Assistive Technology

Outcomes and Benefits

A joint publication of the Assistive Technology Industry Association (ATIA) and the Special Education Assistive Technology (SEAT) Center

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Assistive Technology Outcomes and Benefits

Assistive Technology Outcomes and Benefits is a collaborative publication of the Assistive Technology Industry Association (ATIA) and the Special Education Assistive Technology (SEAT) Center at Illinois State University. This publication is provided at no-cost to readers. It is a peer-reviewed, cross-disability, transdisciplinary journal that publishes articles related to the *benefits* and *outcomes* of assistive technology (AT) across the lifespan. The journal's purposes are to (a) foster communication among vendors, AT Specialists, AT Consultants and other professionals that work in the field of AT, family members, and consumers with disabilities; (b) facilitate dialogue regarding effective AT practices; and (c) help practitioners, consumers, and family members advocate for effective AT practices.

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Assistive Technology Industry Association

Assistive Technology Outcomes and Benefits

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Assistive Technology Outcomes and Benefits

Editorial Policy

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Assistive Technology Outcomes and Benefits invites submission of manuscripts of original work for publication consideration. Only original papers that address *outcomes and benefits* related to AT devices and services will be accepted. These may include (a) findings of original scientific research, including group studies and single subject designs; (b) marketing research conducted relevant to specific devices having broad interest across disciplines and disabilities; (c) technical notes regarding AT product development findings; (d) qualitative studies, such as focus group and structured interview findings with consumers and their families regarding AT service delivery and associated outcomes and benefits; and (e) project/program descriptions in which AT outcomes and benefits have been documented.

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Transitions
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Articles may be submitted under two categories—*Voices from the Field* and *Voices from the Industry.*

Voices from the Field

Articles submitted under this category should come from professionals who are involved in some aspect of AT service delivery with persons having disabilities, or from family members and/or consumers with disabilities.

Voices from the Industry

Articles submitted under this category should come from professionals involved in developing and marketing specific AT devices and services.

Within each of these two categories, authors have a range of options for the type of manuscript submitted. Regardless of the type of article submitted, primary consideration will be given by the journal to work that has *quantifiable results*.

Types of articles that are appropriate include:

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Case Studies. This category includes studies that involve only one or a few subjects or an informal protocol. Publication is justified if the results are potentially significant and have broad appeal to a cross-disciplinary audience.

Design. This category includes descriptions of conceptual or physical design of new AT models, techniques, or devices.

Marketing Research. This category includes industry-based research related to specific AT devices and/or services.

Project/Program Description. This category includes descriptions of grant projects, private foundation activities, institutes, and centers having specific goals and objectives related to AT outcomes and benefits.

In all categories, authors MUST include a section titled *Outcomes and Benefits* containing a discussion related to outcomes and benefits of the AT devices/services addressed in the article.

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An Action Research Study of Computer-Assisted Instruction Within the First-Grade Classroom

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Abstract: This investigation examined the use of computer-assisted instruction (i.e., *WordMaker*) on students having different levels of reading ability. Of particular interest were the effects of *WordMaker* on the spelling performance of first graders in a co-taught classroom. In a short 10-week period, the *WordMaker* software program had a positive impact on children's decoding and spelling skills. Eighty-three percent of the students experienced gains between the pre- and posttest scores. Findings suggest that *WordMaker* is an effective complement to other activities associated with the first grade curriculum (e.g., spelling and decoding) and has the potential to enhance students' reading and writing skills.

Key Words: Action research, Computer-assisted instruction, Reading, First grade

Introduction

Technology provides students with multiple pathways to learning. As the number of computers increase in classrooms, students are provided with immense opportunities to engage in a variety of learning modalities (i.e., visual, auditory, and/or kinesthetic) during the learning process (Lee & Vail, 2005). For computers to have an impact on children's learning, computer activities need to support overall educational goals. When technology is infused within the curriculum, young learners are provided a set of learning tools to assist them in achieving developmental academic goals across the curriculum (Judge, 2001).

The complexity of learning to read is indisputable. Today there are numerous computer programs available to teach reading and reading readiness skills. Yet only a few of these programs have been empirically validated (Lee & Vail, 2005). This study attempts to evaluate the effectiveness of a reading software program for young children. Given the purpose of this study, it is important to review a rationale and outcomes of computer use.

Computer-Assisted Instruction

Over the past three decades, educational researchers have investigated the effects of computer use on student achievement and attitudes. This area of research is expanding to include computer applications in support of the academic curriculum (Lee & Vail, 2005; Simic, 1993). Terms such as computer-based education (CBE), computer-based instruction

(CBI), and computer-assisted instruction (CAI) are commonly found in the literature. CBE and CBI often refer to the general use of computers in the classroom setting. Such use may involve many facets of instruction and can utilize a variety of computer technologies and applications (e.g., databases, drill and practice, Web quests). CAI is used when describing more specific applications such as drill-and-practice, tutorials, or simulation activities offered either as a stand-alone activity or supplemental activities to enhance teacher-directed instruction (Cotton, 1991). A summary of 59 CAI research studies compiled by Cotton provides insight into the benefits and effects of CAI. A few of the research findings shared by Cotton include: (a) The use of CAI as a supplement to conventional instruction produces higher achievement than the use of conventional instruction alone; (b) students learn material faster with CAI than with conventional instruction alone; (c) CAI is beneficial for younger students; (d) CAI is more beneficial for lower-achieving students than higher-achieving students; (e) students with disabilities achieve at higher levels with CAI than with conventional instruction alone; (f) students' fondness for CAI activities centers around the immediate, objective, and positive feedback provided by these activities.

Hall, Hughes, and Filbert (2000) further investigated the effects of CAI on reading instruction for students with learning disabilities. Their research found: (a) the CAI software used in research studies where students made significant gains involved software that was carefully designed to incorporate systematic instructional procedures found to be effective in reading instruction (i.e., explicit, strategic, and scaffolded instruction, engaged time, success rate, and corrective feedback); (b) research reinforces the need to apply systematic, elaborate corrections for students to learn efficiently and effectively; and (c) the application of CAI as supplemental activities to teacher-directed instruction had significant outcomes favoring CAI over other interventions such as additional traditional teaching and workbooks.

