A COMPARATIVE STUDY OF COMPUTER AIDED INSTRUCTIONAL INTERVENTIONS IN THE ACQUISITION OF CONTENT AREA MATERIAL FOR HIGH SCHOOL STUDENTS WITH MILD DISABILITIES

by

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(Under the Direction of Richard T. Boon)

ABSTRACT

The following study is an extension of the current literature base which indicates that the use of computer generated cognitive organizers can help to facilitate student learning (Chan, Sung & Chen, 2000; Boon, Burke, Fore & Spencer, in press; Blankenship, Ayres &Langone, 2005). This study compared the use of concept mapping software to the use of using word processing software on student learning of content area material. Four students who are currently served in Special Education at a large suburban high school under one of the following areas: learning disability, deaf or hard of hearing, or other health impairment will participate in the study. An Adapted Alternating Treatments Design (Holcombe, Wolery & Gast, 1994) will be used to evaluate the comparative efficacy of two interventions. The first intervention was the use of a laptop computer with access to word processing software, *Microsoft Word 2003*, and the second intervention was the use of a laptop computer with access to concept mapping software, *Inspiration7. 6.* Within each intervention condition the student read a Social Studies passage independently for 15 minutes and used the computer program available to them during that

session while reading. Students were then assessed using the dependent measure: a ten question quiz over the material covered in the passage and percent correct data was taken for each measure. It was found that the use of the concept mapping software was not more effective than the use of the word processing software or no computer use.

INDEX WORDS: concept mapping, technology based instruction

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DEDICATION

I had tremendous support throughout my life that enabled me to pursue my every dream. Without the sacrifices my parents made to give me everything I ever needed, I would surely not be at this point. They taught me, through example, how to work hard and to never doubt what is possible. It is a great honor for me to dedicate every hour of work I have done to get here today to my parents.

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My dear husband encouraged me to start this journey, and he has seen me through every tough moment. I cannot thank him enough for giving me the support I needed to do this. Further, each professor in our department, at one time or another, has had a hand in shaping my current knowledge base and career path. I have been guided and mentored by such wonderful people who truly cared about my development in the field. Lastly, I would like to thank the students and faculty at the high school. They were wonderful to work with, and they made this process much easier.

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CHAPTER 1

INTRODUCTION

In many classrooms students are asked to read content area information and acquire knowledge from such reading, and many students with disabilities have difficulty with this skill (Mastropieri, Scruggs, Spencer, & Fontana, 2003). According to the state standards of Georgia, secondary students with disabilities must complete all general education curricula and pass state competency tests in order to graduate high school with a diploma which not based on IEP objectives. Often this can be problematic for students with special needs as they may not possess the skills necessary to meet advanced curricular demands (Deshler, Schumaker, Lenz, Bulgran, Hock, Knight, & Ehren, 2001). These issues cause students with disabilities to drop out of school more frequently than their general education peers as well as demonstrating lower grades, more frequent absences, and more frequently failing courses (Wagner, Blackorby, & Hebbeler, 1993). These students are in need of interventions that can effectively aid them in the comprehension and retention of content area material in order to provide access to general education curriculum and a subsequent diploma. However, there is a comparatively large lack of research aimed at facilitating the learning of high school age students, and this may stem from an overriding belief in the educational community that not as much can be done for older students with disabilities (Deshler, 2002).

The following research is an investigation of a comparatively more effective way to facilitate such learning. Based on research in the area of concept mapping, teachers of students with mild disabilities may have a means of assisting students in acquiring content area

knowledge through independent reading. Many schools across the nation have adopted concept mapping software as part of the software licensed for county or district use. Inspiration Inc., the foremost distributor of concept mapping software, reported company revenue of $17.6 million in 2003 (Electronic Education Report, 2004). It is important to evaluate whether or not this type of software is more effective as an aid for facilitating content area knowledge than software that may be less expensive and more readily available such as basic word processing software. Teachers and districts need to be more certain that an intervention using concept mapping software is successful when used independently and that it would be more effective than word processing alone.

Rationale

A growing body of research has demonstrated that the use of concept mapping software can aid students in the comprehension and acquisition of content area material (Chan, Sung & Chen, 2000, Boon, Burke, Fore & Spencer, in press, Blankenship, Ayres & Langone, 2005). However, much of this research has compared the effects of traditional instruction, without computer use, to the use of an intervention that included the software program. After reviewing such research, two questions merit evaluation. Are such results due to a novelty effect produced by the introduction of a computer program not generally used in traditional instruction, or is concept mapping software actually the reason for the differential results? If isolated, as opposed to being used in conjunction with other teaching procedures such as classroom lead concept mapping, does the use of the concept mapping software produce the same results? Both of these questions which address novelty of the intervention and isolation of the intervention are addressed in this study. The study attempted to extend this literature base on computer aided

concept mapping software and attempt to evaluate such questions by isolating concept mapping versus word processing as the sole variable changed within the comparison phase.

Purpose

The purpose of this study is to compare the efficacy of computer aided concept mapping to the use of word processing software on the acquisition of Social Studies content area material by high school students with mild disabilities. While the literature base in this area is developing, there is a lack of single subject research in the current literature. Further, previous studies lack a design that isolates the use of concept mapping by changing solely this variable. By comparing two conditions which both utilize computer aided instruction, the possibility of the results being due to the novelty of computer use is eliminated. Further, by only changing the software program in use and not implementing an instructional methodology that incorporates many variables, the results can be contributed to the change of that one variable. In this case, the fundamental and explicit change of the software program alone will allow for the comparison of concept mapping to word processing without other instructional features confounding results.

Research Questions

The following research study is an evaluation of three separate research questions. The third question is the central question that will be addressed and the former two are addressed as secondary questions. The dependent measure of percent correct on a daily ten question quiz covering Social Studies content area material read will be used to address each question.

1.) Will the use of the concept mapping software, *Inspiration 7.6*, alone be effective in facilitating acquisition of Social Studies material when independently read by students?
2.) Will the use of the word processing software, *Microsoft Word 2003*, alone be effective in facilitating acquisition of Social Studies material when independently read by students?

3.) When compared, which software package, word processing or concept mapping, increases student learning of Social Studies material more effectively?

CHAPTER 2:

REVIEW OF THE LITURATURE

Introduction

Students with disabilities may lack the skills necessary to independently reading content area material and acquire knowledge from the text due to poor reading and organizational skills (Mastropieri, Scruggs, Spencer & Fontana, 2003). Student educated in Special Education settings are often not asked to read independently, as teacher led instruction is often the norm. However, being able to read content area text to acquire knowledge is an important skill that needs to be developed in students if they seek to be included in general education classroom or to function independently outside of the school environment. A high level of reading comprehension of expository text becomes mandatory in most content area settings. The use of concept mapping is a strategy that has been evaluated as an aid to for reading comprehension and retention of information. It has been shown to be an effective aid in helping students achieve at higher levels (Barenholtz & Tamir, 1992; Institute of Advance Research In Education, 2003). Further, studies have supported the use of computer assisted instruction in the education of students with mild disabilities (Harper & Ewing, 1996). It has been demonstrated that students may respond better to instruction using a computer than to more traditional types of instruction (Higgins & Boone, 1990; Higgins, Boone & Lovitt, 1996). Finally, the marriage of these two strategies will be addressed through a review studies that have demonstrated that students can aptly acquire content area material through the use of concept mapping software (Blankenship, Ayres, & Langone, 2005, Boon, Burke, Fore & Spencer, in press). The purpose of this literature

review is to evaluate the research in the area of concept mapping software with attention to previous studies that support the use of concept mapping, in general, as well as computer assisted instruction.

Related Research

Throughout the literature, strategies that closely resembled concept mapping have been shown to be effective in aiding the reading comprehension of students with mild disabilities across ages (Darch, Carnine & Kameenui, 1986, Hawk, 1986, Malone & Mastropieri, 1992, Jenkins, Heliotis, Stein & Haynes, 1987, Bakken, Mastropieri & Scruggs, 1997, Smith & Friend, 1986, Vallecorsa & deBettencourt, 1997, Idol & Croll, 1987). These strategies have elements that are similar to concept mapping such as story mapping, text structure, summarization, and graphic organizers and are worth noting in a review such as this, and many of these classic studies have become the basis for the development and use of concept mapping software (see Table 1). The ways in which each strategy relate to concept mapping will be discussed as each strategy is presented; however, each strategy relates to concept mapping in the behaviors or skills that must be demonstrated though the use of the strategy. Many of the main behaviors and competencies involved in each strategy are very similar to those that must be demonstrated in order to students to construct a concept map.

Story mapping is similar to concept mapping in that both strategies use a visual representation of the information contained within a written passage to promote reading comprehension. They resemble concepts maps strongly in that they use shapes connected by lines and arrows to illustrate how elements of a story relate to each other. Idol and Croll (1987) demonstrated, using a multiple baseline ABA design, that teaching elementary age students to independently use a story map improved the performance on reading comprehension measures

including a 10 item quiz consisting of comprehension questions and on story retells. Further, 4 of 5 students were able to maintain the skill while three students demonstrated generalization to more difficult classroom materials. Vallecorsa and deBettencourt (1997) demonstrated, also through single subject research, that middle school students with learning disabilities would improve their ability to include relevant information in short story retells when taught to use a story map.

Text structure strategies are interventions that strongly resemble the use of concept maps in that they are designed to help students recognize the structure of written material. Smith and Friend (1986) found, using group design methodology, that high school students with learning disabilities performed significantly better on posttest and delayed posttest measures covering content area material in prose format when taught text structure strategies. The experimental group not only outperformed the comparison group which did not learn test structure strategies, but they improved when comparing pretest to posttest and delayed posttest. Bakken, Mastropieri, and Scruggs (1997) showed that when 8th grade students were taught using a text structure intervention which organizes the text in a logical manner, much the same way a concept map might, they significantly out performed students who did not use such a strategy on the total number of idea units recalled on immediate and delayed recall tests. Students taught the text structure strategy outperformed students taught using traditional instruction as well as students taught a paragraph restatement strategy. Further, students reported that they found the strategy helpful on a social validity measure.

The effectiveness of summarization strategies has also been well documented in the literature. This strategy resembles concept mapping due to the fact that when a student generates a concept map they must use the same techniques a summarization strategy requires. To create a

map of independently read material, students must organize the information into usable summarizations as the map is comprised of small shapes with explanations of the text. The research on summarization demonstrated that it can positively effect student comprehension, therefore, the summarization component of concept mapping should also improve achievement. Jenkins, Heliotis, Stein, and Haynes (1987) compared the effect of teaching a summarization strategy on 3rd-6th grade students with learning disabilities to instruction using more traditional methods that did not include the summarization strategy. They found that when students were taught to write brief summarizations of independently read material, they scored better on written restatements, story retelling, and comprehension questions than students who were taught using traditional instruction. Further, it was found that students would transfer the strategy in tests of transfer and near-transfer. Malone and Mastropieri (1992) also demonstrated that middle school students in grades 6-8 with learning disabilities who were taught a summarization strategy, as opposed to students who solely read the passage and were exposed to more traditional instruction, scored significantly higher on all dependent measure of reading comprehension.

At times in the literature the term graphic organizer appears to be synonymous to concept mapping. For the purposes of this review these strategies have been evaluated as a separate segment of the literature. They resemble concept maps in most ways, but often the term graphic organizers are indicative of teacher made material given to students as an aid. Studies of student use of graphic organizers are directly applicable when evaluating concept mapping. Hawk (1986) studied the use or non-use of teacher made graphic organizers by 390 6th-7th grade students whose achievement levels were variable. The use of the organizers resulted in a significantly higher mean difference between an identical 50-item content area pre and posttest when compared to students who did not use the graphic organizers during instruction. Students

who were able to use the graphic organizers during instruction improved scores on the posttest more than students who did not use the organizers indicating that the use of the organizer aided students in comprehension of content material. Darch, Carnine, and Kameenui (1986) also found that the use of teacher made graphic organizers, which included main ideas, vocabulary, and concepts, in conjunction with instruction in which students used the map, was more successful than a directed reading strategy at increasing posttest scores.

Lastly, visual representation strategies evaluate the use of a visual representation of text much the same way a concept map provides a visual representation of text. These studies helped to build a base for the use of concept mapping. Darch and Eaves (1986) conducted a study that evaluated the use of a visual display by high school age students with learning disabilities that closely resembled a completed concept map where vocabulary, definition, and concepts were presented using boxes or triangles connected by arrows. Results demonstrated that students who used the visual display, as opposed to students who were exposed to only text material and teacher led discussions, scored significantly higher on six experimenter-designed tests of the content information that assessed short term recall. However, no differences were noted on tests of transfer and maintenance. Darch and Carnine (1986) also evaluated the use of a visual display on the comprehension of content area material by forth-sixth grade students with learning disabilities. They found that students who were given a visual display as opposed to students who were solely taught using teacher led discussions and text based information without the use of a visual display outperformed on the posttest measures. However, again no differences were noted on the transfer test scores.

While these strategies are not considered concept mapping, the basis of this literature indicates students will perform better when given options for summarization or organization of

text (Darch et. al., 1986; Hawk, 1986; Malone & Mastropieri, 1992; Jenkins et. al., 1987; Bakken, Mastropieri & Scruggs, 1997; Smith & Friend, 1986; Vallecorsa & deBettencourt, 1997; Idol & Croll, 1987). These types of displays and the use of summarization are the basis of concept mapping in that much of the behaviors and materials are the same in these studies as they would be in concept mapping studies. This literature can be seen as a base for the introduction of concept mapping as a viable intervention.

Non-Computer Aided Concept Mapping

Concept mapping refers an intervention where students generate a semantic map of material. Often students are asked to create an organizer of information that involves linking material and factual information into a map of summarized blocks connected by lines and arrows. This intervention has varied greatly in the literature regarding techniques, implementation, and goals. It has been shown to be successful in improving antisocial and suicidal behavior (McCoy, Maag & Rucker, 1989), improving student writing (Ruddell & Boyle, 1989; Zipprich, 1995) as well as improve reading comprehension (Barenholtz & Tanir, 1992; Ellhelou, 1992; Scanlon, Duran, Reyes & Gallego, 1992; Englert & Mariage, 1991, Boyle & Weishaar, 1997, Boyle, 1996). Reading comprehension and achievement increases are the focus as follows due to applicability to the current study. Following is a summary of how concept mapping, without computer use, has been effective in increasing the achievement and reading comprehension of students with mild disabilities of various ages (see Table 2).

Boyle (1996) evaluated the effects of concept mapping using 30 middle school students who were diagnosed as having a learning disability or as educable mentally retarded on their literal and inferential reading comprehension of narrative passages. He used a mnemonic strategy, TRAVEL, to teach the use of the maps. TRAVEL entailed a guide for students to use

as they read the material and created their maps. The control group of students was not taught the mnemonic nor did they create concept maps. Based on posttest scores, students who created the maps increased both their literal and inferential comprehension. It is noteworthy that students did not score higher on the Stanford Diagnostic Reading Test as they did not attempt to use the mapping intervention indicating that the skill did not transfer.

Boyle and Weishaar (1997) studied the effects of concept mapping on the reading comprehension of 39 high school students with mild disabilities. Three groups of students were included in the evaluation, the first independently generated their own concept maps, the second were supplied with maps generated by an expert, and the third did not use a map and were only exposed to more traditional instruction. The experimental group also used the TRAVEL mnemonic in generating their maps. The students in the group provided maps were taught to use the maps as an aid to helping them read. The results indicated that students who used a map, either student or expert generated, scored significantly higher on several measures of comprehension. Also, students who created their own maps demonstrated significantly higher scores on measures of comprehension than the group who were simply given concept maps to use while reading. It can be concluded that students who generate their own cognitive maps fair batter than those who are given maps or those who do not use maps.

Barholtz and Tamir (1992) evaluated the use of concept maps with high school age students. The experimental group created their own maps of Science material, and the control group used more conventional ways of studying. Results demonstrated that students could independently use concept maps and the experimental group had significantly higher scores on the content material posttests.

Elhelou (1997) studied the effects of concept mapping on the Science achievement of 61 male second graders. The experimental group created concept maps over the text while the control group was instructed using lecture with an emphasis on the text. Posttest results over content are material were significantly higher for students who used concept mapping than for students who were taught using traditional instruction.

Englert and Mariage (1991) evaluated the effect of a comprehension strategy that involved the use of concept maps on the comprehension level of 28 5th and 6th grade students with learning disabilities. The experimental group used a strategy, POSSE, to guide them in the creation of concept maps. Each part of the map corresponded to a letter, and the researchers employed reciprocal teaching methods for strategy instruction. The control group participated in regular routines for instruction with opportunities to read the same passages as the experimental group. Students who used the strategy that included concept mapping made significant gains in their ability to recall textual ideas as compared to the control group who did generate concept maps.

Scanlon, Duran, Reyes, and Gallego (1992) researched the effects of Interactive Semantic Mapping on the reading comprehension of elementary, middle, and high school students with learning disabilities. The experimental groups used a teacher generated outline while they completed specific steps that lead to the development of a concept map. Students at each level created the maps in content areas including science, social studies, or vocational. Each group was compared to a control group of students who participated in definitional instruction. Students who participated in the concept mapping strategy reflected greater recall and comprehension of content area concepts on the dependent measures than students who did not.

