The Computerization of the Self Regulated Learning Assessment System: A Demonstration Program in Developmental Mathematics

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Abstract

The self-regulated learning (SRL) program model is based on a metacognitive (learning how to learn) approach that has been demonstrated to be highly effective in helping students improve their academic performance, with especially impressive results in mathematics. However, SRL program implementation has been hampered by the demands it makes on math instructors, who need to: 1) gather information on students' quiz scores, 2) calculate the relationship between this information and data on students' SRL behaviors, and 3) present the results clearly and in ways that will help students strengthen their mathematical understanding and its relationship to SRL behaviors. To make the procedure more efficient, engaging and effective, we have created a first-of-its-kind computerized version of the SRL quiz-taking program using tablet PCs to summarize the data and present a range of math content and SRL information to students. Our results showed that students found the tablet easy to use and described themselves as engaged in the process. This report contains samples of the SRL tablet PC program and student responses.

Keywords: self-regulated learning, metacognition, mathematics achievement

Introduction

It has been repeatedly demonstrated that poor math preparation is a leading cause of academic difficulty for many incoming two-year and technical college students. The Strong American Schools report (2008) found that more than 40% of high school graduates who enter two-year colleges require mathematics remediation at a cost of between 1.85 and 2.35 billion dollars per year. In some community college systems, up to 80% of incoming students require some form of mathematics remediation. Bailey (2009) reports that students can spend up to two years before they have completed the sequence of required developmental mathematics courses, concluding that most of these students are unable to run this gauntlet and fail out of school. Similarly, the Carnegie Foundation (2009) report found that between

60% and 70% percent of these developmental students do not successfully complete the sequence of required courses.

However, passing developmental mathematics is not a reliable indicator of future successful performance. For example, at the technical college of a large university system in the northeast only 55% of students passed a credit-level introductory college-level mathematics course after successfully completing developmental mathematics. As early as the 1990's Hudesman (1997) studied the relationship between students' mathematics achievement and academic success by tracking incoming associate degree-students over a six-year period. Prior mathematics achievement, as measured by the student's score on the mathematics portion of the college's entrance test, was associated with a variety of both positive and adverse academic outcomes. For example, students who initially passed the mathematics portion of the entrance test had a mean graduation rate of 30% in the School of Technology and Design, whereas students who failed this test had a mean graduation rate of only 13%. Clearly, as expected, proficiency in mathematics represents a major gateway to academic success in two-year and technical college programs.

Self-Regulated Learning: An Approach that Makes a Difference

Most interventions designed to address the needs of at-risk students in college developmental courses have focused on teaching academic content, such as mathematics or writing, together with a variety of academic/study skills, such as note-taking and test-taking. However, reviews of intervention studies have revealed that most such programs do not help students to attain their academic goals (Bailey, 2008; Lucas 2007; Simpson, Hyned, Nist, & Burrell, 1997). Often students continue to use maladaptive learning methods because they fail to recognize the constructive potential of the feedback they receive. Incorporating the correct use of feedback into classroom instruction represents a necessary additional component of the learning process. Implementing the Self-regulated learning (SRL) model in the classroom represents such an approach.

Self-Regulated Learning (SRL) involves teaching students and faculty members a new way of understanding the learning process and how to monitor and manage it. Many theories of self-regulation share common elements such as goal setting, the use of strategies, monitoring, and evaluating one's actions, (Pintrich & Zusho, 2002; Zimmerman, 2002; Butler and Winne, 1995). The SRL theoretical approach described in this article is closely aligned with Zimmerman's (2002) model which consists of three main sections, forethought, performance, and self-reflection; however, our model is characterized by a feedback cycle consisting of three main phases planning, practice, and evaluation (Hudesman, White, & Crosby 2004). The model is represented in more detail in Figure 1.

