The Effects of Student Response Systems on Student Learning and Attitudes in Undergraduate Psychology Courses

Cheryl Fortner-Wood¹, Leigh Armistead¹, Anna Marchand¹, and F. Benjamin Morris¹

Abstract
Student response systems (SRSs) are reported to increase student interest, interaction, and engagement and result in “deeper” learning. However, the effects on learning are still suspect. Here, outcomes were compared for students in SRS and traditional sections of 200-level and 500-level psychology courses. Results showed SRS students reported more engagement, gave higher evaluations, and had fewer absences. There were also main effects of course and interaction effects of SRS and course on engagement and absenteeism. The SRS effect on student achievement varied by course. These findings add to our understanding that the effects of SRS are the result of a mix of learner, teaching, and course characteristics.

Keywords
student response systems, clickers, communication apprehension

At many colleges and universities, faculty are being challenged to achieve “deep learning,” a term popularized by Kuh and colleagues that refers to students’: (a) attending to underlying meanings of what they learn; (b) integrating and synthesizing information; (c) recognizing patterns; (d) applying what they learn; and (e) being able to examine issues from various perspectives (see Kuh, Kinzie, Schuh, and Whitt, 2010). Research suggests several benefits of student response system (SRS)-supported instruction including greater student participation and engagement, better student understanding of complicated material, more student interest and enjoyment, more discussion and interactivity, greater student awareness of their own comprehension, and more instructor insight into student learning difficulties. In most cases, these studies compared traditional lecture classes with more interactive classes and the specific contribution of SRSs to the outcomes were not determined (see Kay & LeSage, 2009; Roschelle, Pennel, & Abrahamson, 2004).

Kaleta and Joosten (2007) report positive results from implementing SRSs at four University of Wisconsin campuses. Both faculty and students reported greater student engagement and interaction and general satisfaction with SRSs. A comparison of 11 courses taught by the same faculty before and after SRS implementation showed significantly higher grades after the faculty began using SRSs. Kennedy and Cutts (2005) found a positive relationship between first-year computer science students’ answering questions correctly and learning outcomes as measured by end-of-course exams and final grades. Pouli, Massen, Robens, and Gilbert (1997) used a simple SRS featuring a single button permitting students to answer “Yes” to lecturers’ questions. During a 4-year period, they found significantly higher final exam pass rates in classes using SRSs. Similarly, Preszler, Dawe, Shuster, and Shuster (2007) reported using SRSs in six biology courses at New Mexico State University. To assess the effect on student learning, the number of questions asked was systemically varied across the semester. Student performance on exams was found to be positively associated with increasing numbers of questions within each course.

Studies of SRS effects on student learning rarely examined whether the effects interact with student demographic or personality characteristics. It is possible that certain groups of students may benefit more than others from SRSs. Students with high levels of communication apprehension, for example, might benefit from learning in SRS-enabled classrooms. Communication apprehension is described as a fear or anxiety about communicating, or the prospect of communicating with others (McCroskey, 1984). People with high levels of communication apprehension typically avoid and withdraw from situations in which they are required to talk to others. In the classroom, they are least likely to ask or answer questions. Some studies report high student satisfaction with the privacy provided

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by response systems—being able to render an opinion, answer a question, or make their confusion known to the instructor without being scrutinized or criticized by their peers (Judson & Sawada, 2002). Students also report satisfaction with class discussions that are not dominated by more assertive students and with their ability to participate in those discussions (Davis, 2003).

SRSs represent a well-established technology in higher education with converging evidence for effectiveness in a variety of fields including physics, mathematics, chemistry, biology, premedical education, business, and computer science courses (Roschelle et al., 2004). The current study extends this research to undergraduate psychology courses investigating the effectiveness of SRS-enhanced classes in comparison to equivalent classes conducted in a more traditional manner.

We expected that the SRS-enhanced classroom environment would result in higher levels of student engagement, lower absenteeism, and higher course grades. We also expected that students in the SRS class with high levels of communication apprehension would report increased classroom interaction and ease of communication as compared with those in the traditional class. Students in the SRS class were expected to report high levels of satisfaction with their experience in the course.

**Method**

**Overview**

Two sections of a 200-level developmental psychology course and two sections of a 500-level behavior modification course were randomly assigned to experience either a classroom response system (SRS, aka “clickers”) or traditional teaching experience. There were two professors in charge of the classes; one taught both sections of the 200-level courses and another professor taught both sections of the 500-level course.

