COMPUTER ASSISTED INSTRUCTION TO PROMOTE COMPREHENSION IN STUDENTS WITH LEARNING DISABILITIES

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Reading comprehension is a crucial skill for academic success of all students. Very often, students with learning disabilities struggle with reading skills and since students learn new information in school by reading; these difficulties often increase the academic struggles students with learning disabilities face. The current study examined whether computer assisted instruction could be effective in teaching a comprehension strategy, story mapping, to nine high school students with learning disabilities. The investigation used a single-subject, multiple baseline designed. Daily quizzes, story maps, and a standardized test measured student progress. In addition, a survey of students' perceptions regarding the computer assisted instruction was administered. Comprehension results varied across students; however, the majority of students showed improved comprehension scores on the Gates-MacGinitie comprehension test regardless of the group in which they participated. These findings suggest the daily readings on the computer, rather than the comprehension strategy itself, might have influenced students' reading comprehension.

In the United States, 90% of the school-age population with learning disabilities (LD) have difficulty reading independently (Vaughn, Levy & Coleman 2002) including problems comprehending. Many students with LD have little or no concept of the structure of narrative or expository text, which in turn holds back their comprehension. These students must learn and implement reading comprehension skills or they do not ascertain new information. However, research shows that strategy instruction in reading comprehension can increase reading comprehension for students with LD (RAND 2002). Many times students with LD have experienced previous school failures, including contact with teachers who did not understand their problems, inability to master learning goals, or the repeating of a grade. These experiences frequently lead students to feel unmotivated (Unrau & Schlackman 2006) and unwilling to learn and practice new concepts that can lead students to dropping out of school altogether.

Thus, the impetus of betterment in reading for students with LD rests with the teacher; though adequate instruction in reading comprehension presents another problem. Both explicit instruction in comprehension strategies (Franzac 2006, NRP 2000 & RAND 2002) and metacognitive auditing of comprehension (Gersten, Fuchs, Williams & Baker2001) do not happen frequently enough in the classroom (Durkin 1978-1979, Pressley & Wharton-McDonald 2002). Comprehension strategies instruction can benefit students with LD by giving them an instructional framework to use when encountering new texts.

Many times students with LD struggle with comprehension in an area related to the structure of narrative fiction known as story grammar (Faggella-Luby, Schumaker & Deschler 2007). This comprehension strategy focuses on the idea that western fiction generally has plot, character, setting, characters, and themes and generally has a similar shape of action driven by conflict with a climax or high point and some sort of resolution (Dickson, Simmons& Kameenui 1998). Studies have examined that students with LD benefit in explicit instruction in these elements thus picking up many of the same skills that their normally functioning peers achieve more naturally (Stetter & Hughes 2010). One way of teaching students story structure is through its visual representation, called story maps, which uses an outline or picture to help students understand and associate the various parts of story grammar such as plot character, setting, and theme.

Students with LD have also redressed their reading deficits with the use of computer programs' repeated practice. In many cases, the extra, non-judgmental, repeated drill that a computer provided made the educational difference for the student (Stetter & Hughes, in press). Unfortunately, there is a research gap in the area of reading and computers because of the rapidly changing nature of technology, use of moneys in other areas, as well as emphasis on other reading research subjects (NRP 2000). Problems exist with the use of computers in the classroom, in part because of the unrealistic expectations that many educators placed on computers. Many educators and researchers expected computers to be a panacea, especially for students with LD, but through a lack of suitable software, this has not been the case. Additionally, many schools spent time and money amassing a great number of computers, without spending matching funds on the software or teacher professional development (Burns & Polman 2006) to accompany them. Often, they purchased software programs that were too complex for students with disabilities to operate.

The main purpose of the current study was to use computers to present a text structure strategy, story mapping, to assist high school students with LD in their reading comprehension. The research used a multiple-baseline single-subject design to answer the following two questions:

1. Does using CAI that incorporates the use of a story map strategy help students with LD improve their reading comprehension of narrative text?
2. What are the perceptions of students with LD regarding participating in CAI to help them develop their reading comprehension?

Method

Participants

The students who participated in this study attended a large, urban high school in the United States. Over 90% of students at the school came from a lower socioeconomic status (SES); based on the criterion of receiving free or reduced price lunch. All the students with LD were informed about the study; however only, 29 students, or approximately 16% of all eligible students, returned a consent form signed by their parent or guardian. Nine students were then randomly selected from the pool of students who agreed to participate and met eligibility requirements (e.g. third to fifth grade instructional reading level).

Nine students were identified by the school as having a learning disability in the area of reading. Seven students were 14-years-old and two were 15-years-old at the start of the inquiry; one of the students was repeating their current grade (See Table 1). Students in the study received special education services in self-contained special education English or reading classes. Students had reading comprehension scores ranging from 3.3 to 4.9 GE as measured by the Gates-MacGinitie reading comprehension test. Three of the nine students were African American girls while the remaining four boys and two girls were Latino.