The above studies demonstrate that the use of non-computer aided concept mapping can be successful as an aid to the acquisition of content area material as well as aiding in reading comprehension of various texts across ages level (Scanlon et. al., 1992; Englert & Mariage, 1991, Elhelou, 1997, Barnholtz & Tanir, 1992, Boyle & Weishaar, 1997, Boyle, 1996). The strategy has proven effective both when a mnemonic is used to guide mapping and when it is not. Further, the range of studies demonstrated that concept mapping can be used successfully with various groups of students including those with and without disabilities. The maps were all created without student use of a computer or software, and each was a paper and pencil based tasks. The literature at this point in the review has been demonstrated that strategies similar to concept mapping that incorporate many of the same behaviors and skills as concept mapping can be successful, and it has further been noted that concept mapping, without computer aid can be successful. Next, it is pertinent to evaluate computer-aided instruction before moving on to the evaluation of computer-aided concept mapping.

Computer Aided Instruction

Each of the above studies focused on paper and pencil generated concept maps. As the use of the computer has proliferated schools and classrooms, the use of it as an aid in student learning has also been shown to be effective as a tool for helping students with disabilities achieve at higher levels (Higgins, Boone & Lovitt, 1996, Higgins & Boone, 1992, Harper & Ewing, 1986). Following is a brief review of three studies that helped to establish computer aided instruction as a viable way to support students with disabilities in the classroom and create a rationale for the use of computer based instruction (see Table 3).

Harper and Ewing (1986) compared the effects of computer assisted instruction to workbook instruction on the reading comprehension of nine adolescent age students with mild

disabilities. The researchers used an alternating treatments design to compare the effectiveness of the two conditions with a best alone condition being the third and final phase. Student used software published by Milliken Publishing Company called *Comprehension Power* alternated against workbook instruction. Results indicated that for eight students the computer instruction was more effective based on the number of comprehension questions answered correctly.

Higgins and Boone (1990) evaluated the effect of computer aided study guides on 49 students with learning disabilities. Students were randomly assigned to one of three treatment groups: lecture only; lecture with a computer study guide; and computer study guide only. The computer study guides were created using the Social Studies content material. The study guides allowed the students to create short explanatory notes, to replace selected test with a clarifying statement, and to move though multiple choice questions. Posttest scores improved the most for students who were in the study guide only group indicating that students achieved at higher levels when they were only exposed to computer assisted instruction. The researchers then used an ABA design to evaluate the effectiveness of the computer study guides on the five students who had demonstrated the lowest achievement scores from the previous analysis. All students demonstrated better scores on a 10-question quiz covering content area material when they used the computer study guides.

Higgins, Boone, and Lovitt (1996) again compared the effectiveness of three conditions: lecture alone; hypermedia and lecture; and hypermedia study guide alone. Participants included 25 high school students who were either diagnosed with a learning disability or were considered to be remedial students. The same basic procedures were applied to each group with the differentiation being the type of instruction. Results indicated that students who had access to the hypermedia study guide in conjunction with a lecture exhibited better retention test scores

than the other two groups of students. This study demonstrates that students can retain information at higher levels when aided by a computer study guide.

Thus far, the literature has shown that many diverse strategies that resemble concept mapping, as well as more direct applications of concept mapping, have been successful in improving student achievement and comprehension. Further, a rationale has been built for the use of computers as an aid for the instruction of students in need of remediation. The marriage of these two bodies of literature, concept mapping and computer aided instruction is what has become the basis for the growth and application of computer aided concept mapping.

Computer Aided Concept Mapping

The body of research investigating the effectiveness of computer aided concept mapping is currently developing. While many have touted the effects of such software beginning in the early 1990's (Anderson-Inman & Zeitz, 1993), little research was undertaken using actual students until much more recently. The use of computer assisted outlining (Anderson-Inman, 1995) and computer assisted concept mapping (Anderson-Inman, 1996; Holtzman, 1995) began to be clarified in the technology literature through usage descriptions, Subsequently, the basics of how to use concept mapping software became the subject of conference presentations (Scappaticci, 2000). This is all occurring as the research base for the viability of this intervention is mounting. In this section several studies are reviewed, both single subject and group designs, that have evaluated the effects of computer aided concept mapping, specifically the use of *Inspiration 6* software on high school age students with mild disabilities (See Table 4).

Boon, Ayres, and Spencer (in press) evaluated the effects of computer generated concept maps on ten high school age students with mild disabilities. The students were provided a concept map to aid lecture retention and subsequently created a concept map of the same Social

Studies content material using *Inspiration 6* software. The dependent measure was a 15-item quiz covering the content of the lesson, and a paired sample t-test was used to evaluate score differences between pre and posttests. The results demonstrated significantly higher scores on the posttest with comparable scores achieved on a one-week delayed posttest. Although, this study was not comparative in nature, it does demonstrate that computer based concept mapping is a viable aid to increasing student acquisition of Social Studies content area material.

Another non-comparative study done by Blankenship, Ayres, and Langone (2005) indicated that the use of Inspiration software could effectively aid students in acquisition of Social Studies content. Three high school age students with behavioral disorders were allowed to read passages from their Social Studies text independently, without teacher guided reading or lecture, and independently generate a concept map using the classroom computers. Using a multiple baseline design across condition/chapters the researchers evaluated if students would acquire content area knowledge independently when they were able to read the passages and create a concept map using *Inspiration* software. Students all demonstrated high levels of achievement when they were able to use the software to create maps of the independently read material across chapters. This finding supports the fact that using the software with independently read material is a feasible intervention for such students.

Boon, Burke, Fore, and Spencer (in press) compared the effects of using *Inspiration 6* software to those of traditional instruction on the acquisition of Social Studies content area material by high school age students. The sample included students who were diagnosed with mild disabilities as well as students served in general education as both populations were included within two inclusive Social Studies classrooms. Students in the experimental group filled out a teacher provided concept map during a lecture that they subsequently transferred into

a cognitive organizer using *Inspiration 6* software. The control group was exposed to more traditional instruction including guided reading and teacher led instruction. Results indicated that students who used *Inspiration 6*, as opposed to students who did not, did significantly better on the posttest measure of a 35 item test. These results demonstrate that the use of computer generated cognitive organizers seems to be better at aiding students in acquiring Social Studies content then more tradition types of instruction.

A replication study was done by Boon, Burke, Fore, and Hagan-Burke (in review) sought to bolster these results in a replication by using the control group from the previous study as the treatment group in this subsequent study and vice versa. The procedures in this study were the same as the previous study with different Social Studies content as the focus. Again, results demonstrated higher levels of achievement for students in the computer-based concept mapping group versus students taught using traditional instruction. These results further indicate that the use computer aided concept mapping, through *Inspiration 6* software, is a viable aid for students in acquisition of Social Studies content area material.

Chang, Sung, and Chen (2001) evaluated the effects of concept mapping software on acquisition of Science material by seventh grade students. Student were broken into three groups including a group that constructed a concept map on the computer without aid, and group that constructed a concept map on the computer with a scaffold provided, and a group that produced a paper and pencil concept map without computer aid. Students in both concept mapping groups outperformed students in the paper and pencil group on 23-item multiple choice test covering the Science content with students who were provided the scaffold outperforming students who were not. Further, social validity data indicated that 100% of the students in the group without a scaffold and 94% of the students in the group with the scaffold expressed that computer based

concept mapping was a positive experience for them. This is opposed to 71% of students in the paper and pencil group who indicated that they enjoyed concept mapping.

Sturm and Rankin-Erickson (2002) researched the effects of computer-generated versus hand-drawn concept maps on the writing behaviors of middle school students diagnosed with learning disabilities. Two essays from 12 students were compared under three separate conditions: without mapping; generation of a hand-drawn map; and generation of a concept map on the computer. *Inspiration 4.0* was used as an aid to students in generating their concept maps, and all essays were typed using a word processing program. When essays were assessed, students who generated maps outperformed students who did not. Further, students indicated significantly better attitudes toward writing in the computer aided concept mapping condition on a social validity measure.

While much more research is needed, this growing body of literature indicates that computer aided concept mapping can help students to learn content area material (Boon et. al., in press; Blankenship et. al., 2005), that students may learn better when they generate a concept map on the computer as opposed to more traditional types of instruction (Boon et. al, in press; Boon et. al., in review), and that students enjoy computer-based concept mapping more when compared to conditions in which no computer was used (Chang et. al., 2001; Sturm & Rankin-Erikson, 2002). The research on computer based concept mapping follows the logical progression of the literature previously reviewed which demonstrated that paper and pencil concept mapping and similar strategies, as well as technology based instruction, are effective. It serves to reason that when these two strategies are married, computer aided concept mapping would also be effective.

Conclusion

This review traces the consistent process through which research in this area has been established, and while the research base supporting computer-aided concept mapping is growing, more research is needed in this area. Specifically, it is important to evaluate is computer aided concept mapping is differentially more effective than other computer-based strategies. In many studies computer-aided concept mapping is compared to traditional instruction without computer aid. This may be a barrier in the current research base as it cannot be definitively surmised that concept mapping was the key variable in the subsequent study results. It may have been a novelty effect associated with computer use. Further research is needed to evaluate this question. Further, the literature is mainly comprised of group design research. It is important for evaluate the effects of such an intervention on individual students with disabilities prior to making judgments regarding efficacy. Lastly, current research body warrants further study simply due to the scant nature of the research.

Implications

This study is a necessary extension of the previous research on concept mapping software. Particularly, this research ensures that the use of the software is not a novelty effect related to the use of the computer by directly comparing two interventions that use the laptop. Previous research did not ensure that this was the case. This research can give practitioners confidence that the use of concept mapping software, specifically *Inspiration 6*, is indeed a sound teaching practice. Teachers and districts can now justify the purchase and use of such software despite the fact that word processing software is already readily available.

Future Research

This literature base is still developing, and more studies are needed to evaluate aspects of the use of this software. It is important to consider whether the use of student-generated versus teacher-generated concept maps is more beneficial to students. If a teacher created a template concept map, and provided it to the students, would that be more or less effective that if the students generated their own maps? It is also important to consider how the use of this software would generalize to other subject areas. Further, would the use of this software generalize to settings other than independent reading or small groups? Could the use of concept mapping software be beneficial in larger classrooms? These are all important questions that need to be researched in the area of computer generated concept mapping as it has, thus far, been shown to be a valuable aid for students.

Related Research

Citation	Participants	Intervention	Procedures	Results
Idol & Croll (1987)	5 elementary students with mild learning disabilities	Story Mapping Strategy	Multiple Baseline ABA Design used to evaluate the effects of story mapping training and use on various reading comprehension measures.	Four students increased scores on sets of 10 comprehension questions and increased use of story mapping components in retells. The fifth student improved somewhat, and lack of improvement deemed due to more involved disability.
Vallecorsa & deBettencourt (1997)	3, 13-year-old males with learning disabilities	Story Mapping Strategy	Single subject research design used to evaluate effects of a story mapping procedure on story retells.	All students included more relevant information in story retells when story mapping was used.
Smith & Friend (1986)	54 high school age students with learning disabilities - 30 students in experimental group - 24 students in comparison group	Text Structure Strategy	An analysis of pre and posttests (2x2 ANCOVA) was used to evaluate the difference between the two groups. The experimental group learned text structure strategies over a series of five lessons while the comparison group was exposed to instruction	The text structure strategy was successful in significantly improving the experimental group's ability to recognize text structures and recall of content. The experimental group out performed the

Related Research

Citation	Participants	Intervention	Procedures	Results
			focused on workbook and discussion.	comparison group.
Bakken, Mastropieri, & Scruggs (1997)	58 8th grade students with learning disabilities - 3 conditions with 18 student randomly assigned to each condition	Text Structure Strategy	An analysis of pre and posttests (3x2 ANOVA) was used to evaluate the differential effects of each strategy with 18 students receiving text structure based instruction, 18 students receiving paragraph restatement strategy, and 18 students receiving a more traditional instruction.	Text structure strategies significantly improved central and incidental information recall over traditional instruction and recall of central information over paragraph restatement instruction.
Jenkins, Heliotis, Stein, & Haynes (1987)	32 3rd-6th grade students with learning disabilities - 2 conditions with random assignment	Summarization Strategy	An analysis of pre and posttest with repeated measures (3x2x2 ANOVA) was used to evaluate the differences between the experimental group who were taught to write restatements as they read to a control group not taught the strategy on several reading comprehension dependent measures.	Student taught the summarization strategy outperformed on tests of training, near transfer, and transfer tests involving reading comprehension.

Table 1

Related Research

Citation	Participants	Intervention	Procedures	Results
Malone & Mastropieri (1992)	45 6th-8th grade students - 3 conditions with random assignment	Summarization Strategy	An analysis of posttest and transfer tests (3 separate ANOVA's) was used to determine differences on dependent reading comprehension measures among three conditions including a group taught a summarization strategy, a group taught the summarization strategy plus self-monitoring, and a group taught using traditional instruction.	All students who were taught the summarization strategy scored significantly higher scores on all measures of reading comprehension when compared to students who were exposed to traditional instruction. Further, students who were also taught self-monitoring performed better on transfer measures.
Hawk (1986)	390 6th-7th grade students across achievement levels	Graphic Organizer	An analysis of pretest and posttest scores (ANCOVA) was used to determine effects of the use of teacher generated graphic organizers by the experimental group compared to the control group which did not use the organizers.	Students who used graphic organizers improved their scores on a 50 item content area assessment from pre to posttest significantly more than students who did not indicating that instruction with use of teacher made graphic organizers was more effective than instruction

Related Research

Citation	Participants	Intervention	Procedures	Results
				without organizers.
Darch, Carnine, & Kameenui (1986)	84 6th grade students - 4 conditions/classes with random assignment	Graphic Organizer	An analysis of pretest, posttest, and transfer test scores (planned contrasts) between four conditions including two groups of instruction on the use of a graphic organizer strategy (individual and group instruction), a directed reading strategy, an SQ3R strategy.	Students who were taught to use a graphic organizer in a group structure were more successful on posttest measures than students taught individually or using a directed reading strategy.
Darch & Eaves (1986)	22 9th-11th graders with learning disabilities - 2 groups with random assignment	Visual Representation Strategy	An analysis of posttest and transfer test scores (independent sample t-tests) for two groups were compared. One group of 11 students received instruction using a visual display while the control group of 11 students received the same information text based.	Students who used the visual displays outperformed students who did not on short term recall tests only. There were no differences observed on transfer or maintenance tests.
Darch & Carnine (1986)	24 4th-6th grade students with learning disabilities - 2 groups with random assignment	Visual Representation Strategy	An analysis of probe test and posttest, (2x3 ANOVA) determined effects of the use of the use of a visual display by the experimental group in which instruction was text based.	The results indicated a significant treatment effect for the experimental group for the immediate probe test and the immediate posttests.

Table 2

Non-Computer Aided Concept Mapping

Citation	Participants	Intervention	Procedures	Results
Boyle (1996)	30 6th-8th grade students with mild disabilities - 2 groups formed with matched pais consisting of 15 students each	Students were taught strategy to facilitate independent creation of concept maps while reading independently	Pretest and posttest scores were analyzed for and experimental group who was taught the concept mapping strategy and a control group who was not.	Students in the experimental group who used concept mapping improved significantly on both literal and inferential comprehension questions as compared to the students who did not use concept mapping.
Boyle & Weishaar (1997)	39 10th-12th grade students with learning disabilities - 3 groups (2 experimental and 1 control)	Student generated concept mapping vs. Teacher generated concept mapping vs. no concept mapping	Pretest and posttest scores were analyzed (MANCOVA) to determine differential effects of the three conditions on several dependent measures of reading comprehension.	Students who used concept mapping outperformed students who did not, with students who generated their own concept map scoring significantly higher on one measure of literal comprehension.
Barholtz & Tamir (1992)	10th and 11th grade students including 19 classrooms	Student generated concept mapping	Pretest and posttest scores were analyzed (t tests) to compare achievement of the concept mappers to the non-concept mappers.	Overall achievement was higher for students who used concept mapping on tests of content area achievement.

Non-Computer Aided Concept Mapping

Citation	Participants	Intervention	Procedures	Results
Elhelou (1997)	61 male students across achievement levels - two groups/classes with random assignment	Student generated concept mapping	Posttest only scores were analyzed (t-test) to determine if students who generated concept maps during instruction performed better on an achievement test when compared to students who did not generate maps.	The students who generated maps did significantly better on the posttest than students who did not.
Englert & Mariage (1991)	28 4^{th}-6^{th} grade students - 2 experimental classrooms and 3 control classrooms	Interactive semantic mapping	Pretest and posttest scores were analyzed (MANOVA) to determine differential effects of a strategy which incorporated the used of a concept map to students who were taught using traditional instruction.	Students who used the strategy that included concept mapping had significantly better scores on measures of recall and knowledge of comprehension strategies.
Scanlon, Duran, Reyes, & Gallego (1992)	3 groups from various grade levels - 2 groups in each set including students who used the strategy and those who did not	Interactive semantic mapping	Posttest scores were evaluated to determine comparative gains for students in each set across both groups including students who generated maps and those who did not.	Students who used the strategy that incorporated concept mapping had greater recall and comprehension of content area material than students who did not.