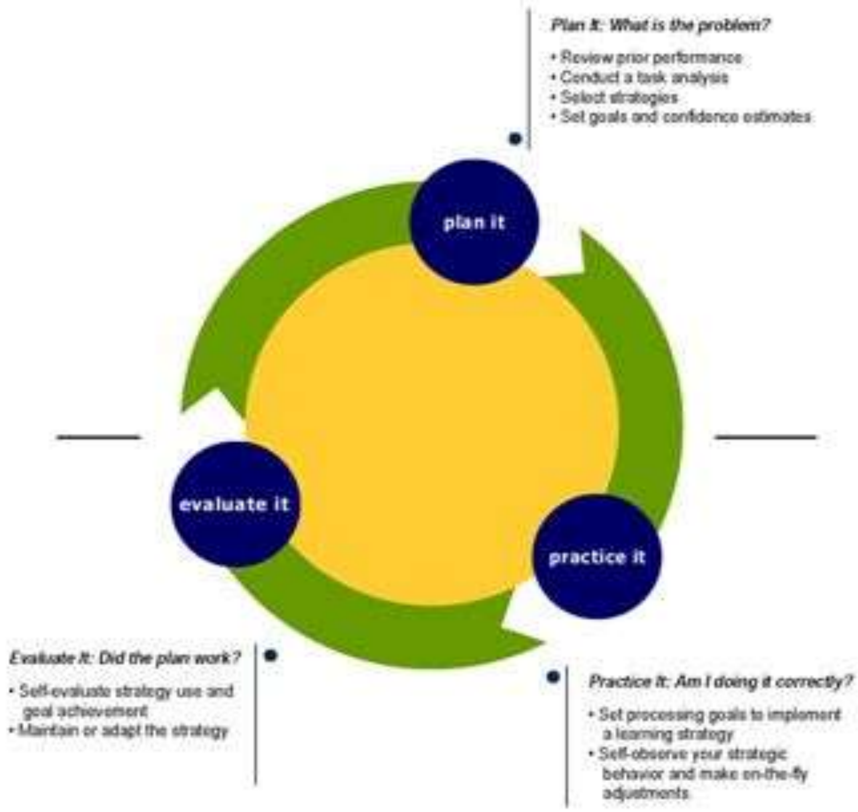

Figure 1. **Model of Self-Regulation**

During the planning phase, students in our SRL programs conduct an academic task analysis, choose those strategies that best address their specific learning challenge, set identifiable goals, and make self-efficacy and self-evaluative judgments. Within the practice phase, students design and carry out their implementation plan. During this phase, they learn to monitor their progress and make appropriate on-the-fly adjustments to their plan. In the evaluation phase, students learn to assess the effectiveness of each intervention. That is, they use self - and instruction-generated feedback to build on successful strategies and modify or replace less effective strategies. The students' responses from the evaluation phase then become the basis for the planning phase in the next SRL cycle. Implicit in the SRL model is that learning involves a series of these learning cycles each of which brings the student closer to his/her academic goal. This cyclical model provides students with multiple opportunities to constructively make use of the instructor's feedback. A number of investigators have demonstrated that students trained in self-regulation can demonstrate improvement in their academic achievement (Schunk 1996; Paris & Paris 2001; Cleary & Zimmerman 2004). Additionally, a meta-analysis of studies of elementary and high school students found that self-regulation produced statistically large achievement effects, (Dignath & Buettner, 2008). These gains were especially noteworthy in the area of mathematics.

In working with instructors and counselors to implement SRL based programs, we have been guided by two general principles: 1. Instructors and counselors must give students fast, clear, and accurate feedback about their performance, and 2. Instructors must insist that students demonstrate that they understand this feedback and can use it to improve their performance. These implementation principles are very similar to those emphasized in formative assessment programs that have become a priority for college administrators, accrediting agencies and educational investigators.

Self-regulation increases the likely hood that students are more likely to take responsibility for their learning. Self-regulated students understand that academic success is a function of experimenting with different strategies and not a function of 'natural intelligence' or some other external force such as whether the instructor likes them or not (Zimmerman, 2002). The power of the SRL model is highlighted in a classic study by Zimmerman and Bandura (1994) who demonstrated that SRL skills are more highly correlated with college grade point average than are scores on the Scholastic Aptitude test (SAT).

