

Evaluation of the Success of a Student Response System in a Computer Concepts Course

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Abstract

Student Response Systems (SRS) are becoming more popular in the classroom. The use of an SRS system is to give students the opportunity to control their learning. This study looks at the application and success of an SRS system in an introduction to computing course.

College Students as Adult Learners

Students in a higher education setting are caught between the world of pedagogy (the teaching of children) and the world of Andragogy (the teaching of adults). College students have left a world of pedagogy where they are taught what is expected of them by government agencies and school districts. In the andragogical setting, students are choosing what topics they wish to learn with a focus on a specific career or goal.

As teachers of adults, it is the educator's responsibility to address the four characteristics of adult learners (see Table 1) with the respect and attention that they deserved [6], as well as to help motivate the adult or, in the higher education setting, the new adult, to learn. One way to increase the motivation is to stimulate the adult's interest in advancement or learning. Giving some level of control to the adult learner can increase the student's motivation as well as increase the amount of learning that occurs.

In addition, Chickering and Gamson identified "Seven Principles for Good Practice in Undergraduate Education" (March 1987) which identified the need for active learning for students and their need for prompt feedback. In any classroom, and in particular in a large one, this goal becomes difficult for the instructors to manage [4]. This is particular difficult when combined with the students' out-of-class life demands. To compete against some aspects of life, the classroom and the teacher need to reduce any other barriers students encounter in the classroom such as boredom, speed of instruction delivery [6], existing knowledge of the topic, or time of day (such as the after-lunch fatigue). One such tool that a teacher can use to engage the students is the use of a Student Response System (SRS).

Table 1. Four Characteristics of Adult Learners

Characteristic	Description
Autonomy	The direction of the educational process (courses, majors, etc.) is left to the student to choose.
Application of experience and knowledge	While the life experiences of an entry-level college student are not at the level of a non-traditional college student, current college students do have other demands of their time (such as work and family) and may, in fact, have some previous work experience that influences their choices.
Goal-oriented	People enroll in college for a variety of reasons -- from not having anything else to do to pursuing a specific career. Both of these reasons have specific goals from "just" taking a course to taking a course that gets the student closer to that goal of a career.
Relevancy	Adults need to know why they need to learn a specific task, ability, or knowledge. What they are learning must be seen as relevant their current interests or their career goal [6].

What is SRS?

Student Response Systems are used in institutions around the U.S., from Arizona State University to Wake Forest University in North Carolina and from elementary schools to colleges and universities. A student response system allows students to provide immediate feedback to their instructor regarding their level of understanding of a topic.

SRS systems can range from hand-held remote-control devices where students can select responses to the use of a software system and standard PC computers which provide the input via a specific Website. Either way, responses are transmitted, the data collected and tabulated, and forwarded on to the instructor. The instructor can, if she chooses, show a graphic representation of the collected responses. The data can also be saved for use at a later time by the instructor [4].

The SRS system (Numina II) in use at the University of North Carolina Wilmington (UNCW) is a Web-based student response system. The system uses wireless networks, handheld computers, and a data projector. Students submit their responses to question via a Website. On this Website, students see an answer pad specific to the question posed by the instructor and use this answer

pad to respond to the instructor. The general form of Numina II resembles the audience participation portion of the TV show “Who Wants to be a Millionaire.”

The Website allows students to submit responses to questions posed by an instructor. The instructor poses a question, using a variety of formats, and directs students to a Website that generates the appropriate answer pad on their computer or pocket-PC screens through which they submit their responses. A variety of question formats are possible. On the backend, a database stores the question’s responses. Since the students do not login to the system, there is no information about the student associated with the questions. Responses are completely anonymous [7].

Once questions have been presented, an image, such as in Figure 1, appears in the classroom view. When students respond, they see a graphical representation of the answers as shown on the right side of Figure 1. Students are presented, on the Website, with a simple view for selecting their answers. Figure 2 shows one example of a student view.