Table 1

Personal Data of Participating Students

Student*	Grade	Age	Disability	Ethnicity	Gender
			Intervention		
Phil	9	14	LD	Latino	Male
Taylor	9	15	LD	African-American	Female
Jasmine	9	15	LD	Latino	Female
			Delayed Intervention		
Vanessa	9	14	LD	African-American	Female
David	9	14	LD	Latino	Male
Paul	9	14	LD	Latino	Male
			Baseline		
Tanya	9	14	LD	African-American	Female
Andrew	9	14	LD	Latino	Male
Katherine	9	14	LD	Latino	Female

Note. All student names are fictional.

Instruments

***Standardized test*.** The Gates-MacGinitie (MacGintie, MacGintie, Maria & Dreyer 2001) has two forms, which measure comprehension and vocabulary with test levels for students in grades pre K

through adult. Only the comprehension subtest was administered to students, which took 35 minutes to administer, and consisted of 48 multiple-choice questions based on different reading passages. Students took the Gates-MacGinitie comprehension subtest at the beginning of the study to ascertain a more accurate reading comprehension level, repeating the procedure with the alternate form at the end of the study, approximately eight weeks later, to chart any growth.

Comprehension quizzes. After each story, in the baseline, intervention, and maintenance phases, participants completed a 20-question comprehension quiz on the computer. The multiple-choice quizzes measured comprehension through factual, vocabulary, story grammar, and inference questions that were included with the stories by the publisher (Goodman 1994). The multiple-choice quizzes gauged whether the students generalized and applied the new knowledge of the story elements to their comprehension of story events and story grammar. Each question had three possible answers, of which one was correct. Comprehension quizzes were normalized with five adult good readers and five reading professionals completing all quizzes. After they completed the quizzes, the researcher performed an item by item analysis (Thorndike 1997). Questions that appeared to be problematic were examined, and they often had unclear wording or misleading, so the researcher rewrote them in an effort to clarify.

Students' perception survey. After the study was over, the students took a 13-question survey with ten questions via a 4-point Likert scale (1=strongly agree, 4=strongly disagree) and three oral open-ended questions. The questions gathered student feedback on the ease of use of the web pages, their attitudes toward the story grammar strategy, and student perceptions about learning on the computer. Students in the Baseline Group considered their experiences during the baseline phase. The researcher examined scores across participants in order to ascertain overall reactions of participants via percentages.

Materials

Readings. The 35 stories used throughout the study came from the three-book-series, *The Reader as Detective* (Goodman 1994) which were available at the high school and had short narrative stories with comprehension questions. All stories contained at least one conflict or problem and at least two main characters. The stories were between 830-980 words and with a mean GE readability of 3.7 reading level according to the Fry Readability Formula.

Story maps. As part of the intervention, students completed a story map on the computer that consisted of 20 items related to specific story elements for each of the stories used during the intervention phase. Students had pull down menus for character names, description of the characters, setting time and place, conflict, type of conflict, high point of the story, resolution of the story, story events, and theme, with story elements data collected daily.

Procedures

After students had signed consents and taken the Gates-MacGinitie test, they were randomly assigned to be part of the Intervention, Delayed Intervention, or Baseline groups. Students met with the researchers in the school's computer lab during their assigned class period for the intervention and each had his or her own computer to perform all tasks associated with the study. Teachers excused the students from class, neither penalizing them for their missed work nor rewarding them with a grade for being in the study. Students who finished any of the work in the study earlier than the end of the 46-minute period read or worked on computer activities of their choice.

*Baseline phase***.** During the baseline phase, students met with their small group every day during their assigned class time. On the first day, the researcher modeled how to progress through the story and answer the comprehension questions using an instructional script, as the students referenced their own computers. On the second day, the researcher reviewed the procedure with the small group, using an instructional script, and gave the students time to work on their own computers to read and answer questions on the next story. Each story began with a directions page, progressed to a page of vocabulary definitions, another page presented the text of the story, and a final page administered a 20-question comprehension quiz. Students had access to both the story and the vocabulary page while taking the comprehension quiz. Students received no instruction after the initial training session, though the research assistant answered procedural questions throughout. When students in the Intervention Group stabilized their baseline, as measured by the comprehension quiz, they proceeded to the intervention phase. The first student moved on to the intervention phase after five sessions and the other two students after ten sessions. The Delayed Intervention Group proceeded to the intervention

phase after 20 sessions to allow the group to receive at least ten intervention sessions; however, not all students had stabilized their baseline using the criteria outlined above.

*Intervention phase***.** After the students completed the baseline phase, students in the intervention groups progressed into the two-day intervention-training phase, where the researcher modeled the activity on a computer with the students following on theirs. On the first intervention training day, the researcher, using an instructional script, defined and clarified the story elements including plot, character, setting, and theme. The students discussed the story elements and then worked together on the story and the first day's story map. Students then completed the comprehension quiz on their own. On the second day of the intervention training phase, the researcher, using an instructional script, reviewed the different pages. Students then began progressing independently through a new module. The intervention included the following sections: directions, a story grammar reference page that defined story grammar elements, a vocabulary page, the story map page where students identified story grammar elements, and a comprehension quiz page. Data collection occurred daily. The websites were available to students online after the end of the intervention.