Computer Aided Instruction

Citation	Participants	Intervention	Procedures	Results
Harper & Ewing (1986)	9 middle school students with mild disabilities	Comprehension Power Software	An alternating treatments design was used to compare the effects of paper and pencil activities to those using the computer software on student ability to answer comprehension questions over short passages.	For all but one of the none students the computer aided instruction was more effective based on the number of comprehension questions answered correctly.
Higgins & Boone (1990)	49 9th grade students both with and without disabilities - 3 groups/classes with random assignment 5 students who had lowest achievement scores of 49 total students	Computer study guides and/or lecture	The first study used pretest, probe, posttest, and retention test scores (3x3 ANOVVA) to compared the effects of lecture only, to lecture/computer study guide, to computer study guide only. The second study used an ABA design to evaluate the achievement of the 5 lowest achieving students.	The use of computer study guides alone was as effective as lecture alone and the group who used the computer study guide demonstrated higher posttest scores. Each of the five students demonstrated better performance on the 10 question dependent measure when computer study guides were used then when they were not used.

Table 3

Computer Aided Instruction

Citation	Participants	Intervention	Procedures	Results
Higgins, Boone, & Lovitt (1996)	25 high school students classified as learning disabled or remedial - 3 groups with random assignment	Hypermedia study guide and/or lecture	Scores from pretest, 10 question daily quizzes, and retention test were analyzed (three way ANOVA) were used to evaluate the effects of different instructional strategies including the use of lecture only, use of a hypermedia study guide, and hypermedia study guide only.	Students who used the hypermedia study guides in conjunction with lecture retained information best over time when compared to other groups. Although a significant differences among test scores was noted for the groups researchers were unable to pinpoint where the difference lies due to statistical issues.

Table 4

Computer Aided Concept Mapping

Citation	Participants	Intervention	Procedures	Results
Boon, Ayres, & Spencer (in press)	10 10th grade students with mild to moderate disabilities	Teacher lessons that involved computer aided concept mapping	Pretest, posttest, and delayed posttest scores were analyzed (paired sample t test) to determine if the intervention was successful at teaching content area knowledge to students.	A significant improvement was noted from pretest to posttest for recall and comprehension of Social Studies facts.
Blankenship, Ayres, & Langone (2005)	3 students with emotional behavioral disorders	Independently read Social Studies material in conjunction with computer aided concept mapping	A multiple baseline across conditions/chapters was used to analyze if students would acquire content area material from independent reading and concept mapping.	All students were able to independently read Social Studies material and perform to criterion on dependent measures of mastery of content material.
Boon, Burke, Fore, & Spencer (in press)	29 10th grade students (20 students classified as learning disabled) - two groups	Four 90 minutes periods in which students were exposed to content area material using computer aided concept mapping	A pretest posttest group design (one-way ANOVA) was used to determine if the experimental group who used computer aided concept mapping would demonstrate higher levels of achievement on a test of content area knowledge than students who were exposed to traditional instruction.	Students who received instruction which incorporated the use of computer aided concept mapping made significantly more improvement from pre to posttest than did the group involved in traditional instruction.

Computer Aided Concept Mapping

Citation	Participants	Intervention	Procedures	Results
Boon, Burke, Fore, & Hagan-Burke (in review)	26 10th grade students (18 with a classification of mild disabilities) - two groups - same participants as previous study	Four 90 minutes periods in which students were exposed to content area material using computer aided concept mapping	A pretest posttest group design (one-way ANOVA) was used to determine if the experimental group who used computer aided concept mapping would demonstrate higher levels of achievement on a test of content area knowledge than students who were exposed to traditional instruction.	Students who received instruction which incorporated the use of computer aided concept mapping made significantly more improvement from pre to posttest than did the group involved in traditional instruction.
Chang, Sung, & Chen (2001)	48 7th grade general education students - 3 groups/classes	Three different types of concept mapping were compared.	A pretests posttest control group design (ANCOVA) was used to evaluate differences among three groups including students who constructed maps by themselves using a computer, students who were given access to a scaffold to aid them in map construction on a computer, and students who constructed maps using paper and pencil.	Students in both computer aided concept mapping groups outperformed students in the paper and pencil group on 23-item multiple choice test covering the Science content with students who were provided the scaffold outperforming students who were not.

Table 4

Computer Aided Concept Mapping

Citation	Participants	Intervention	Procedures	Results
Sturm & Rankin-Erickson (2002)	12 middle school students with learning disabilities	Compared three different types of interventions on student essays including a condition with computer aided concept mapping.	A repeated measures within subjects design (ANOVA) was used to evaluate which condition including a condition without mapping, generation of a hand-drawn map, and generation of a concept map on the computer would have the most effect on student writing.	Students who generated maps did make improvements in written essays; however, students in all conditions made improvements. Students indicated significantly better attitudes toward writing in the computer aided concept mapping condition on a social validity measure

CHAPTER 3:

METHODS

Participants

Description

Due to the nature of the study, in order to participate, students had to demonstrate that they were in need of the intervention as evidenced by low scores on dependent measures prior to the intervention phase. The criteria set for a student to be deemed in need of the intervention will be discussed further in the section.

Four students participated in the study. Their results vary on achievement measures and IQ scores. The caseworker and Study Skills teacher were consulted for each student in order to determine if they were appropriate candidates for the study procedure, interventions, and measures. Upon reports it was determined that each student was able to complete independent work and that they each functioned at a level necessary to read independently and acquire information from relatively grade level work. The average Letter-Word Identification score as evidenced through scores on the Woodcock-Johnson III (WJ-III) was a 90 with a range of 75-100. The average Passage Comprehension score was a 96 for all students and had a range of 78-114. Only three students had IQ scores available because Maria was not administered an IQ test for her placement into Special Education. The average full scale score on the Wechsler Intelligence Scale for Children III (WISC-III) was a 100 and the average verbal subscale score was a 103. Detailed information regarding each student can be found on Table 5.

Participants were all in grade 9, and taking associated coursework. All students were enrolled in courses that follow the general education curriculum, either at a technical or college preparatory level, and are expected to master the standards set for by Gwinnett County Public Schools as well as the State of Georgia. Students are all enrolled in a Study Skills class indicating that they need more direct instruction and interventions to aid them while studying content area material, and each student is working toward a general education diploma. The class is designed as an aid for students who require more direct intervention in academic areas that cannot always be provided within the class periods associated with each subject area.

Prerequisites and Exclusions

Students were excluded if they did not have parental permission to participate or if their caseworker felt that they would not benefit for the interventions proposed. The setting for the study is a Study Skills class, and if a caseworker felt that a student may need to use that time for other interventions or programs currently in place within the classroom environment the student was not included in the study. Parental permission was obtained through an informed consent form, and students also signed an informed consent form detailing all procedures and issues.

Students who are previously considered competent in the independent reading of Social Studies material without intervention were excluded from the study. Any student who was able to read independently and score at or above 70% correct on any one passage without the aid of either computer software package will be considered competent. Only one participant was excluded from the study based on this criteria. The criteria of 70% was established as competent because this is the score that must be obtained in order to be considered “passing” within the school the study was conducted. The interventions are designed to help facilitate learning of Social Studies material through independent reading, and the student who was able to

successfully do this without aid may not be in need such an intervention. This study sought to remediate issues associated with independent reading, and the above criteria was considered a better way to establish that issues may be present as an alternative to a standardized score on an achievement test. While these scores are provided (see Table 5), this measure was deemed more natural and a better estimate of actual ability due to the fact that it was administered just prior to the study inception and that it directly assessed the skills the intervention sought to remediate.

Further, students' history of absence was evaluated. Any student who had a history of chronic absence from school would have been excluded. Attendance records for each participant were evaluated for the month prior to the study. In order to be included each participant had to have been in attendance at least 85% of school days for one month prior to data collection. No student was excluded based on this criteria.

Due to the demands of their coursework and the structure of the Study Skills classroom setting, each participant was familiar with any prerequisite skills that may have been necessary for the study. Each student in Study Skills class has, at least, a basic knowledge of computer use as computers are frequently used within this setting. The students were not be required to have any formal typing skills as the actual amount of typing done in each intervention can vary from participant to participant without skewing results. Further, students are all familiar with reading content area material, working independently, and the format of the dependent measures as each of these skills are practiced daily in their coursework. However, students did have a one day training session prior to the comparison phase of the study to ensure that they could create a word document and a concept map using each piece of software. If any student was unable to create either document after the training session will attend an independent training session directly after the group training until the student can generate both documents. No student

needed further instruction, and all were able to use each piece of software after the one day training session.

Setting

The study took place in a large suburban high school with approximately 2800 students. The school is in a relatively affluent area with most students being from middle class backgrounds.

The classroom setting for the study was a Study Skills classroom. This class is an elective that can be taken by students who may need extra help studying or organizing for their academic classes, and it is not required for graduation or by the Special Education department. Instead students, parents, and caseworkers together choose for the student to take the course in order for them to receive additional support in academic areas. The Study Skills teacher generally does not follow a curriculum for teaching students specific skills. Instead, most learning is done through teachable moments in the classroom which arises from preparing for academic classes. The teacher in the classroom facilitates organization of class work for other classes each student attends and assists each student in preparation of academic areas. The Study Skills teacher holds a Bachelor's degree in Special Education, and has worked with students with mild disabilities at the high school level for five years. She has previously taught Study Skills.

The classroom is approximately 20x20 feet which gives students ample work space and a quiet, disruption free environment. There are areas set up in the classroom for students to listen to books on tape, work in a study carol, use computers for academic work, as well as regular classroom desks. This setting was chosen due to the fact that most students enrolled in Study Skills class have a history of needing aids to help them facilitate learning as well as needing assistance with independent tasks. Further, the structure of the classroom allowed for flexible

intervention and data collection. While Social Studies content is being used in the study, this is not a requirement for the Study Skills course, but the interventions used can be considered part of a Study Skills curriculum in as much as the help students learn ways to read material independently.

The teacher in the classroom does have a desk at the front of the room; however, she generally is working with students independently throughout the class period. She travels through the classroom assisting students as needed and may be with any one student at a time. The researcher was also be in the classroom during intervention, and there was an undergraduate student from the Special Education department in attendance on some days to fulfill practicum requirements. The undergraduate was not a part of study procedures. Because each student was located at in a different area of the classroom based on student preference, the researcher and teacher were close enough to each student to assist and answer questions as they arose, but far enough away to ensure that each student worked independently while reading. They also walked through the room monitoring progress without giving instruction to any participant. The teacher supervised non-participants while the researcher primarily supervised participants.

Materials and Equipment

The materials used in this study included three laptop computers, *Microsoft Word 2003* software, *Inspiration 7.6* software, Social Studies content area reading passages taken from the Nation Geographic website as chosen by the researcher, researcher made 10 question quizzes that accompany each reading passage, reinforcement passes or tokens, pencils, and forms for data collection.

The laptops used were PC notebooks that will be provided by researcher. They are identical in nature, and each laptop will be fitted with the identical software including both

Microsoft Word 2003 and *Inspiration 7.6*. The computer program that the participants used each day was already opened by the researcher when the passage and the laptop were given to the student to ensure that the student did not use the laptop in any other way then what is appropriate for the purposes of this study.

The Social Studies content area passages have been carefully selected to meet many criteria. These passages, while being Social Studies content, could not represent content that might overlap with any Social Studies course a participant may be been taking outside of the Study Skills classroom. It was important for these passages to be completely independent of actual material studied in these courses as not to skew results. For this reason, passages used were taken from the *National Geographic* website and focus on recent events and issues from the last five years (see Appendix). The reading level of each passage is equivalent to each of the other passages in that all passages are from the same source. However, precautions were taken to ensure that one passage does not skew results, and such precautions are described in detail in the procedures section. Further, each passage is completely independent of each other. Reading no one passage the previous day influenced the student's score on the quiz the following day. Lastly, all passages are approximately one page long when typed in 12 point font and double spaced.

The quiz that accompanies each passage consists of a researcher generated 10 open-ended questions that cover the content in that passage (see Appendix). Each quiz question is factual in nature and no question involves interpretation. Each answer is explicit within the text.

Pencils were provided to students by the researcher, and all other materials that may have influenced the student's ability to attend to the passage was placed at the front of the room so that the student's work space was clear except for the passage and the laptop.

In order to ensure that each student fully attended to the passage and that they demonstrated sufficient and equal effort each day, the students were reinforced for correct answers on the quiz. Due to the fact that a Study Skills grade cannot be based on the content of the passages, and the fact that students were required to score below a passing score on all baseline passages in order to meet inclusion criteria, grades on the quizzes were not involved in the calculation of the students' Study Skills course grade. However, to encourage attention and success, students were reinforced for correct answers on each quiz using procedures other than typical grades. The teacher in the classroom was asked to choose a reinforcer that students would be willing to work for that would not affect their Study Skills grade. Upon her indication, each student was given one "token" for each correct answer to a quiz question. Each token was worth two minutes of free time in the Study Skills classroom (see Appendix). The student could use the free time that day or bank it to use on any day that data was collected for the study. The student could chose any activity that is not disruptive to others during free time including listening to music with a headset, resting, reading, etc. The banking of free time allowed students the possibility of saving free time minutes accumulated and having one larger, more significant time off.

Data collection sheets were used by the researcher to note the passage, condition, score, etc. (see Appendix).

Recording Procedures

Data was taken using the 10 question quiz as the dependent measure in order to assess student acquisition of Social Studies facts from independently read material. The same data collection procedures were followed across all phases and conditions. Each student was required to take a quiz each day after the 15 minute independent reading session. Each student was given

5 minutes to complete the quiz. A key for each quiz was developed prior to the implementation of the study, and the quiz was graded with a percent correct score assigned each day. The fact that the quiz is a permanent product easily facilitated data collection after the session as well as reliability assessment through a second independent scorer.

General Procedures

Overview

This study will took 25 sessions to complete, and generally one session was conducted each day of the week. There were a couple of exceptions to this during data collection when student absence or testing required more than one session per day. The time of day for each session remained constant for each participant as they will receive each session within their Study Skills class. An Adapted Alternating Treatments Design (Holcombe et. Al, 1994) was used and the number of sessions per condition was set a priori. There were 3 sessions of baseline to ensure that students are not competent in acquiring knowledge from independent reading without intervention. Following baseline alone, there was a comparison phase in which 3 conditions alternated: baseline or no intervention, use of word processing software, and use of *Inspiration7. 6* software for concept mapping. The conditions alternated randomly both within and between participants with no more than 2 consecutive days in any one condition. Five sessions of data were taken for each condition making the comparison phase a total of 15 sessions. Lastly, there was a best alone condition in which the best intervention, as determined by the highest average scores during the comparison phase, was used alone across 3 days for each student.

Pretest Sessions

At the beginning of baseline, at the beginning of the comparative intervention phase, and at the beginning of the best alone phase, a pretest consisting of all of the questions the student would be expected to answer for each passage during that phase was administered to ensure that students' prior knowledge did not skew results. If a student demonstrated prior knowledge on any of the quizzes, that quiz and corresponding passage was used for that participant and an alternative passage was found on which the student did not posses prior knowledge. A student was considered to have prior knowledge of a passage topic if they scored at or above 20% correct on the pretest for that passage. The criteria of 20% was chosen based on the fact that a student may, by chance, answer one question correctly, but given the fact that the questions are fill in the blank, it is unlikely that the student would be able to answer 2 or more of 10 correctly without possessing any prior knowledge of the subject matter. For example, a pretest for all of the baseline phase quiz questions consisted of 30 questions (10 from each quiz across 3 sessions in the baseline condition). These exact questions were given to the student in random order prior to any reading of the material. Once the student completed the pretest, the researcher teased out the questions and got a score for each of the three quizzes. If a student scored a 20% or higher, meaning they got more than one question correct, on any of these separate quiz scores, the corresponding passage and quiz was not be used for that student. The student was assessed the following day on two passages per passage omitted in the same pretest format. The researcher then incorporated the passage with the lower pretest score into the student's passages for baseline data. These testing sessions ensured that each session the student started without prior knowledge of the subject in the passage, and that all passages across all conditions start the student at the same level regarding subject matter knowledge. The fact that a pretest was done

for each phase helped to ensure that any knowledge gained in any phase is not a result of the administration of the pretest measure.

Computer Training Session

A one day training session over both pieces of software was given to all participants in a group format. They were introduced to both pieces of software on the laptop they used during the intervention conditions. At the end of the session, the researcher evaluated each student on their competency with each piece of software by asking them to create a brief word document and a brief concept map. No reading material was used during the training session as it was solely to enable students to become familiar with the software. Any student who was unable to create either product would have been trained independently directly following the group session until they could successfully generate both documents requested by the researcher. However, all students became competent within the group format, and no individual instruction was necessary.

General Data Collection Sessions

The following description is applicable to the baseline, each of the intervention conditions in the comparison phase, and the best alone phase. Each session consisted of a 15 minute independent reading time and a 5 minute quiz totaling 20 minutes for each session. The session began when the researcher handed the participant the passage for that day and, if applicable, the laptop with the software in use for that session already open. At the end of 15 minutes the researcher took the passage and the laptop, if one was used in that session, from the student and administered the quiz and a pencil. Each student kept the laptop and the passage for the entire 15 minutes to ensure that equal effort and attention was given to each passage. The student kept the quiz for up to 5 minutes, but was permitted to turn it in early to the researcher if complete before the allotted time. The researcher graded the quiz immediately and delivered

reinforcement for correct answers directly after grading the quiz. The free time earned by the student was recorded and the student chose whether to use the free time then or bank it for use on another day. Students were given a token for each correct answer which was worth 2 minutes of free time. This helped to ensure effort across all days as well reducing potential disruption issues.

