The Canadian Journal for the Scholarship of Teaching and Learning

Volume 1 | Issue 1 Article 5

6-21-2010

The Effectiveness of Library Instruction: Do Student Response Systems (Clickers) Enhance Learning?

Diane Buhay
University of New Brunswick, dbuhay@unbsj.ca

Lisa A. Best
University of New Brunswick, lbest@unb.ca

Katherine McGuire
University of New Brunswick, mcguire@unb.ca

http://dx.doi.org/10.5206/cjsotl-rcacea.2010.1.5

The Effectiveness of Library Instruction: Do Student Response Systems (Clickers) Enhance Learning?

Abstract
In the present study, we were interested in determining if library instruction would be more effective if personal response systems (clickers) were used during instruction. Furthermore we were interested in examining if students in a class could benefit from clicker technology even if they did not have access to a personal clicker. To examine these issues, we conducted 3 library instruction sessions: Session 1-half of the students were randomly assigned a clicker; Session 2-all students had individual clickers; and Session 3-clickers were not used. Although half of the students in Session 1 did not have clickers, they were presented with all of the information, were aware of the clicker questions, and were presented with the graphs of responses. Students in all 3 sessions completed a pretest and posttest and difference scores were calculated such that positive numbers indicated higher scores. Overall, scores were significantly higher for students who had access to clickers. A comparison of specific clicker use showed that both the individual and group clicker sessions led to significantly higher difference scores. Results indicated that the benefits of clickers are not limited to individual access and group clicker use was as effective. Overall, these results confirm research supporting the integration of technology into classroom instruction.

Dans cette étude, nous avons cherché à déterminer si la formation en recherche documentaire était plus efficace lorsqu'on utilisait des systèmes de réponse personnelle (télévoteur). De plus, nous voulions savoir si les étudiants en classe profiteraient de cette technologie même s'ils n'avaient pas accès à un télévoteur individuel. Pour ce faire, nous avons organisé trois séances de formation en recherche documentaire. Pendant la première, nous avons distribué un télévoteur à la moitié des étudiants choisis au hasard. Pendant la deuxième séance, chaque étudiant disposait d'un télévoteur. Au cours de la troisième séance, aucun d'entre eux n'a utilisé cet appareil. Même si la moitié des étudiants n'avaient pas de télévoteur au cours de la première séance, ils ont reçu toute l'information, ils connaissaient les questions auxquelles il fallait répondre avec le télévoteur et les chercheurs leur ont présenté les graphiques des réponses. Tous les étudiants ont passé un prétest et un post-test et les différences de résultats ont été calculées afin que les chiffres positifs indiquent des résultats plus élevés. Dans l'ensemble, les étudiants qui avaient accès au télévoteur ont obtenu des résultats significativement plus élevés que les autres. La comparaison de l'utilisation spécifique du télévoteur a montré que les séances en groupe et individuelles au cours desquelles les étudiants utilisaient cet appareil entraînaient une différence significativement plus élevée en ce qui a trait aux résultats obtenus. Les résultats indiquent que les avantages du télévoteur ne se limitent pas à l'accès individuel et que l'utilisation de ce dispositif en groupe était aussi efficace. Dans l'ensemble, ces résultats confirment la recherche qui appuie l'intégration de la technologie dans l'enseignement en classe.

Keywords
student response systems; clickers; learning; information literacy

Over the years, various technologies have been used by instructors as teaching tools. Recently, however, more active learning tools that require input from both the student and the teacher have become popular in the classroom (Auras & Bix, 2007). These interactive tools are considered by many to enhance traditional lectures by increasing student engagement and learning (Cain & Robinson, 2008; Menon, et al., 2004). One such tool gaining popularity in postsecondary education is the audience response system (ARS) that is referred to by several names including student response systems (SRS), personal response systems (PRS), classroom performance systems (CPS), and the colloquial term *clickers* (Cain & Robinson, 2008; Premkumar & Coupal, 2008). When clickers are used in a lecture, all students are provided with a clicker and the instructor incorporates multiple choice questions into his or her lecture. These questions are typically presented to the students via Microsoft PowerPoint™ and students respond to these questions using their clicker. Immediately after all the responses are made, a graph showing the pattern of responses is presented. This technology allows instructors to gauge the knowledge of specific concepts and, if appropriate, expand on the different answer choices. Although clickers can be used in a variety of ways and can change the delivery mode of information (i.e., Beatty, Gerace, Leonard, & Dufresne, 2006; Draper & Brown, 2004; Mazur, 1997), they are typically used as a tool to enhance, rather than replace, traditional lectures. In the current study, we were interested in whether the use of clickers improved learning, and we integrated clicker questions into a traditional lecture.

