Integrating Nursing Classrooms with Technology via Audience Response Systems:
A Pilot Study

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Abstract

An audience response system (ARS) was used to integrate a nursing classroom with technology. ARS can both engage students and provide immediate feedback. Students (n=60) enrolled in an introductory professional nursing course at a Southeastern U.S. university evaluated ARS use for testing. Literature on ARS use in nursing education is limited, thus the need to determine nursing students’ perceptions of the appropriateness of ARS for evaluation. Facilitation of testing and instruction are a few benefits of using ARS. A 4-point Likert perception scale (Strongly Disagree to Strongly Agree) was distributed to students after all coursework for the semester was completed. Survey questions were projected on the screen and students clicked in their responses. On the perception scale, for Agree or Strongly Agree, 56 (94.9%) indicated they liked using the CPS for quizzes, 49 (85.9%) preferred CPS to written mid-term exams, 51 (87.9%) perceived it was a fair method of grading quizzes, 50 (96.2%) indicated a desire for greater use, and 51 (94.4%) recommend use of CPS to others. Younger, female students preferred (p<.05) use of CPS for quizzes, wished it were used by faculty in other courses and recommend use of CPS to other students. Younger students also preferred (p<.05) using CPS for quizzes rather than having a written mid-term exam. Students who reported fewer years since high school completion preferred the use of CPS for written final exams. Overall entry error rate was .013 for six quizzes throughout the semester.

Keywords: audience response system, classroom participation system, nursing education, clickers

1. INTRODUCTION

Technology-savvy students, an unstable economy and the need to streamline processes may prompt healthcare educators to infuse technology into the classroom. The generational diversity of today’s college students and workforce now includes more than 81 million Nexters—persons also known as Generation Y, Generation Next, Neters, and Millennials. [1] They have entered young adulthood using personal digital assistants (PDAs), MP3 players, iPods, cell phones, text messaging, and personal computers to access information and communicate. The challenge in the classroom is to engage and motivate this technology-driven generation of students while providing students with meaningful feedback. Traditional lecture formats may prove monotonous for some students, thus the need to address students with approaches that may be more familiar to them. Audience response systems are one option that has only recently been used in nursing education.

Electronic response systems have varying names; however, primary goals tend to be uniform—increased attendance, participation, and enhanced learning. ARS may potentially serve as an equalizer relative to classroom participation when viewed through the activity-based, problem-oriented approach of Gutiérrez [2] as she seeks to understand the role of culture and how varying types of participation is linked to the kinds of cognitive approaches individuals create to accomplish social and cognitive functions. She purports that some level of shared cultural understanding may influence the degree of activity or participation in the classroom.

2. REVIEW OF LITERATURE

Little research supports use of response systems for evaluation in classrooms.

Evaluating effectiveness of ARS in other disciplines

Having an understanding of research findings and use of ARS or classroom participations systems (CPS) in other disciplines can provide insight into potential applications in nursing classrooms. Johnson [3] used a compact, wireless audience response system during dentistry lectures to facilitate comprehension of core concepts. The primary goal was to encourage students’ self-assessment of their understanding of course material. A Likert questionnaire was administered to 103 students with a 76 percent response rate. Seventy-four percent of participants indicated their agreement that the response system helped to assess how well they understood lecture content and 77% agreed that basic concepts were reinforced with the use of the response system. Graham [4] reported that
most students found their audience response systems to be helpful to include increased involvement of students, learning engagement, [5] and increased attention in classrooms. [6]

Freeman found that students who used clickers performed better, had lower failure rates, and higher attendance. [7] Student performance was also significantly higher on exam questions using clickers in biology courses. [8] Students taking both biology and genetics courses valued the clickers. Latessa used an ARS to augment interactive learning and reported “The audience in our study clearly felt that the [ARS] enhanced their educational experience.” [9] Chui and Sathasivan used a wireless CPS to survey students, assess factual recall of information, and for problem solving in biology classes. The goal was to break the monotony of straight lecture, emphasize information, and for problem solving in biology classes.