Disruption or problem behavior was not an issue due to the reinforcement system in place across phases. However, the general classroom procedures were followed when small disturbances took place, and students were prompted to stay on task by the researcher or teacher as needed.

Baseline Procedures

The purpose of the baseline condition was to evaluate how well students would acquire Social Studies content area knowledge from independently reading a passage without the aid of either computer software program, and to ensure that such an aid is necessary for each student. Students were asked to independently read a passage for 15 minutes without the aid of computer software and to take the corresponding quiz for 5 minutes. They were seated at their desks and worked without interruption, and they were allowed to make any marks on the passage as they desired with the pencil provided to them.

Students often work independently in their Study Skills class and behavior was not of issue. Students were prompted to stay on task as needed by the teacher or researcher. These prompts were generic in nature and did not have anything to do with content or the condition in place. Further, students did not exhibit behavioral problems due to the introduction of the reinforcement procedures for correct responding. Students were expected to work independently, and they found this freedom and the reinforcement system to be of value to them.

When a student asked a question regarding content of the passage the research or teacher answered the question in a way that would not help the student acquire the knowledge presented. For example, students were told to “try your best” or “maybe try rereading it” when a content area question was asked.

Only students who were not competent without aid, as demonstrated by a score of less than 70% on each quiz, went on to the intervention phase. Any student who was deemed competent did not need such aid. The one student who was competent without the aid of the computer did not move onto the intervention phase.

Three sessions of baseline alone condition were conducted prior to beginning the comparative interventions phase. However, 5 sessions of the baseline condition continued in the comparative phase as to allow for a stronger evaluation of the efficacy of each intervention and assess mutlitreatment interference. The students followed the same procedures in the comparison phase including the reinforcement system and the pretest session as described above.

Software Intervention Procedures

The independent variables compared to each other and to the baseline condition are the use of word processing software, *Microsoft Word 2003*, and the use of concept mapping software, *Inspiration 7.6*. Each of these interventions was presented on the same laptop computer to students, and the students were able to use each software program independently.

During the comparison phase a total of 15 sessions of data was taken across 15 days. Five sessions of data were taken for each condition: baseline or no software, word processing, and concept mapping. The conditions alternated randomly across sessions both within and between students.

In order to limit the number of variables changed across phases and conditions, the procedures previously described was also followed in the comparison phase. Each student was given a passage and, if one of the intervention conditions is in effect, a laptop already opened to the appropriate software for that session. The student was verbally cued as to what condition is in effect. The student had 15 minutes to read the passage and use the software package, if applicable that day. At the end of 15 minutes, the researcher removed the passage and laptop from the student's desk and administered the 10 question quiz. To ensure equal time and effort for each passage, the student kept the passage for the entire 15 minutes, but students were allowed to turn in the quiz when complete. The quiz was graded immediately and reinforcement awarded for correct answers. The student could redeem or bank the free time for use on any day data are collected.

As was the case during the baseline condition, students are expected to work independently. The same procedures were in place for answering student questions. However, if a student had a question about the general workings of either software package, despite the training session done at the beginning of the comparison phase, such a question was answered. It was important to ensure that student's were able to successfully use the software in order to results to be representative of the intervention applied. If said questions were not answered, the student may not have utilized the software thus skewing results.

Students were trained according to the procedures above on how to use both pieces of software. However, students could use either program as they preferred in order to aid them in their reading. Although there were many ways found in the literature to teach students to use concept maps, in an effort to limit the variables changed, students were not taught a certain way to formulate a map. If done so the results may have been due to the methodological training, not

the software. Hence, students could create concept maps as desired to facilitate their independent learning. While students were required to make a word document using the word processing software or a concept map using *Inspiration 7.6*, depending on the condition in place, the maps were not graded for content. Each product was be saved to the laptop in order to certify completion. One student, Beth, had two folders in which concept maps were saved. One folder was accidentally deleted just after study completion. Therefore, only four of her maps were available after study closure.

Experimental Design

Overview

This study used an Adapted Alternative Treatments Design (Tawney & Gast, 1984, Holcombe et.al, 1994). This design can be used when "two separate issues are analyzed: Are the patterns in the data for each of the interventions different from baseline? Are the patterns produced by each intervention different from one another?" (Holcombe et.al., 1994, p. 132). This design is applicable in the evaluation of the research questions posed for this study as it can be used to evaluate effectiveness of each intervention against baseline, as bolstered by the continuation of baseline during the comparison phase, as well as the comparison of the efficacy of each intervention to the other. By comparing each intervention to all baseline data as well as by comparing the intervention data to each other, the design evaluates experimental control and can answer the research questions posed.

Internal Validity

The design evaluates threats to internal validity in many ways. History is evaluated in that conditions are rapidly alternated in the comparison phase across days, thereby not establishing a history with a particular condition. Further, by not only rapidly alternating the

conditions, but doing so in a random manner, cyclical variability is also evaluated. Maturation is evaluated by the fact that baseline is continued in the comparison phase, and if these levels stay low, this helps to rule out the possibility that student maturation is a factor in the data. Testing did not pose a threat to the internal validity of the study as students are being reinforced for correct answers in an attempt to encourage continuous effort on the part of the student. The facts that the same reinforcement system is used across all phases and that all passages are independent of each other further eliminated testing as a threat. Attrition was not a factor due to the prerequisite attendance requirements in place when choosing participants, and all students attended regularly throughout data collection.

Instrumentation may have been the largest threat to the internal validity of the study in that while all passages were designed to be of equal difficulty and level, this is a difficult task to accomplish. However, because a different passage was used each day, and because there were numerous passages used throughout the study, it was unlikely that any one passage being slightly different would substantially influence results. Precautions were taken to evaluate this threat such as the same researcher created all tests and select all passages from the source, the passages were very similar regarding length, all quiz questions were in the same format, all passages will come from the same source, and all passages were randomly assigned to students. The research evaluated the data for issues related to testing throughout the study, and no threat was as evidenced by an unusually high data point either within or across participants.

The design evaluates multitreatment interference in several ways because multitreatment interference is often the most crucial threat to internal validity that comparison designs face. In order to evaluate if one treatment may be affecting another, the following steps were be taken. One, baseline condition data continued to be taken in the comparison phase. Two, a “best alone”

condition attempted to make certain that the treatments were not influencing each other if the data in the best alone condition are representative of the data taken in the comparison phase. Lastly, the interventions were alternated randomly across days with no more than two consecutive days of the same condition. This helped to ensure that enough time lapsed between conditions so as not to interfere with each other.

External Validity

While this study alone would not demonstrate external validity beyond the extent to which participants differ from each other, it was an attempt at the extension of the literature base on concept mapping and concept mapping software. There have been group studies (Boon et.al., in press, Chang et.al., 2001) as well as single subject studies (Blankenship et.al., 2005) that have demonstrated the effectiveness of this intervention. However, this study attempted to extend upon that literature by evaluating if the results could be attributed to the novelty of computer use and that concept mapping software, *Inspiration7. 6* in particular, is more effective than providing students access to a computer with word processing software. Due to the fact that word processing software is already readily available to schools and districts, this is an important question that needed to be addressed prior to the continuation of research in the area in order for districts to be certain that such software is in fact more effective at increasing content area achievement.

Reliability

Dependent Variable

Data were collected regarding reliability of the dependent variable scoring for 100% of the data points in each phase by having all quizzes rescored by an independent observer. Because the data are very sensitive and one mistake may skew the data, 100% agreement was

achieved. This was not difficult in that the dependent measure involves a permanent product. An independent observer, the teacher in the classroom, rescored all quizzes. If there was a discrepancy in the scoring, which happened twice, the quiz was rescored by the researcher and the observer. Data was only entered once an agreement was reached and the key for the quiz had been consulted.

Procedural

Procedural reliability data was taken to ensure that all procedures were maintained by the researcher across all sessions. This data was taken over 20% of the sessions in each phase and each condition in the comparison phase. This translated to 1 day of the 3 days in the baseline phase, 3 days of the 15 days in the comparison phase, and 1 day of the 3 days in the best alone phase. Again, the independent observer was the classroom teacher. The teacher was not involved in the study in any way besides taking reliability data. The observer had a checklist regarding the procedures to be followed during that session which will be the same across all sessions (see Appendix). A percent of procedures followed by the researcher was calculated each day procedural reliability data was taken by dividing the number of procedures correctly followed by the total number of procedures x 100.

The basic procedures that the researcher followed involved the systematic application of the same behaviors across all students and sessions. The researcher was expected to have all materials ready upon student entry, to provide the proper amount of guidance while ensuring that students work independently, to promptly grade quizzes and administer reinforcement, etc.

Social Validity

Social validity data was taken regarding student preference. Students were asked to complete a brief questionnaire on the last day data of collection in the best alone condition. The

questionnaire involved items designed to assess to whether the students preferred no intervention, the use of the word processing software, or the use of the concept mapping software (Appendix F). The questionnaire was informal, and was in an open-ended format. Students were encouraged to write as much as they would like regarding why they preferred one condition to another. The questionnaires was evaluated and complied by the researcher to evaluate whether the students preferred the “best” condition for them and what their reasoning was for preferring one condition to another.

Table 5

Student Demographic Information

Category	Beth	Maria	John	Mitch
Primary Disability	SLD	DHH	OHI(ADHD)	OHI(ADD)
Grade Level	9	9	9	9
Age	15	15	15	15
Coursework	Technical	College	College	Technical
Achievement Data (WJ-III)				
Letter Word ID	85	75	99	100
Passage Comprehension	92	78	114	100
IQ Scores (WISC-III)				
Full Scale	85	na	107	109
Verbal	76	na	112	107
Performance	98	na	100	110

CHAPTER 4:

RESULTS

Introduction

This chapter presents the results of the study in three main sections. Analysis of the three research questions, a secondary analysis of the concept maps, and the results from the student survey are each evaluated. In determining efficacy, each section is assessed separately prior to making an overall statement regarding use of the interventions.

In the first section procedures for data analysis are described, and findings are reported regarding each question separately and overall statement of findings is then brought forth. First efficacy of each intervention when compared to baseline is discussed, and then the subsequent question of differential efficacy is detailed.

Results will be reported from a secondary analysis that looked at the quality of the concept maps in comparison to dependent measure scores. After initial evaluation, the need for such an assessment was determined due to the early data reported. The details concerning the secondary analysis and its usefulness will be discussed.

In the description of the student survey, each question is analyzed and both quantitative and qualitative results are reported. Further, a data in this section is evaluated to determine if the student perceptions seem to coincide with what is found in the analysis of the three research questions.

Lastly, a summary of findings will illustrate the overall effectiveness of each intervention. Further, the final determination regarding use of each intervention to teach content area material to high school age students with mild disabilities will be made.

Statement of the Problem

Evaluation of the research regarding the use of computer aided concept mapping has determined that it is a promising intervention for the facilitation of acquisition of content area material. While a solid research base on computer aided concept mapping is still emerging, it is important to evaluate what about the use of the software seems to make successful use in the classroom possible. It is further important to evaluate if the use of concept mapping software may be due to a novelty effect regarding computer use in general. As reported, most of the studies that evaluate the use of the software compare it to a condition which does not use the computer. This may mean that results could be attributed to novelty. Further, the majority of the studies to date use concept mapping in conjunction with an instruction package that contains other elements. From evaluation of this research it is difficult to determine if the results can solely be contributed to the use of the software itself.

The purpose of this study was to isolate the use of the concept mapping software, *Inspiration 7.6*, from other variables and to compare its efficacy to another condition that used computer software, in particular *Microsoft Word 2003*. The study can then begin to evaluate if use of the software is effective, in and of itself, in the acquisition of content are material for high school students with disabilities.

The research questions were evaluated using an Adapted Alternative Treatments Design (Tawney & Gast, 1984, Holcombe et.al, 1994). This design allowed for the continuation of baseline data collection in the comparison phase allowing the question of efficacy to be

addressed for each intervention as well as a comparison to be made regarding the differential efficacy of each intervention.

Four students participated in the study. Each student was 15 years old and in the 9th grade. All students were enrolled in a Study Skills class to gain extra assistance in the areas of study habits, time management, and assignment completion. All students were considered to have mild disabilities. Beth has been diagnosed with a Specific Learning Disability and has difficulty across academic areas. She spends most of her day in small resource courses, but she is pursuing a Technical level general education diploma and participates in general education curriculum. Maria is served under Deaf/Heard of Hearing, and she spends time each week with a speech pathologist. Maria spends all of her day, aside from the Study Skills class, in general education, college preparatory courses. John is served under Other Health Impairment and has a medical diagnosis of ADHD. He takes medication to help him focus and increase on-task behavior. All of John's academic courses are large, general education classes focusing on college preparatory curriculum. Lastly, Mitch is also served under Other Health Impairment and has a diagnosis of ADD. Despite the fact that Mitch's achievement and IQ scores are well within normal limits, his coursework is completed in a smaller, resource, setting. It is indicated that Mitch needs the smaller setting in order to help him focus and have necessary guidance. He is participating in general education curriculum at the technical level.

While student scores vary on achievement measures and IQ scores, teachers report that these students function at relatively similar levels in class. While standard scores are a momentary look at functioning and are subject to student motivational issues, etc., teachers report that each student would be a good candidate for the study. Each student was deemed able to complete independent work, and to have a functioning level necessary to read independently

and acquire information from relatively grade level work. The average Letter-Word Identification scores as evidenced through scores on the *Woodcock-Johnson III* (WJ-III) was a 90 with a range of 75-100. Similarly, the average Passage Comprehension score was a 96 with a range of 78-114. Only three students had IQ scores available, as Maria was not administered an IQ test for her placement into Special Education. The average full scale score on the *Wechsler Intelligence Scale for Children III* (WISC-III) was a 100 and the average verbal subscale score was a 103. Detailed information regarding each student can be found in Table 5.

Data was collected over a total of 25 sessions for each student. Each day the students read a passage covering social studies content area material and were asked to either make a concept map using *Inspiration 7.6* software, make a word document using *Microsoft Word 2003*, or to not use the computer during reading. The students then completed a 10 question open ended quiz covering the main concepts in the passage. These scores are evaluated to determine the relative efficacy of each condition.

At the end of the study, students were given a researcher developed social validity measure to gauge their thoughts and feelings regarding the use of the software packages. Results of these questions are presented in an effort to assess if students were generally accurate regarding the best intervention for them as based on dependent measure scores as well as to determine student preferences and reasons behind preference.

Once the data was initially evaluated, a secondary analysis regarding the quality of the concept maps and a possible relationship of quality to dependent scores was completed. Results are an attempt at quantification of student effort in relation to the dependent data.

Research Questions

The following research questions are addressed through analysis of the dependent scores. Visual analysis and descriptive statistics utilizing percent correct scores on the ten question quiz in relation to specific condition evaluate each question.

1.) Will the use of the concept mapping software, *Inspiration 7.6*, alone be effective in facilitating acquisition of Social Studies material when independently read by students?
2.) Will the use of the word processing software, *Microsoft Word 2003*, alone be effective in facilitating acquisition of Social Studies material when independently read by students?
3.) When compared, which software package, word processing or concept mapping, increases student learning of Social Studies material more effectively?

The third question is the primary research question and the two subsequent questions are addressed as secondary. The first question deals with the relative and differential efficacy of each software package when compared to each other while the second and third questions both evaluate if each software package alone seemed to facilitate student learning of content area material.

While there is not a specific research question regarding the qualitative data collected via the student surveys, these data will also be evaluated in an attempt to assess student preference.

Analysis Procedures

Descriptive Statistics

Descriptive statistics including mean, median, mode, and range are reported for each phase and for each condition within the comparison phase (see Table 6-11). These data are reported for individual students and across all students. The descriptive statistics from the three conditions in the comparison phase are used as one way to assess which intervention worked

better as an aid to acquisition of content area facts for high school students with mild disabilities. In order to determine efficacy of each intervention, the descriptive statistics for each intervention will be compared to those of the baseline condition.

Visual Analysis Guidelines

The central way in which the data is analyzed is through a visual analysis of the graphic display for each student. The only variable that changed between the baseline phase and the comparison phase is the introduction of either software package, all other procedures and materials remained the same. Because the dependent measure is not assessing a skill that takes multiple sessions to acquire, the between condition data should demonstrate an immediate level change upon introduction of either intervention if the use of either software is indeed more successful at facilitating acquisition of facts than reading alone.

Absolute level changes are evaluated between each phase and for each condition within the comparison phase (see Table 12). Absolute level change was chosen, as opposed to relative, because the data would be expected to make an immediate and abrupt increase due to the nature of the skill measured if the intervention is more successful that reading alone. The data trends in all phases are evaluated and the split middle procedure was used if the data do not apparently demonstrate trend direction.

Lastly, percent of overlap is calculated within the comparison phase across all conditions. This is calculated by using the relative position of data points. These data are reported for each student including information regarding which data points for each condition were higher than the compared condition. The percent of overlap, along with the level change, trend direction, and descriptive statistics of the two interventions within the comparison phase are used to assess differential efficacy of the interventions for each student (see Tables 6-14).