Self-Regulation: What We Know about the Application of an SRL Program Model.

Over the last 10 years, our SRL program group has iteratively developed and researched various components of an SRL Program model. A variety of SRL based programs have been designed and implemented in high schools and colleges in New York, New Jersey, and Ohio (Blank, Hudesman, and Zimmerman, 2007; Hudesman, 2005, 2010; Zimmerman, Moylan, Hudesman, White, and Flugman in press). Many of these initiatives have been funded by major federal agencies including the Institute for Education Sciences (IES), the Fund for the Improvement of Post Secondary Education (FIPSE), and the National Science Foundation (NSF). The IES study described below has particular relevance to our present demonstration program.

The Application of the Model in Developmental Mathematics: An IES Development Study Program.

Zimmerman, Moylan, Hudesman, Flugman, & White (in press) developed a paper-and-pencil SRL semester-long classroom intervention and then pilot tested its effectiveness with incoming associate degree students enrolled in developmental mathematics courses. All of the mathematics sections were taught by experienced instructors. Two hundred and eight students were randomly assigned to either an experimental classroom (receiving the self-regulatory intervention) or a control classroom (receiving conventional instruction) for a 15-week semester. The program procedure, which is also used in the present demonstration project, consisted of:

1. A series of math quizzes. Every two to three class sessions, students in the SRL sections were administered a 15-20 minute quiz involving four mathematics problems as a vehicle for frequent feedback to students and teachers (Appendix A). These quizzes were formatted so that both before and after attempting to solve each problem students were required to make confidence judgments indicating how sure they were that they could correctly solve the math question, i.e., they were asked to make task-specific self-efficacy judgments before solving individual problems and self-evaluative judgments after attempting to solve each math problem. The rational for this process is that many students 'don't know what they don't know', and they consistently overestimate their self-efficacy and self-evaluation judgments. By making these judgments, and then receiving feedback about their accuracy, students become more accurate in calibrating these critical self-regulation processes and apply this knowledge as part of the process of selecting appropriate strategies. For example, students who think they understand the material, when in fact they do not, are less likely to prepare for their next quiz.

2. The self-reflection process. After receiving graded quizzes from the instructor, SRL students had the opportunity to earn additional quiz credit by completing self-reflection and mastery- learning form designed to guide student' thinking about their erroneous answers to items on the quiz. The self-reflection form (Appendix B) required students to compare their self-efficacy and self-evaluative judgments with their actual performance on the quiz item, explain their ineffectual strategies with regard to solving the mathematics quiz item and establish and try out new, more effective mathematics and SRL strategies. A main portion of the reflection form requires that students redo the incorrect quiz question and include a description (in words) of the step-by-step strategies that were used to solve the problem. Students also had to solve a new problem that required them to use similar strategies.

3. Program results. Although the students in both the SRL and control group developmental math students had similar pre scores on the

mathematics portion of the American College Testing program ACT, i.e., the COMPASS (2006), SRL students demonstrated greater academic progress than did students enrolled in the control group sections. Indications of progress include: 1. higher mean scores on major examinations given periodically during the semester: 69.98 compared with 63.12 (ANOVA=4.6, $p<.05$, effect size =.37) for the students who completed the semester in the SRL and control group sections respectively; 2. Higher pass rates on a departmental final examination, 52% compared with 31% (Chi square = 9.42, $p<.01$, effect size =.44) for SRL and control group students respectively. Finally, 46% of the students initially enrolled in the SRL sections of developmental mathematics passed the COMPASS compared with only 25% of the students enrolled in the control group sections (Chi square= 9.94, $p<.01$, effect size=.45, cohort analysis). The COMPASS outcomes become more striking if we compare only those students who completed the course, i.e., did not withdraw during the semester (N=140). Sixty-four percent of the students enrolled in the SRL sections who completed the course passed the COMPASS vs. only 39% of the students enrolled in the control group sections (Chi square = 8.13, $p<.01$, effect size =.50).