**SRS Sections**

Each student in the SRS sections borrowed an SRS device during each lecture class. We numbered each device, and each student used the same number throughout the semester. Doing so allowed the professor to use SRS to take attendance and to monitor students who repeatedly performed poorly on content questions. We asked students in the SRS sections probing content and opinion questions (using LCD projection) throughout the lecture classes and were asked to respond to those questions. We tallied class responses and reported back to the class immediately (shared responses were not individually identifiable). Except for attendance, SRS data were not used to assign or inform grades. Students using SRS devices had no grade advantage over students not using the device.

**Traditional Sections**

Students in the traditional sections participated in these courses just as students had in previous semesters and will in subsequent offerings of these courses that do not utilize SRS technology. Therefore, students not participating in the SRS sections had the same advantage/disadvantage as students taking the course in any other semester.

**Participants**

Students enrolled in the course through normal advising and registration procedures. During the first week of class, 90 students were notified of the study. They learned of their right to refuse to have their data included in the study, received two copies of informed consent agreement explaining what their participation would mean, and signed and returned one copy of the agreement if they were willing to participate. To address the possibility that students might feel compelled to participate in the study out of concern for their final grade in the course, the professors left the room while students reviewed and signed the consent agreement and a volunteer from the class delivered the envelope of signed/unsigned agreements to the department office. Students were informed that the agreements would be stored in the department office and that the professors would not have access to them until after final grades were submitted to the registrar. After the students had left campus for winter break, we learned that every student in the 200 course \((n = 25 \times 2)\) and every student in the 500 course \((n = 20 \times 2)\) agreed to have their data included in the study. Seven of the eight graduate students in the study were enrolled in the 500 course. Graduate status and duplicate enrollment \((n = 1)\) are addressed in the analyses.

**Measures**

Student grades, communication apprehension, class engagement, and evaluations of teacher and course are included in these analyses. We operationalized grades as the percentage of total possible points the student earned in the course.

**Communication apprehension.** Communication apprehension was measured at the beginning of the semester by adapting items from McCroskey’s (2005) measure and adding additional questions. Exemplars from the questionnaire include, “I am tense and nervous while participating in group discussions,” “While giving a speech, I get so nervous I forget the facts I really know,” and “When a professor asks a question, I prefer to let someone else answer it.” Respondents used a 1–5 Likert-type scale for all 34 items of the measure. Cronbach’s \(\alpha\) for this measure with this sample = .96.

**Class engagement.** Student engagement in the course was measured at the end of the semester by adapting items from the National Survey on Student Engagement (Kuh, 2001; NSSE, 2006) and creating new items. Exemplars from the 28-item scale include “I discussed ideas from the readings or class with fellow students outside of class,” “In general, I participated more in this class than I usually do,” “I thought about ideas or information from previous classes while reading material for this course or during class discussions,” and “I had to think more than I usually do during this class.” Cronbach’s \(\alpha\) for this measure with this sample = .87.
Teacher and course evaluations. Evaluations of teacher and course were assessed at the end of the course using the three quantitative items on the evaluation issued by the department to all students at the end of every course. Students responded to the measure without the professor present and a volunteer from the class delivered the evaluations to the department office. Just as with the consent forms and questionnaires for this study, the evaluations were not accessible to the investigators until final grades were submitted to the registrar. Students were asked to indicate, “Your satisfaction with the availability of the instructor outside the classroom,” “How would you rate the teacher in this course?” and “How much did you learn from this course?” Cronbach’s $\alpha$ for these three items with this sample was 0.79.

Results
Descriptive statistics for all measures are presented in Table 1.

Were Students More Engaged in the Clickers Sections?
As displayed in Figure 1, a $2 \times 2$ factorial analysis of variance (ANOVA) revealed main effects of SRS use, $F(1, 82) = 16.85, p < .001$, and course level, $F(1, 82) = 8.81, p = .004$, as well as an interaction of course and SRS use, $F(1, 82) = 6.118, p = .016$. These effects remained when graduate students were selected out of the analyses and when institutional grade point average (GPA) at the beginning of the semester was controlled. Both SRS sections had a lower average number of absences than the traditional sections. Both 200-level sections had fewer absences and the SRS section of the 500-level course had the fewest number of absences.

Were students in SRS sections absent less often?
As seen in Figure 2, a $2 \times 2$ factorial ANOVA revealed main effects of SRS use, $F(1, 67) = 15.07, p < .001$, and course, $F(1, 67) = 4.23, p = .044$, as well as an interaction effect of SRS use and course for undergraduates, $F(1, 67) = 9.13, p = .004$. These effects persisted even when cumulative GPA at the institution was controlled. Both SRS sections had a lower average number of absences than the traditional sections. Both 200-level sections had fewer absences and the SRS section of the 500-level course had the fewest number of absences.