Mioduser, Tur-Kaspa, and Leitner (2000) investigated specific features of computer technology related to targeted outcomes regarding children's acquisition of early reading skills. This research involved 46 at-risk kindergarten children. Software used in this study allowed concrete manipulation of letters and word components in activities and games involving the decomposition, recomposition and creation of words. Findings identified key features of the software learning environment, which were relevant to building early reading skills. Such features involved the concrete manipulation of language entities through the act of touching, hearing, seeing, constructing, playing and replaying auditory constructs. The features also held substantial potential for assisting young children to acquire needed skills in reading.

The balance of this article describes the components of an action research study that includes: (a) a broad overview of the Four-Blocks® Literacy Model (Cunningham, Hall, & Defee, 1998) that provided the conceptual framework in the development of the *WordMaker* software program; (b) a brief description of *WordMaker* software activities that engaged participants in the study; and (c) the methodology, findings, and outcomes of CAI, specifically *WordMaker* software, on the spelling performance of first graders.

Four-Blocks® Literacy Model

Cunningham et al.'s (1998) literacy program known as Four-Blocks® attempts to meet the needs of as many learners as possible through a multilevel, hands-on, developmentally appropriate literacy model. Based on earlier studies (Cunnigham, Hall, & Defee, 1991),

their later research was designed "to figure out how to provide reading instruction to children with a wide range of entering levels without putting them in fixed ability groups." (Cunningham, Hall, & Defee, 1998, p. 652)

The Four-Blocks® model represents four components of reading to be taught to children to maximize reading acquisition. These components include: (a) *shared/guided reading*, which involves the use of basal readers along with other materials; (b) *self-selected reading*, where children have a choice of any book they like and respond to any part of that book they want; (c) *writing*, which is usually carried out in a Writers' Workshop fashion where the teacher models all the aspects of writing (e.g., looking at the Word Wall for spelling assistance); and (d) *working with words*, where children engage in reading and spelling of high-frequency words and decoding patterns (Cunningham et al., 1998)

This non-ability-grouped instruction has proven to be effective for students with minimal reading skills and does not hinder the progress of the top academic performing children. One of the reasons for its success is that the Four-Blocks® program provides a variety of ways for learners to approach reading and writing tasks (Cunningham, et al., 1991).

The "Making Words" block of this model is an activity in which children are given letters to make words. Typically, the teacher calls out a word to be made, children make the word with their individual letters at their desks, and one child makes the word with large letter cards at the board. During this activity children discover letter-sound relationships and learn how to look for patterns in words. They also learn that changing just one letter or even the sequence of the letters can change the whole word (Cunningham & Cunningham, 1992).

Research involving decoding by analogy supports spelling patterns used in the Making Words activities. Goswami and Bryant (1990) demonstrated that children can use words they already know how to read and spell while trying to figure out new unknown words. Aiken and Bayer (2002) discovered "the particular strength of Making Words is teaching students to notice patterns and make discoveries about written language that they could apply to other situations" (p. 73). Using of the Making Words activity resulted in children developing interest in making words and making progress on formal and informal decoding assessments in their classrooms.

Making Words is a powerful activity that provides an instructional format with endless possibilities for discovering how the alphabetic system works. It is a quick, every-student-responds, manipulative activity with which many children get actively involved (Cunningham & Cunningham, 1992).

WordMaker Software

The *WordMaker* software program, developed by Don Johnston Inc. (2003) in collaboration with Dr. Patricia Cunningham, is based on the Four-Blocks® Literacy Model (Cunningham, et al., 1991). *WordMaker* provides a systematic, sequential approach to teaching phonics and spelling while offering engaging activities, graphics, supporting sounds, and a motivating literacy environment for learners. Activities within the program encourage learners to engage in experiential learning, guided discovery, and knowledge transfer techniques. A wide range of learners are accommodated through creative and effective built-in scaffolds and customized feedback. The software is available in both PC and Mac platforms, is teacher-friendly, and easy to install. The program features extensive reporting of learner progress which provides an in-depth look at patterns and details of mistakes and successes.

WordMaker Activities

The lessons within the *WordMaker* software program are divided into 5-lesson units. Students begin using the *WordMaker* software on different levels/lessons according to the results of their pretests. Lessons 1-29 focus on beginning sounds. Lessons 31-140 focus on recognizing patterns in word endings and rhymes. During the lessons students have many different activities that can be divided into the following groups: manipulating letters to make words, sorting words by either beginning sound or by ending rhyme, and word recognition. When working with the pictures or the words the learner can place the cursor over the item to have it pronounced as many times as needed.

In the *Making Words* activity, students either have to (a) make a simple two-letter word (e.g., 'at') with the sounds that were introduced before; (b) move the letters around to spell another word (e.g., 'ring-grin'); (c) take one letter away and spell another word (e.g., 'can-cap'); or (d) add another letter to spell a new word (e.g., 'sad-sand'). Words are pronounced to provide learner support. The words are repeated three times: first in isolation, then in a sentence, and then again by themselves. If students make a mistake, the computer encourages students to listen to the first/last letter carefully or suggests that other letters should be used. After several trials, all the letters that the student already attempted fade away. This leaves only the correct choice, allowing the student to make the target word, thus, minimizing frustration and allowing the student to experience success. At the end of the *Making Words* activity, students explore a secret word. They must use all the letters from the lesson to spell it. In early lessons, all the letters are in place except for one so students can't get it wrong. In each unit, students randomly spell a secret word without any visual supports and find the right place for all the letters. If assistance is needed, students can use the check button and receive clues. After spelling a secret word, points are awarded (e.g., 5 points if the word was spelled without any clues, 4 points if spelled with 1 clue). These points are accumulated throughout the program. At the end, students are encouraged to do a better job next time.

The last lesson in each unit is a review where students have the opportunity to engage in not only making words or sorting words, but also word recognition activities such as *Find Words, Wordo*, and *Be a Mind Reader*. In the first activity (*Find Words*), students must find each word that is pronounced to them in a timed scenario. Before being presented with the timed scenario, students are offered an option to click on each word to hear it as many times as they wish. In order to adjust this activity to different learners the teacher can change the amount of time (i.e., 1, 3, or 5 min). After Lesson 10, students can participate in the *Wordo* activity where they play a bingo-like game against the computer finding the words that were pronounced. When students win, they are awarded 3 points that accumulate throughout the program.