Engaging students with ARS: The effectiveness of a student response system was examined by Auras and Bix in a large “packaging” class. Faculty made a deliberate decision not to use clickers for quizzes and tests because of its recent implementation. Participation points were awarded to students in two courses. In one course 2.8% of points were possible and in another 4.4% points, but only for those students who answered 80% of all questions posed during class time. Use of clickers prompted increased attendance, even though only minimal participation points were possible. In addition, they reported more verbally interaction, concluding that the system enhanced ongoing communication, evaluation and feedback. They reported more verbal interaction, thus, enhancing ongoing communication, evaluation and feedback. Investigators further encouraged evaluation of similar CPS options for quizzes and exams. [11]

Issues of participation and involvement are crucial when dealing with students who are accustomed to instant responses and feedback via technological devices. Parent’s [12] exploratory study of long-term use of a discussion-based internet system with undergraduate business students (n=137) resulted in increased participation and a voice for students who were otherwise less likely to engage consistently in verbal classroom discussions. On the other hand, they also noted a decline in creative approaches and examples. Some students found it difficult to type and listen concurrently. Overall the researchers encouraged continued assessment of technology in the classroom and recommended structured division of class time for technology based learning and then specific times for verbal discussions only. [12] Leidner and Jarvenpaa noted that technology combined with case-study approaches resulted in constructive, cooperative learning with instruction oriented more favorably toward the student. [13] Increase in interactivity and participation seem to be two of the primary potential benefits of the system, [14] as well as maintaining students’ attention, promoting engagement, creating a comfortable environment for more shy students, verifying students’ understanding of the content, [15] and encouraging attendance in scheduled classes. [16]

South Australian instructors in obstetrics and gynecology in a pilot study combined the use of hand-held electronic voting device (EVS) clickers with video-recording of telemedicine case studies. Participants reported use of EVS enhanced case study problem-solving by prompting discussion and stimulating individual student argument for their chosen treatment plans. [17] In a similar study, Palmer found no differences between randomized groups of first year medical students in a standard tutorial program relevant to gender and academic ability. There was significant improvement in scores right after tutorials and six weeks later regardless of EVS use. For one topic, abdominal pain, there was sustained improvement in scores and the greatest retention of knowledge (0.52, SD=0.26, t-test = p<0.05). Twenty-five percent indicated no difference in use with tutorials. [18]

Pros and cons of ARS use in classrooms

Conflicts periodically arise regarding using of response systems in classrooms. Australian researchers found no significant advantages in using ARS over traditional lectures. Some critics think technology in classrooms can interfere with student creativity and active learning. [19]

Challenges often associated with CPS include setup time, distractions, faculty finesse with technology, time for clicker questions, facilitating class-wide discussions, and need for more faculty using CPS for testing. [15, 20] Some faculty may attempt to use traditional exam questions for clicker response systems in the classroom. To stimulate varying levels of cognitive development on a particular subject, varying question formats posed for clickers need careful development. [21, 22] Beatty used CPS to implement question-driven instruction to focus on development of problem solving abilities, cognitive skills, and analysis about physics. [23] This approach to instruction requires specific goals and logical design for questions. The approach used by Beatty seeks to extend student knowledge beyond lectures and reading assignments and are rooted in a “question cycle”. Questions are posed and discussed in groups; answers are collected and displayed via CPS, followed by class-wide discussion and follow-up. (Figure 1)

Figure 1. The Question Cycle Used for Question-Driven Instruction with a Classroom Response System

Note: Diagram used with permission of author. [23]

Zurmehly’s [24] feedback strategy to improve learning is a component of the Question Cycle. [23] The primary focus is student participation followed by immediate feedback, timely adjustments and ongoing communication. The goal is to promote evaluation, guidance and elaboration of content. [24, 25]
Use of ARS in nursing education

