compared with test scores of students participating in standard teaching strategies?
2. What is the perception of students who use a student response system in class?

The terms clickers and student response systems are used interchangeably in the following sections.

Method

The design was a quasi-experimental 2-group comparison (Burns and Grove, 2009) with one section of a course using Clickers

and one section of the same course receiving standard teaching. A quasi-experimental design was appropriate for this study since the students independently registered for class sections and were not randomly assigned to a section. The use of a comparison group, which received no intervention, increased “the ability of researcher to detect differences between groups in the real world” (Burns and Grove, 2009, p. 253). The independent variable was the teaching strategy of the SRS or clicker use during class. The dependent variables were the three unit exams and the final exam. A qualitative descriptive component using focus group methodology described student perceptions of the use of clickers in the classroom.

Setting and sample

The setting for this study was a school of nursing at a private university located in the mid-Atlantic region of the United States. The course was taught in a fixed seat amphitheater style classroom. The design of this classroom does not facilitate the creation of small groups for the use of interactive teaching strategies. The sampling for this study was of convenience. All students in two sections of a junior level adult medical-surgical nursing course were invited to participate in the fall 2007. There were no exclusion criteria. All of the students enrolled in the study ($N = 70$). Students in the morning section comprised the experimental group ($n = 38$) and the afternoon section of students was the control group ($n = 32$). All students in the experimental group were invited to participate in one of three focus groups.

Procedure

Prior to initiating the study, Institutional Review Board approval was obtained. On the first day of class, the investigators answered all questions about the study prior to students signing the informed consent. All students completed a demographic data form. Participation in the study was voluntary and students were offered the alternative to not participate. Students were informed that their decision to participate had no effect on their class standing or grades. No compensation or course credit for participation was provided. The faculty member teaching the course de-identified all test score data prior to entry into the database by the primary investigator. No students withdrew from the study during the course of the semester.

The same faculty member facilitated the course in both the morning and afternoon. She taught the same content weekly to each section and all students completed the same pre-test, unit tests, and final exam. At the end of each class, both sections answered the same multiple-choice review questions on content discussed during class. A variety of questions were presented, from knowledge-based to analysis level. The control group students answered the questions with a ‘hand raise’ response while students in the experimental group used the clickers on class days, for six class days. For this group, the questions were integrated into the PowerPoint® presentation using TurningPoint® technology and students responded individually to the questions using the clickers. A histogram was displayed of the responses and further discussion and misunderstanding of content clarified at that point in time.

For the qualitative component of the study, after the third unit exam students in the experimental section were invited to participate in a focus group. Three groups with 30 students participated. The primary investigator conducted the focus groups in a conference room on campus. They lasted approximately 45–60 min. The groups were audiotape recorded and transcribed. Examples of focus group questions included:

1. What were the strengths of the using clickers in the classroom?
2. What were the limitations of using clickers in the classroom?
3. How did the clickers influence your learning of the course content?

Data analyses and results

Quantitative data

A total of 70 students participated in the study. Thirty-eight were members of the experimental group while 32 served as controls. Sixty-five students provided demographic data: 35 from the experimental group and 30 from the control group. A pre-test did not demonstrate any significant difference between sections. The groups appeared to be similar in all demographic and attribute variables. Table 1 provides demographic data for both groups. Chi square analysis indicated no significant differences in the groups on nominal attribute variables. Likewise, *t*-tests indicated that there were no significant differences between the groups on hours of employment or years working in health care. Using student's *t*-test for exploratory analysis with alpha set at .05 (Munro, 2005), no significant differences between the groups on any measure of outcome performance were found. Table 2 provides a comparison of the experimental and control group data. Therefore, no further analysis was done.

Qualitative data

For the qualitative data, the computer program, NVivo®, was used to assist with data management and analysis. Group responses were analyzed for common themes and patterns. An audit trail was established to ensure credibility of the findings. Member

Table 1
Demographics of sample.