Computerizing the SRL Assessment System

This study, together with a number of other research and development SRL programs (Blank, Hudesman & Zimmerman, 2007; Hudesman, Zimmerman, & Flugman 2010), demonstrates that while using this program model can significantly improve student performance. However, there were a number of issues that emerged during the program implementation. These issues, and how they can be effectively addressed by the computerized version of the SRL Assessment System, include the following:

1. When using the paper and pencil version of the SRL Assessment Program students only completed only about two-thirds of the self-efficacy and self-evaluative judgments on the quizzes. We know that completing these judgments is associated with an improved understanding of their self regulation processes (Zimmerman, Moylan, Hudesman, White, & Flugman, in press). The tablet PC version of the program requires students to take their quiz and show their work on the tablet. As part of this process students must make 100% of their SRL judgments because they are not able to continue on to the next quiz question until all the SRL judgments have been made.

2. Instructors often expressed concern about having to discuss the relationship between the self-efficacy and self-evaluative judgments and students' quiz performance indicating that they are math teachers and not educational psychologists. The tablet PC model automatically addresses this problem by creating summary graphics of the self-efficacy and self-evaluative judgments and quiz scores for each student

and for the entire class, thus making it much easier for instructors and students to understand the relationship between SRL processes and mathematics performance.

3. Instructors indicated that implementing the entire SRL program takes too much time. The tablet PC version of the program automatically provides each student's quiz scores and allows the instructors to make constructive comments on the electronic copies of the students' quizzes. It also enables the instructor to store assessment material more efficiently.

The computerization of the SRL assessment process that is demonstrated in this program is the first-of-its-kind. It is designed to enhance the effectiveness of the SRL assessment and instruction intervention. Using the tablet PC is particularly well suited to Science, Technology, Engineering, and Mathematics (STEM) students in general and mathematics students in particular because it allows them to show all of the their work, including formulas, symbols, and the like. It would be very cumbersome for students to show their work on a regular computer as they would have to hunt and peck for each symbol, a process that would soon become impractical. Within this context, this demonstration program was specifically designed to address the following questions:

1. Can we create a computerized version of the successful paper and pencil SRL Assessment System that used in the IES study described above?
2. Will students find this system acceptable and be willing to use it on an ongoing basis in the classroom?
3. Will the graphical representations depicting the relationship between their mathematical and metacognitive processes be helpful to students?
4. Does the tablet PC version of the SRL Assessment System, in comparison to the paper and pencil version, facilitate the academic progress of students in a developmental mathematics course?

Method

Participants

Students were registered in a six week summer session developmental mathematics course at the technical college of a large northeastern university. The course was delivered to all students using the SRL method previously described. The course had an enrollment of 18 entering freshmen all of whom had failed the mathematics portion of the American College Test, i.e., the COMPASS (2006). Nine students volunteered to use the tablet PC version of the SRL Assessment System and nine decided to use the traditional paper and pencil version of the SRL program. The course was taught by an experienced developmental mathematics instructor. As is the case for all of the college's summer developmental mathematics courses, there was an in class tutor.

Materials and Procedure

As part of the course, the instructor administered a series of seven short quizzes, none of which exceeded 20 minutes. Each quiz contained four questions, each with a value of 25 points. Starting with the fourth quiz, the tablet PC program students took their quizzes on an HP TouchSmart tm2 tablet PC. The format for using the tablet PC was for students to log in and then take the quiz, one question per screen. In keeping with the SRL program, described in an earlier section of this report, the students were instructed to read each question, make a self-efficacy judgment before answering the question, answer the question showing all their work, and then make a choice of the correct answer from among five choices. Students then made a self- evaluative judgment, after which the next question would appear. Students were unable to proceed to the next question without making the self-evaluative judgment for the previous question. At the end of the quiz students were asked to answer two questions about their 'time on task,' i.e. how much time they spent on homework, and how much time they spent preparing for the quiz.' The student's work was then uploaded to the instructor's tablet PC as well as to the college's server.