It was hypothesized that students would have higher scores when either the word processing or concept mapping interventions are in effect when compared to the baseline condition in which students solely read material without the aid of either software. It is was further hypothesized that students would demonstrate higher scores on the dependent measures when the concept mapping software is used in comparison to the word processing software. It was expected that either intervention will be better than no intervention with concept mapping being better at aiding students in acquiring facts from independently read Social Studies material when compared to the use of word processing software.

Reliability

Dependent Variable

Reliability data were collected over all dependent measures. Due to the nature of the dependent measure, in that one grading error would change the percent correct score by 10%, it was deemed necessary to have all quizzes rescored by an independent observer. If there was a discrepancy between the two scores, the key was consulted and a determination regarding accuracy of the student response was decided on by the two scorers.

The dependent measure being in open ended format did not seem to affect the scorability of the measures on the part of the two raters. Twice during data collection a discrepancy was found. Once, it was due to a mathematical error which was resolved by a simple recalculation of the percent correct. Once, the error was due to the second observer awarding student credit for an item which was indeed incorrect. Once the key was consulted, the issue was easily remedied.

The results of the dependent measures reliability were thus 100%. This is important in that it ensures the use of the data in the evaluation of the research questions is useful and valid.

Procedural

Procedural reliability data were taken on random sessions throughout the study. Data was collected over 20% of the data sessions, translating to five sessions worth of procedural reliability data. Data was collected by an independent observer in the classroom. Observation was done of the researcher during the interaction with one student one each day data was taken. The observer evaluated the researcher on several points critical to the integrity of the procedures. Each point was posed in the form of a question with the observer providing a dichotomous score of either "yes" the procedure was followed or "no" the procedure was not followed. Each time the observer scored a question as "yes," one point was given. These points then led to a percent of procedures followed score represented as a percent in increments of ten.

Data was collected on five days and in each condition. The observer scored one day during the baseline phase, three days during the comparison phase, and one day during the best alone phase. On all days data was taken, the researcher received a 100% indicating that all procedures were following correctly. This measure of the accuracy with which procedures were followed is of importance as it allows for comparison across sessions.

Analysis of Research Questions

In analyzing the research questions, the questions were evaluated by first looking at the efficacy of each intervention in comparison to the read only or baseline condition. It is important to first determine if both interventions are effective in and of themselves prior to a comparison of differential efficacy.

Research Question One

The first research question addressed the use of the concept mapping software, *Inspiration 7.6*, and whether or not the use of this software alone would facilitate the

independent acquisition of Social Studies content area material by high school age students with mild disabilities when compared to the baseline condition in which students solely read the passages without the aid of the software.

The design of the study allowed for an assessment of this software to be made without the influence of other instructional activities. While the use of such procedures might have helped to further student success, such procedures too may have confounded results making it unclear if the use software alone would have generated the same results. As previously determined, this was an area of interest after review of the emerging literature base regarding the use of concept mapping software. Previous studies demonstrated the efficacy of concept mapping software when used in conjunction with other instructional interventions, and the results from these studies could not support a statement that the software alone was what had solely facilitated the changes in dependent data (Boon et. al, in press; Boon et. al., in review, Chang et. al., 2001; Sturm & Rankin-Erikson, 2002).

Beth

Prior to introduction of either intervention, Beth demonstrated a need for intervention with a baseline mean of 1.5% correct without either aid. These data were stable. The mean score is representative of how well Beth performs when given a content area passage, asked to read the passage without aid, and then is quizzed over the passage content. Because her baseline phase scores were low enough, she then proceeded to the intervention phase.

In the intervention phase Beth used *Inspiration 7.6* to aid in her reading of the content area passages. Upon introduction of the intervention her absolute level change was -10% indicating a decline on her dependent measure score from baseline to intervention. Further, her mean score in the Inspiration condition was a 10%, also a decline from baseline. The baseline

condition was continued in the comparison phase in order to attempt to address the question of efficacy with further data. Her total mean for all data taken when the baseline condition was in effect was also a 10%. When the data in the baseline condition of the comparison phase is compared to the Inspiration data taken during the same phase, Beth performed marginally better when the Inspiration condition was in effect, 10% compared to 8% correct. This made her best alone phase the Inspiration condition. However, these data or so similar it makes it impossible to differentiate between the baseline condition and the Inspiration condition regarding efficacy. Beth's mean dependent measure score in the best alone condition was even lower with a 3% correct. The raw scores from these sessions were 10%, 0%, and 0% correct. These data indicate that Beth performed poorly on dependent measures despite introduction of *Inspiration 7.6* software as an aid.

There was an accelerating trend demonstrated in the Inspiration condition in the comparison phase. However, this trend is negated when the data from the best alone condition is evaluated with comparison phase scores. Although both data paths are stable, the data taken during the Inspiration condition was higher only 60% of the time indicating that these data paths often cross each other.

Mary

Mary indicated a need for intervention with baseline condition scores of 0%, 10% and 30% when she read the passages without either intervention. Upon the first day of use of the *Inspiration 7.6* software Mary's dependent score noted a 20% drop to 10%. When the means of the two conditions within the comparison phase are evaluated there is a negligible difference with the Inspiration and baseline scores being 18% correct and 14% correct respectively. Mary's

scores did not improve when the Inspiration condition was in effect, and the scores remained low despite use of the software program.

The data are stable at low levels with Inspiration data being at or above the levels of the baseline data 80% of the time. The trend noted for the Inspiration condition is accelerating while there is a decelerating trend in Mary's baseline data. Despite the accelerating trend, Mary did not obtain a raw score above 30% correct when the Inspiration condition was in place.

John

John scored higher than either Mary or Beth in the baseline phase, but still demonstrated a need for intervention with a mean score of 56% correct on the three dependent measures administered during this phase. The score in the first session of the comparison phase when the Inspiration condition was in effect dropped 20% from the last session in the baseline phase. John's scores within the comparison phase are all comparable with a mean of 44% correct when Inspiration was in effect and a mean of 32% when baseline conditions were in effect. It should be noted that John's raw scores in the baseline condition of the comparison phase are variable in that only three of the five scores fall within 20% of the mean rounded to the nearest tens percent. His median and mode for the data collection when Inspiration was in effect are both 50%, while the median in when baseline was in effect was only 20% with a range of 0% to 90% correct.

It is noteworthy that while the data taken during the baseline condition demonstrated a decelerating trend, there seems to be a slight accelerating trend in the Inspiration condition of the comparison phase. However, this trend is only noted once the last data point is removed as an outlier. While this may seem to indicate that John was indeed becoming more proficient with the use of Inspiration, the scores are still low and have little variability. Further, relative data points

reveal that data taken from sessions when Inspiration was in effect were at or above the levels of baseline data 80% of the time.

Mitch

Upon initial data collection, Mitch demonstrated a need for intervention with a baseline phase mean score of 40%. Upon introduction of Inspiration software, Mitch's score declined by 50% as noted by the absolute level change. While Mitch did not consistently have passing scores, he demonstrated the highest scores among participants. Further, he outperformed when in the baseline condition as compared to both conditions that utilized a software program. His scores in the baseline condition of the comparison phase had a mean of 60% with a range from 40% to 80%. His scores in the Inspiration condition of the comparison phase only had a mean of 26% with a range from 0% to 70%. The median score for baseline was 60% correct while his median score for Inspiration was 20% correct.

Most noteworthy regarding Mitch's data is that the baseline condition data path and the Inspiration condition data path in the comparison phase only have 20% overlap. This indicates that he consistently performed better on dependent measures in the baseline condition when compared to the Inspiration condition.

Research Question Two

The second research questions addressed the efficacy of the use of *Microsoft Word 2003* to facilitate the acquisition of content area knowledge compared to the read alone or baseline condition. This question was a secondary question and was evaluated in conjunction with the third research question.

The use of *Word* in the study was in an effort to control for any novelty effects that might have been demonstrated due to computer use. If *Inspiration* is the only computer software

program used and compared to a no computer condition alone, then the effects that may be seen could be due to the novelty of student computer use. With the incorporation of another software program, this threat to internal validity is decreased. *Microsoft Word* was chosen as it is often used by teachers and students for purposes such as those in this study. The second research question solely addresses if the use of this software is more effective than nonuse of the program.

Beth

As stated above, Beth's scores in the baseline condition, without the use of either program, demonstrated the necessity for intervention. Upon introduction of the *Word 2003* software program, Beth's dependent measure score dropped 10% as noted by the absolute level change. Her mean scores in the baseline and Word conditions were the same at 8% correct, and if all baseline data points are averaged her mean score in the Word condition is actually lower than that of the baseline data with the baseline total mean being 10%.

In the comparison phase, both data paths for Word and the baseline condition were stable; however, baseline data was below relative positions of Word data 60% of the time. While there is no trend noted in the baseline data taken during the comparison phase, there is an accelerating trend in the Word data path possibly noting that proficiency with the program may have been increasing with time. However, data are too low with little range to absolutely make such an argument.

Mary

Mary did not demonstrate improvement when the Word condition was in effect over the baseline condition. The absolute level change from the last data point in the baseline phase to the first data point in the Word condition of the comparison phase was -30%. Her scores remained low with mean values at 14% correct in the baseline condition of the comparison phase

and 12% correct in the Word condition of the comparison phase. Her range of data for both conditions in the comparison phase was 0% to 30% in the baseline condition and only 20% in the Word condition.

These data are stable at low levels. While the data trend for baseline is decelerating the trend in the Word condition is marginally accelerating. These data seem promising in that the Word condition improves over time, the dependent measure scores remain low.

John

When evaluating if Word was more successful at aiding John in the acquisition of content area material, it is important to note that he only received one score on any dependent measure that would be considered passing. This once score was noted while the baseline condition was in effect during the comparison phase. Again, it seems as though Word was no more effective at helping John to acquire concepts than reading alone was, and both conditions seemed to be ineffectual. Mean scores within the comparison phase for baseline and Word conditions were 41% correct and 42% correct respectively. It is noted that the strongest accelerating trend was demonstrated in the Word condition of the comparison phase with scores improving 50% and increasing with regularity. However, even with such an increase, John did not score above 60% correct on a dependent measure while using Word. The data paths for baseline and Word overlap 40% of the time indicating that neither condition was consistently more effective than another at aiding John in achieving higher dependent measure scores.

Mitch

When evaluating Mitch's scores comparing the baseline and Word conditions, he scored better on dependent measures when in the baseline condition. His mean score when in the baseline condition of the comparison phase is 60% correct compared 14% correct when in the

Word condition of the comparison phase. His median scores are 60% and 0% respectively. This performance pattern was consistent in that when the relative position of the data points is compared, Mitch did better when in the baseline condition 100% of the time.

Research Question Three

Research question three address the differential efficacy of the two software programs and is the primary question of interest. Data are interpreted to determine if either program was more successful at aiding students in acquisition of content area information. This assessment is made by comparing those data taken in the comparison phase when either the Inspiration or Word condition is in effect.

This evaluation lends itself to statements regarding which software program would be superior for these purposes. The use of both computer software programs allows for a comparison without the threat of novelty. Further, only the use of the program was changed, all other variables remained the same. Therefore, this comparison assures that any differential results would indeed be due to the program itself as opposed to an instructional intervention in which concept mapping might be only one part of said intervention.

Beth

Beth's mean score in the comparison phase when Inspiration was in effect was 10% correct. Her mean score while Word was in effect was 8%. For all intense and purposes, these scores are relatively equivalent. Raw data indicates that her range for both conditions was 0% to 10%. Both of these data paths are stable with a slight accelerating trend. Interestingly, 80% of the data points for Inspiration and Word have the same relative position further indicating that Beth's performance did not vary depending on what condition she was in.

Mary

When comparing the efficacy of the two software programs, Mary's mean scores in both conditions are very similar with the mean in the Inspiration condition being 20% and the mean in the Word condition being 10%. Data in the Inspiration condition are marginally better than in the Word condition with a median of 20% and 10% respectively. Further, the range in the Inspiration condition ceilinged at 30% with 30% also being the mode, while raw data in the Word condition ceilinged at 20%.

Mary performed slightly better when the Inspiration condition was in effect making her best alone phase Inspiration. Her best scores were demonstrated during this phase with a mean score of 23% correct when Inspiration was used. Despite the fact that this was her better condition, results were still low and did not illustrate acquisition of key concepts. Both data paths are stable with 80% of the data points falling within 20% of the mean.

John

When evaluating differential efficacy of the two software programs, it is noted that neither program was adequate in facilitating learning as measured by the dependent scores for John. The scores across the two intervention conditions were almost identical with the mean percent correct score for the Inspiration condition being 44% and the mean percent correct score for the Word condition being 42%. The use of Inspiration demonstrated slightly elevated scores enough to warrant the use of the software during the best alone phase. However, this difference was negligible. The best alone phase score then fell to 20% correct.

When evaluating the relative position of the data points, the data only overlaps once with the Inspiration condition scores noted as higher or the same 80% of the time.

Mitch

When looking at relative effectiveness of each intervention, Mitch's data are the most clear. He seemed to do better when he did not use either software program as noted by higher means. However, his scores in the two intervention conditions are relatively similar. Mitch did slightly better when the Inspiration condition was in effect with a mean percent correct score of 26% compared to when Word condition was in effect with a mean percent correct score of 14%. While the data points for the Inspiration condition are higher than for those of the Word condition 100% of the time, the data paths seem to follow the same basic trend so quantitatively the differences are negligible. Both data paths have a accelerating trend and both drop at the last data point which may indicate a compliance issue. Mitch consistently scored higher when neither computer software program was in effect, and therefore his best alone condition was baseline. Mitch's data are stable with 80% 100% of the data points falling within 20% of the mean, and all descriptive statistics are higher when in the baseline condition. However, even in baseline, Mitch was unable to consistently achieve scores above 70%, with only two scores at or above 70%.

Conclusion

Overall, the data are low and no student seemed to benefit greatly from either intervention. The only student, Mitch, who showed marginal differential results, faired better when the baseline condition was in effect and he was not using either computer program. Scores on dependent measures were low regardless of condition, and no firm statements can come from evaluation of the data.

Secondary Analysis

Description

Due to the nature of the initial results, a secondary analysis was performed in order to evaluate the concept maps the students generated. While students were trained in how to use *Inspiration 7.6*, they were not made to use it in any particular form or fashion. Students were told to use the software how they thought it would best help them when reading the passages independently. Throughout the study, the passages were not graded for content, only completion, and the researcher or teacher did not instruct students in what needed to be included in the map. This was done in an effort to only change on variable from the baseline condition so that results could be more readily attributed to the use of the software, and not the use of the software in conjunction with an instructional strategy beyond the program.

Due to the fact that no student demonstrated any results that would securely lead to an assumption that concept mapping was more successful than use of Word or no computer use, the concept maps themselves were evaluated. The evaluation consisted of the construction of a rubric, and the appraisal of each map in accordance with the rubric. Each map was read in combination with the passage to determine the relevance of each entry and the inclusion of the most important details in the passage. Further, the maps were evaluated on the basis of the number of entries and the students' use of superordinate to subordinate concepts. Each concept map was scored in each of the four categories with a lickert type score ranging from 1-5 , 0-1, or 1-2, depending on the category, with higher numbers being associated with more elaborate maps (see Table 15).

Once each student had a numerical score, this was translated to a percent by dividing the total number of earned points by 10 and multiplying by 100. The percent score of the concept

map was compared to the score of the dependent measure to look for patterns in student map quality and dependent scores (see Table 16).

Beth

Due to a computer error not all concept maps were available for Beth. Four maps were available and scored. The maps Beth made were very short and half of them only consisted of one to three entries. The entries made did not link to each other and were often irrelevant and surmised minor points from the article. The quality of the maps did not seem to indicate any clear pattern regarding her dependent measure score in that her best map resulted in her lowest quiz score.

Mary

Mary's maps were of generally good quality. Every map except for one had 10-15 entries, and she often linked superordinate to subordinate concepts together appropriately. Further, while the data is not overwhelming, it seems as though there is a slight link between the quality of Mary's maps and her score on the corresponding dependent measure. However, this statement is guarded due to a restriction of range issue. Because Mary's dependent scores during the Inspiration Condition only range from 0%-30%, it is difficult to determine any relationship. If divided in half, the average of the better half of the concept mapping scores is 75% which corresponds to an average dependent measures score of 23%. The bottom half of the concept mapping scores averages to 53% which corresponds to an 18% average dependent measures score. While this difference in the dependent measures score is negligible due to a restriction of range; interestingly, three out of the four of her lowest dependent measures scores are associated with three of the four lowest scores on the concept maps.

John

John's maps were most often mid-length when compared to the maps of other students. All maps, except for one longer map, had between four to nine entries. He never linked superordinate to subordinate topics, and most often his maps used the title as the central idea with facts simply branching from the title. The most significant distinctions in his maps that most greatly influenced the scores were the number of ideas included and the relevance of topics chosen for inclusion on the map. Again, as Mary's data demonstrates, there does seem to be a tentative link between map score and dependent measure score. The most obvious finding being that the three lowest scored maps are linked with three of the four lowest dependent measures scores. There are some data that do not support this as the highest scored map is not linked with the highest dependent score, but taken in total, the slightly better maps are associated with slightly higher dependent measures scores.