Sample attribute	Total group (N = 65)		Clicker group (n = 35)		Control group (n = 30)	
	N	Valid (%)	N	Valid (%)	N	Valid (%)
<i>Gender</i>						
Female	62	95.4	33	94.3	29	96.7
Male	3	4.6	2	5.7	1	3.3
<i>Marital status</i>						
Single	56	86.2	31	88.6	25	83.3
Married	5	7.7	2	5.7	3	10.0
<i>Living with significant</i>						
Other	3	4.6	1	2.9	2	6.7
Divorced/separated	1	1.5	1	2.9	0	0
<i>Race</i>						
White American/Indian	43	66.2	22	62.9	21	70
Alaskan native	1	1.5	1	2.9	0	0
Asian	6	9.2	4	11.4	2	6.7
Black	5	7.7	2	5.7	3	10.0
African-American	8	12.3	4	11.4	4	13.3
Hispanic/Latino	1	1.5	1	2.9	0	0
No response	1	1.5	1	2.9	-	-
<i>Previous educational degree</i>						
None	51	78.5	28	80.0	23	76.6
Associate degree	11	16.9	6	17.1	5	16.7
Bachelor's degree	2	3.1	0	0	2	6.7
Graduate degree	1	1.5	1	2.9	0	0
<i>Current grade point average</i>						
A (3.7–4.0)	3	4.6	3	8.6	0	0
B (2.7–3.6)	59	90.8	31	88.6	28	93.3
C (2.0–2.6)	3	4.6	1	2.9	2	6.7

Table 2

Comparison of unit exams and final exam for experimental (clicker) and control groups (N = 70).

Measure (possible points)	Experimental group (n = 38) Mean (SD)	Control group (n = 32) Mean (SD)	t	p
Unit 1 exam (50)	43.76 (2.78)	44.16 (2.85)	−0.583	0.562
Unit 2 exam (50)	40.42 (3.09)	41.19 (3.48)	−0.976	0.332
Unit 3 exam (50)	39.18 (3.47)	37.53 (3.74)	1.915	0.060
Final exam (80)	65.84 (4.95)	64.59 (5.92)	0.962	0.340

checks were conducted with participants following the interpretation of data.

Students generally perceived the clickers as a positive addition to the class. Multiple comments centered on the “fun” nature of the clickers, as one student noted “It [using the clickers] was fun. I'd look forward to it.” The primary negative feature of the clickers that emerged was malfunction of the technology. This will be discussed under educational implications. Three themes emerged from the focus group data. The themes were: being able to respond anonymously, validating an answer while providing immediate feedback, and providing an interactive and engaging environment.

Virtually all of the participants addressed the anonymity of using the clickers. The perceived benefit was ‘Being able to respond anonymously’. Raising one's hand in class and answering incorrectly in front of an entire class had the potential to be embarrassing. With the clickers “no one has to be embarrassed.” Students shared that some of them conferred with the student sitting next to them but ultimately selected the response they believed to be accurate independently. They liked that “no one knows you picked the wrong answer.” This was certainly true when only a couple of students selected an incorrect answer.

Students perceived the second theme of ‘Validating an answer while providing immediate feedback’ as a great way to confirm and clarify their understanding of a particular concept. Additionally, they noted that “if half of the class got it wrong, then you don't feel so bad.” Having the faculty provide rationale for the correct response immediately after the polling also facilitated understanding of difficult concepts. Several students noted that this helped them with examinations because they could remember the discussions. Another aspect of this validation focused on providing students with an idea of how they were doing with respect to the class as a whole and “if you're on pace with the rest of the class”.

‘Providing an interactive and engaging environment’ was the last theme. The students perceived that they “actually started interacting more with each other in class” and “it brought the class closer.” They spoke of talking to the students next to them about the answers they selected and compared responses. PowerPoint® presentations were the primary method of content delivery for this class and one student shared that “it gave me something to do, so I woke up”.

Discussion

Student response systems are a creative, alternative strategy for reinforcing concepts, evaluating the understanding of concepts, or testing. Even though in this study, the clickers did not improve learning outcomes as measured by objective testing, perceptions shared by the students indicated an increased degree of classroom engagement.

Exam performance

Objective testing scores were not significantly different for the two groups. It is possible that due to the technological problems

and the limited intervention time that the experimental group did not have sufficient time with the clickers to demonstrate a significant increase on test scores. The literature reveals mixed results with respect to change in exam performance, from no change (Fies, 2005; Stein et al., 2006) to positive effects (Hall et al., 2005; Morling et al., 2008). Further research is needed in this area if SRSs are adopted as a best practice in nursing education.

Classroom engagement

The data from this study suggest that the outcome variable may not be test scores. The qualitative data support increased engagement and interaction in the classroom. Neither degree of engagement or attendance was measured in this study. Several authors have referred to clickers as electronic ‘entertainment toys’ (Conoley et al., 2006). Even with the entertainment aspect, if students attend class, want to participate, and experience enhanced attention; use of the clickers may be worth the effort. Engagement has been assessed in several previous studies (Bullock et al., 2002; Morling et al., 2008; Fies, 2005). Morling et al. (2008) assessed engagement with items that focused on attendance, reading prior to class, enjoyed coming to class, and paying attention in class. However, these items may not sufficiently capture engagement and facilitate learning. Faculty needs to examine their own practices in the classroom with respect to the activities that they believe are engaging. Additionally, it seems that examining what students believe engage them in the classroom would also be beneficial.