At the beginning of each intervention session and prior to students beginning the day's computer work, the researcher reviewed the students' answers to the previous day's story map for about five minutes. Students received their answer sheet back, corrected with the right answer(s). Students who missed sessions picked up where they left off and continued through the procedure. All students ended after their 30th session.

*Maintenance phase***.** Two weeks after the intervention ended, three students were randomly selected (one from each group) to participate in a short maintenance phase. Students completed reading activities identical to those in the baseline phase for five additional sessions.

Results

Comprehension Quizzes

Students completed a 20-question comprehension quiz (see Table 2) at the end of each session throughout all phases of the study. These multiple-choice quizzes determined if students understood

Table 2

Average Quiz Scores Before and After Intervention

	Baseline		Intervention		Maintenance	
	M	SD	M	SD	M	SD
			Intervention			
Phil	8.60	2.30	7.16	1.95	-	-
Taylor	11.60	2.54	9.80	3.05	-	-
Jasmine	11.80	2.39	12.40	2.06	13.20	2.28
Total	10.67	2.41	9.79	2.35	-	-
			Delayed Intervention			
Vanessa	11.20	3.11	11.50	2.46	-	-
David	10.35	3.18	9.60	2.45	-	-
Paul	12.80	3.04	14.7	3.33	12.40	3.84
Total	11.45	3.11	11.93	2.75	-	-
			Baseline			
Tanya	13.41	3.03	-	-	-	-
Andrew	7.00	2.44	-	-	-	-
Katherine	10.30	2.69	-	-	10.60	2.70
Total	10.24	2.72	-	-	-	-

key points of the narrative they read. The researcher examined each student's score daily for its relation to the student's own progress as well as its relation to other students in the group (Intervention, Delayed Intervention, and Baseline). Logarithmic trend lines of student scores denoted trends in data scoring across baseline, intervention, and maintenance phases (See Figures 1, 2, and 3). Student mean scores did not correlate significantly to the reading level of the passage, with a Pearson's coefficient of .082.