Few studies of audience response systems have focused on nursing education. Moredich sought ways to increase attentiveness, interactive learning and attendance among large classes of nursing students enrolled in a physical assessment course. [26] Benefits of using audience response systems included increased attentiveness, invitations for critical thinking, promotion of learning from peers and shared clinical experiences, creation of safe environments for timid students’ participation, ability of instructors to check student progress, and provision of immediate feedback. Cultural sensitivity was a concern for the investigators, thus, they sought to raise self-esteem of students, especially those students whose first language is not English. Students and faculty have to become familiar with the concept of infusing classrooms with technology, use of equipment and development of thought-provoking questions. [26] No disadvantages were included with descriptions of uses and implementation.

Beebe, Bailey and Phillips, surveyed students (n=51) in a nursing course using handheld response devices and indicated that students participated more (79%), paid more attention (98%), found CPS to be a useful learning tool (80%), and that all students (100%) expressed satisfaction regarding instant feedback on performance. [27]

Skiba used clickers with undergraduate nursing students through game show-like applications. Her themes were encouraging active learning, student-faculty contact, cooperation among students and prompt feedback. She used ARS for quizzes on reading assignments, exam reviews, and discussion of case studies. Students were divided into small groups for discussion when activities require rationales for responses. [28] Game show-style pretest reviews for anatomy and physiology course levels I and II were the focus of another audience response study with nursing students. After team members responded, instructors elaborated on correct answers. Participants (94%) reported ARS reviews positively affected examination grades; however, evaluation did not reflect higher average class scores compared with students who experienced traditional reviews. [29]

Nursing faculty must explore new approaches to learning as we engage learners accustomed to a technology-rich society. Not only do we need to consider the use of CPS for review of content and ongoing feedback to students, but also for evaluation regarding understanding and application of course content. Fies suggested that further research continues to be needed to explore use of CPS across diverse disciplines. (25)

3. PURPOSE

Because a search of nursing literature did not reveal documented nursing research on grading with student response systems, this study was pursued as a pilot to determine the effectiveness of using an audience response system in a nursing classroom. Specifically, perceptions of current nursing students regarding use of i-Clickers® for testing purposes was examined. The overall intent was to assess perceptions of junior level nursing students in an introductory course in professional nursing regarding the use, fairness, and applicability to other nursing courses.

4. DESCRIPTION OF THE SYSTEM

The i-Clicker® is a compact hand-held keypad used for submission of responses to an electronic base unit. [30] (Table 1) (Figure 2) The term i-Clicker® is used to include the entire system, namely, both i-Clicker® and i-Grader®.

Table 1. Description of i-Clicker® Technology

<table>
<thead>
<tr>
<th>System and Base Unit</th>
<th>投票灯</th>
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</thead>
<tbody>
<tr>
<td>915 MHz radio frequency transmitter &amp; base</td>
<td>Voting light</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multidirectional clicker use</td>
<td>Estimated 200 hour battery life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key pad for faculty and students</td>
<td>USB base connection to PC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique faculty and student ID numbers</td>
<td>Votes instantly recorded on LCD display</td>
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<tr>
<td>LED indicators</td>
<td>Capacity up to 1500 students</td>
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<td></td>
<td></td>
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<tr>
<td>Pre-loaded flash drive with software</td>
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Figure 2. i-Clicker® Keypad

Note: Photo used with permission of iclicker.com (http://www.iclicker.com/software/software.html) [30]

System software includes an onscreen floating menu bar that allows polling of students with pre-determined or impromptu questions. Responses are viewed on screen or saved for later access. [30] Student online or system registrations are completed at any time. A Settings and Preferences wizard is available (i-Clicker® and i-Grader®). The base unit logs responses for import into i-Grader® (gradebook). [30] Questions and sessions are reviewed in advance and participation, attendance and performance points established. Grades are importable into spreadsheet applications and various online learning systems such as Blackboard (VISTA). [31] Questions can be deleted and points assigned. The Term and Session Summary and Review reports provide responses for the term to date and individual sessions; questions and histograms can be shared. The Student Voting Data report contains grades for individual students, sessions and questions. The Cumulative Student Scores gives each student’s performance for each session.