The Literacy Challenge

P-12 classroom teachers (both general educators and special educators) are challenged to work together to meet the specific educational needs of every student. A careful examination of the *WordMaker* software program features and skill building activities allows teachers to make informed instructional decisions to determine if it would be a viable tool for their classroom. Software features were aligned with classroom curriculum goals, state standards, learning styles, teaching styles, and classroom routines. Using technology such as *WordMaker* software in providing CAI could give classroom teachers additional learning tools to extend learning opportunities needed to meet diverse

needs and build necessary literacy skills for school success.

Research

Research Questions

The specific purpose of this study was to examine the advantages and/or disadvantages of the use of CAI program, *WordMaker*, among students with different levels of reading ability. Of particular interest were the effects of *WordMaker* on the spelling performance of first graders in a co-taught classroom. Research was guided by the following questions:

1. What impact does the *WordMaker* software program have on vocabulary and spelling skills of first grade students?
2. What impact does the *WordMaker* software program have on students with various reading ability levels, including those with identified disabilities?
3. How feasible is it to implement the *WordMaker* software program while delivering instruction aligned with a mandated state curriculum?

Setting

The research took place in a typical first-grade classroom in a primary school located in a rural school district of eastern North Carolina. Students are immersed in a literacy-rich learning environment through meaningful pictures, posters, word walls, and books that are strategically placed around the room. The major pattern of instruction within this first grade classroom involves small groups engaged in cooperative learning activities. The groups are not fixed but change according to the subject area, students' interests, and classroom themes. This primary school and county serve an economically depressed population where 75% of the students receive free or reduced lunch. The classroom where the research took place was a co-taught classroom where a special educator and general educator shared in teaching responsibilities.

Participants

Students. Participants were 18 students in this co-taught first grade class that included children with disabilities (n = 3); those at-risk for a disability label (n = 2); English Language Learners (n = 3); average performing students (i.e., academically performing at first grade level, n = 6); and students eligible for enrichment programs (i.e., advanced level of academic performance, n = 4). By gender the students included eight males and 10 females representing white, African American, and Hispanic backgrounds. Table 1 provides additional information on the participants.

Besides students who performed on grade-level with no additional service, there were four other groups of students identified by the services they were receiving within the school-wide system. The at-risk group included students (n = 2) who were in the intervention stage of the referral process for special education services. It is important to note that by the end of this study, it was determined that these students did not qualify for special education services. The enrichment group included students who were identified as gifted and talented within the school, thus allowing them to participate in school-wide enrichment activities. The English Language Learners group included students receiving English as a Second Language (ESL) services. The identified disabilities group included students with disabilities who received special education services under an individualized education program (IEP).

Teachers and classroom assistants. This study involved a general educator, special educator,

Table 1
Student Demographics (*N* = 18)

Gender	Ethnicity	Special Services or Abilities
F	African American	At-risk, receives speech and language therapy
F	African American	Average academic performance, receives speech and language therapy
M	African American	Average academic performance*
M	African American	Qualifies for Enrichment Program
F	African American	Average academic performance*
F	African American	Average academic performance*
F	African American	Qualifies for Enrichment Program
M	Hispanic	English Language Learner
F	Hispanic	English Language Learner
M	Hispanic	Developmental disabilities, Previously retained
M	Hispanic	English Language Learner
F	Hispanic	Qualifies for Enrichment Program
M	White	At-risk, receives speech and language therapy
M	White	Learning disabilities
F	White	Average academic performance*
M	White	Average academic performance*
F	White	Qualifies for Enrichment Program
F	White	Developmental disabilities

*Note: Average academic performance indicates that student is academically performing at grade level.

and classroom assistant. The general educator held a bachelor's degree in elementary education and had four years of teaching experience at the lower elementary level. This was her first experience co-teaching with a special educator. The special educator was a first-year teacher who had completed a master's degree in special education/learning disabilities. The teaching assistant had 15 years of working with first- and second-grade students. She had experience in working with students in small groups providing guided practice and supervising independent practice so she felt confident with monitoring and facilitating one of the stations during the station co-teaching model.

Co-teaching model. The co-teaching model was designed for the special educator to be in the room for an hour and a half every day, usually in the morning. The general and special educators shared teaching responsibilities and planned all lessons together. Instruction was provided and research conducted within the co-teaching station model (Cook & Friend, 1996; Vaughn, Schumm, & Arguelles, 1997) enabling teachers to work with small groups of students who rotated among the teachers, so each student received instruction from both teachers and a teaching assistant

Methodology

Categorization of students into the groups was strictly for record-keeping and research purposes to compare pre-/posttest scores. All students received the same instruction and participated in the same activities within the first-grade classroom.

The three guiding research questions involved different sources of evidence. To address the first and second questions, first-grade students were given a paper-pencil spelling pretest to determine on which lesson each student should begin working in the software program. This pretest was also used as a baseline by which post-interventions achievement was compared. As a result this exact pretest was used as both a pre-and posttest to compare achievement. The final question was answered through teachers' interviews, student interviews and written expressions of their personal use of the software program, and examination of the current first grade English Language Arts curriculum standards for the State of North Carolina (State Board of Education, n.d.).

General Procedures

One day a week, the class was divided into three groups to perform the station co-teaching model. Students were divided into three co-teaching groups randomly and not according to their ability level. In each co-teaching group there were students representing all ability levels. The general education teacher and her assistant had two-thirds of the students working on different skills in math, reading or writing at two stations. At the same time, in the third station (consisting of 3 computers) the special education teacher conducted this computer research with the remaining students for 10 weeks. During the computer time one-half of the students in the third station worked with the *WordMaker* software program while the other half remained at their desks to complete either spelling or vocabulary teacher-directed game-activities, waiting for their turn on the computer. The students rotated within this station until all had completed at least 1 or 2 *WordMaker* lessons on the computers. During the 1.5 hours of co-teaching block students strategically moved through all three stations spending approximately 30 minutes at each, allowing all 18 students to work on the *WordMaker* program in one day.