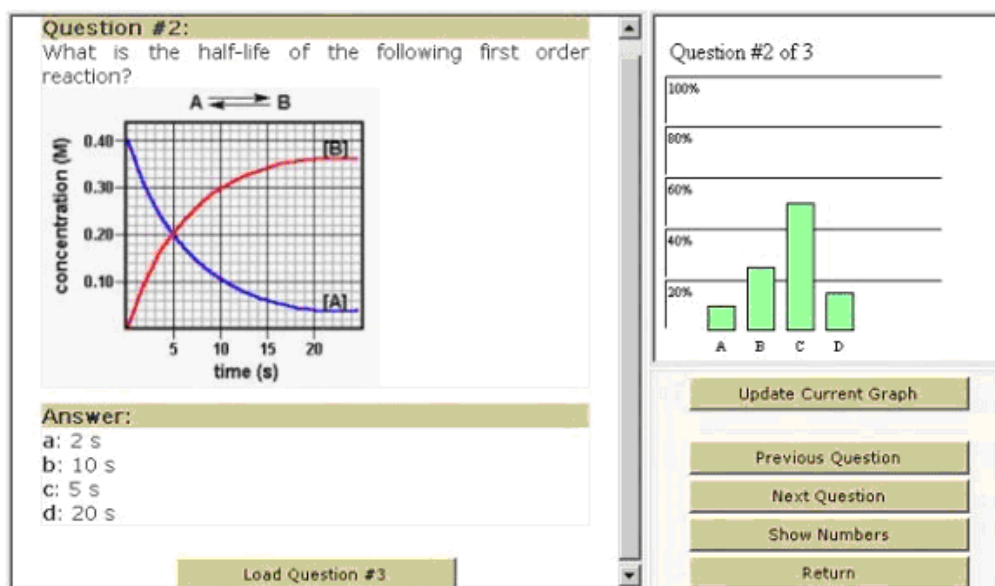


Figure 1. Example of UNCW’s Numina II SRS classroom view [7].

Use of a Student Response System (SRS) may help both students and the instructor in the active learning classroom [4]. The rate for student participation in some courses at UNCW rose from only 30 percent of the students to nearly 100%.

The SRS system is more than an electronic “raising of the hand.” In many settings, students may be unwilling or uncomfortable to signal a lack of understanding through raising their hands. For an instructor, silence can be interpreted to mean that students understand the topic or information presented [5]. SRS, then, is an opportunity to express thoughts, questions, concerns through a level of anonymity. In addition, as the instructor receives the input from the students, SRS becomes an opportunity to provide immediate feedback [4]. Through the use of SRS, the instructor (and the students) can see how people have responded to a question (what percent or number have answered “A,” “B,” and so on.). Time is not lost while the instructor counts hands [4].

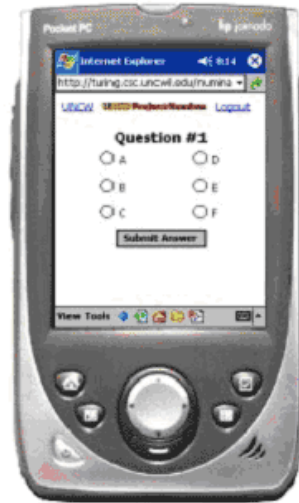


Figure 2. Example of UNCW's Numina II SRS student view [7].

There are other advantages for the students as well. Andragogy suggests that students need to be actively engaged in the learning process. An SRS system can help achieve this. Frey and Wilson [2] list five educational benefits that an SRS system brings. Horowitz [3] also found five similar benefits for the learner.

1. The SRS engages students in the instruction through asking questions, allowing input on the speed of instructional delivery.
2. The SRS allows collaboration and consensus-building through the immediate receipt of questions, answers, and opinions from the students.
3. The SRS provides immediate feedback to the students. Based on input from the students, instructors can modify their instruction and clarify concepts.
4. The SRS increases the amount and type of communication between the instructor and the students. Rather than waiting for the students to respond or to visit during office hours, the SRS system provides an immediate opportunity for students and instructors to communicate regarding course and classroom issues.
5. The SRS collects data from the students that can be used for classroom and content evaluation, as well as provide data to the students that can be used for other forms of evaluation.

Focus of the Study

At UNCW, many students take an introduction to computer concepts course to fulfill the institution's computer-literacy requirement. Frequently, 14 sections of this course are taught each semester with each section trying to cover all the required topics in addition to learning how to use productivity software such as Microsoft Office. For some of the students, however, this material may be a repeat of information that was provided to them in high school (North Carolina has a high school computer literacy requirement as well). The use of Numina II SRS allows the instructors to control the speed at which information is provided. The instructor can also choose to either skip material or to delve deeper into the topic. Numina II is used by some of the instructors to question students' understanding of the material and the speed at which it is presented.

To determine if the use of an SRS system in this course made a difference in student outcomes, four of the introductory courses taught during spring semester 2005 were compared. Two of the

sections (n=52) were taught using Numina II SRS and two sections (n=57) did not use Numina II. While the SRS sections were taught by one instructor and the other sections taught by a different instructor, the sections utilized the same lecture slides, class projects, and exams. Two different instructors were used to prevent possible “carry-over” in terms of speed, depth of discussion, etc. to the non-SRS sections. In each section, students were presented with three multiple-choice exams conducted over WebCT and used the same grading system. Student success rates, as defined by exam grades, were compared.