Mitch

Mitch is the one student who performed better when not in the Inspiration condition. His maps consisted of the title used as the main idea, and the first sentence of each paragraph used as the subordinate branches. All maps ranged from four to nine entries, and none had any idea linked from a subordinate entry. There does not seem to be any link between map quality or quantity and his scores on dependent measures. His lowest dependent score is linked with a better map, and vice versa.

It can be guardedly stated that two students may have demonstrated a cautious link between map quality and scores on dependent measures. This may indicate that if given more structured requirements regarding map content that students may perform better on dependent measures. A discussion of this implication for teachers and researchers will follow.

Student Satisfactory Survey

Upon the conclusion of the study each student was given an eight question survey with both multiple choice and open ended items in order to assess social validity from their standpoint (see Appendix). These data are important in that they represent student preference and willingness to use concept mapping software again. Despite the fact that the data above are marginally influential at best, these data do become important when assessing student interest as students will have a more difficult time complying with requests to use such programs if they do not find them appealing and attractive.

The data reported are quantitative and qualitative in nature in order to gain the most information possible from the student responses. Each question and student responses as deciphered by the researcher can be found in Table 17. Subsequent analysis of some genuine written responses is included.

While the answer to the overt question of preference did not favor concept mapping, other responses indicate that the students did see the value in the use of the software. The results from the first and second questions clearly indicate a preference toward solely reading without the use of the computer with 75% of the students indicating that they would rather read alone without either software as an aid. One of the four students did not like reading alone and this student preferred to use the word processing software to the concept mapping software. No student indicated that concept mapping was their favorite of the three conditions.

The students were asked to respond in an open ended format explaining why they liked their choice best. Half of the students indicated that they preferred to read alone because it helped them in some way with the material. For instance, one student who preferred to read without the software wrote, “I got more done and I got better scores.” The other half of the

students indicated that they preferred another condition to the use of the software because the condition they chose was easier than using the software.

Despite the fact that the software was not their favorite condition, when asked if they would use concept mapping software again all students indicated an answer that was in some way positive with half indicating yes and half indicating maybe. One student responded, "Maybe, it [concept mapping] wasn't bad, they [all conditions] were fun."

When students were asked why they would use the software again two students gave answers they may indicate that they would use it again because it was a different experience than what they were used to. One student wrote, "It was a new experience." The other wrote, "It's cool." One student wrote an answer that dealt with the fact that Inspiration helped her to break up each paragraph.

Students were then asked to determine if they knew of any ways a teacher might use any of the interventions to help them in other areas. It seemed as though the students may not have understood this questions because it was either left blank or an answer of "I don't know" was given 75% of the time. The one student who answered simply wrote "book reports and other things."

The students were asked if they would use concept mapping as a teacher and why or why not. Three of the four students indicated that they would use the software. The one student who would not use it was also the one who chose it as his least favorite condition. His response when asked why he would not use it was, "I would be creative and do my own thing." The others who indicated that they would use it all had answers that in some way indicated that the software would be helpful to students. One student wrote, "It helps them [students] learn." Another

student wrote, “Because it might help them [students] out.” The last student wrote, “Because it may be easier for them [students] to understand.”

Overall, the students did not seem to prefer the use of Inspiration to the other conditions, but it seems as though most of them saw the benefit in using such software to aid them in reading and retaining information. Most students indicated that they would use the software again and that they would use it in instruction if they were teachers.

Summary

The data presented above are not strong, and the data did not demonstrate hypothesized patterns. The students consistently perform at low levels despite the condition in effect, and the data did not reveal a predilection for one intervention over another. The only data, Mitch’s, that did demonstrate some slight pattern, favored the baseline condition of no computer use. While some data did demonstrate accelerating trends in the computer usage conditions, these are marginal considering that students so rarely scored at a percentage that would be considered passing on the dependent measures. The secondary analysis revealed that quality and quantity of map construction may impact student success; however, this statement must be guarded because data is not overwhelming.

As noted on the student preference survey, students did seem to enjoy using *Inspiration 7.6*. They often indicated that it helped them and that they would use it if they were teachers. These qualitative statements are positive, but when evaluated in conjunction with the data, they do not seem to carry a great deal of weight.

Table 6

Descriptive Statistics for Beth

Data	Mean	Median	Mode	Range
Baseline Phase	1.5	1	1	1-2
Baseline in Comparison Phase	.8	1	0.1	0-2
Total Baseline	1	1	1	0-2
Inspiration in Comparison Phase	1	1	0,2	0-2
Word Processing in Comparison Phase	.8	1	0.1	0-2
Best Alone (Inspiration)	.3	0	0	0-1
Total Inspiration	.75	.5	0	0-2

Table 7

Descriptive Statistics for Mary

Data	Mean	Median	Mode	Range
Baseline Phase	1.3	1	na	0-3
Baseline in Comparison Phase	1.4	2	0,2	0-3
Total Baseline	1.4	1.5	0	0-3
Inspiration in Comparison Phase	1.8	2	3	0-3
Word Processing in Comparison Phase	1.2	1	1,2	0-2
Best Alone (Inspiration)	2.3	2	2	2-3
Total Inspiration	2	2	2	0-3

Table 8

Descriptive Statistics for John

Data	Mean	Median	Mode	Range
Baseline Phase	5.6	6	6	5-6
Baseline in Comparison Phase	3.2	2	na	0-9
Total Baseline	4.1	4.5	6	0-9
Inspiration in Comparison Phase	4.4	5	5	2-6
Word Processing in Comparison Phase	4.2	4	4.6	1-6
Best Alone (Inspiration)	2	3	3	0-3
Total Inspiration	3.5	3.5	3,5	0-6

Table 9

Descriptive Statistics for Mitch

Data	Mean	Median	Mode	Range
Baseline Phase	4	5	5	2-5
Baseline in Comparison Phase	6	6	na	4-8
Total Baseline	5.3	5	5	2-8
Inspiration in Comparison Phase	2.6	2	na	0-7
Word Processing in Comparison Phase	1.4	0	0	0-6
Best Alone (Read Alone)	4	0	0	2-7
Total Baseline with Best Alone	4.9	5	5	2-8

Table 10

Descriptive Statistics for Group

Data	Mean	Median	Mode	Range
Baseline Phase	3.1	2.5	1,5	0-6
Baseline in Comparison Phase	2.9	2	0	0-9
Total Baseline				
With Best Alone	1.9	2	1,0	0-9
Without Best Alone	3	2	1,0	0-9
Inspiration in Comparison Phase				
With Best Alone	2.5	2	2	0-7
Without Best Alone	2.2	2	0,2	0-7
Word Processing in Comparison Phase	1.9	1	0,1	0-6
Best Alone (Inspiration for 3 students)	1.6	2	0,3	0-6

Table 11

Table of Means in Comparison Phase

Student	Baseline	Inspiration	Word Processing
Beth	.8	1	.8
Mary	1.4	1.8	1.2
John	3.2	4.4	4.2
Mitch	6	2.6	1.4
Group	2.9	2.5	1.9

Table 12

Absolute Level Changes Between Conditions

Student	Baseline to Inspiration	Baseline to Word Processing
Beth	-10%	-10%
Mary	-20%	-30%
John	-20%	-50%
Mitch	-50%	-50%

Table 13

Trend Direction Within Comparison Phase

Student	Baseline	Inspiration	Word Processing
Beth	zero	accelerating	accelerating
Mary	Decelerating	decelerating	accelerating
John	decelerating	zero	accelerating
Mitch	accelerating	accelerating	accelerating

Note: Data path for John during Inspiration condition accelerates for 4 of 5 data points with one low outlier.

Table 14

Data Stability Within Comparison Phase

Student	Baseline/Stable	Inspiration/Stable	Word Processing/Stable
Beth	100%/yes	100%/yes	100%/yes
Mary	100%/yes	100%/yes	100%/yes
John	60%/no	80%/yes	80%/yes
Mitch	100%/yes	80%/yes	80%/yes

Note: Data considered stable with 80% of data points falling within 20% of mean rounded to nearest ten percent

Table 15

Concept Mapping Evaluation Rubric Summary

Element of Concept Map	Lickert Scale
Number of entries	1: 1-3 2: 4-6 3: 7-9 4: 10-12 5: 13-15
Student use of main concept	0: Main Concept Not Addressed 1: Main Concept Addressed
Use of superordinate to subordinate	0: No links 1: At least one link 2: Two or more links
Inclusion of relevant details	0: No relevancy between concepts 1: Relevancy between concepts vague 2: Relevancy between concepts clear

Table 16

Concept Map and Dependent Measure Scores

Student	Concept Map Score	Dependent Measures Score
Mitch		
Artic Melting Pot	30%	0%
9/11	30%	10%
Fighting Crime	30%	30%
Pirates	20%	70%
Eating Mush	20%	20%
Mary		
Artic Melting Pot	70%	10%
Women Suicide Bombers	90%	30%
G8 Nations	70%	30%
Grizzly Man	70%	20%
Katrina	60%	0%
London Bombing	60%	20%
Lightening	50%	30%
Rain Forest	40%	20%
John		
Artic Melting Pot	60%	40%
9/11	40%	50%
Female Suicide Bombers	40%	50%
Hobbit	30%	60%
Katrina	20%	20%
London Bombing	50%	30%
Tsunami	20%	30%
Rain Forest	20%	0%
Beth		
9/11	40%	0%
Biodiversity	10%	0%
Pirates	30%	10%
Hobbit	10%	20%

Table 17

Student Survey Results

Questions	Frequency	Percent
1. What part [of the study] did you like best?		
When you just read without using the computer	3	75
When you read and used word processing	1	25
When you read and made a concept map	0	0
2. What part [of the study] did you like least?		
When you just read without using the computer	1	25
When you read and used word processing	1	25
When you read and made a concept map	2	50
3. Why did you like your choice from above best?		
Answer indicated ease of use (one wp and one no computer)	2	50
Answer indicated it helped them read and/or retain (no computer)	2	50
4. Would you want to use concept mapping on the computer again?		
Answer indicated yes	2	50
Answer indicated maybe	2	50
5. Why or why not [would you use concept mapping again]?		
Answer indicated that it helped in acquisition	1	25
Answer indicated possible novelty	2	50
Answer indicated unsure	1	25
6. How else could a teacher use these interventions to help you-if at all?		
Answer indicated unsure	3	75
Answer indicated an academic area	1	25
7. If you were a teacher, would you ask your students to make concept maps?		
Answer indicated yes	3	75
Answer indicated no	1	25
8. Why or why not [would you assign concept maps]?		
Answer indicated concept maps help students	3	75
Answer indicates that student would rely on their own creativity	1	25