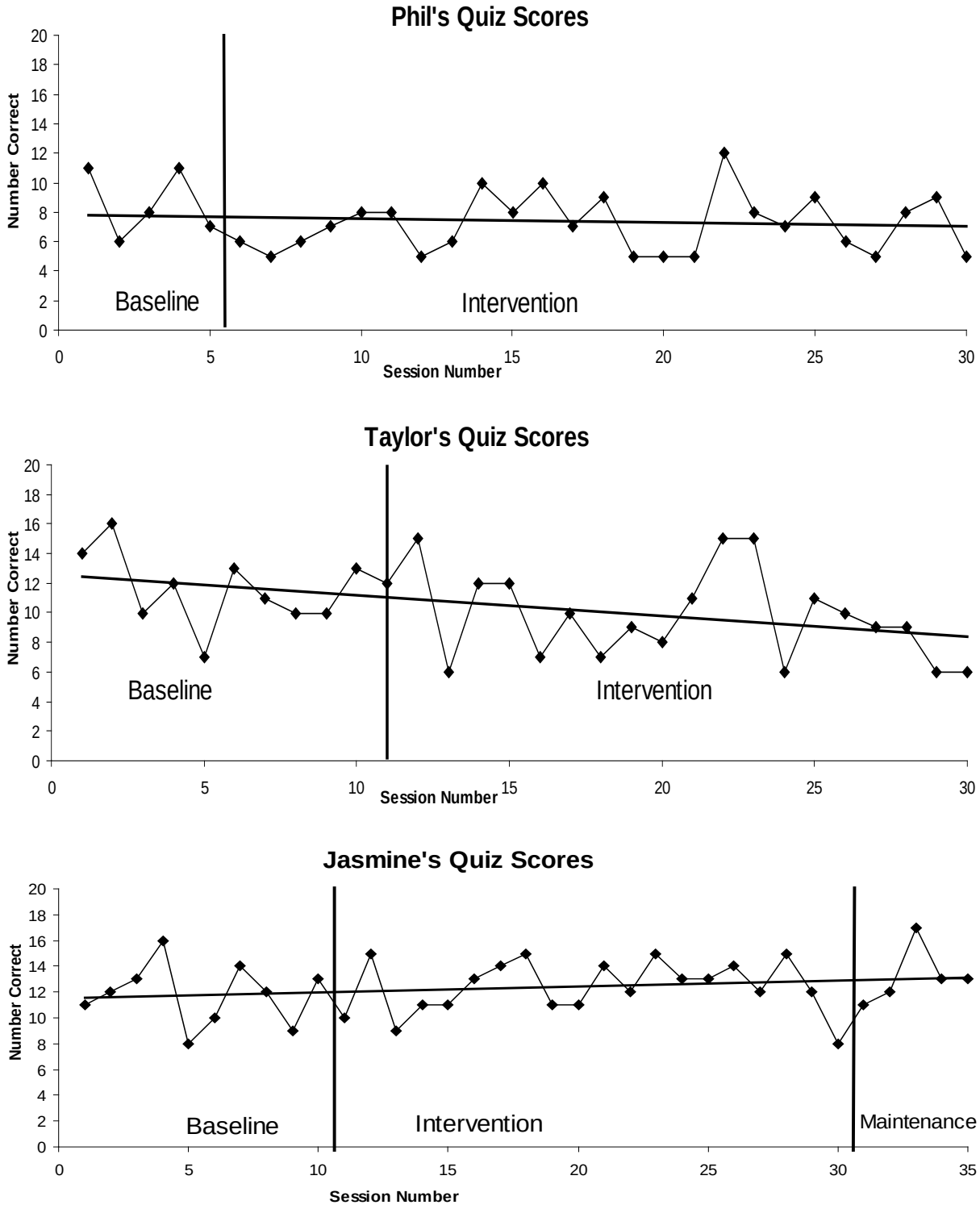

Figure 1. Intervention group quiz scores.

*Intervention group***.** Students' results on the daily comprehension quiz are available in Figure 1. Overall, students in this group showed little or no increase in quiz scores as they moved from baseline to intervention phases. During the baseline phase, Phil averaged a score of nine on the quizzes, but dropped to an average of seven during the intervention phase. Phil exhibited a slowly decreasing trend in scores across the baseline and intervention phases. Taylor's average on the quizzes was 12 points during the baseline stage and 10 points during the intervention stage. Taylor's quiz score trend during the course of the study was decreasing. Finally, Jasmine's quiz scores during baseline and intervention averaged 12 points. Jasmine showed a stable trend throughout the study. She participated in the five-

session maintenance phase where her average on the quizzes increased slightly to 13, which showed an upward trend in scores.

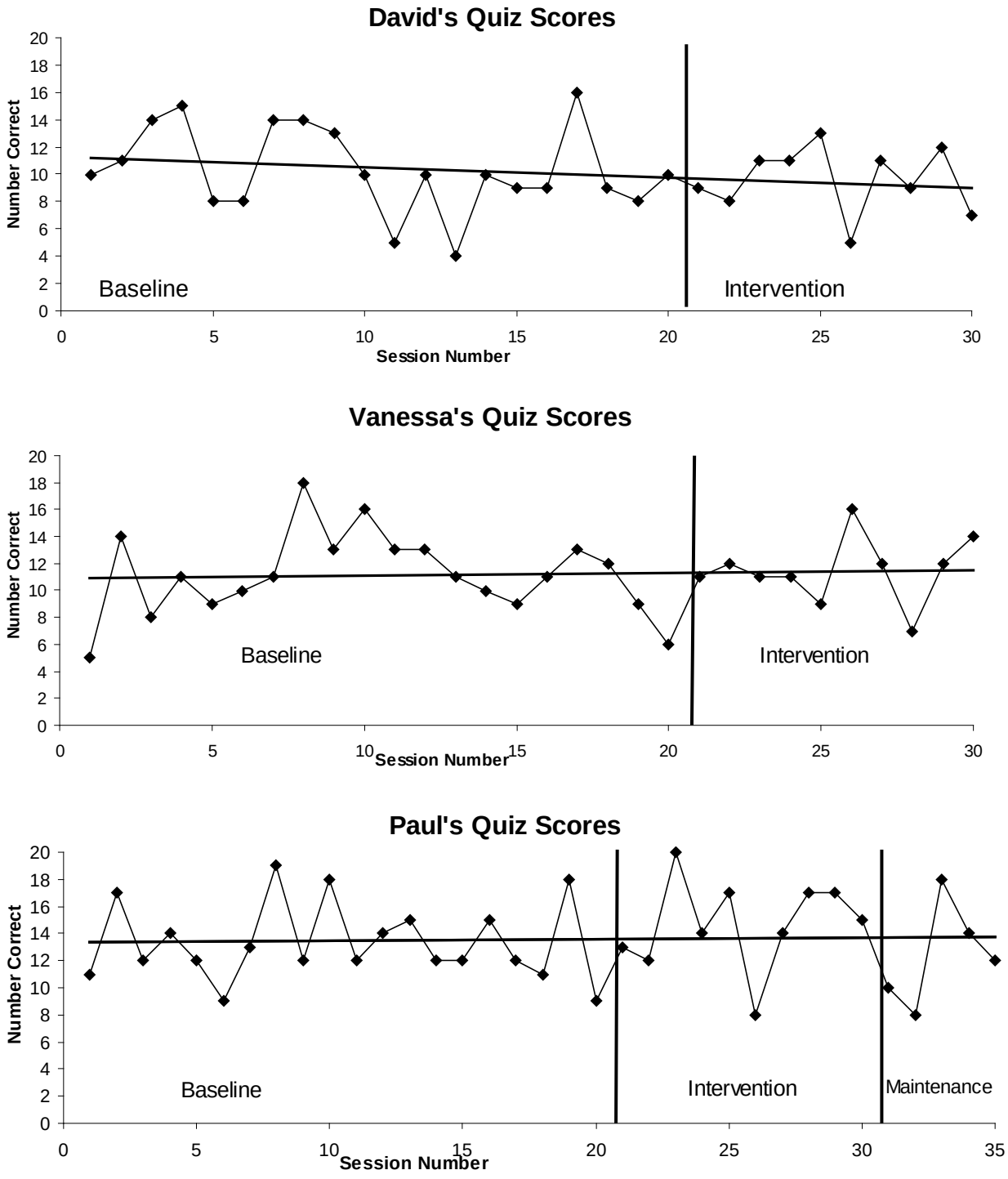

Figure 2. Delayed intervention quiz scores.