Uploaded work was automatically scored by the computer which generated the following information that was immediately available to the instructor, tutor, and the student: 1. Score on the quiz; 2.an indication for each question as to whether it was correct or incorrect; 3. A series of graphs that related the students' quiz score to their SRL behaviors, i.e., their self-efficacy and self-evaluative scores, as well as to their time on task. These graphs were cumulative in nature thus allowing students and instructors to graphically track the relationship between the math and SRL behaviors over time.

The instructors was also able to view each student's uploaded quiz on her tablet PC, make written comments directly on her tablet PC, award partial credit, and send a copy of the entire package to the student's home computer as a PDF. Students were then able to use this information to make appropriate revisions on incorrectly answered questions by using the self reflection (mastery learning) form (Appendix B). Based on the quality of the students' work it was possible for them to earn up to 100% of the credit value of the original incorrectly answered question.

As part of this demonstration program, those students using the tablet PCs were asked to complete a total of three, three-question surveys on how using the tablet PC compared with taking quizzes using a paper and pencil format. An additional survey, administered to all students during the last week of the course, asked for their reactions to various SRL interventions, including the use of tablet PCs.

Results

Individual Student Results

As previously mentioned, tablet PC users received an email packet after each quiz. The packet consisted of the corrected quiz and two graphs. Students used the tablet PCs for quizzes 4 – 7. Based on the information supplied by the student, the computer automatically created graphs that illustrate the relationship between the student's math and SRL skill levels. Sample graphs for two program students are presented. Figure 2 shows the relationship between the student's actual quiz score and his SRL judgments, i.e., his self-efficacy and self-evaluation judgments.

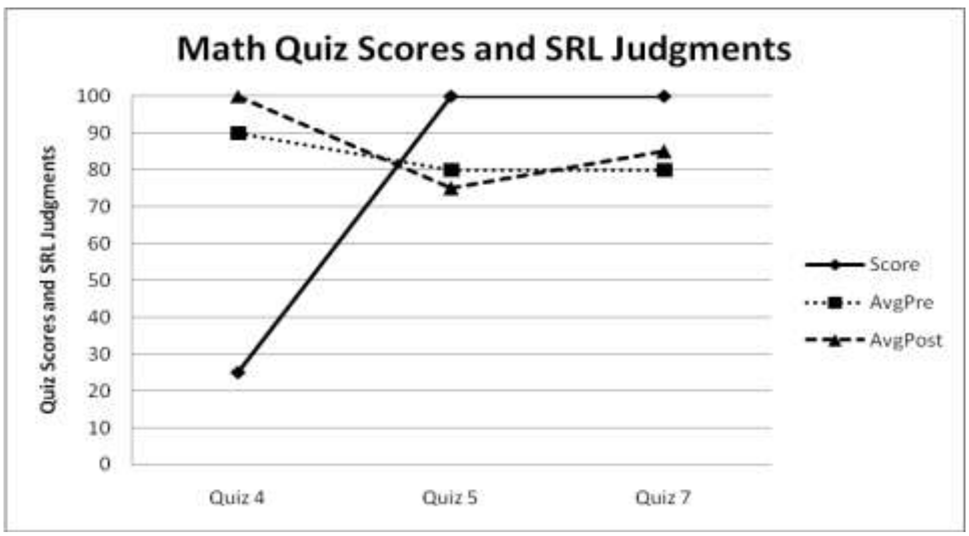

Figure 2. **Results of the Relationship between One Student's Math Quiz Scores and SRL Judgments. Notes:1 Mean pre self-efficacy and post self-evaluative judgments were transformed from a scale of 1-5 to a scale of 20 – 100; 2. This student was absent for quiz 6.**

The score is the student's actual score for each of the quizzes. The self-efficacy judgment (AvgPre) represents the mean of the student's self efficacy judgments for each quiz. Similarly, the self-evaluation judgment (AvgPost) is the mean of the student's self-evaluation judgments for each quiz. What is noteworthy in this graph is that at the start of the process (quiz 4) the student's SRL judgments are noticeably higher than his actual score. This discrepancy illustrates the difference between what the student thinks he knows in terms of his judgments (a lot) and what he actually knows in terms of his quiz score (not so much). However, by the end of the seventh quiz the gap has narrowed considerably indicating that what the student thinks he knows is much more closely aligned with what he actually knows. This self knowledge is a critical for the student if he is to develop more adaptive academic behaviors.