Pretest/Posttest Assessment

During the first day of this study students were given the *WordMaker* spelling pretest to

Figure 1. Pre-and posttest comparisons between various ability levels.

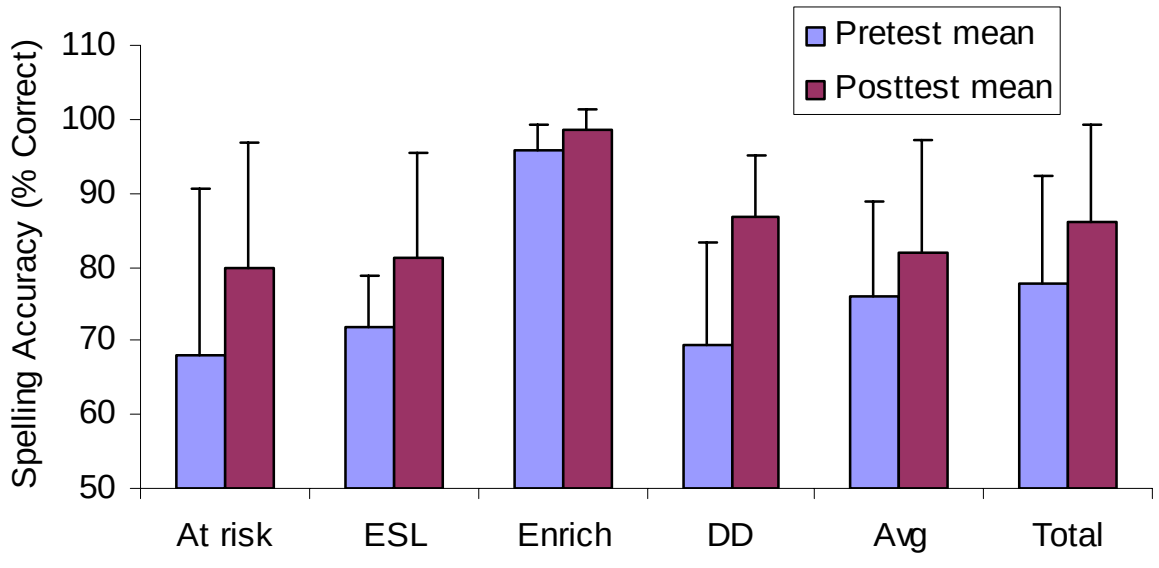


Table 2
Pre-/Posttest Spelling Accuracy (%) for Students Sorted by Group (*N* = 18)

Group (*N* = 18)	Student	Individual Pretest	Individual Posttest	Pre-/ Posttest Paired Differences	*M* of Pair Differences for Each Subgroup	*SD* of Paired Differences for Each Subgroup	Group *N*	*t*-value	*p*	*df*
		% Spelling Accuracy	% Spelling Accuracy							
Disabilities	1	84	96	12	17.33	6.11	3	4.914	0.0195	2
	2	68	84	16	--	--	--	--	--	--
	3	56	80	24	--	--	--	--	--	--
At- Risk	4	84	92	8	12	5.657	2	3	0.102	1
	5	52	68	16	--	--	--	--	--	--
ELL	6	68	68	0	9.33	8.326	3	1.94	0.096	2
	7	68	80	12	--	--	--	--	--	--
	8	80	96	16	--	--	--	--	--	--
Average	9	56	76	20	6	13.564	6	1.083	0.164	5
	10	72	80	8	--	--	--	--	--	--
	11	76	96	20	--	--	--	--	--	--
	12	92	96	4	--	--	--	--	--	--
	13	72	56	-16	--	--	--	--	--	--
	14	88	88	0	--	--	--	--	--	--
Enrichment	15	92	95	3	3	2.16	4	2.777	0.035	3
	16	98	100	2	--	--	--	--	--	--
	17	94	100	6	--	--	--	--	--	--
	18	99	100	1	--	--	--	--	--	--
Total	--	--	--	--	8.424	9.712	18	3.68	.0009	17

determine the appropriate starting level for each student within the software program. Before beginning the computer station, the special education teacher read the words for students to spell on their papers in a spelling test format. This multi-level pretest assessed the students' mastery of each word level. In order to move to the next level students must score 100% on the previous one. Fourteen students made errors in the first 25 words and started the program at Lesson 1. The four remaining students spelled the first 25 words

correctly and moved beyond the first level. Those students continued to move throughout the pretest, spelling 12 more words on each following level. As a result, they each had a different number of words to spell and started the *WordMaker* program at different lessons (i.e., Lessons 26, 31, 36, 46). During the posttest, students were given the same words they had on the pretest and the percentage of words spelled correctly determined if improvement was made.

Results

In this 10-week study, students completed 16 out of 140 possible lessons. In response to the first research question, "What impact does the *WordMaker* software program have on vocabulary and spelling skills of first grade students?", 15 out of 18 children demonstrated improvement on the posttest. A one-tailed (Ho: $\mu D = 0$ vs. Ha: $\mu D > 0$) paired t-test was performed to measure the difference between pre-/posttest means to determine if there was a significant impact on the number of correctly spelled words as a result of using the *WordMaker* software program.

Pre-and posttest spelling accuracy percentages for each student sorted by group is reported in Table 2. Mean scores were calculated from the ratio of the correctly spelled words over the total words students had to spell. Due to the fact that the total number of words each student received was different, the score percentages were reported. The differences between the pre-/posttest scores for the data were found and the mean and the standard deviation of those differences were calculated (see Table 2).The average difference in pre-/posttest scores for the entire class was 8.424 ($SD = 9.712$) which was statistically significant (t=3.680, p=0.0009, df=17).