Clickers add a "game approach" that may be more engaging than other interactive methods (Martyn, 2007) and add an element of fun to the learning situation (Hoffman & Goodwin, 2007; Homme, Asay, & Morgenstern, 2004). Teachers also benefit by receiving more immediate feedback on student comprehension, more "honest" student feedback because of the removal of student conformity which may occur when students respond by raising their hands, and, in many instances, student participation reaches 100% (Eggert, West, & Thomas, 2004; Stowell & Nelson, 2007).

Response systems have been used for a variety of purposes (Cain & Robinson, 2008), with most research confirming benefits in the classroom, such as increased student engagement and interest, greater discussion and interactivity (Auras & Bix, 2007; Martyn, 2007), and positive learner perceptions (Cain & Robinson, 2008; Medina et al., 2008). The few studies assessing the use of clickers to improve students' academic performance have produced mixed results. For instance, Morling, McAuliffe, and DiLorenzo (2008) found small, positive effects on exam scores for large introductory classes using clicker technology. In contrast, Morgan (2008) found that grades were lower for introductory classes using clickers, although not statistically significantly lower, whereas Stowell and Nelson (2007) reported no significant effect on quiz performance.

Library Instruction

In 2005, Julien (2005) reported that 48% of Canadian libraries indicated that informational technology had changed how information about library resources was delivered, and over 95% indicated that technology had changed the content of information. Librarians are required to teach information literacy skills across a variety of disciplines both in and out of the classroom. To effectively complete assignments, university students must understand how to use the library and the resources available to them. With the belief that response systems could increase information retention and hence the literacy skills gained from library instruction,

Instructional Services at Texas A&M University began using clickers in basic library sessions in the summer of 2006 (Hoffman & Goodwin, 2007). These researchers incorporated several clicker questions into traditional 50-minute lectures on library resources. Although clickers were used, the mode of presentation did not change. Prior to implementation, library instruction feedback forms indicated that students felt overwhelmed by material presented in the sessions, with some stating that they would probably forget most of the information. After implementation, Hoffman and Goodwin reported that the use of clickers in classroom sessions resulted in fewer students reporting feeling overwhelmed, confused, or uncertain about retention of the information presented, and most reported that using clickers made the sessions fun.

Although Hoffman and Goodwin (2007) reported positive results from applying response systems during library-related instruction, there are few hard data on how effective information literacy classes are in teaching library literacy skills using this method (Petersohn, 2008). Petersohn (2008) conducted a pilot study to assess the impact of response systems during library instruction on short-term retention. Forty-eight freshmen students from Communication or English Composition classes at Georgia State University's Alpharetta Campus participated in a 20-minute library instruction session. Participants were randomly selected to be in a clicker or a nonclicker session. Clicker groups were given classroom instruction in a computer lab. At the beginning of the session, a five-question pretest was posted on the participants' computer screen. Students responded using individual keypads, with responses immediately graphed on the screen. A lesson followed a discussion of the responses. Feedback requiring students to use their assigned keypads was obtained at points throughout the session. Upon completion of the class the students answered a six-item on-screen posttest. For the nonclicker group, neither computer screens nor clickers were used. Paper pre- and posttests were completed, and student feedback during the lesson was obtained by a show of hands. Results indicated that both groups showed improved scores between the pre- and posttests. However, Petersohn (2008) reported statistically significant differences between the clicker and nonclicker groups; specifically the clicker group showed more improvement than the nonclicker group; however, generalization of these findings is limited because of the small number of participants.

Current Study

As previously indicated, the research evaluating student response systems has provided mixed results. Some researchers have reported positive results, but others did not find that clickers led to higher retention. Given these results, we were interested in further examining the effectiveness of clickers among university students participating in library instruction sessions with the expectation that the use of clickers would lead to higher retention. We were specifically interested in examining overall class retention when clickers were available to only *half* of the students in the classroom. We expected that class retention would be higher in sessions when either all or half of the students had clicker access and lower in sessions when clickers were not used.

Method

The purpose of the current study was to determine whether student response systems increase knowledge about information literacy.