Figure 3 illustrates the relationship between another student's time-on-task on each quiz, as measured by time spent on homework as well as time spent in quiz preparation, and his quiz score.

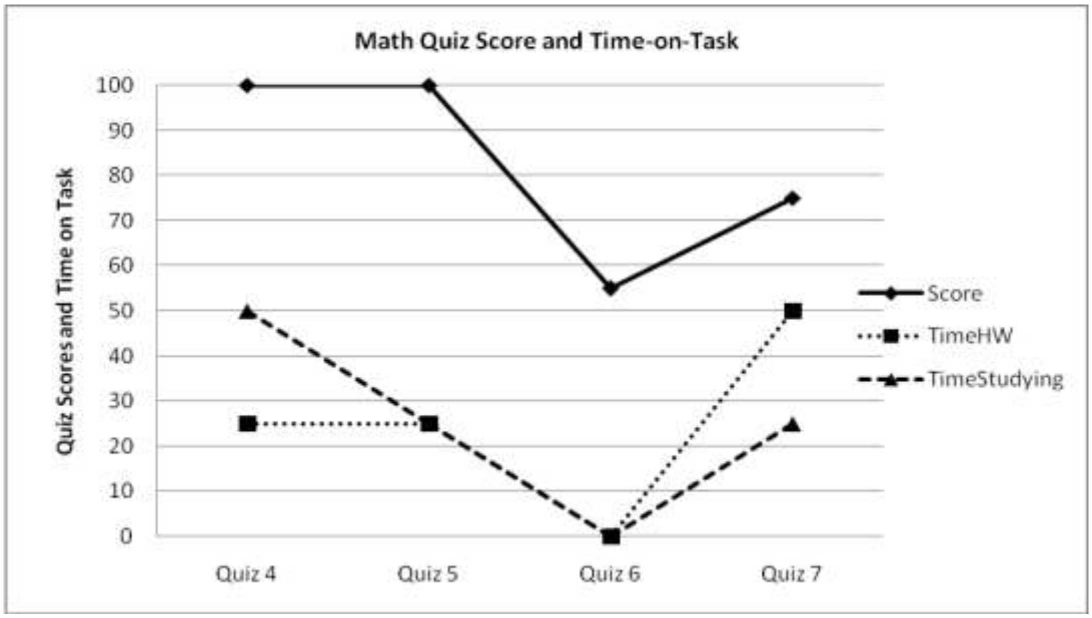

Figure 3. **The Relationship between One Student's Math Quiz Scores and His Time-on-Task Reports.**

The two time-on-task measures were calculated on the basis of how many minutes students spent studying by: 1. doing homework problems (Time HW), and 2. the number of minutes that they spent studying for the quiz in addition to their homework. Time on task was calculated by categorizing the number of minutes as follows: 0 minutes= 0, 1 – 29 minutes = 25, 30 – 59 minutes = 50, 60 – 119 minutes = 75, 120 minutes (+) = 100. What is noticeable is that when the student's preparation time decreases (see quiz 6) so does his quiz score. Conversely, when the student's preparation time increases so does his quiz score (see quiz 7). Providing this type of feedback to students on an ongoing basis can be an important feedback aid in assisting students to see the relationship between effort and results.

Class-wide Responses to the Project

On three occasions students using the tablet PCs were given a brief survey. Seven to eight students out of the nine participants responded to each question. Students were asked: 1. to compare taking the class quizzes using the tablet PC with taking the quizzes using a paper-and-pencil format, 2. whether it was helpful to receive computer generated graphs that related their math outcomes to SRL behaviors, and 3. whether there was a certain 'cool factor' to using the tablet PC. Table 1 summarizes the cumulative responses for the three surveys.