Rhem (2007) notes that faculty need to get a “sense of what constitutes the best practices or pedagogies for evoking student engagement in a specific course compared with students’ assessment of how often they are participating” (10). He suggests that assessing both faculty (FSSE: faculty survey on student engagement) and student (CLASSE: classroom survey of student engagement) perceptions of engagement in a specific course may provide more effective and compelling information for faculty to formulate pedagogical choices. Likewise, administration of these tools, pre and post semester may offer better insight into what the best practice for engagement is in a particular classroom setting.

Given the size of the class and structure of the classroom in this study, one goal was to increase interaction among the students during class. Interestingly, the focus group data supported the perception of increased interaction; however, it was the anonymity the clickers provided that the students seemed to prefer and focus upon. Other researchers have also reported this finding (Fies and Marshall, 2006). Additionally, the literature seems to indicate mixed results as to whether clicker technology can really transform the learning environment (Fies and Marshall, 2006). While students may enjoy the technology and ‘wake up’ in class, costs of acquiring and maintaining the system, faculty time investment, as well as dedicated technology support services, demands further examination of the impact of these devices on actual learning. If this method does not involve active dialogue among faculty and students about the questions and their distracters, a push of a button may have replaced opportunities for thinking aloud and practicing verbal communication skills in the class setting. Likewise, moving the focus away from the passive environment of a large lecture classroom to an engaged interactive classroom may necessitate consideration of a variety of alternative strategies.

Limitations

A number of limitations existed that may have influenced the outcomes for this study. First, the use of the clickers during class time was limited to a brief time period, approximately 15 min, at

the end of 6 classes. Increasing the frequency of use and/or number of class times, as well as exploring different options for use during the class may have an impact on objective outcomes. Second, problems with technology, such as a ‘cleaner’ software program that erased the TurningPoint® software each night, and the need to use the same USB port each session contributed to frustration for both the faculty and students. Students expressed disappointment when the technology did not function. The majority of the technological problems were resolved before the end of the semester as faculty mastered the system. A third limitation was the non-random assignment of sample. Students selected the morning or afternoon section they wanted on personal preference.

Implications for nursing education

Implications for teaching and learning include (1) encouraging active learning by facilitating interaction and engagement of students in large class settings; (2) encouraging participation among students by allowing students reluctant to interact in large groups to actively participate; (3) providing prompt feedback so a student can identify misunderstanding of concepts during a class, thus allowing the student to validate his/her understanding and seek assistance prior to testing; and (4) allowing faculty to ascertain student areas of difficulty prior to evaluation and give meaningful feedback during a specific lesson (Skiba, 2006). In addition, the data may be used to facilitate course and teaching strategy revisions.

This was the first use of this particular technology for these researchers and despite the fact that there was a lack of significant objective data, the use of SRS seems to offer promise in increasing student engagement. Smart classrooms are becoming a standard feature at most institutions of higher education, with SRS being only one of the new advances in the educational setting. These devices are effective for a multitude of uses, relatively easy to use, and suitable for higher education. However, faculty needs to be clear about the rationale for any alternative teaching strategy relative to the investment of time and money. Specifically with clickers, faculty needs to make pedagogical decisions regarding their use. How will they be used in class? Considerations might include whether the use is for formative or summative assessment, individual versus group assessment.

As student profiles change, faculty must adapt to the varied learning needs of the students to accomplish the mission of nursing education. Additionally, technology is rapidly evolving offering new and innovative teaching/learning approaches that faculty must investigate as to their pedagogical value. Replication of this study with a larger sample, combined with other alternative strategies seems indicated as nursing education seeks to expand its evidence on alternative classroom strategies. This study has contributed to the body of nursing education literature on evidence-based teaching approaches and the incorporation of wireless technology in professional nursing education.

Conclusions

Despite no significant differences between the two sections in objective testing, the nursing students in the experimental section of this study generally perceived the clickers as a positive addition to the classroom environment. The use of clickers seemed to increase interaction and engagement in the classroom. The students also identified the benefits of anonymity of responses and immediate feedback as facilitators to understanding complex concepts. Clearly, further research is warranted examining active learning strategies, such as clickers, with student engagement and knowledge acquisition.

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