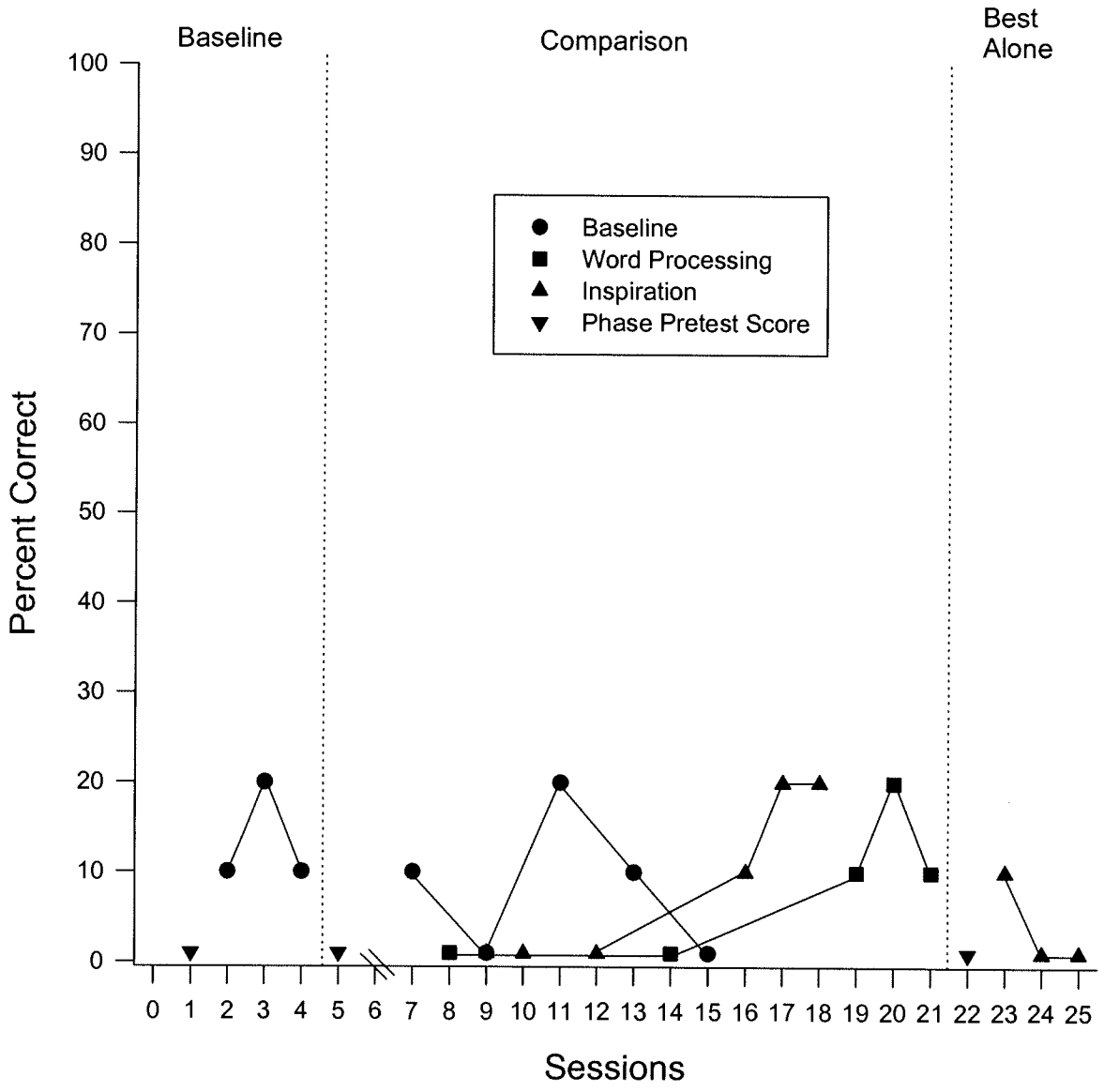

Figure 1: Beth

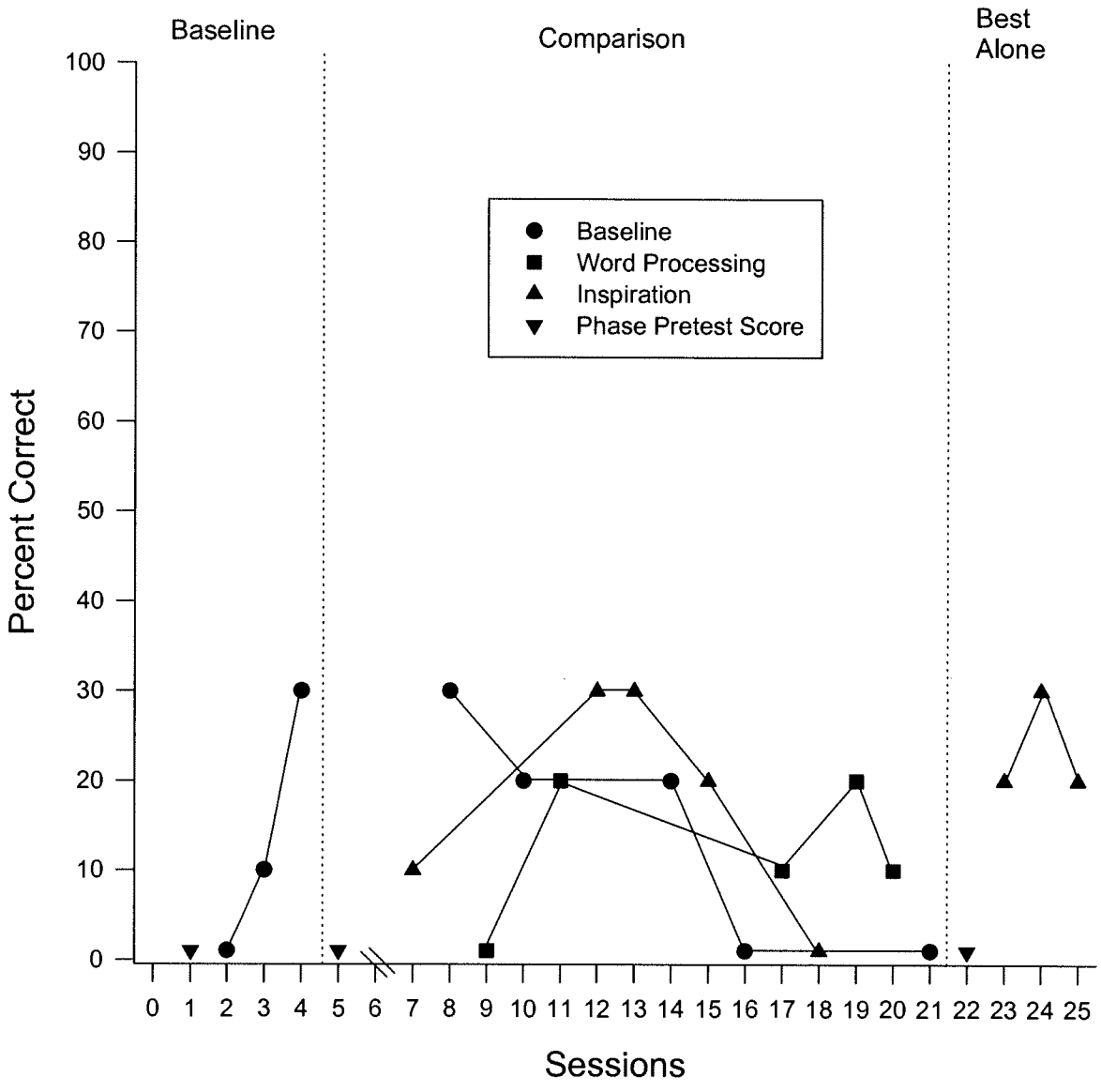

Figure 2: Mary

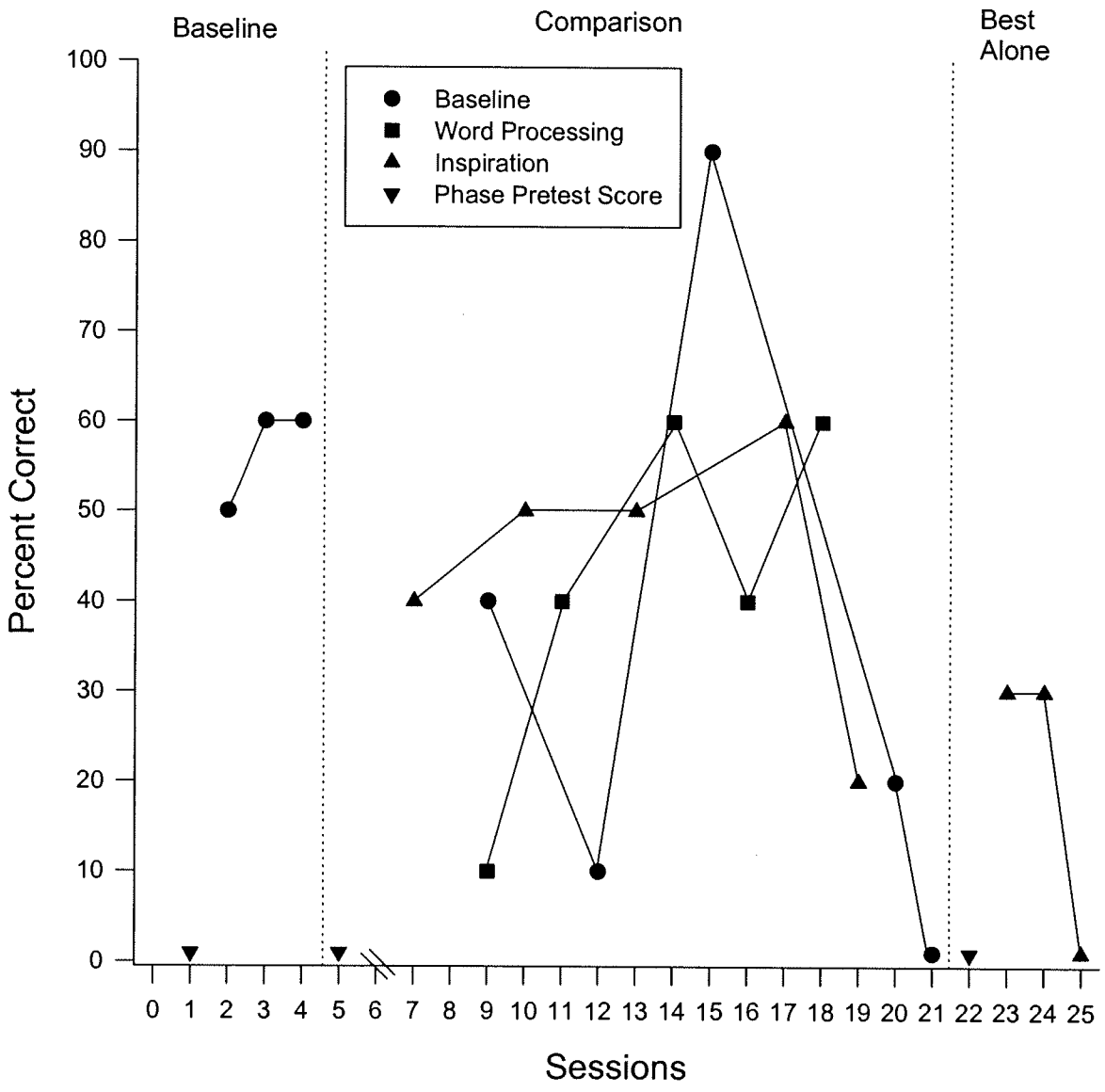

Figure 3: John

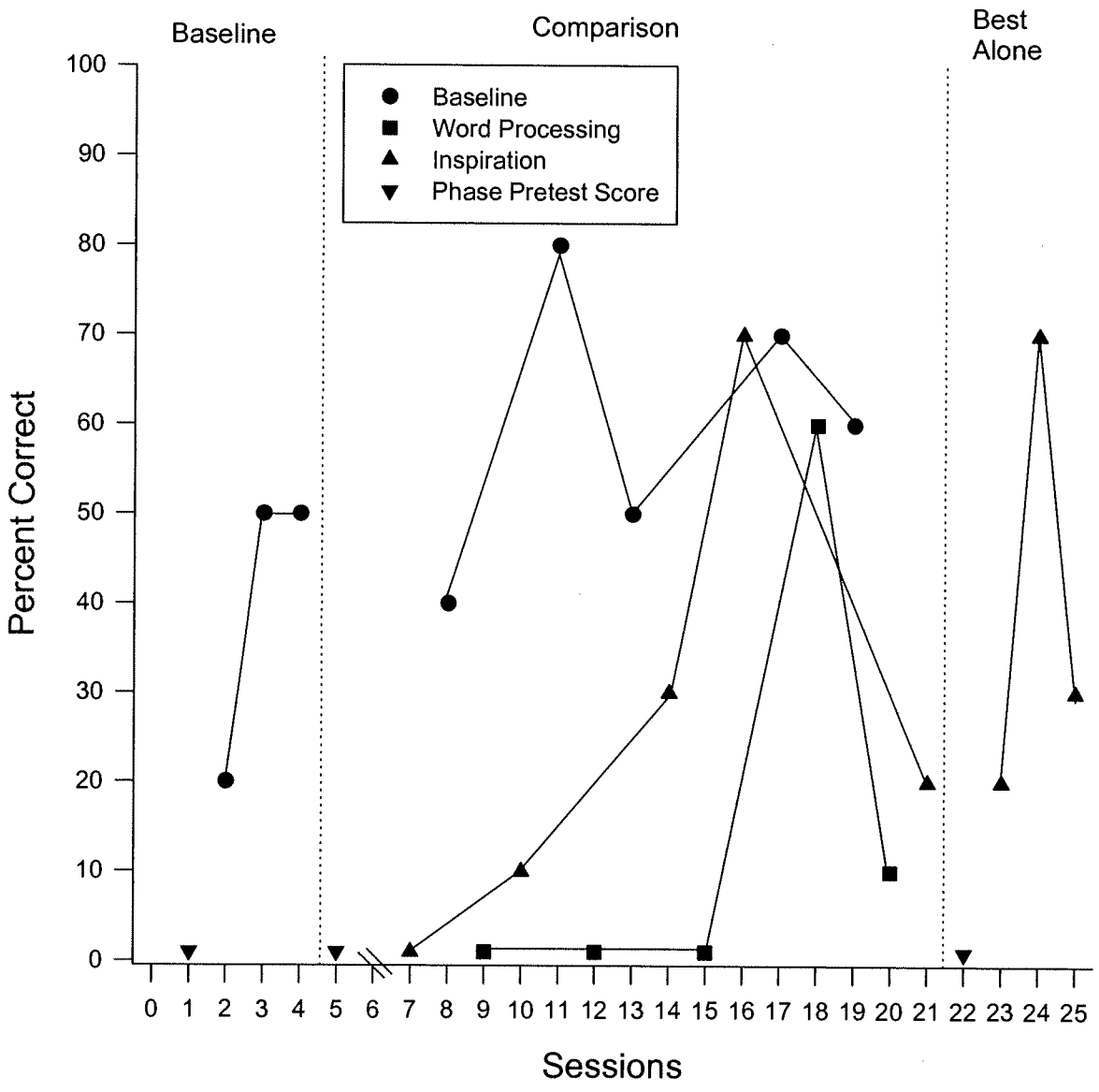

Figure 4: Mitch

CHAPTER 5:

DISCUSSION

Introduction

The following chapter provides a summary of the results of the study accompanied by summary and evaluative statements regarding the data. Each research question, the secondary analysis, and the student perception data will be discussed in further detail with regard to generalized statements that may be made in light of results. Further, a discussion of the challenges and issues faced during implementation will continue in the evaluation of the study overall. Implications, for both instruction and research, are discussed. Lastly, recommendations for future research regarding the use of concept mapping software are made.

Summary of Results

This study was designed to evaluate the effect that the use of concept mapping software would have on the acquisition of Social Studies area material from independently read material. Three conditions were in place in order to clearly assess such effects. The first condition, baseline, had the student solely read a passage containing Social Studies content area information without the aid of computer software. The second condition provided the student access to the concept mapping software *Inspiration 7.6* in order for them to make a concept map while reading the passage independently. The third and final condition was expressly identical to the second condition except that the student used the word processing software *Word 2003* as an aid while independently reading the passage. The dependent measure used to assess acquisition was a ten item open ended quiz pertaining to the main ideas expressed throughout the passage.

The study used an Adapted Alternative Treatments Design (Tawney & Gast, 1984, Holcombe et.al, 1994). The design allows for the comparison of two interventions to a baseline condition and comparison of each intervention to the other. The fact that the baseline condition was continued during the comparison phase further strengthened the merit of such comparison.

The results of this study were negligible with little informative information resulting from implementation. The statements that can be made from the results are marginal and are only applicable in future study design. The results did not return as hypothesized, but may possibly be of some value in the overall line of research regarding concept mapping as will be discussed in further detail. Overall, the data did not support the hypothesis that students will acquire concepts from independently read material better with the aid of either computer software program. Each research question will be evaluated in order to determine if any summative statements can be made after data evaluation.

The three research questions were:

1.) Will the use of the concept mapping software, *Inspiration 7.6*, alone be effective in facilitating acquisition of Social Studies material when independently read by students?
2.) Will the use of the word processing software, *Microsoft Word 2003*, alone be effective in facilitating acquisition of Social Studies material when independently read by students?
3.) When compared, which software package, word processing or concept mapping, increases student learning of Social Studies material more effectively?

The secondary analysis provided results regarding the quality of the maps made and a comparison to the dependent measures scores was attempted. The results tentatively indicated that the quality and quantity of the maps produced affected scores on the dependent measures.

Lastly, social validity data over student perceptions was evaluated quantitatively and qualitatively in order to assess student attitude toward the use of the software programs. Despite the lack of strong dependent data, the students seemed to enjoy the use of Inspiration. One student expressly did not enjoy the concept mapping condition, and this attitude did seem to be supported by his data which showed a clearer preference for the read alone condition.

Research Question One

The first research question asked if the use of Inspiration software would be better at aiding students in acquisition of facts through independent reading than reading alone. Before a comparison of the two software programs to each other, it was important to establish the efficacy of each independently. From the data collected in this study, it is not possibly to indicate that the use of Inspiration software was better, or even effective, in helping students during independent reading. The results were disappointing, but may have been a helpful step in the line of research regarding the use of concept mapping software as will be discussed later.

None of the students successfully were able to read the passages and retain facts to a satisfactorily level regardless of the condition in place. Once the concept mapping software was introduced, all students demonstrated a drop in their performance on dependent measures as evidenced through their absolute level changes.

However, all students except for Mary did demonstrate an accelerating trend during the Inspiration condition of the comparison phase. This statement needs to be made hesitatingly because the data rise only marginally, and two students showed a drop in performance on the last data point. From visual analysis, it seems as though students may have been beginning to become more proficient at the use of the software. Due to the final drop for Mitch and John, it seems as though there may have been a compliance issue which will be discussed later. Also,

further data collection may have helped but was not possible due to school scheduling, and this point will be evaluated in further detail in the challenges and issues section.

Although three students, Beth, Mary, and John, all had the highest mean score during the Inspiration condition, this fact is not solid enough to make a summative statement because the mean scores in all conditions were so similar. The slight difference may have simply been measurement error, and values were often only discrepant by a few percentage points. Further, when averaged as a group, the mean score was slightly lower for the Inspiration condition due to the incorporation of Mitch's data.

Mitch's data expressed the clearest pattern, and it showed a preference toward the baseline condition. While these data are also not incredibly powerful, they are the strongest of the four participants, and they lend themselves toward an opposite conclusion as the one hypothesized.

During study design it was important to only change one variable in each condition, the use or nonuse of either software program. This was done in an effort to isolate the effect that the software, in and of itself, had on dependent scores. However, this also meant that students were allowed to use the software without a guiding instructional practice such a template or mnemonic device. Because the data in this study did not conform to the hypothesis that concept mapping software was a better aid to students' independent reading, it may be tentatively stated that concept mapping software, without any specific instructional supports, is only as or less effective than simply allowing students to read a passage independently. This statement, though cautiously made, may be of some importance when evaluating instructional practices and designing future research. While a statement about what does work cannot be made, in essence, a statement about what does not work may be helpful as a guidepost for teachers and researchers

in the future. It may be inferred from this data that allowing students independent access to Inspiration software is no more effective than not providing such aid. Further, the use of the software without specific instructional aids designed to facilitate more structured use did not prove effective in helping high school age students with mild disabilities to become proficient at acquiring knowledge from independently read Social Studies material.

Research Question Two

Secondary to the evaluation of *Inspiration 7.6* was the evaluation of the use of *Word 2003*. Word was compared to the baseline condition to evaluate whether or not it was effective in aiding students in acquiring information. Results were similar to those expressed above. It was hypothesized that the use of Word would be more effective than no computer use but not as effective as the use of Inspiration. The group means revealed that word processing was the least effective intervention. No individual student faired better when in the Word condition. However, once more, individual and group means are so similar to each other that this is a provisional statement.

All data paths in the Word condition were accelerating, but increases were not substantial. However, it may be that students were becoming more proficient at using the program as an aid. No student received a passing score, 70% or better, on any dependent measure when in the Word condition; though, percent correct data increase as much as 60% during the condition.

Just as in the Inspiration condition, students were allowed to use Word as they thought would best help them. In an effort to only change on variable at a time during the comparison phase, students were not provided an outline or other instructional aids to use in conjunction with the software. At best, it can be stated that allowing students to use the software program without

specific aids incorporated into instruction is no more effective than allowing students to read a passage independently without aid. This statement may be of importance instructionally for teachers as will be discussed in further detail in a later section. Although no condition raised scores to a level necessary to be deemed effective, the use of Word seemed to be the least effective, albeit a small difference.

Research Question Three

The third and final research question attends to differential efficacy of both software programs. In comparison to each other, the question addresses if the use of Word or Inspiration software was more effective as an aid to students while independently reading content area information as measured by scores on the open ended dependent measure. Because the prior two questions both addressed efficacy of each software program independently and data revealed that neither program could be deemed more effective than nonuse, it stands to reason that the statements that can be generated regarding this third and final question are guarded.

All four students had slightly elevated scores when in the Inspiration condition. However, these differences were often insignificant. The group mean for the Inspiration condition was 25% correct were as the group mean for the Word condition was 19%. This difference is not substantial nor is it of any relevant importance, meaning that both means are very low and well below what would be considered passing.

When the relative data points are compared for each student, 85% of the time the data for the Inspiration condition is at the levels of, or slightly elevated from, that of the Word condition. Again, this difference is often small, but it seems to be relatively consistent. This finding may indicate that the use of concept mapping software has greater potential as an aid if coupled with the appropriate instructional practices that seem, from evaluation of these data, to be needed in

order for it to be more effective. Even Mitch's data, which shows a clearer preference to no computer use, did demonstrate higher levels of performance when Inspiration was in place as opposed to Word.

Clearly, the data do not lend themselves to specifics. However, a slight elevation of scores within the Inspiration condition was found. This difference was found to have little impact as it was not enough to increase scores to an acceptable percentage correct, but this finding may lend itself as an aid to the development of future research questions and practices.

Secondary Analysis

The secondary analysis looked at the quality of maps generated and compared these scores to the scores on corresponding dependent measures. It was found that two students, Mary and John, may have had a weak link with higher quality maps being associated with higher quality dependent scores. This analysis was hindered by the small range of dependent measure scores. Little difference could be noted due to the small amount of variability in the data. However, this finding opens the door for a more in depth evaluation of this type. Further, it may begin to indicate that if students were given stricter requirements and increased guidance regarding map construction that dependent measures scores may increase.

