

Software to Promote Universal Design

(Keywords: universal design, special education, assistive technology)

Presented at the National Education Computing Conference (NECC)
on July 2, 2008

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Software to Promote Universal Design for Learning

Purpose & Objectives

The primary interest for this project was to determine the effectiveness of providing text-to-speech (TtS) and speech-to-text (StT) software in technology-rich general education classrooms (grades three through five) when implemented following guidelines for universal design for learning (UDL). The general education classrooms were selected with a homogeneous mix of students, including those with and without special learning needs. Elementary classrooms typically include emergent readers, English language learners (ELL), and students that struggle with basic writing and editing skills. In any classroom the instructional time lost through remedial teaching puts severe demands on teacher time and school building resources. Recovery of instructional time and improved student performance is crucial to convincing teachers to learn about and use interventions. Any software that could help regain instructional time is worth investigation. TtS and StT software has the capacity to act as a facilitator allowing students to work independently while restoring instructional time for the teacher (Dabbagh & Kitsantas, 2005; Franklin, 2007; Iiyoshi, Hannafin, & Wang, 2005; McNamara, O'Reilly, & Best, 2006). Software does not “care” how many times a student may ask to have a word repeated to them before they understand how it is said. Nor does software “care” how many times a dictionary definition is asked to be repeated, or used in a sentence, or read to a student. This use of an independent cognitive prosthesis as a scaffold for all students in the classroom allows for use based on individual student need and level of proficiency adding to student self-efficacy (Edyburn, 2006a).

This study sought to investigate the implementation of TtS and StT software in technology-rich general education primary classrooms with the hypotheses that TtS and StT could be possible solutions for skill building that would not involve intense teacher management. The study was conducted over the course of the 2006-2007 school year to determine use through one academic year.

UDL expresses a core concept that any assistive technology (AT) device may be beneficial to all students, not just those students that have special needs (Abell, 2005; Gordon, 2002; Harac, 2004; Howard, 2004; Pisha & Coyne, 2001; Santovec, 2005). Any general education student can potentially find benefit from using AT in the classroom. Computer technology has frequently taken applications from an initial classroom use as intervention or accommodation to mainstream use; spell-checking and word prediction are two common examples (Pisha & Coyne, 2001). UDL is a framework for equity-in-learning for all students in the classroom.

When the goals of the project were established the Department of Special Education in Missouri's Department of Elementary and Secondary Education (MO DESE) determined that the professional development provider with the greatest expertise and capacity to meet the goals and support implementation was the eMINTS (enhancing Missouri's Instructional Networked Teaching Strategies) National Center. eMINTS provides a two year program of professional development to transform classrooms into inquiry based constructivist learning environments. In addition to providing intensive teacher professional development to the classrooms teacher, eMINTS classrooms are equipped with one computer for every two students, a SMART Board™ and digital

projector, teacher laptop, digital camera, scanner, and high speed web access. At the time of the project there were over 800 eMINTS teachers. The teachers selected to participate in the project were purposefully identified as having completed at least one year of teaching experience after concluding their two-year eMINTS professional development program. Teachers and districts were contacted for participation in the study in spring 2006 for the 2006-2007 school year.

The objective of the pilot project was to examine the learning potential possible when TtS and StT software was implemented in technology-rich general education classrooms based on teacher perceptions of student use. Participating classrooms ranged from third through sixth grades (student ages from eight to eleven). The specific questions investigated in the project were:

1. How would teachers model the software for student implementation?
 - a. How would students implement the software?
 - b. Would there be a difference in frequency or duration of use over the course of the school year?
2. Would there be an observable difference in frequency or duration of use between any identifiable group(s) of students?
 - a. Would there be an observable difference in frequency or duration of use between classrooms and/or schools?
3. What instructional activities were best suited, over time, to use with the software?
4. What were teacher perspectives on the effectiveness of the software in improving student performance (all groups) and the likelihood of their continued use of the software?