Delayed intervention group. Students in this group started participating in the intervention after they completed 20 baseline sessions. The overall results of the intervention for this group (see Figure 2) showed that two students had a slight increase in comprehension quiz scores during the intervention phase, while one student showed no improvement. Vanessa's average on quiz scores during the baseline phase was 11 points, which grew to an average of 12 points during the intervention phase. Overall, her scores showed a slightly increasing trend. David had quiz scores that averaged at ten points in both the baseline and intervention phases. However, he displayed an overall decreasing trend. The

third student in this group, Paul, averaged a 13 on quiz scores during the baseline and increased his average to 15 points during the intervention phase, showing an upward trend. Paul also participated in the maintenance phase where his average dropped to 12. He started out lower in the maintenance phase than where he ended in the intervention phase but showed an upward trend in these scores as well.

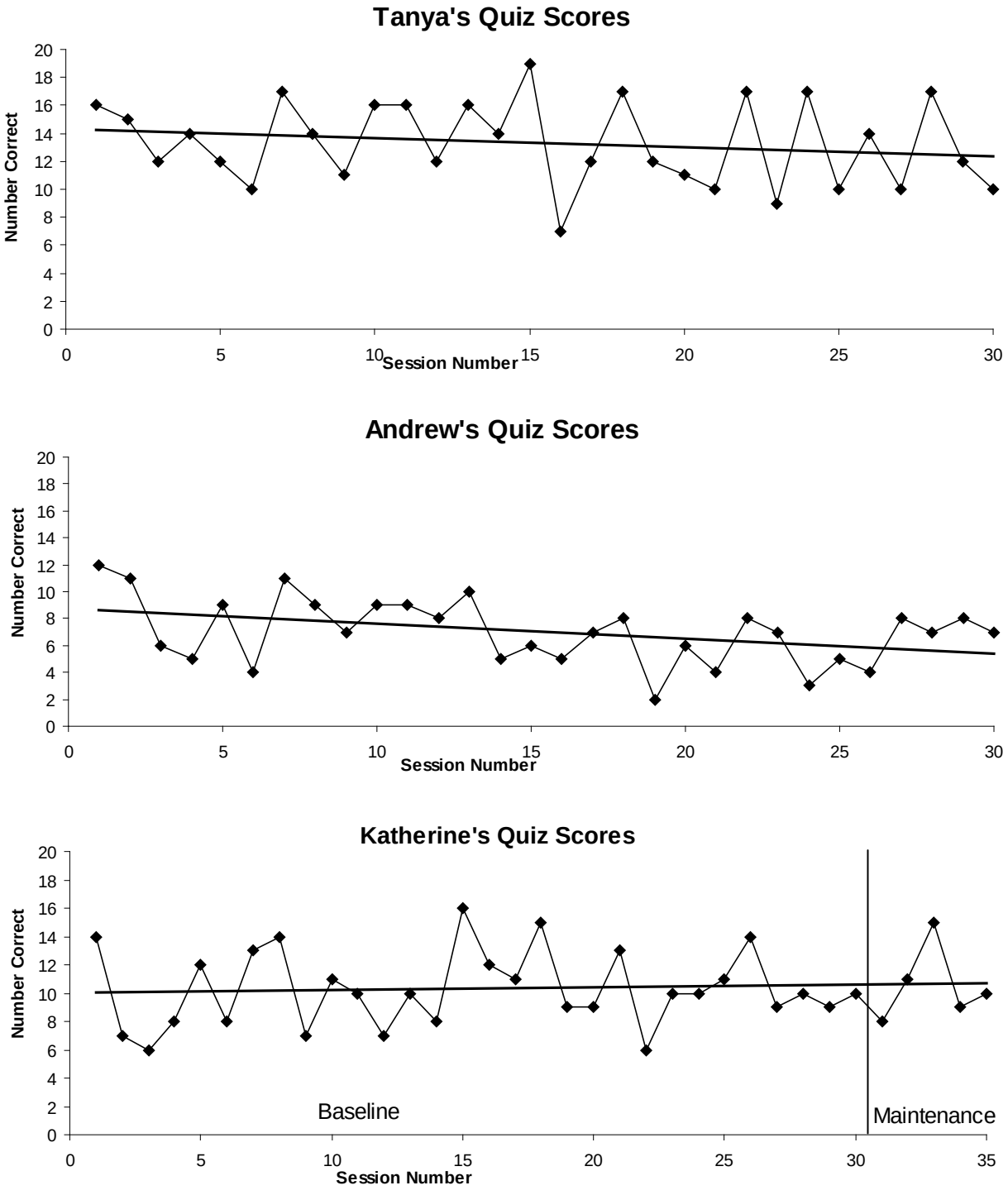

Figure 3. Baseline quiz scores.