Table 1
Survey Responses for Students Who Used the Tablet PC

Measures	Cumulative Survey Responses		
	Yes	Same	No
Is the tablet pc-paper easier than pencil paper?	9	13	0
Are Graphs helpful?	20	NA	2
Is there a 'cool factor' using the tablet pc?	20	NA	2

Notes. (1) There were seven respondents in the first and second surveys, and eight respondents in the third survey. (2) NA indicates that there was no 'same answer' option applicable for this question.

As can be seen by the response pattern in Table 1, all of the students who used the tablet PCs found it at least as easy to use as taking a paper-and-pencil quiz. Almost all of the survey respondents found it helpful to receive the tablet PC graphs that illustrate the relationship between their mathematics performance and their SRL behaviors. This type of graphical feedback is not available to students (or instructors) using the paper and pencil version of the SRL Assessment Program. And almost all of the students who used a tablet PC thought there was a 'cool factor' in using this technology.

In addition to the three brief surveys completed by the tablet PC users, all the students (tablet PC users and non-users) were surveyed at the end of the course about their reactions to a variety of SRL course interventions, including the use of tablet PCs. The results of this survey are summarized in Table 2.

As seen in Table 2 almost all students in both groups responded positively to a wide variety of SRL course features including the use of tablet PCs. All of the students in the class, except for one student who did not use the tablet PC, recommended that tablet PCs should be used in future mathematics classes.

These survey results reflect the reports of informal discussions that took place between students, the instructor, the tutor and which indicated that the tablet PC information was quite helpful.

To determine the extent to which using the tablet PC would in any way show promise in facilitating students' academic progress in the course, tablet PC students and paper-and-pencil students were compared on a number of measures.

Table 2
Survey Responses for All Students Taking the SRL Developmental Mathematics Class

	Tablet Users (N=9)		Non Tablet Users (N=9)	
Questions	Yes	No	Yes	No
Was it helpful to have frequent quizzes?	9	-	9	
Was it helpful to make confidence judgments before and after each quiz?	7	2	7	2
Was it helpful to make grade predictions?	7	2	8	1
Was it helpful to enter your study/hw prep time?	8	1	8	1
Was it helpful to complete self –reflection forms for incorrectly answered questions?	9	-	9	
Is there a connection between math and non math (SRL) activities in this class?	9	-	9	-
Would you recommend the tablet pc be used in future classes?	9	-	8	1

Table 3
A Comparison of Mean Course Measures and COMPASS Scores for Tablet PC Users and Non Users

Course Measures	Tablet PC Users (*N*=9)	Non Tablet PC Users (N=9)
Pre Course COMPASS: Algebra Score	24.00	23.89
Mean Number of Absences	1.44	2.11
Mean Homework Score	62.22	46.78
Mean Quiz Score	87.82	74.85
Mean Test Score	79.33	70.78
Final Exam	82.44	76.67
Course Average	81.56	74.56
Post Compass: Algebra Score	35.38	36.63

While it was not the intent of this demonstration to determine the relative effects of tablet PC vs. paper and pencil versions of the program on academic performance, we were interested in whether there would be any consequences of using technology in what was already a successful program. The data in Table 3 indicate that while the tablet PCs were only used by students for approximately half the course, the tablet PC group performed slightly better than students in the paper and pencil group on six out of seven academic measures (absences, homework scores, quiz scores, periodic exam scores, final examination score, and course average). Obviously, a larger more rigorous efficacy study needs to be done in order to investigate the potential of the SRL tablet PC system to assist students to improve their academic performance over and above the pencil-and-paper version of the program.

Discussion

Multi-component instructional systems that emphasize 'learning how to learn' concepts and skills are often difficult for instructors to deliver in content area classes resulting in their non- or underutilization. In the latter case, students and instructors not only have difficulty in managing all of the parts of the program but also struggle to fully understand metacognitive concepts and how they can be used and learned.