To answer the second research question, "What impact does the *WordMaker* software program have on students with various reading ability levels, including those with identified disabilities?", comparisons were made between various ability levels. Scores were divided into 5 different groups: identified disability ($n = 3$), at-risk ($n = 2$), ELL ($n = 3$), average ($n = 6$), and enrichment ($n = 4$). Figure 1 illustrates that all groups performed better on the posttest. As indicated in Table 2, the mean increase in words spelled correctly for students with an identified disability spelled was 17.33% ($SD = 6.110$) from pretest to posttest which demonstrated a statistically significant difference ($t = 4.914$, $p = 0.0195$, $df = 2$). Students in the at-risk group had a mean increase of 12% ($SD = 5.657$) of words spelled correctly which was not statistically significant ($t = 3$, $p = 0.102$, $df = 1$). Students in the ELL group averaged an increase of 9.33% ($SD = 8.326$) of words correctly from pretest to posttest which was not statistically significant ($t = 1.94$, $p = .096$, $df = 2$). The average performing group had a mean increase of 6% ($SD = 13.564$) from pretest to posttest which was not statistically significant ($t = 1.083$, $p = .164$, $df = 5$). Student in the enrichment group had a mean increase of 3% ($SD = 2.16$) of words spelled correctly from pretest to posttest which was statistically significant ($t = 2.777$, $p = .035$, $df = 3$).

In response to the third research question, "How feasible is it to implement the *WordMaker* software program while delivering instruction aligned with a mandated state curriculum?", teacher interviews revealed that the *WordMaker* software program is an excellent supplement to the first grade curriculum and enhances students' learning of phonics. One teacher stated, "*WordMaker* software corresponds well with the first-grade curriculum and provides extra activities for practicing essential first-grade skills." This program helps students to achieve the goals set forth by the state of North Carolina in language arts for first grade as outlined in

North Carolina Standard Course of Study (NCSCS; State Board of Education, n.d.). Teachers reported that it corresponds to the following competences of the NCSCS, Language Arts, First Grade: 1.01, 1.02, 1.04, 5.01, 5.02 (State Board of Education). With the help of the *WordMaker* program, teachers were able to apply technology not only in order to meet students' individual needs, but also to execute the NCSCS. Both teachers participating in this study stated that students were highly motivated by this program and benefited from the practice of essential skills though various activities.

Discussion

The purpose of this investigation was to examine the advantages and/or disadvantages of the use of the computer software program *WordMaker* on students with different levels of reading ability.

In the short time this study was implemented the majority (83%) of students experienced gains between pre-and posttest scores. The following paragraphs discuss three specific research questions that were addressed in this study: (a) What impact does *WordMaker* software program have on vocabulary and spelling skills of first grade students? (b) What impact does *WordMaker* software program have on students with various reading ability levels, including those with identified disabilities? and (c) How feasible is it to implement the *WordMaker* software program while delivering instruction aligned with a mandated state curriculum?

Increased Skills

Within the *WordMaker* program, students progressed in their spelling and decoding skills. The program is set up to provide opportunities to work with the same words in different ways. Obvious gains were accomplished by students. Benefits of this program can be seen through the following examples. For example, one student made a mistake in the words 'jump' and 'jumping' on the pretest. She also made the same mistakes in Lesson 12 where those words were introduced. In the computer lesson she learned how to spell those words correctly. In Lesson 15, when those words were reintroduced, she didn't make a mistake. When given the posttest, she spelled those words correctly. Interesting enough, when that student was given those words on the posttest she stated, "I saw these words on the computer. I know how to spell them." Students began to transition the skills from the software program to other writing tasks. Another example of how students progressed in skills throughout working with this program involved making mistakes with the words 'has' and 'had' on the pretest. The computer introduced the correct way of spelling them in Lesson 4 after the student repeated these mistakes. When those words were reintroduced in Lesson 5 there were no mistakes. In addition, the student didn't make the same mistakes on the posttest.

Throughout the use of the *WordMaker* software, students manipulated letters to make the words, which lead them to discover new word patterns. Students began to experience success while spelling unfamiliar words. For example, the word 'kittens' that was on the pretest was not a part of any lesson students in this study were able to complete. In Lesson 14 there was a word 'rabbits' that has a similar pattern. As a result, some students were able to spell the word "kittens" correct on the posttest. Interestingly enough, word pattern is not a part of the first grade curriculum. For that reason it was not introduced by teachers throughout the year. This leads the researchers to believe that such improvement on the posttest can be attributed to the use of the *WordMaker* software program (for further discussion see Outcomes and Benefits section).

Varying Abilities

The classroom chosen for this study is a snapshot of a typical first-grade classroom in a public school with children performing on different levels. When examining the effects of the *WordMaker* software program on students with various reading ability levels all groups showed different levels of improvement. One of the most interesting findings in this study was that the two groups that had a statistical significance in differences between the pretest and posttest scores were the children with disabilities group and the enrichment group. Such a finding supports that the *WordMaker* program benefits struggling readers as well expanding the abilities of the enrichment learner even further. Teachers in this study reported that the individualized pace of the software program provided the enrichment group practice of essential reading and writing skills while advancing them to more challenging word levels. Students in the children with disabilities group benefited from the practice of essential skills in a learning environment that reduced distraction and required hands-on learning. It's important to note that students in the children with disabilities group shared comments such as, "I like to pull the letters to the line" or, "it is fun because you have to drag the letters to make a word," when asked, " what do you like about this program?"

These findings suggest that *WordMaker* doesn't just work as a remediation tool for students with disabilities to work on specific areas of deficiency such as making words. It benefits all groups of students. Because of this finding, teachers in this study strongly agreed that *WordMaker* can be easily used in a typical first-grade classroom both for students with disabilities and typical students. The fact that overall difference on the pretest and posttest for all students in the class together was significant supports the idea that first-grade students of varying abilities may benefit from using the *WordMaker* software program.

It should be noted that throughout the use of the *WordMaker* program, the students' approach toward literacy tasks began to change. Teachers observed students exploring words in their environment and playing games to make new words. This appeared to be fostered by their use of *WordMaker*. All students stated when asked that they enjoyed working with the *WordMaker*. Each student found something that caught his/her attention in this program. Students liked different parts of the *WordMaker* software program. One student mentioned, "I like to play Find Words. We need to find the things that the computer says. We need to do it fast because the time is running out." Another student enjoyed Secret Word: "I like Secret Word because it is fun. It is like a mystery and it gives you hints. It makes you figure the word out. And when you get something right, they give you points." Many students liked Wordo, noting that "It's just like tic-tac-toe", or "It's fun because you can beat the laptop or the laptop can beat you."