Did Students With SRS Rate Their Experience More Positively?
As displayed in Figure 3, a $2 \times 2$ factorial ANOVA revealed higher anonymous evaluations of professor and course by

<table>
<thead>
<tr>
<th>Variable</th>
<th>SRS</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade (% possible points)</td>
<td>0.79 0.11</td>
<td>0.77 0.12</td>
</tr>
<tr>
<td>200 Course</td>
<td>0.75 0.10</td>
<td>0.77 0.11</td>
</tr>
<tr>
<td>500 Course</td>
<td>0.83 0.11</td>
<td>0.77 0.12</td>
</tr>
<tr>
<td>Total communication apprehension</td>
<td>93.22 24.44</td>
<td>86.22 22.97</td>
</tr>
<tr>
<td>200 Course</td>
<td>93.38 25.09</td>
<td>84.80 22.37</td>
</tr>
<tr>
<td>500 Course</td>
<td>94.29 24.23</td>
<td>88.25 24.40</td>
</tr>
<tr>
<td>Total engagement</td>
<td>99.59 9.68</td>
<td>90.67 13.66</td>
</tr>
<tr>
<td>200 Course</td>
<td>100.13 10.36</td>
<td>96.13 13.27</td>
</tr>
<tr>
<td>500 Course</td>
<td>98.92 8.99</td>
<td>82.81 10.13</td>
</tr>
<tr>
<td>Total evaluation</td>
<td>14.51 2.20</td>
<td>12.37 2.52</td>
</tr>
<tr>
<td>200 Course</td>
<td>15.01 1.96</td>
<td>13.64 1.92</td>
</tr>
<tr>
<td>500 Course</td>
<td>13.75 2.38</td>
<td>10.73 2.27</td>
</tr>
</tbody>
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Note. SRS = student response system; SD = standard deviation.
undergraduates in SRS sections, $F(1, 75) = 20.96, p = .000$. Likewise, there was an effect of course level, $F(1, 75) = 18.85, p < .001$, on evaluations. The interaction was not significant, $F(1, 75) = 2.94, p = .091$. Only the main effect of course persisted when graduate students’ evaluations were included in the analyses.

As seniors comprised the largest group in the 500 course ($n = 24$) and sophomores comprised the largest group in the 200 course ($n = 20$), we examined whether or not they differed significantly in the ratings of their experience. Sophomores rated their experience 1.825 points higher than seniors, $t(42) = 2.52, p = .016$, on the scale with a possible total score of 18.

**Are Clickers Associated With Higher Grades?**

When all students are included in the analyses, SRS did not appear to help student achievement. There was no main effect of clicker use or course level on the average percentage of possible points students earned. However, when graduate students were removed from the analyses and only undergraduates are considered, a two-way ANOVA revealed a significant interaction of course and clicker use, $F(1, 75) = 5.74, p = .019$. Undergraduates experiencing SRS in the 500-level course outperformed their counterparts in the traditional section (as shown in Figure 4).

To be sure, this was a true interaction effect and not the result of differences in the students who chose the courses or time slots, we reran the analyses controlling for communication apprehension and cumulative GPA. We wondered whether students with higher communication apprehension might benefit differentially from the anonymous participation SRS allows. However, communication apprehension proved to be a poor covariate for course grade ($r = .14, p = .24$) and the model did not adequately fit the data. Furthermore, students in the sample who scored in the top and bottom thirds on communication apprehension did not differ significantly in their final grade in the course, $t(51) = .189, p = .851$. The model where GPA was controlled was a good fit since GPA was strongly related to course grade ($r = .50, p < .001$). When GPA was controlled, the Course × SRS interaction disappeared.

**Discussion**

These findings augment previous evidence regarding student experience and performance in courses using SRS. Like Anthis (2011), this research found no effect of SRS on grades for students in a life span development course. Similarly, there was no difference in the grades of developmental psychology students in Christopherson’s (2011) study. However, the present findings contradict Christopherson’s findings of no difference in student engagement with measures of engagement, ratings of experience, and attendance. These students viewed the course and professor more highly when the SRS technology was incorporated into their experience. Their own reports and class attendance support this assertion. Furthermore, undergraduates in the 500-level behavior modification course did reap a performance benefit. More experimental and quasi-experimental studies are needed to understand how the complicated relationship between learner variables, teaching strategies, and course characteristics differentially benefit student learning.

In this study, we examined the effects of SRS use in relatively small classes. The small class sizes necessarily mean smaller group and sample sizes which, in turn, make it more difficult to find significant effects of SRS use on student grades. However, main and interaction effects were revealed for engagement, attendance, and evaluations despite the small number of students reporting. In addition, these effects
persisted or increased when the sample size was decreased by removing graduate students. Also, there was a significant interaction of SRS use by course level. To replicate our findings and explore the issue of course level and effectiveness in smaller classes, we have arranged to continue the study with future same size and larger sections.

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References