*Baseline group***.** Students in this group completed 30 baseline sessions and did not participate in the intervention. Two students in this group showed a small decrease in scores over time, while one student increased slightly (see Figure 3). Tanya scored an average of 13 points on her quizzes and showed a stable trend with a slow downward orientation on her quiz scores. Andrew averaged seven on his quiz scores and showed a downward trend over the course of the study. Lastly, Katherine averaged a ten

throughout baseline and then increased her average to 11 during the maintenance phase. Katherine showed a slight increasing trend from the baseline to the maintenance phase.

Standardized Comprehension Test

Prior to acceptance in the study, each student took the Gates-MacGinitie (MacGintie et al, 2001) comprehension subtest to ascertain their comprehension. Approximately six weeks later at the conclusion of the study, students retook another form of the test (listed in Table 3). The Grade Equivalent (GE) scores, which show an estimate of the performance of a typical student at grade level and the Extended Standard Score (ESS), which reflects a more standardized interpretation of scores for statistical analysis are both presented. ESS scores on level in the ninth grade can range from 374 at the first percentile to 662 at the ninety-ninth percentile. As students progress, they gain fewer ESS points per year, so that during the ninth grade year, students are expected to pick up seven ESS points (Johnson & McCabe 2005).

Table 3
Student Gates-MacGinitie Scores

	Pretest		Posttest		
Student	GE	ESS	GE	ESS	Gain/Loss
			Intervention		
Phil	3.2	463	2.8	447	-16
Taylor	3.3	463	4.3	485	+22
Jasmine	4.5	490	5.8	510	+20
Average	3.7	472	4.3	481	+9
			Delayed Intervention		
Vanessa	3.3	463	5.6	507	+44
David	4.5	490	3.6	472	-18
Paul	4.9	496	5.6	507	+11
Average	4.2	483	4.9	495	+12
			Baseline		
Tanya	3.5	468	5.8	510	+42
Andrew	3.4	466	4.3	486	+20
Katherine	3.4	466	4.3	486	+20
Average	3.4	466	4.8	492	+26

Note. GE stands for Grade Equivalency, ESS for Extended Standard Score

In the Intervention Group, two students, Taylor and Jasmine, showed improvement in their reading comprehension, while Phil's scores dropped 16 ESS points from pretest to posttest. The group as a whole averaged a growth of nine ESS points over the study. In the Delayed Intervention Group, two students showed progress while one student slipped backwards on test scores. Vanessa and Paul both gained points, 44 and 18 respectively, while David scored a net loss of 18 points. The Delayed Intervention Group averaged an increase of 12 points from the start of the study. Surprisingly, all students from the Baseline Group made gains on the Gates-MacGinitie reading comprehension subtest. Tanya scored a net gain of 44 points, while Andrew and Katherine scored a gain of 20 points. The Baseline Group averaged a growth of 26 ESS points over the course of the study. In summary, all but two students showed gains in their reading comprehension as measured by the Gates-MacGinitie with the students in the Baseline Group showing the most gains on average.

Student Perceptions

Overall, the student perception survey indicated that students enjoyed the activity, preferring to receive computer instruction rather than instruction from their own teacher. Both intervention groups seemed to enjoy working on the computer to help them with their reading, while five of the six liked filling out the story map, felt that it helped them with their story element terms, and preferred it to teacher instruction. Five of six students who completed the intervention reported that they used the vocabulary page and the story page to help them in answering questions. Students indicated that they understood the directions; with only one of the five stating the activity was too hard. Tanya, Andrew, and Katherine in the Baseline Group answered the same questions with all references to the story map deleted. The three students felt that the quiz helped them understand the story better and felt the computer helped them with their reading. Two of the three liked filling out the quiz and working on the computer, feeling that the quiz helped them better understand story elements. All three felt the activity was not too hard and understood the directions. Two preferred working with the computer to working with their teacher.

Discussion

The purpose of this study was to assess the use of computers to present a text structure strategy, story mapping, to assist high school students with LD in their reading comprehension. Though results on the daily quizzes showed little or no growth in students' comprehension, two out of three students in each intervention group and all students in the Baseline Group showed improvement on the Gates-MacGinitie comprehension test.