Student Perception

The final day of data collection students were administered a survey addressing perception of the interventions and preference ofconditions. Three of the four students preferred to read passages independently without using the computer, and one student preferred to use the Word software. However, the disjointed nature of the students' perception is revealed in that three of the four students consistently indicated that they felt like the software would be helpful to students and that they would use the software if they were teachers. One student, Mitch,

whose data showed a clearer pattern of success when in the baseline condition, did indicate that that he would not use the software as a teacher. All of the students were open to using the software again in the future.

While a concern was the novelty of computer use, it seems as though the students preferred to read in a way in which they were more comfortable and familiar, which was the no computer use or the use of Word software conditions. In effect, the novelty of the software program seemed to be more of a hindrance for these students than anticipated. However, half of the students indicated that that they would use the software again because it was a "new experience" or because it is "cool."

It seems as though the students were open to the software, and no student indicated extreme negativity toward it. If given more time, and possibly a more structured approach to its use, students may increase these already generally positive views.

Relation to Previous Research

Because the summative statements that can be made from this study are limited, it contributes to the literature only in that it provides evidence in support of a negative statement, that using Inspiration software alone is no more effective than no computer use or the use of Word software. It does not contribute a finding to the research base regarding what works, what does not work can only be inferred from the data.

Previous research has demonstrated the effectiveness of using concept mapping software as part of an instructional package (Boon et. al., in press; Blankenship et. al., 2005, Boon et. al, in press; Boon et. al., in review, Chang et. al., 2001; Sturm & Rankin-Erikson, 2002). However, the statement that could not be made to date in the literature was that the use of concept mapping alone would contribute to increased scores on academic dependent measures. Being able to

insert that finding into the extant research base was one of the purposes of this study. However, that statement cannot be made upon evaluation of these data. What can be said is, in fact, the opposite of this. What may be tentatively inferred from these data are that using concept mapping alone, not as part of an overall instructional program, will not facilitate acquisition of content area facts , and this practice is no more effective than having the students read independently without any computer aid.

Further, the studies that make up the research base regarding concept mapping software compare the use of the software to a non-computer condition. The rationale for the inclusion of the Word software program as a comparative intervention was to avoid this in the present study. It was thought that results found in previous studies may be attributed to a novelty effect regarding computer and software use. The clear demonstration that positive effects on acquisition of content area material were not due to novelty was another finding that was hypothesized. Because the initial evaluation of efficacy of the software proved no effect, then the statement regarding of novelty became unable to be settled.

This study does not contribute to the current literature base in the way that was hypothesized. However, results do show, at best, that in order for concept mapping to be effective, it may need to be used as part of an instructional package. The use of a mnemonic device as an aid for map construction or the strategies that have been proven successful in previous research may be applicable as part of an instructional program involving concept mapping software (Englert & Mariage, 1991, Boyle & Weishaar, 1997, Boyle, 1996).

Challenges and Issues

A few challenges did present during study implementation and design. First and foremost, selection of reading passages proved to be more difficult than anticipated. Each

passage needed to be independent of each other and at the same difficulty level. fortunately, students functioned at relatively similar levels with three students presenting reading achievement scores within normal levels, and one student, Beth, below average. Passages needed to be difficult enough for students to demonstrate a need for intervention by having baseline scores below 70% consistently. However, the passages also needed to be at a readability level where students could, with the aid of the computer, achieve at higher levels. The reading level of the passages may have impacted data negatively in that students seemed unable to do well despite the intervention condition. That being said, all passages were at or near student ability levels and were approved by the classroom teacher.

A related matter may be a dependent measures issue. Because students were not successful, despite the condition, it may be that the dependent measures used in the study were too difficult for the students. However, the measures were created with the construct to be measured in mind meaning that they were designed to assess the acquisition of facts. If the measures were made easier in an attempt at having students reach a predetermined criterion then the construct the measures assessed may change. The dependent measures were valid assessments of factual knowledge; however, they may have been difficult for students due to any number of measurement variables such as item format or response structure.

This leads to another challenge encountered during development and implementation, student effort. Using scores on the dependent measures for grades in the course was unethical, but without such motivation, students knew that their work “did not count.” A reinforcement system was put into place as previously described, and this worked well for students the majority of the time. Few compliance issues are noted, but at times data seemed to fall to lower than anticipated levels. For example, John demonstrated the ability to score at acceptable levels with

a 90% correct on one passage during the baseline condition of the comparison phase. However, his last two data points are each at 20% or less, each taken during baseline condition. This may reflect a lack of motivation. Mitch's scores also rose steadily throughout the comparison phase, and then his last two data points drop from passing scores at 70% to 10% and 20% consecutively. These lower points greatly effected means and data trends. While compliance was not noted as an issue during data collection, these data reflect that there may have been an issue toward the end of the comparison phase for these two students.

Lastly, time was a factor that may have stunted study results. Although dependent scores were low toward the beginning of the comparison phase, as data collection continued a slight accelerating trend seemed to be emerging. This trend may have continued had more data been taken during the comparison phase. However, due to state and county testing, the impending holiday season, and the semester break, data collection stopped at the session number set a priori.

While study results are not promising, they may have been affected and underdeveloped due to some or all of these factors. Each of the challenges noted would be important to address in the design and implementation of future research.

Limitations

This study is limited not only by the lack of influential data, but by a number of factors inherent in design and implementation. Mainly, this study only had four participants. In order to increase the external validity of any findings, the study would need to be replicated across more students. Further, the study participants were limited to ninth graders with mild disabilities. Again, the study would need to be replicated across age levels and disability populations.

It is also important to note that the study evaluated behaviors that were independent in nature. This opens up the study to any issue that may be applicable when students are asked to

complete independent work. During study design and implementation precautions were taken to try to combat many of these concerns, but it is difficult to control for all issues. Motivation may have been a factor in that the students knew that these scores would not affect their course grades. A positive reinforcement system was put into place and maintained throughout the study, and all students seemed motivated by the system. However, the data does, at times, suggest that a lack of motivation may have been a factor, particularly toward the end of data collection. Further, when students work independently, their strategies, habits, and academic behaviors are more difficult to control and assess. These may have varied day to day and this variance may or may not have been condition related.

Lastly, the study did not plan for maintenance or generalization checks. Data may look differently after the passage of time, in a different setting, or across differing materials. The independent use of the software programs may have different effects if students use it across curricula. Further, the comparison phase may have needed more data collection. While motivation may have been an issue toward the end, more data collection would have been helpful in evaluating data trends.

Implications for Instruction

This study does not result in any summative statements directly applicable to instruction. However, at best, it may be stated that the study results do seem to provide evidence that the independent use of concept mapping software, not coupled with any other instructional practices, is not effective in helping high school age students acquire content are material. This may be of some importance instructionally. While this statement does not provide teachers with answers regarding what to do, it does help them understand what not to do.

Often teachers use research in order to guide instruction. At times, teachers may choose what parts of an intervention may be applicable to their classrooms and students. As a result of this study, it is understandable that teachers should not use concept mapping software unaccompanied for independent reading of content area material. As will discussed further, more research is needed in order to be able to guide instructional best practice regarding what should be coupled with the use of the software in order to make the independent use of the program successful, but this study confirms that teachers should not plan for students to acquire knowledge from independently read material any better with the aid of the software.

Implications for Research

These data do not impact the current research base in a measurable way in that they do not lend themselves to summative statements that would translate to best practice. However, these data may impact the direction of future research. While previous research had failed to isolate the concept mapping variable, this study was successful in doing this. Despite the fact that the results did not return as hypothesized, they are somewhat valuable in that it was demonstrated that concept mapping software is not effective alone, and is it no more effective than independent reading without aid.

It is important for the research line in this area to continue to add variables, one at a time, in conjunction with the use of concept mapping in order to evaluate what must be coupled with the use of the software in order to make it effectual. Future research is needed in which concept mapping is used with more instructional aids, such as a mnemonic device, which have already proved effective for paper and pencil concept mapping (Englert & Mariage, 1991, Boyle & Weishaar, 1997, Boyle, 1996). Further, future research that may use concept mapping as part of any two part instructional practice would be of value. By adding only one variable, this will help

the field to understand what concept mapping software instruction should look like and with what variables it needs to be used in order to promote success. Examples of such added variables may be teacher led discussion, an instructor-made template, or a text structure strategies. Finally, this research needs to be continued across age levels and disability categories as well as content areas.

Another area evaluated post data collection was the quality of the maps in relation to scores on dependent measures. There was slightly promising data from which can be inferred that quality of map construction may impact success. This would be yet another area in which future data may be of interest.

Conclusion

This study was designed to evaluate the differential effect the use of concept mapping software, *Inspiration 7.6*, would have on the acquisition of content area knowledge for high school students with mild disabilities when compared to the use of *Word 2003* and no computer use conditions. The findings from this study are marginal in that no difference was found between the conditions, and the use of the concept mapping software was not successful in facilitating acquisition of facts from independently read material as evidenced by scores on an open ended quiz.

This study would have a relatively minor impact on the current research base in that it does not allow for statements regarding best practice to be made. At best, results can be used to aid in future study conceptualization and design. Studies can now focus on concept mapping used in conjunction with other aids to evaluate what combinations make for the greatest amount of student success. Results may be of minor impact instruction in that they do indicate to

teachers that the unaccompanied use of concept mapping software is no more successful than having students merely read a passage without the aid of the software.

The secondary analysis was an attempt to assess map quality in comparison to student success. The results tentatively reveal that map quality and quantity may impact the acquisition of facts. This is a minor finding that is guarded, but would be of interest in future research.

Further research is needed, and these results provide direction for said research. It is important to better understand how to use this software instructionally in order to facilitate student learning. Teachers and districts are increasing in the purchase and use of concept mapping software, and the fact that the software, if used unaccompanied, is no more useful than reading alone may be of importance in the overall extant research.

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APPENDIX A

SAMPLE PASSAGE

Hazy Summer Days and Air Pollution

Have you noticed that on some hot summer days the sky can look brownish instead of clear blue? Pollution causes poor air quality – and it can be bad for your health.

Scientists say that haze and smog are the problem. "Smog comes from two words, smoke and fog," said Alison Davis of the U.S. Environmental Protection Agency. Both haze and smog are caused largely by pollution from sources like power plants, factories, cars, and even wildfires.

Particle pollution is one type of pollution that affects air quality. The pollution is caused by tiny particles thrown into the air by factories and other sources. "If you took a grain of table salt. … That's 40 times bigger than the biggest [tiny particle]," Davis said. While something so small might seem harmless, Davis explained that the particles can get deep into your lungs and even affect your heart.

Air pollution from particles and other sources like ozone can also hurt trees and animals. Ozone is created when pollution from places like factories combines with sunlight. "Ozone can make asthma and existing lung problems worse," said Kerry Shearer of AirShare in California.

The summer usually has the worst air quality, because there is more sunlight. Sunlight reacts with pollutants to create ozone. Ozone is helpful high in the atmosphere, because it helps block the sun's harmful rays. But down closer to Earth, ozone can be harmful to people. But that doesn't mean that you should be afraid to play outside. Davis suggests that you check the Air Quality Index. The Air Quality Index works like a weather forecast. It lets you know how healthy the air you breathe is that day. The index gives a color to each day. Green means that the air is healthy and clean. Yellow means that people with asthma should be a little more careful than usual. "If it's a code red day, then you shouldn't play as hard," Davis said.

According to Davis, air quality in general has been improving in the United States. In 1970, the U.S. passed the Clean Air Act. The act has helped make the air cleaner, Davis said. In London, England, the air used to be so dark and polluted that cars would have to drive with their headlights on in the middle of the day!

But there is still a lot of work to do – and you can help. Shearer said that kids could make a big difference. "[Pollution] ties in with energy conservation and shutting off lights," he said. He suggests that kids encourage their parents to carpool. Davis agrees. She also says that recycling can help, because it saves energy. Saving energy means that factories and power plants don't have to create as much pollution.

Recently, the U.S. National Aeronautics and Space Administration (NASA) has assembled the most comprehensive view of air pollution in the Earth's atmosphere to date. Images from NASA's Terra spacecraft offer new ways to locate, identify, and track major sources of air pollution on Earth.
The spacecraft's initial observations reveal expansive clouds of carbon monoxide and other air pollutants spreading over continents and oceans worldwide. The major sources of these pollutants include natural air pollution from forest and grassland fires as well as human-based emissions from fossil-fuel burning.

John Gille, lead investigator at the National Center for Atmospheric Research in Boulder, Colorado, stated that, "With these new observations, we clearly see that air pollution is much more than a local problem. It's a global issue." Huge clouds of carbon monoxide from dry season fires in South America and Africa were seen to be spreading across the Southern Hemisphere. Across the Northern Hemisphere, the wintertime burning of fossil fuels was found to be a major source of air pollution.

http://news.nationalgeographic.com/kids/2004/07/Hazysummer.html
http://news.nationalgeographic.com/news/2001/05/0531_nasapollution.html

APPENDIX B

SAMPLE DEPENDENT MEASURE

Hazy Summer Days and Air Pollution Quiz

1. According to the researchers, poor air quality can be attributed to two primary components. What is one of these two components?

2. Working like a weather forecast, what is the name of the measuring device that allows us to check the general air quality?

3. According to NASA, what is one primary sources of air pollution (detected using NASA's Terra spacecraft) that have led to an increase in the levels of carbon monoxide in the atmosphere?

4. Smog comes from what two words?

5. Ozone is created from the combination of pollution from places like factories and _____.

6. Pollution caused from tiny particles thrown into the air by factories and other sources is known as what kind of pollution?

7. List one major sources of overall air pollution (contributing to both haze and smog) discussed in the article.

8. What is the name of the act passed by the U.S. in 1970 that has helped improve air quality?

9. How does ozone high in the atmosphere benefit air quality?

10. The air quality in London, England was once so dark and polluted that the local residents had to take what driving precautions?

Answers to Hazy Summer Days Quiz

1. Haze and smog
2. Air Quality Index
3. Natural air pollution from forest and grassland fires, human-based emissions from fossil-fuel burning
4. Smoke and fog
5. Sunlight
6. Particle pollution
7. Power plants, factories, cars, and wildfires
8. Clean Air Act
9. It helps block the sun's harmful rays.
10. They had to drive with their headlights on during the day time.

APPENDIX C

REINFORCEMENT SYSTEM

We appreciate your effort!!

For each block initially by Ms. Blankenship or Ms. Casalou, you will get 2 minutes of free time. You earn these by getting quiz question correct.

Here are the rules:

- Your free time must be used by you and only you.
- You can use it today or any day that Ms. Blankenship is here.
- We will cross off the blocks as you use your free time.
- You cannot disrupt others during free time.
- During free time you can read, sleep, draw, etc.

Thanks again, and enjoy your break! You have earned it!!

APPENDIX D

DATA COLLECTION FORM

Student Name _____ Researcher _____

Pretest Scores

Session 1: Date _____ Pretest Score _____
Session 5 and 6: Dates _____ Pretest Score _____
Session 22: Date_____ Pretest Score _____

Passage Name and Number	Pretest Score	Prior Knowledge (Y or N)

Baseline

Session	Date	Condition	Passage Title Passage Number	Percent Correct	Notes
2		No Computer			
3		No Computer			
4		No Computer			

Comparison

Session	Date	Condition	Passage Title Passage Number	Percent Correct	Notes
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					

Best Alone

Session	Date	Condition	Passage Title Passage Number	Percent Correct	Notes
23					
24					
25					

Social Validity

Date Administered: _____

Notes:

APPENDIX E

PROCEDURAL RELIABILITY FORM

Procedural Reliability Checklist

Date_____ Researcher_____ Observer _____

Participant in Session_____ Session Condition _____

Please note with a yes or a no if each of the following procedures were followed during the session for one student:

1. Did the researcher queue the student upon session beginning as to what condition was in effect?

2. Did the researcher already have all materials ready upon session beginning including correct program opened on laptop if applicable?

3. During independent reading time, was the researcher within proximity to the student to allow for independent work, yet, available to answer questions (approximately 2-15 feet)?

4. Were student questions dealt with as to not facilitate content area learning?

5. Was the student kept on task during the session by the researcher as needed?

6. Did the independent reading time consist of exactly 15 minutes?

7. Was the independent reading time disruption free by the researcher and teacher control of other student behaviors?

8. Was the student given no more than 5 minutes to work on the quiz?

9. Was the quiz scored immediately following the quiz?

10. Was reinforcement delivered immediately following the quiz being scored?

Percent of Procedures Followed:

$$\frac{\text{Number Steps Marked Yes}}{10} \times 100 = \boxed{}$$

APPENDIX F

STUDENT SURVEY FORM

What did prefer and why?

Please answer the following questions regarding what you preferred during the study and why you preferred it. This information will help other teachers decide what to have their students use to help them read independently. Please be honest and take your time. Only appropriate responses will be evaluated. If you want extra space you can use the back.

1. Which part did you like best?
    a. When you just read without using the computer
    b. When you read and used word processing
    c. When you read and made a concept map

2. What part did you least like?
    a. When you just read without using the computer
    b. When you read and used word processing
    c. When you read and made a concept map

3. Why did you like you choice from above best?

4. Would you want to use concept mapping on the computer again?

5. Why or why not?

6. How else could a teacher use these interventions (word processing and concept mapping) to help you – if at all?

7. If you were a teacher would you ask your students to make concept maps?

8. Why or why not?

Thank you so much for participating in this study! You have helped lots of teachers and students by using these interventions and giving us your feedback. You are very important in helping teachers decide what to use to help students!