The lecture format of the course utilized PowerPoint slides to highlight points of interest from each chapter. The PowerPoint slides used were virtually identical among the four sections; however the slides for the SRS sections had prompts for the instructor to ask SRS questions. Based upon student responses, the SRS instructor would then vary her lecture to either skip some topics, delve more deeply into others, or continue at her normal pace.

Procedures

The grades from all four sections were collected and listed in spreadsheet form. The grades of each of the groups were recorded in two spreadsheets to keep the information separate between the experimental (SRS) and control (non-SRS) groups. All exam grades were recorded, including those of students who failed the courses. Only students who did not complete all three tests (and had withdrawn from the course) were eliminated from the data. If the student did not withdraw and missed any test, they were assigned a grade of zero. The means for each course were determined and a two-tailed independent samples t-test was used to compare the means of the experimental and control group samples.

Null Hypothesis

The null hypothesis created for this study was that there would be no statistically significant difference between the means of the exam grades of students enrolled in the SRS version of Introduction to Computing and Computer Applications course when compared to the exam grades of students enrolled in the non-SRS version of the course.

The above null hypothesis was tested at the level of .05 significance. This level of significance was chosen with some certainty that the results would fall within a 95% range of confidence.

Region of Rejection

The region of rejection for the hypothesis described above was two-tailed. A two-tailed test was used since the research hypothesis is non-directional for effect of instructional method on grade outcomes. The 5% region of rejection area was equally divided between the two tails.

Statistical Tests

The arithmetic means of the final grades of each course was determined by adding all the corresponding letter grade values and dividing the result by the number of students who received a final grade. Once those values had been determined, the two-tailed independent samples t-test was used for comparing the means of the experimental and control group samples. The t-test was used because each of the courses was a small sample and was drawn from the same parent population.

A statistical analysis software was utilized to compare the final grades or scores of the two groups. The means and standard deviations for each group were also determined. Results were kept separate for each of the different courses.

Assumptions

There were several assumptions required by this study. First, it was assumed that the instructors for both the traditional and distance-education courses provided consistent instruction for each of the two groups. Second, it was assumed that the instructors used the same criteria for grading in each of the two courses. Third, it was assumed that the teaching style of both instructors was similar enough across the four sections to have been only a minor influence on the outcome. Fourth, it was assumed that all of the students registered in both sets of courses had an equal chance to pass the course. Fifth, it was assumed that each group entered the course with the prerequisite skills needed to complete the course.

And the Survey Says...

At the end of the semester, the various final exam grades were collected from both sets of courses and plotted in a spreadsheet format. The grades were collected with no names associated with them. Only after the names had been removed and the exam scores randomly sorted were the data provided.

The exam scores of each of the samples were recorded in an Excel spreadsheet to keep the information separate between the experimental (SRS) and control (non-SRS) groups. Each set of courses was given its own worksheet within the spreadsheet. There were no incompletes ("I") or unreported grades ("Z") associated with either set of courses. All grades were included, including those of students who failed the courses. The students who withdrew from the class with a "W" were not included in the final calculation. Only those students who completed all three exams were included. The grading for both groups followed a traditional plus/minus system.

The means for each course were determined and a two-tailed independent samples t-test was used to compare the means of the experimental and control group samples to determine if there was a statistically significant difference in exam scores between the experimental course and the control course.

Exam averages for each of the exams is shown in Figure 3. The average for Exams 1, 2, and 3 for the SRS sections is 72.2, 81.1, and 78.8 respectively with an overall grade of B or 83.2. For the non-SRS sections, the average for the three exams is 76.2, 73.0, and 77.0 respectively with an overall grade of B- or 80.9.

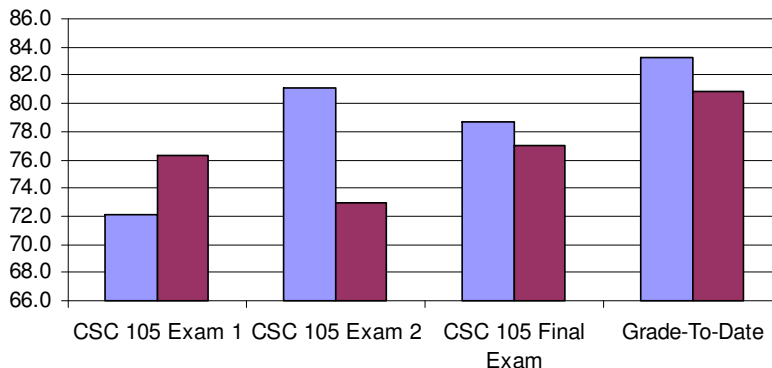


Figure 3. Exam averages for SRS (blue) and non-SRS (maroon) sections.