As stated in the NRP (2000) and the RAND study group (2002) reports, instruction in comprehension strategies such as visual imagery, advance organizers, visual imaging, visual mnemonics, summarization, main idea, self-questioning strategies, and multiple strategy instruction improve reading comprehension in students with LD. Teaching comprehension strategies to students, especially those with LD, have assisted students in improving their comprehension (Franzac 2006). The present study hypothesized that extensive work with story grammar would give students with LD a tool that they could successfully use on unfamiliar narrative material. Reading comprehension was measured in two ways, through a daily quiz, and a standardized pre and posttest, the Gates-MacGinitie. Students in the two intervention groups made little or no improvement in their reading comprehension as measured on the quizzes. However, after four of the six students who learned the story map strategy, comprehension scores improved on the Gates-MacGinitie. Of the two students who did not show improvement in comprehension, they had differing pretest reading levels; one at the lower end of the scale and one higher. Informally, the traits that they shared were that initially, they were among the most interested in being recruited for the study, yet when in the study, observationally, they seemed the least interested in it. These two students also seemed to have some of the fastest times in completing the materials. Students had the possibility of using an entire 46-minute class period to complete the activities on the computer, but generally students used only a third of the period to complete the study activities during the baseline phase and less than half the period to complete the activities during the intervention phase. Students may have progressed quickly through the intervention due to their not accessing the reference pages available to them. It was easy for them to simply pass through the information without reviewing or reading it, while studies have found greater success when forcing the students to really review the information. Other studies suggest that students improve their ability to comprehend due to their increased ease of referencing story text, and important vocabulary when presented in computerized form (Pearman 2008). The intervention students, who made progress from pre to posttest of the Gates-MacGinitie, seemed to use the reference pages almost every day, while others referred to them occasionally.

Another reason that students may not have improved their reading comprehension to the extent expected could be that they lacked motivation to carefully read the text and materials, since participation in the study did not impact their grades. Certainly, studies have found that motivation to read declines over time in school (Unrau & Schlackman 2006) and that students with LD often have problems with attention. The main way that teachers in the field have to address lack of motivation and attention is through tying reading to situational interest (Unrau & Schlackman 2006) as well as through good teaching and teacher/student involvement in tasks. Ultimately, it is the teacher who introduces and directs learning activities, increasing success for the student (Franzac 2006). The study at hand may have lacked sufficient teacher-led instruction in the reading comprehension strategy itself (Dynarski et al 2007). Students received only two in-depth teacher-led discussions of the strategy, which perhaps should have been increased, as students with LD may need more teacher-directed intervention with their computer support (Dynarski et al 2007). Additionally, the way in which students received feedback, at the beginning of the class for five minutes may have been insufficient and not most meaningfully placed. Better instruction might have included immediate teacher or computer feedback, so that students could have seen and learned from their own mistakes while completing the story map. Some successful computer intervention studies have paired the computer with active teacher-led instruction and feedback.

Though computer-based studies have emphasized the teacher-led intervention portion of computer learning, studies in the field of reading comprehension have also emphasized passing a blueprint of strategies on to students to assist with working with their reading comprehension (NRP 2000). These blue prints often involve in-depth, multi-strategy approaches to reading comprehension. Perhaps working with one strategy, the story map, was not sufficient to support comprehension, as other studies have attempted to provide students with a packet of strategies to assist in comprehension with great success.

Though all of the previously mentioned issues could have impacted student learning to produce the inconsistent findings associated with the two intervention groups, results were further confounded by the fact that the students in the Baseline Group improved their reading comprehension scores on the Gates-MacGinite, without experiencing the comprehension strategy the intervention students had. It is possible that the students improved their scores on the comprehension test due simply to the exposure to the number of stories that the students read in the course of the eight-week study. Often students do not get the opportunity to read and class time is spent idle, or following along as others read (Pressley & Wharton-McDonald 2002). These students read thirty stories in an eight-week period on their instructional level, which is a significant amount of reading, when students do not necessarily get enough contact with text.

Perhaps the biggest points to take from the inconclusive standardized test scores are two-fold. Teacher instruction in reading comprehension may not only be important in itself (Pressley & Wharton-McDonald 2002) but especially crucial when scaffolded with instruction on the computer. Due to students with LD having problems in motivation and organization, explicit, in-depth, repeated instruction in reading comprehension strategies may need to take place.

As previously noted, there exists a dearth in the literature regarding computerized instruction (NRP 2000, RAND 2002). Literature has been very basic, exploring whether simply reading in front of the computer can benefit students with LD as well as examining the successfulness of hypertext supports (Twyman & Tindal 2006). Although studies are moving into more of an examination of the usefulness of specific computer programs, they often show little success (Dynarski et al 2007). Ultimately, having students do the same work that they might do in a workbook on the computer has not shown to be successful (Twyman & Tindal 2006). Conceivably, if the research intervention had been more assistant-led, students might have experienced a more meaningful learning experience on the computer. Though the presentation of the strategy on the computer with minimal teacher support appeared to have little impact on student learning, having students read the great amount of material that they did on the computer had some effect on students in both the intervention and baseline groups. Students read 30 stories in a short period, with the computer providing an excellent means of presenting the information. Increasingly, classrooms are introducing actual reading of texts via the computer as seen in digital storybooks as well as hypertext. It is the wave of the future that students will increasingly view text on computer screens. This trend makes the ability to read both paper and digital text more important. Students' increases in their reading scores might correlate with most students' expressed preference for working on the computer. In fact, one of the two students who did not improve emphatically stated that he preferred books to the computer. His dislike of the computer may have influenced his performance in the intervention. His attitude is in contrast to previous studies where students preferred work on the computer to workbook instruction (Pearman 2008).