DOI: http://dx.doi.org/10.5206/cjsotl-rcacea.2010.1.5

Participants

Two hundred undergraduate students enrolled at the University of New Brunswick participated in group library instruction sessions, 80 males (M_{age} = 19.94, SD = 1.68) and 113 females (M_{age} = 22.92; SD = 8.53); 7 participants did not report their gender. A total of 132 participants identified themselves as first year university students, and 68 reported that they were in their second, third, or fourth year of university. Although first year students have not typically declared a major, 57 reported that they intended to major in Arts; 18 intended to major in business; and 69 intended to major in science.

Fifty-four of the 200 participants were engineering students; their data were collected during a regularly scheduled class, and thus all engineering students were in a combined session. The remaining 146 were psychology students recruited from the Department of Psychology Research Pool who received class credit for their participation. There were no differences in retention of the psychology and engineering students, as evidenced by a nonsignificant t test, $t(194) = 1.71$, $p = .09$.

When the Research Pool was used, students signed up to participate in small groups of 20 to 30 students. The group sessions were randomly assigned, and several different session times were scheduled. The different types of sessions were scheduled such that, in a given week, there was one individual, one combined, and one control session. Sessions were scheduled on different days and at different times of day. Participants signed up to participate in a research project on *library instruction* but were not aware that different types of sessions were scheduled. Even if participants were aware that there were different sessions (i.e., through word of mouth), they would not have been able to predict which sessions (individual, combined, control) that they were signing up for. Across all participants, the preexisting knowledge about the library was examined and no group differences were found, $F(2, 193) = 2.9$, $p > .05$. Three participants' data were removed from all analyses because their standardized retention scores were more than three standard deviations *lower* than the average.

Equipment

Thirty Interwrite PRS Radio Frequency personal response systems were used by participants.

Procedure

All sessions were conducted during Fall 2008 and were held in a university classroom that was equipped with an overhead data projector. Microsoft PowerPoint™ was used by the instructor to aid in the presentation of relevant information. In total, seven sessions were conducted: one combined (Engineering), two combined (Psychology), two clicker (Psychology), and two control (Psychology) groups. The basic procedure was explained to the students when they entered the classroom. Students were informed that they would be presented with information about the services offered by the library and that, to assess their learning, we wanted them to complete two tests: a pretest to assess their existing knowledge and a posttest to assess what they learned during the session. They were given the opportunity to ask questions about the procedure. After this introduction, they completed an informed consent form and the library knowledge pretest. The pretest was designed by a librarian to assess general knowledge about the

library and more specific knowledge about how to obtain specific types of information. The test included 10 multiple choice questions (e.g., *Which of the following is a characteristic of a scholarly journal? A. Usually read by the general public; B. Articles include references/bibliographies; C. Report on current events; D. Usually published weekly*).

After completing the pretest, participants were presented with specific information about library services and how to conduct academic research. Information was presented in three different formats:

1. Combined Groups (N = 90; 58 males, 32 females): Students entered the classroom and chose a seat. After all students had completed the pretest, clickers were randomly distributed to half of the students. Each student with a clicker was seated beside a student who was not assigned a clicker. Although not all of the students had access to a personal clicker, all questions and tallied results were presented to the entire class (the specific clicker questions that were presented focused on the information in the session; however, individual clicker responses were not recorded). Thus, students who did not have a clicker were also presented with the questions and responses and could potentially benefit from this information.
2. Individual Groups (N = 56; 10 males, 46 females): All of the participants had access to a clicker, and thus all participants personally answered all questions and could compare their clicker response with the responses of the other participants.
3. No Clicker Groups (N = 48; 13 males, 35 females): These sessions served as control sessions. Although the same information was presented and the same questions were asked, clickers were not used.

The length of the instruction sessions was approximately 45 minutes, and the information presented in the three formats was identical. After the instruction session, participants completed a posttest (which included the same 10 questions as the pretest) to assess whether the instruction sessions were effective.

Results

To determine the overall effectiveness of the library instruction sessions, data from all sessions (combined, individual, no clicker) were pooled and pre- and posttest scores were examined. As can be seen in Figure 1, pre- and posttest scores did not differ as a function of university faculty (arts, science, business); furthermore, specific university major did not influence test scores. Overall, an independent groups t test was conducted and there was a statistically significant difference in pre- and posttest scores, $t(199) = 9.41$, $p = .0001$. As expected, pretest scores were lower ($M = 5.24$, $SD = 1.64$) than posttest scores ($M = 6.31$, $SD = 1.47$). Regardless of faculty membership, scores on the posttests were higher than those on the pretests, indicating that the instruction served to increase knowledge. Given the fact that library instruction is commonly used at our university and librarians are often invited to give in-class instruction, these results are positive as they suggest that the instruction actually does improve general knowledge about academic research.