The purpose of this demonstration program was to address this overall challenge by designing and implementing a computerized version of the SRL Assessment System that built on the earlier successes of the paper-and-pencil version. Our goal was to optimize the delivery of components, make it more efficient, and determine if these changes showed promise in effecting student outcomes. The computerization was made all the more difficult by the need to capture student work in mathematics, including symbols and equations, necessitating the use of tablet PCs.

While only one component of the SRL system was computerized and used for only approximately half the course, the results indicated that computerization proved feasible for classroom use, was perceived as useful and interesting by the students who used it as well as those students who observed its use, and showed preliminary promise of improving student outcomes. Specifically, our results showed that computerization was able to address problems that emerged during the implementation of the paper-and-pencil version of the program in that: 1. Students generated all the self-efficacy and self-evaluation data, making it possible for the instructor to do a more complete analysis of their quiz scores. 2. Students in the tablet PC group (and the instructor) received immediate feedback regarding quiz scores which could be acted on while the pencil and paper students needed to wait for their quizzes to be hand scored. 3. Students in the tablet PC group were able to receive an email PDF package that included instructor comments and suggestions regarding their work as well as and graphs illustrating the relationships between their mathematics quiz scores, self-efficacy and self-evaluation judgments, and time-on-tasks; 4. The tablet PC automatically saved all of the students work. By giving instructors access to this type of stored data they have the ability to analyze student performance on an individual or group level for formative assessment purposes. Although a potentially powerful process, formative assessment is frequently limited by the instructor's inability to store and manage large amounts of student data (Heritage, 2010). In terms of outcomes, there were some indications that students in the tablet PC group demonstrated better performance on a number of course related academic measures, e.g., the final examination.

These conclusions are limited by the small number of students enrolled in the demonstration program and by its implementation in one class for approximately half of the course. Despite these limitations, we were encouraged by the observation that our results consistently favored the tablet PC group. Future research needs to increase the number of students and instructors who implement the program and evaluate it using an experimental design. To date, however, we have begun the computerization of a complex intervention that has the potential to optimize its implementation in a wide range of settings

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Appendix A

Quiz

Professor

Name: ____ Date__________

Before solving each problem, circle the number that represents how confident you are that you can solve it correctly.	**REMEMBER!** **Show all your work.** **Simplify all your answers.**	**After** you have solved each problem, circle the number that represents how confident are you that you solved it correctly.
1 · 2 · 3 · 4 · 5	**1.**	1 · 2 · 3 · 4 · 5
1 · 2 · 3 · 4 · 5	**2**	1 · 2 · 3 · 4 · 5
1 · 2 · 3 · 4 · 5	**3.**	1 · 2 · 3 · 4 · 5
1 · 2 · 3 · 4 · 5	**4.**	1 · 2 · 3 · 4 · 5
1 · 2 · 3 · 4 · 5	**5.**	1 · 2 · 3 · 4 · 5

Appendix B

SRL Math Revision Sheet, Quiz #____ Item # ____

Student: ________________________ Date: ________

Instructor: ___________________________

8pts

Now that you have received your corrected quiz, you have the opportunity to improve your score. Complete all sections thoroughly and thoughtfully. Use a separate revision sheet for each new problem.

PLAN IT

1. a. How much time did you spend studying for this topic area? _______

   b. How many practice problems did you do in this topic area ______________________________in preparation for this quiz?

   (circle one) 0 – 5 / 5 – 10 / 10+

   c. What did you do to prepare for this quiz? (use study strategy list to answer this question)

2. After you solved this problem, was your confidence rating too high (i.e. 4 or 5)? yes no

3. Explain what strategies or processes went wrong on the quiz problem.

8pts

PRACTICE IT

4. Now re-do the original quiz problem and write the strategy you are using on the right.

Definitely not confident	Not confident	Undecided	Confident	Very confident

5. How confident are you now that you can correctly solve this similar item?

1 2 3 4 5

4pts

6. Now use the strategy to solve the alternative problem.

4pts

7. How confident are you now that you can correctly solve a similar problem on a quiz or test in the future?

1 2 3 4 5