Though students generally enjoy working on the computer, it is common that they do not always take advantage of the computerized supports given to them unless compelled (Fitzgerald, Koury,& Mitchem 2008). From observational data in the current study, the researcher did not see many of the students referring back to the story grammar reference page and rarely to the vocabulary page and story. This is consistent with other studies using similar CAI; students do not always take advantage of the supports offered to them unless compelled to view them, or at least pass through the information (Johnson-Glenberg 2005). Another consideration is the ease with which a piece of technology can be used, as with the Quicktionary Reading Pen II which has been used with students with great success (Higgins & Raskind 2005). The Reading Pen II is about the size of a regular ballpoint pen, which assists in the ease of its use and allows students to scan unfamiliar words in text.

Plausibly, the activity on the computer in the study at hand was too passive for the students, in that they only had to select the correct answer from a multiple-choice drop-down menu. Other studies have shown measurable student gains in comprehension with activities that involve students more actively in tasks, such as replacing more difficult text with text that is easier for students to understand (Pearman 2008), taking computer notes on text read, or creating questions after reading text (Johnson-Glenberg 2005)**.** The students in this study needed more interactions with the text and material, rather than just choosing answers from a pull-down menu. Students might have also benefited from a more interactive story map section with games or activities that reinforced the story grammar elements.

Limitations of the Study

Although the researcher made every effort to standardize all procedures, there are always threats to the validity of any study. These can come from within the study, the way that the researcher implemented the study, or from the nature of single-subject research itself. History posed a threat to internal validity in this study. The students participating in this study were also in school full time during the day, making it difficult to know what other teachers covered at the same time that this study took place. All of the students in the study had one additional reading or English course, which might have included instruction in story grammar elements. When a student experienced the same instruction from many different sources, it could have contributed to the variable results throughout. It was also difficult to estimate what students already knew about story grammar and its application to improve reading comprehension. Having a measure of story grammar before the intervention would have been beneficial in informing the results of the study. It would have allowed for a measure of student knowledge of story grammar elements before and after the intervention in order to measure any changes.

Implications of the Findings

This study tested the ability of one CAI technique to assist in the teaching of a comprehension strategy to students with LD; as has been shown in previous literature. It extended the literature by combining a comprehension strategy with website-based presentation, as well as including a short teacher introduction of the strategy. The growth in comprehension test scores for some of the students pointed to the ability of the individual attention of the computer to assist with overall comprehension growth for some students, as can be seen in previous literature.

Most of the previous literature with computers has been descriptive, e.g., testing whether just placing students in front of a computer can help them with their knowledge or ability to read text (Pearman 2008). Few studies looked at a specific strategy or program in an effort to help students with achievement. Not only has little work been done with computers in the manner of this study but also, little has been done with comprehension strategies on the computer. The NRP (2000) found only 21 studies on computers and reading and of those only three dealt in any way with reading comprehension. This study placed the measurement instruments on the computer, as well as introduction and review of the strategy.

The study suggests additional responsibilities in the teacher role when using technology, as can be seen in recent literature (Dynarski et al 2007). To use technology effectively, teachers must strategically plan and implement its use in order to increase student learning. Teachers may need to scaffold the work on the computer with active feedback so that students will understand and use all supports available to them. Many students, especially those with LD need discrete and meaningful direct instruction of concepts in order to learn.

The role of teacher planning and implementation is crucial not only in the use of computers but also in the teaching of comprehension and comprehension strategies. Actively teaching reading comprehension strategies has been shown to benefit students, especially those with special needs (Pressley 2002). Students need this explicit instruction in how and when to use comprehension strategies. This study looked at the use of story grammar, but the same holds true for other comprehension strategies. Additionally, most of the work with story grammar instruction of students with LD has focused on the middle school level instead of the high school level. The current study looks at a somewhat neglected age group.

Suggestions for Future Research

The results of the current study suggest that additional study in the areas of reading comprehension and computers for adolescent students with LD is needed. Future research should continue to examine these areas in an attempt to help individual performance. The exposure of the students to text via the computer contributed to an effect on student learning, but may be better utilized with students in a more explicit way. Perhaps the addition of graphics and visuals could assist students in improving their comprehension as well as better utilizing the medium of the computer.

Increased teacher participation might have added a metacognitive component to instruction, thus making the intervention strategy more useful to students such as that depicted in prior story grammar studies (Faggella-Luby et al 2007). This additional metacognitive component could have taken many forms, such as self-questioning or even a pop-up checklist to help student better remember the strategy.

The current study lacked an explicit component of helping students understand when and how to use the story mapping strategy that has been helpful for students with LD both in their understanding of various comprehension practices as well as the specific understanding of story grammar elements. Students may have benefited from more explicit instruction in how to utilize the strategy.

Reading comprehension strategies and the use of computers are helpful strategies that could benefit students with LD as they move through both their school and work lives. Involving explicit teacher instruction in these areas can better the learning experience of students. The results of this study indicate the need for further work involving teacher instruction paired with computer usage.

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