DOI: http://dx.doi.org/10.5206/cjsotl-rcacea.2010.1.5

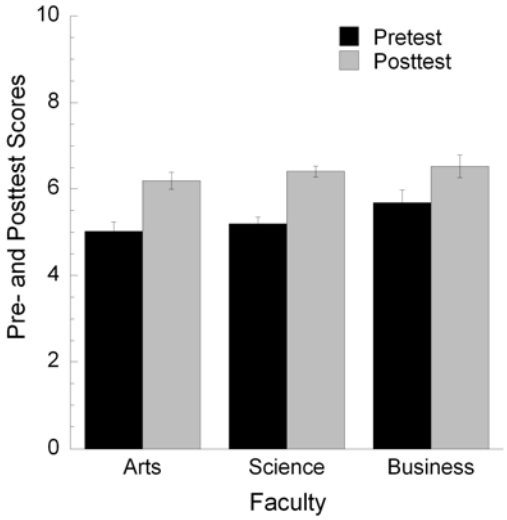

Figure 1. The pre- and posttest scores as a function of university faculty. The error bars represent standard errors of the mean.

A 2 (University Level: upper vs. lower) x 2 (Gender: male vs. female) x 2 (Test: pre vs. post) mixed model ANOVA was conducted to determine specific differences in learning. Results indicated that those in upper and lower level university courses had almost identical pre- and posttest scores, $F(1, 190) = .01$, $p = .92$, suggesting that students at all levels can benefit from instruction. Interestingly, there was a statistically significant main effect for gender, $F(1, 190) = 7.21$, $p = .008$. Overall, females had higher scores than males ($M_{female} = 6.02$, $SEM = .13$; $M_{male} = 5.47$, $SEM = .16$). The interaction between test type and gender approached statistical significance, $F(1, 190) = 2.77$, $p = .09$. On the pretest, the scores of males and females were almost identical, but on the posttest, the scores of female participants were higher, which suggests that library instruction was particularly effective for female participants.

The Effectiveness of Student Response Systems

A difference score between the pre- and posttest scores was calculated such that positive numbers indicated that the posttest score was higher than the pretest scores. Overall, the average difference score was 1.07 ($SD = 1.61$), indicating that participants answered approximately one more question correctly on the posttest. Although this is a modest gain, it does represent more than a 10 % increase in scores from the pretest to the posttest.

In assessing differences in learning according to instruction type, an ANOVA indicated a statistically significant effect for instruction type, $F(2, 193) = 4.41$, $p = .013$. When participants had individual access to a clicker, the average difference score was highest ($M = 1.63$, $SEM = .20$). Difference scores were lower in combined groups in which half of the participants had clicker access ($M = 1.07$, $SEM = .15$) and in control groups in which clickers were not used ($M = .81$, $SEM = .21$). A Boneferroni post hoc test indicated that there were statistically significant differences between each of the instruction types, suggesting that the library instruction sessions that provided individual clickers were more effective than those in which only some students had clickers. Sessions that did not provide clicker access were the least effective.

The three groups were not equivalent in terms of gender composition; the individual clicker group included 10 males and 46 females, the combined clicker group included 58 males

and 32 females, and the control group included 13 males and 35 females. Because of these unequal numbers of males and females, an overall analysis of gender by instruction type would not have been statistically valid and, thus, was not conducted.

To examine any possible gender differences as a function of *overall* instruction type, clicker use was coded such that participants who had individual access to a clicker were differentiated from those who had no clicker access. Thus, across all three groups (individual, control, and combined), participants who actually had a clicker were differentiated from those who did not. A 2 (Gender) x 2 (Instruction Type: clicker vs. no clicker) ANOVA was conducted, and the main effect for clicker use approached statistical significance, $F(1, 187) = 3.24$, $p = .07$. When clickers were used, the difference between the pre- and posttest scores was, on average, 1.33. When clickers were not used, the average difference between the pre- and posttest was only .94.

The main effect for gender was not statistically significant, and there was no difference in the retention scores of males and females ($M_{males} = .99$; $M_{females} = 1.29$). There was a statistically significant interaction between gender and instruction type, $F(1, 187) = 4.68$, $p = .03$. As can be seen in Figure 2, when clickers were not used, the difference scores for males and females were similar, but when clickers were used, the difference scores for females were significantly higher. Thus, the integration of clickers did not affect the retention of information for males but led to higher retention for females.