Theoretical Framework

TtS and StT software has been examined both as an accommodation and as an intervention for students with disabilities. Investigations usually focused on a one-to-one basis, with a researcher or aide supporting one student, especially as a tool for engaging and improving reading. These research efforts are typically conducted after school or during summer months, with children who have special needs and are often conducted in limited duration as reported by Joseph Sencibaugh in his recent meta analysis (2007). Researchers have suggested further study for implementing assistive technology in regular general education classrooms to “level the playing field” among all students in the classroom (Sencibaugh, 2007). UDL research suggests that specific benefits could be derived by many general education students, not just students with special needs, when using AT in the classroom (Abell, 2005; Acrey, Johnstone, & Milligan, 2005; Downing, 2006; Garderen & Whittaker, 2006; Hitchcock, Meyer, & Rose, 2002; McGuire, Scott, & Shaw, 2006; Sencibaugh, 2007; Wehmeyer, 2006). Using AT in general education settings can be viewed as a “cognitive prosthesis” (Edyburn, 2006a). As cognitive prosthesis AT is used as a scaffold that will allow struggling students to achieve on a level with their peers. When no longer needed, the scaffold can be reduced or abandoned. A review of the literature found there are no studies extant of multiple technology-rich classrooms in different schools and districts implementing TtS and StT software simultaneously to examine the benefit for all students in the classroom.

Research Methods

Teachers in elementary classrooms in the suburban area of a midwestern metropolitan city were purposively reviewed to be invited to participate in this study. The level of teacher expertise for technology integration was determined by the eMINTS program personnel who administer the professional development program for teachers. Teachers that demonstrated a strong understanding of inquiry learning, constructivist methods, and use of technology were identified. After identification of teachers, individual districts and buildings were reviewed. Principals' administrative support was required for project participant. Invitations to participate were extended to eleven teachers. Nine teachers volunteered to participate in the study. In one building the special education teacher was part of the collegial community and was invited to participate. Three districts each had one elementary building with multiple classrooms participating.

All participants taught in technology-rich classrooms, except for the special education teacher. Most of the students had at least one year of prior experience in a technology-rich classroom so they were familiar with extant technology. The TtS and StT software would be new to the students as well as the teachers.

The study participants met in spring of 2006 to select the software they would use in their classrooms for the 2006-2007 school year. Several different TtS and StT software packages were demonstrated by special education consultants familiar with various software packages. Teachers collaborated on possible classroom uses and asked questions about the programs. Building principals and the technology/network administrator or information technology (IT) coordinator accompanied participating teachers. Several concerns central to the selection of the software emerged: cost per room (site license or license by workstation), ability to run the software across the network (to supply students with their work or program settings anywhere in the building), program extras (especially the ability to translate to and from Spanish, word predication, multiple use dictionaries, simple operation, access into PDF documents), and which software package could easily be used by students in grades three through five. Teachers were allowed time to work with the different programs and generate ideas. After discussion and walkthroughs the teachers selected Read & Write GOLD™ (R&WG).

Hardware upgrades to computer memory were made as needed to meet published software requirements. One headset (consisting of integrated microphone and headphones) was purchased for each computer. Every classroom had one computer for every two students. The software was initially installed on each student PC. Following trouble shooting and access challenges software was installed on the school server with access for students through their school accounts.

Two formal training sessions were conducted. Staff from the eMINTS program and an AT specialist from one of the districts met to developing training materials and review tutorials and information available from the software vendor. The software multimedia training material from the vendor was determined to be an excellent training tool and was used in the initial teacher training session rather than developing new materials. The teachers also used the software multimedia training to introduce the software to their classes. For the second training session teachers demonstrated what they were implementing in their classroom. To continue the discussions an online learning

management system, Moodle, was used to give teachers easy access to one another. Moodle discussions were used to ask for help, share challenges and successes, and distribute information. At least two classroom visits were made to each participating teacher to determine the support needed as well as to provide in-classroom support and to monitor the level of implementation. Further visits were made at teacher request.

At the end of the school year a focus group was held with all participating teachers. The recording of the focus group was transcribed. Teacher logs and discussions were downloaded from Moodle. A survey was distributed prior to the focus group and collected before the focus group started. In the coding of all data sources individual teacher identities were replaced with anonymous common names to retain individual participant comments and observations over the course of the school year. Survey responses were transcribed and identified in the same anonymous manner. After all transcriptions were completed and files downloaded from Moodle, all files were downloaded into ANsWR, a qualitative analysis software package developed by the Center for Disease Control.