5. USE OF THE I-CLICKER® SYSTEM IN A PROFESSIONAL NURSING COURSE

During the first class, each student registered their i-Clicker® using the on-screen scroll and clicked as their name appeared. At the beginning of subsequent classes, students were asked to turn on their i-Clickers® and check the battery status. For quizzes, a slide display announced the quiz. Students were polled verbally by the instructor to determine if students were ready to answer the question. The timer was set for the number
of seconds predetermined by students. Responses were registered and the process continued until each quiz item was posted. Students submitted hard copies of their answers in the event of entry errors in i>Grader® (gradebook conversion software).

After responses were recorded and hard copies of answers turned in, quiz items were reviewed verbally. Bar graphs of responses were displayed on a screen for review. Later, correct responses were entered into i>Grader®, exported to a spreadsheet and then uploaded into Blackboard’s VISTA product. [31] When grades were posted in VISTA, they appeared with headings of dates the quizzes had been given and in order of students registered for the course. This process was completed during setup of the i>Clicker® system for use in the course by faculty prior to quizzes. Hard copies of the i>Grader® file and the spreadsheet were printed, then used to check for entry errors and identify students who were absent. The latter were given a parallel quiz at the beginning of the next class. Overall processing from the end of the class period to final posting of grades was less than 20 minutes.

### 6. METHODOLOGY

The use of technology in our nursing ethics classroom was a novel approach to instruction. Thus we were interested in student perceptions on the use of the audience response system using clickers in the classroom setting. We also wanted to know perceptions of students regarding use of clickers for testing purposes. Finally, we were interested in demographic characteristics of students that might be associated with their perceptions of the use of clickers.

#### Study Sample and Procedure

All students in a junior level introductory professional nursing course in a school of nursing in the southeastern United States were invited to participate after grades for the course were officially recorded for the semester. Of 83 total students, 60 chose to participate (72% response rate). Participants were informed of their rights as human subjects as approved by the institutional review board of the university.

#### Instrumentation

The instrument consisted of two sections with the first section eliciting responses on individual student characteristics. The second section consisted of 11 items on a four-point Likert scale (strongly disagree to strongly agree) eliciting student perceptions of the use of i>Clickers in classrooms. As a pilot study, the validity and reliability of the survey tool has not been established. Further testing is in progress with other nursing courses.

#### 7. FINDINGS AND DISCUSSION

The average student responder (n=60) was a 21-30 year old (76.7%, n=46), Caucasian (79.7%, n=47) woman (93.3%, n=56) with no previous college degree (71.7%, n=43). Nearly 40% completed high school five or more years prior, and while most students were exposed to clickers in the School, one-third had no familiarity. Nearly 95% (n=56) support clicker use; 85.8% (n=49) preferred ARS quizzes over having a mid-term exam; and 87.9% (n=51) reported that it gave them immediate feedback. Slightly over 96% of students (n=50) desired use of ARS in other nursing courses, but three students did not recommend clickers.

Positive associations were found between ages, years since high school, gender, and selected statements. (Table 2) Younger, female students preferred (p<.05) use of ARS for quizzes, wished it were used by faculty in other courses and recommend use of ARS to other students. Younger students also preferred (p<.05) using ARS for quizzes rather than having a written mid-term exam. Students who reported fewer years since high school completion preferred the use of ARS for written final exams.