The grade breakdown for the SRS sections, Figure 3, shows a bell-shaped curve with a grade of B as the median grade.

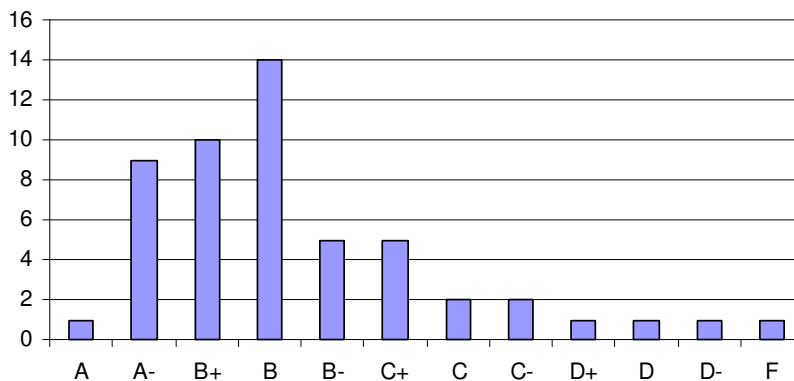


Figure 4. Grade distribution for the SRS sections.

The grade breakdown for the non-SRS sections, Figure 5, also shows a bell-shaped curve with a grade of B as the median.

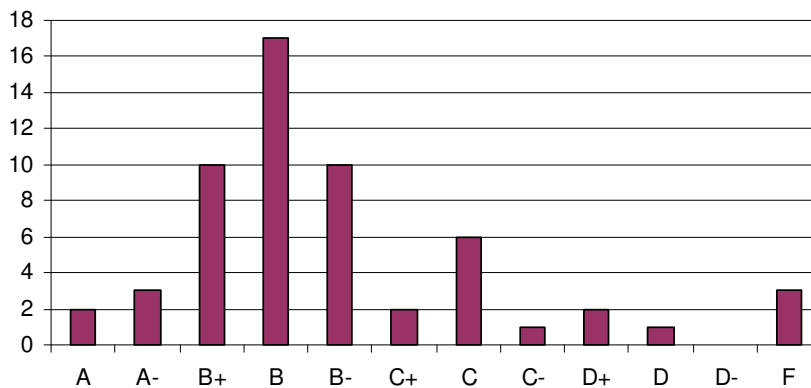


Figure 5. Grade distribution for the non-SRS sections.

Figure 6 shows the overall grade distribution for the two groups.

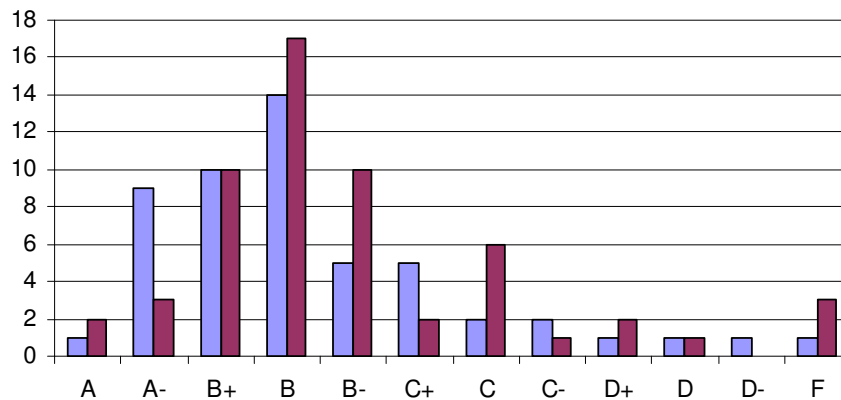


Figure 6. Grade comparison between the SRS (blue) and non-SRS (maroon) sections.

Exam 1

A two-tailed region of rejection was used with $\alpha = 0.05$ and a critical value of 2.04 at a degree of freedom of 108. The results ($z = 1.236585179$) showed there was no statistically significant difference in the sections of the course when one section is taught using SRS and the other section is taught without SRS. The results were achieved using Microsoft Excel software and the values confirmed manually.