Natural Fit

The *WordMaker* software program enhances the first grade curriculum. Literacy is the biggest part of any first-grade daily routine and takes the majority of the time in the academic year. For that reason the *WordMaker* software program is a natural fit in the first-grade classroom. However, existing research on assistive technology makes it clear that simply providing technology to teachers and students will not result in academic improvements. Careful thought and consideration must be taken in order to use any software program in a meaningful way for students. In this study, the use of the software program was to complement teacher-directed activities. Teachers were involved in planning and preparing literacy experiences throughout

the entire day. The *WordMaker* software was infused into the instructional routine. It was a meaningful and useful tool that provided students with another opportunity to learn and use phonics and spelling skills.

Outcomes and Benefits

The specific purpose of this 10-week study was to examine the advantages and/or disadvantages of the use of the computer software program *WordMaker* on students with different reading ability levels. In order to determine the impact of the software program, the spelling performance of first graders in a co-teaching classroom was examined. Eighteen students in this study represented a variety of categories (i.e., average, at-risk, identified disability, ELL, and enrichment) that are typically found in a first-grade general education classroom. Differences in students' pre-/posttest scores for the children with disabilities group and the enrichment group were found to be statistically significant.

This study reveals similar results as the research review conducted by Cotton (1991) a decade earlier. In summary, the following findings for students working with the *WordMaker* software in this study were compared to the research literature review of CAI:

1. Previous research supports that CAI is beneficial for younger students. This study found that first grade students benefit from using the *WordMaker* software.
2. Previous research supports CAI is more beneficial for lower-achieving students than with higher-achieving ones. This study found overall differences in pre-and posttest spelling scores were significant for students with identified disabilities and students involved in enrichment programs, however the difference was greater for students with disabilities or at risk groups in other ways.
3. Previous research found students' fondness for CAI activities centers around the immediate, objective, and positive feedback provided by these activities. This study reports that students benefited from multimedia approach involving hands on activities of moving letters, engaging graphics and sounds.

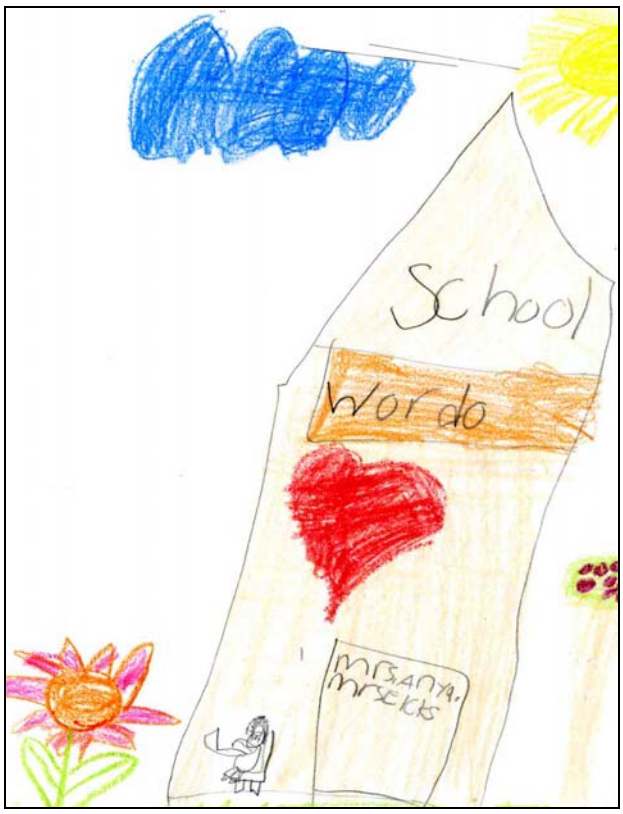
Limitations

One of the major limitations to this study is the lack of control group; therefore, it is difficult to attribute results to the specific intervention alone. However, several word patterns used on the pretest and posttest were not introduced in the first grade classroom. Thus we can suggest that the improvement on the spelling test can be somewhat attributed to the use of the *WordMaker* software. Another major limitation is the small number of students in each ability group. Nonetheless, we are encouraged by the increase in scores from the pretest and posttest demonstrated by the entire class. The final limitation to this study discussed here is the length or duration of the use of the software. Perhaps if this study were conducted throughout entire academic year significance might have been reached in all groups. Further research is recommended in order to challenge such limitations.

Software Feedback and Suggestions

Both teachers and students saw the many benefits of *WordMaker*. Immediate feedback was mentioned several times. Teachers stated that when a student misspells a word, the computer provides immediate speech feedback that serves the purpose of strengthening the reader's decoding and spelling ability and avoiding the possibility

Figure 2. Students express their feelings about using *WordMaker* software. This picture illustrates how one first-grader loves school, her teachers, and *Wordo*.



that errors go unnoticed. One student with learning disabilities mentioned that, "You hear every letter and word you click on so you can figure if something is wrong."

Teachers expressed that immediate feedback was important but it wasn't always enough. They would like to see the software program make adjustments within the current lesson. The special education teacher shared:

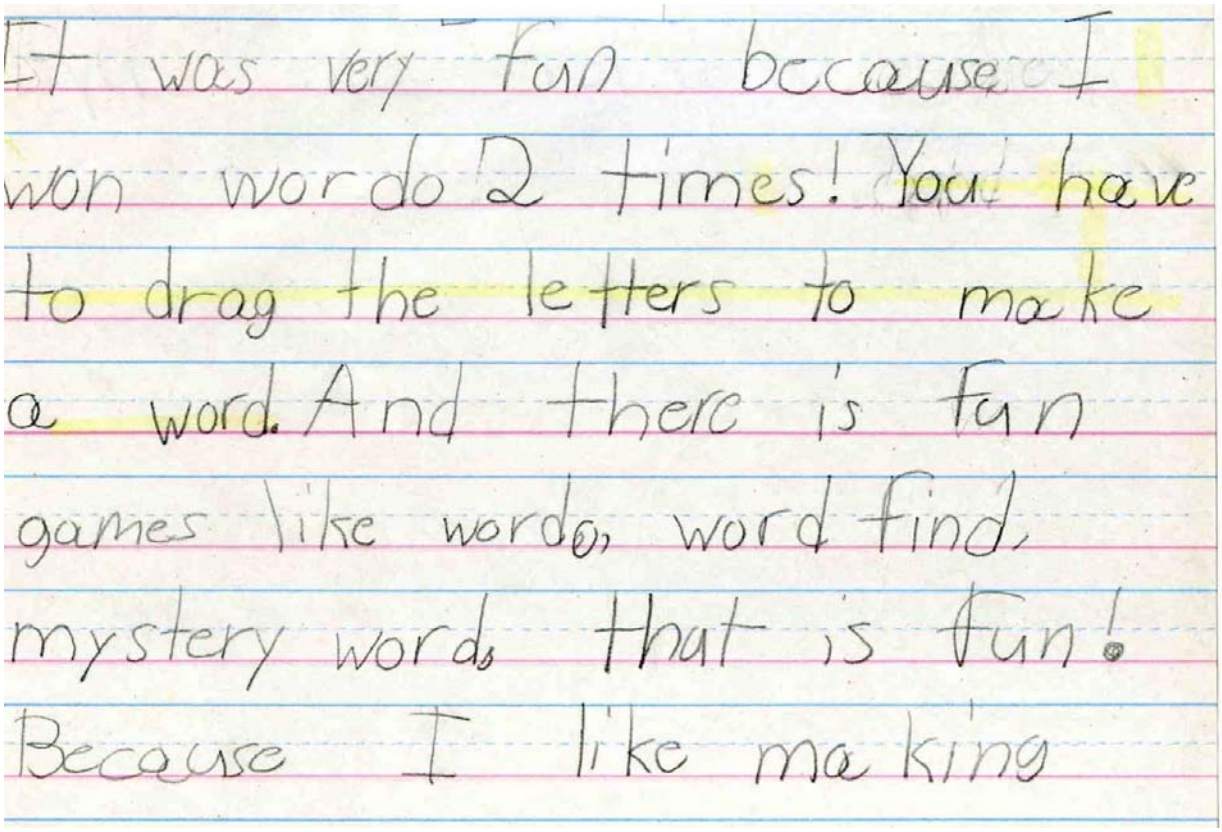
> I would like to see an improvement within the *WordMaker* program. For some students it wasn't enough to have the same words repeated a couple of times. It appeared that little or no adjustment was made within the lessons if students were not successful with words in the lesson. Students could benefit from some adjustment in the following lesson if they were not very successful in the previous one. For example, I observed that if one student scored 65% in one lesson while another scored 100% on the same lesson, both would have the next lesson with the same words regardless of level of mastery. It appears that *WordMaker* software does adjust the following lesson but only in case when a student failed the previous one completely. Ideally, I would like the software to provide an individualized bonus activity or a game throughout the program engaging the student to use the troublesome words until mastery was reached.

In further conversation, both teachers expressed how surprised they were to see the students really enjoying making words and exploring new words but on and off the computer. Yet teachers expressed that "regardless of the benefits of *WordMaker* it would probably be difficult to have every student work with the program everyday due to time limitation and computer availability."

When students were asked, "What did you like about the *WordMaker* program?" every student had positive things to say about it. One first grader shared, "I like *WordMaker* because I get to think and make words." Another student stated, "I like *WordMaker*. I can write difficult words. It's fun. I can spell easy words. I can spell hard words." Students were encouraged to work with this software because as one of the students noted, "I like *WordMaker* because it gives me points." When working in the Wordo, another student expressed that "Wordo is a fun game because sometimes I win. Sometimes she wins (in this case she refers to the computer)." Other examples of students' feedback in using the *WordMaker* software can be found in Figures 2 and 3.

Teachers observed first-hand that *WordMaker* engaged students in practicing decoding and spelling skills in a fun way. Every student enjoyed using the program and didn't feel it was tedious or too difficult. Other teacher comments in this study include: (a) enrichment students benefited from the individual pace and the opportunity to move beyond first-grade words; (b) although teachers are skeptical in their particular educational setting of how the software could be used everyday for every student; as a supplementary instructional tool it seems to

Figure 3. First-grade student writes about his *WordMaker* experience.



works very well with the curriculum; and (c) both teachers and students enjoy using CAI.

Future Studies Needed

This action research study provides insight to the use of CAI, specifically *WordMaker* software, for first-grade students. Yet, the following questions still remain unanswered and need further research: (a) If students used the *WordMaker* software for an entire academic year, would academic growth increase or would children grow tired of it? Would student lose interest and motivation? If so, what could be done to minimize this occurrence? and (b) Is it possible in today's typical classrooms to integrate CAI for daily use by every student? If so what additional benefits would accrue to students?

In a 10-week period the *WordMaker* software program had positive impact on children's decoding and spelling skills. It was found to be an effective complement to other activities associated with the first grade curriculum (e.g., spelling and decoding) and has the potential enhancing students' reading and writing skills.

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ATIA Innovation Cooperation
Assistive Technology Industry Association

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CALL FOR PAPERS

Assistive Technology Outcomes and Benefits

Fall, 2007
Submission deadline: March 31, 2007

Assistive Technology Outcomes and Benefits is a peer-reviewed, cross-disability, transdisciplinary journal that publishes articles related to the outcomes and benefits of assistive technology (AT) across the lifespan. The journal's purposes are to (a) foster communication among vendors, AT Specialists, AT Consultants, and other professionals that work in the field of AT, family members, and consumers with disabilities; (b) facilitate dialogue regarding effective AT practices; and (c) help practitioners, consumers, and family members advocate for effective AT practices.

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Assistive Technology Outcomes and Benefits invites you to submit manuscripts of original work for publication consideration. Only original papers that address *outcomes* or *benefits* related to assistive technology devices and services will be accepted. These may include (a) findings of original scientific research, including group studies and single subject designs; (b) marketing research conducted relevant to specific devices having broad interest across disciplines and disabilities; (c) technical notes regarding AT product development findings; (d) qualitative studies, such as focus group and structured interview findings with consumers and their families regarding AT service delivery and associated outcomes and benefits; and (e) project/program descriptions in which AT outcomes and benefits have been documented.