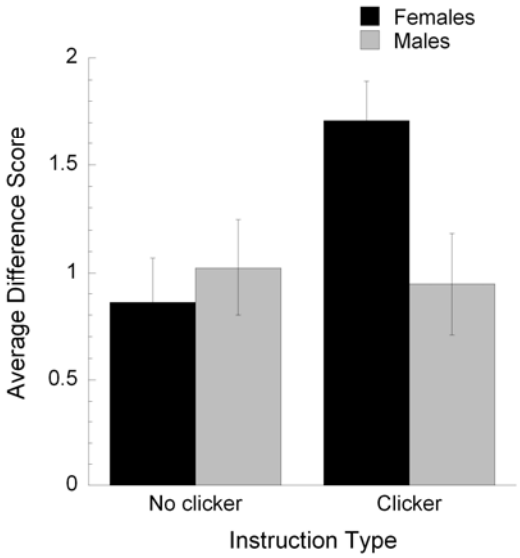

Figure 2. The difference between pre- and posttest scores as a function of gender and instruction type. The error bars represent standard error of the means.

Discussion

There is a growing body of research suggesting that integrating technology into the classroom is effective and can lead to higher exam scores (Morling et al., 2008). We were interested in determining if library instruction would be more effective if personal response systems (*clickers*) were used during instruction. Our results suggest that library instruction does enhance student knowledge and, regardless of whether clickers were used or not, student scores on the posttest were higher than those on the pretest. Given that library instruction is widely

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available and used to teach students about how to conduct academic research, this result is positive. The results of the current study suggest that student response systems further enhance student learning. When individual clickers were used, student learning was higher when all the students had clickers than when only half of the students had clicker access. Learning was lowest when none of the students had access to clickers. Although the gains in knowledge from pretest to posttest were modest, clicker use did appear to enhance learning.

Figure 2 presents one of the most interesting findings. Regardless of whether they were in a combined or individual session, the retention scores of the females were higher when they actually had access to a clicker. Interestingly, the scores of the male participants were similar regardless of whether they had clicker access. Although most of the published studies on gender differences in clicker use focus on perceptions, Reay, Li, and Bao (2008) used a pretest/posttest model to examine the actual retention of information and reported that when no clickers were used, males had higher posttest scores, indicating greater learning. However, when clickers were used, there were no differences between male and female scores, suggesting that clickers reduced the gap in performance between males and females. Given that the results of Reay et al. (2008) differ from the current results, future researchers should closely examine possible gender differences associated with clicker use.

Limitations

Although clicker use did lead to increased knowledge, the gains were modest. On average, student scores were approximately 10% higher on the posttest as compared to the pretest. All participants were volunteers, and the information presented to them during the instruction sessions was not included on any of their formal tests or exams. It is possible that the participants were not optimally motivated to learn the presented information, and it follows that the gains associated with clicker use may have been different if retention were tested more formally. In the future, we plan to integrate the information presented in the library instruction sessions with specific course material and encourage instructors to include test questions specific to library information. This integration would allow us to examine the effectiveness of clickers in situations where students had more to gain from the instruction sessions.

There is also need to address the fact that the participants were not randomly assigned to the various groups, and so differences as a result of group assignment or volunteering to participate in a given group may have caused the differences between groups.

To assess the effectiveness of clickers, we employed a pretest/posttest model. Although there are methodological strengths associated with this design, in the current study there are two flaws. First, as is typical, the pretest and the posttest had the same questions. Second, the posttest was completed immediately following the 45-minute instruction session. It is possible that the length of time between the pre- and posttests was too short and participants were able to remember how they answered specific pretest questions. In retrospect, we should have had participants complete the posttest several weeks after the instruction sessions. This modification would tap into not only short-term retention but also any long-term benefits of using student response systems to enhance learning.

General Conclusions

A comparison of specific clicker use showed that both the individual and group clicker sessions led to significantly higher difference scores. Results indicated that the benefits of clickers are not limited to individual access and group clicker use was as effective. Although the current results support the integration of clickers into the classroom, they also suggest that the gains associated with clicker use are modest. As noted by Morgan (2008), it is possible that how an instructor makes use of the clickers, rather the clickers themselves, determines effectiveness.

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