#### Table 2. Relevant Pearson $\chi^2$ for Demographic Variables and Likert Scale Perception Scale Items (n=60)

<table>
<thead>
<tr>
<th>Statement</th>
<th>$\chi^2$</th>
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<tbody>
<tr>
<td><strong>Age</strong></td>
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</tr>
<tr>
<td>I like using the CPS for quizzes in this course.*</td>
<td>70.130</td>
<td>12</td>
<td>.000</td>
<td>59</td>
</tr>
<tr>
<td>I would rather have quizzes with the CPS than a written mid-term exam.**</td>
<td>23.275</td>
<td>12</td>
<td>.025</td>
<td>57</td>
</tr>
<tr>
<td>I wish CPS were used by faculty in other nursing courses.*</td>
<td>59.928</td>
<td>12</td>
<td>.000</td>
<td>52</td>
</tr>
<tr>
<td>I would recommend use of the CPS to other students.*</td>
<td>63.207</td>
<td>12</td>
<td>.000</td>
<td>54</td>
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<tr>
<td><strong>Years Since High School</strong></td>
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<tr>
<td>I would rather have quizzes with the CPS than a written final exam.</td>
<td>6.520</td>
<td>9</td>
<td>.687</td>
<td>57</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
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</tr>
<tr>
<td>I like using the CPS for quizzes in this course.*</td>
<td>14.138</td>
<td>3</td>
<td>.003</td>
<td>59</td>
</tr>
<tr>
<td>I wish CPS were used by faculty in other nursing courses.*</td>
<td>12.918</td>
<td>3</td>
<td>.005</td>
<td>52</td>
</tr>
<tr>
<td>I would recommend use of the CPS to other students.*</td>
<td>13.086</td>
<td>3</td>
<td>.004</td>
<td>54</td>
</tr>
</tbody>
</table>

Note: Significance level p<.05
* Positive association with younger age and female gender
** Positive association with younger age

Due to the small sample size and limited number of older students, no inferences can be drawn from these results, but rather needs further study. Entry errors were calculated from the data provided by the system. If a letter option was blank on the summary sheet in i>Grader® and should have had an entry by the student for a question, it was counted as an error. The overall error entry rate was .013 for the entire semester (6 quizzes) and was considerably less than originally anticipated. Students did, however, indicate clearly (89.5%, n=51) that they strongly agreed or agreed that turning in a hard copy of their quiz was important to them. Hard copies were used to reconcile differences and, in case of disputed answers, were used as documentation of the intended student response.

#### Challenges

Problems associated with ARS included those similar in the reported literature. A few students had difficulty registering their clickers, [32] occasionally a battery was dead, a response would not register, or a student would fail to bring the clicker to class. The instructor had extra batteries, hard copies replaced any missing data, and a student could complete a paper copy of
the quiz. Students needed to learn to look for the green light on the clicker to affirm recording of their voting response.

The issue of cheating is difficult to assess, but students were on the honor system and were read their ethical responsibilities for not cheating at the beginning of class. With the very short length of time between when an individual test item was posted on the screen and they were asked to click in their responses, looking up answers was extremely unlikely. Looking at someone else’s clicker in an auditorium type classroom with risers could not be prevented. It was determined by the faculty that only quizzes were to be graded by this method and counted for only a small portion of their overall course grade.

8. LIMITATIONS AND CONCLUSIONS

Limitations included a small sample size, only one junior nursing class and lack of a more diverse student body from a demographic perspective. Additional data is currently being collected in other courses using a more expanded questionnaire. Further research continues to be needed on student and faculty perceptions, long term retention of content, and issues associated with potential cheating. Despite less than 100% agreement among the students on use of ARS for testing, the response was overwhelmingly positive. Based on the experience in this course, others now use clickers both for interactive teaching and testing.

Consideration for how feedback is used to facilitate learning is warranted. When students recognize their need for improvement in a non-threatening way, goals for interactive teaching may be accomplished. [33] Grade-free performance during clicker-prompted class discussions may enhance the learning environment. Overall there should be continued assessment of technology in the classroom combined with structured balance between technology and verbal discussions. [12] Ultimately clickers may expedite classroom assessment while providing rapid feedback to the technologically-savvy.

9. REFERENCES