Exam 2

A two-tailed region of rejection was used with $\alpha = 0.05$ and a critical value of 2.04 at a degree of freedom of 108. The results ($z = 2.629631818$) showed there was a statistically significant difference in the sections of the course when one section is taught using SRS and the other section is taught without SRS. The results were achieved using Microsoft Excel software and the values confirmed manually.

Exam 3

A two-tailed region of rejection was used with $\alpha = 0.05$ and a critical value of 2.04 at a degree of freedom of 108. The results ($z = 0.892113902$) showed there was no statistically significant difference in the sections of the course when one section is taught using SRS and the other section is taught without SRS. The results were achieved using Microsoft Excel software and the values confirmed manually.

Overall Exam Scores

A two-tailed region of rejection was used with $\alpha = 0.05$ and a critical value of 2.04 at a degree of freedom of 108. The results ($z = 0.996060003$) showed there was no statistically significant difference in the sections of the course when one section is taught using SRS and the other section is taught without SRS. The results were achieved using Microsoft Excel software and the values confirmed manually.

The null hypothesis for this study stated that there would “be no statistically significant difference between the means of the exam grades of students enrolled in the SRS version of Introduction to Computing and Computer Applications course when compared to the exam grades of stu-

dents enrolled in the non-SRS version of the course.” The null hypothesis failed to be rejected for two of the three exams.

The independent t-test scores for exams 1 and 3 were below the critical values at a 0.05 level of significance; however it was above the critical value at a 0.05 level of significance for exam 2.

Table 2 shows both groups with the individual means for the SRS instruction format and the non-SRS instruction format, the degree of freedom (df), t-values, and p- values. Students in the traditional classroom courses, as shown in Table 2, had a higher final grade point average.

Discussion

The results of this ex post facto study further do not support the evidence that students who take an active role in the classroom using SRS score statistically significant higher exam grades than those who do not use SRS.

To better compare these two types of teaching formats, as many as the variables as possible should be controlled or kept to a minimum [1]. This study controlled for textbook, semester in which the course was offered, exams, grade base, and PowerPoint lecture slides. The one area that was not controlled was for the instructor.

The results of these comparisons showed that, while there was a statistically significant difference in exam 2, there is statistically no significant difference between the two modes of instruction when controlling for textbook, semester in which the course was offered, exams, grade base, PowerPoint lecture slides for exams 1 and 3, and for the overall grade for the course.

Table 2. Individual Means for SRS and non-SRS Instruction Formats

	Means		Degrees of Freedom	t-values	p-values
	SRS Format (Ex-	Non-SRS Format (Con-			
Exam 1	72.15	76.25	108	1.234585179	$p > 0.5$
Exam 2	81.08	73.00	108	2.629631818	$p > 0.5$
Exam 3	78.75	76.96	108	0.892113902	$P > 0.5$

While the results of exam 2 are interesting, the overall result of no significant difference here means that the end results, student final grades, are not significantly different between the two modes of instruction.

While the comparison between the two means showed there was no significant statistical difference between the two modes of instruction for this course, the internal validity of the methodology for evaluating the students in either group can be questioned. In hindsight, the instructors may believe that they were equal in the evaluation because assignments and grades were the same in both sections; however, the instructors’ teaching styles could not be controlled.

Internal validity may also have been influenced by the small sample size. The total number of students compared in two groups were 52 and 57. The interpretation of the results should be done carefully with the small sample. With a comparison over time, when the population of students becomes larger, the end results may be different.

Conclusions

Two conclusions resulted from this study. The conclusions were the result of the research question that asked if there was a statistically significant difference between the exam scores of students in either the SRS based course or the non-SRS based course when controlling for the textbook, semester in which the course was offered, exams, grade base, and PowerPoint lecture slides. Results from the study showed there was no statistically significant difference between the two groups. The independent samples t-test results failed to reject the null hypothesis at a 0.05 level with regard to the independent variable or method of instruction.

Recommendations

As a result of this study, several recommendations can be made. Because the t-test does not assess whether the quality of instruction is better in one setting or the other, it is recommended that the quality of instruction between the two methods also be compared.

A second recommendation would be to add a control of instructor to the setting and evaluate the course again using both an SRS based and non-SRS based instructional format.

The third recommendation would be to continue with additional comparisons of other courses that utilize both the SRS based and non-SRS based instruction. This continued comparison would provide information for future courses that could add SRS based instruction to its standard teaching format.

A fourth recommendation would be to compare results within the two groups to determine if there is a statistically significant difference in final exam scores between the genders.

A final recommendation would be to compare results from student evaluations to determine if there was a statistically significant difference in whether the students felt they had learned more in an SRS based instructional format.

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