The fourth volume of this peer-reviewed journal will include a broad spectrum of papers on topics specifically dealing with AT outcomes and benefits issues, in (but NOT limited to) the following areas:

- Transitions
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For information on how to submit manuscripts see the *Guidelines for Authors* at http://www.atia.org/

Guidelines for Authors

Assistive Technology Outcomes and Benefits
Submission deadline for Volume 4(1): March 31, 2007

Submission Categories

Articles may be submitted under two categories—*Voices from the Field* and *Voices from the Industry.*

- *Voices from the Field.* Articles submitted under this category should come from professionals who are involved in some aspect of assistive technology service delivery with persons having disabilities, or from family members and/or consumers with disabilities.
- *Voices from the Industry.* Articles submitted under this category should come from professionals involved in developing and marketing specific assistive technology devices and services.

Within each of these two categories, authors have a range of options for the type of manuscript submitted. Regardless of the type of article submitted, primary consideration will be given by the journal to work that has *quantifiable results.*

Types of articles that are appropriate include:

- **Applied/Clinical Research.** Original work presented with careful attention to experimental design, objective data analysis, and reference to the literature.
- **Case Studies.** Studies that involve only one or a few subjects or an informal protocol. Publication is justified if the results are potentially significant and have broad appeal to a cross-disciplinary audience.
- **Design.** Conceptual or physical design of new assistive technology models, techniques, or devices.
- **Marketing Research**. Industry-based research related to specific AT devices and/or services.
- **Project/Program Description.** Grant projects, private foundation activities, institutes, and centers having specific goals and objectives related to AT outcomes and benefits.

In all categories, authors MUST include a section titled 'Outcomes and Benefits' in which a discussion is provided related to outcomes and benefits of the assistive technology devices/services addressed in the article.

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Assistive Technology Outcomes and Benefits

(Note: These guidelines apply to all *Voices from the Field* and *Voices from the Industry* submissions)

All articles submitted will be refereed by the Editorial Review Board. Recommendations on suitability for publication will be taken as final by the Editor.

All other items would not be reviewed, but the editors reserve the right to refuse or (with the approval of contributors) to edit copy.

- Each manuscript must reflect style guidelines of the *Publication Manual of the American Psychological Association* (5th edition, 2001).
- Manuscripts should be **no more** than 25 pages in length (**double-spaced**), *including* references, tables, and figures. Due to the electronic format of the journal, all submissions should be submitted as email attachments in either Microsoft Word or rich text (RTF) formats. The following information should be provided on the cover page of each manuscript:

    - Author'(s') full name(s) and title(s)
    - Name of corresponding author
    - Job title(s)
    - Organization(s)
    - Full contact information of the corresponding author, including email address, postal address, telephone and fax numbers
    - Each manuscript should have at least the following components:
        - Title (up to 10 words)
        - Abstract (75 to 150 words) presenting the main points of the paper and the contributor's/s' conclusions regarding outcomes and benefits
        - Four keywords
        - Main body of paper
        - **Outcomes and Benefits section**
        - References

- Submissions should be double-spaced.
- Articles should be subdivided into unnumbered sections, using short, meaningful headings according to *Publication Manual of the American Psychological Association* (5th edition, 2001).
- Footnotes and endnotes are **not** accepted; all such information should be included in main text.
- The keywords (just after the abstract) should be separated by **commas**, and each keyword phrase should have initial caps (for example, Communication devices, Families).
- Authors should not use <u>underline</u> to highlight text, but rather use *italics* instead.
- For figures, BMP, GIF, and JPG are the preferred formats. Figures should be included in the text at appropriate places and centered horizontally. Captions (maximum 6 to 8 words each) must be provided for every figure (below the figure) and must be referenced in the text. The figures must **NOT** be larger than 500 pixels in width. **Authors must supply separate**

figures in one of these formats even if they are embedded in text. In the event that the file(s) can't be opened, the Editor will contact the corresponding author by email and request that the appropriate format be provided.

- Tables should be included in the text at appropriate places and centered horizontally. Captions (maximum 6 to 8 words each) must be provided for every table (below the table) and must be referenced in the text.
- The References section should contain appropriate citations noted in the APA Manual (5th ed.)

Sample citations

Journal article

James, P., & Tatem, J. J. (2003). Assistive technology benefits. *American Journal of Occupational Therapy, 39,* 336-337.

Paper presentation

Stuart, S. K., & Kemp, L. M. (2003, January). *Native Americans and AAC issues.* Paper presented to the Annual Meeting of the Assistive Technology Industry Association, New Orleans, LA.

Book

Kalyanpur, M., & Harry, B. (1999). *Culture in special education. Building reciprocal family-professional relationships.* Baltimore: Brookes.

Book chapter

Soto, G., Huer, M., & Taylor, O. (1997). Multicultural issues in augmentative and alternative communication. In L. Lloyd, D. Fuller, & H. Arvidson (Eds.), *Augmentative and alternative communication* (pp. 406-413). Boston: Allyn and Bacon.

Legislation (please cite any law that is described in the manuscript narrative; see p. 404 of APA Manual)

Individuals with Disabilities Education Act Amendments of 1997, 20 U.S.C. § 1400 *et seq* (West, 1993).

Individuals with Disabilities Education Act of 1990, Pub. L. No. 101-336, § 2, 104 Stat. 328 (1991).

Web site

Institute for Matching Person and Technology. (2003). *Matching person and technology (MPT) assessment process*. Retrieved February 27, 2004, from http://members.aol.com/impt97/mptdesc.html

- The Editor will acknowledge receipt of a submitted article immediately.
- Authors are encouraged to write in the third person and use "person-first" language, i.e., the individual *precedes* the disability. For example, phrases such as "persons with disabilities," "students with mental retardation," "and "adults with cognitive impairments" are more appropriate than such phrases as "the disabled," "learning disabled students," or "mentally retarded adults." Consumers and family members who submit manuscripts describing specific practices may use the first person.
- A cover statement in the submission should indicate that the manuscript has not been published in whole or substantial part by another publisher and that it is not currently under review by another journal.

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