When all documents were loaded entries were read and topics for common themes were recorded. After the initial read-through statements were grouped with sub-themes identified and grouped according to their relationship to the four initial research questions. Emergent themes were coded in the same manner.

It was clear from initial reading of the transcripts and other data sources that teachers had concentrated on using the software with communication/language arts lessons. Common instructional activities were focused on how reading and writing were supported. Common themes that emerged for writing were: variations on peer editing after individual editing, variations on student preparation for teacher conferencing on writing, student increases in the amount of writing, higher quality writing, an increase in engagement in writing, and teacher's reporting an increase in instructional time. Common themes that emerged for reading were: single use by "good" readers for pronunciation of single words or terms, sharing resources determined by students by need, increased attention to task when using headsets and teachers' reporting recovery of instructional time.

Analysis

Quantitative

The research base for using TtS and StT as a UDL component strongly suggested the positive learning results this study has reported. Challenges emerged that should be carefully considered before initial classroom implementation. The most significant contra-issue that emerged was the need for an age appropriate process for the students to train the software so voice recognition could be effective. However, it should be noted this project implemented the R&WG software in a fashion not intended by the developers of the software. This study implemented the software as a support tool available for all students in general education classrooms following UDL methodology, not as a tool intended exclusively for individual children with special needs. In the role as AT for individual students with special needs there would be sufficient time and specific training

strategies put in place to train the software for proper voice recognition as defined in the student individualized education program (IEP).

Table 1: Student Participants by Grade

Grade level	School A	School B	School C	Total (n=)
Third	18			18
Fourth	22	65	34	121
Fifth	10		30	40
Sixth	16			16
TOTALS	66	65	64	195

Analysis of results for project students on Missouri’s annual statewide test, the Missouri Assessment Program (MAP), was made by building for the Communication Arts portion of the test. For schools “A” and “C” the Communication Arts MAP achievement scores are compared with the same grade level classrooms in the same building. School “B” had comparisons made to other schools with similar demographics as all four of the 4th grades had participated in the project. Two of the classrooms were funded by the project; the other two were district- funded. Three comparison elementary schools were identified for MAP score analysis by reviewing total enrollment in 4th grades in the building, minority status, assessed valuation and tax level of district, free and reduced lunch, and Title II D status from MO DESE demographics ("Annual reporting of school district data FTP downloading site," 2007). A total of 195 students participated in the study. Twelve teachers participated with ten being general classroom teachers, one a teacher of ELL, and one special educator.

Quantitative results

Analysis of means by grade level was calculated using SPSS for schools “A” and “C.” The classes participating in the pilot project all scored higher than their non-participating peers for “proficient” and “advanced” levels on the MAP Communication Arts test. The t-tests means indicated a trend that participating classrooms had a positive effect on MAP Communication Arts scores even though the differences in the scores are not statistically significant (using α at the .05 level). SPSS analysis of school “B” to similar peer classrooms confirmed the trend of higher means on the MAP with participating classrooms. The differences were not statistically significant using α at the .05 level. The overall trend for all participating classrooms to have higher scores on the MAP was significant.

Qualitative

During the school year teachers kept logs in Moodle, were assisted by trainers through classroom visits, and met to share challenges and successes. At the end of the year all participating teachers completed a survey with open ended questions was participated in a focus group. Logs, trainer’s notes, survey responses, and a transcript of the focus groups were reviewed. ANsWR, a qualitative analysis software package developed by the Center for Disease Control was used for qualitative analysis. All entries were read and common themes recorded. After the initial read through statements were

grouped with sub-themes identified and grouped according to their relationship to the four research questions as follows:

- 1) teachers model the software
 - a) student use
 - b) any differences over year
 - i) introduction to the software,
 - ii) implementation, and
 - iii) changes with continued use,
- 2) differences in use between
 - a) students,
 - b) groups of students, and
 - c) classrooms in different schools,
- 3) over time, what was the best use of the software, and
- 4) teachers' perspectives on continued use of the software.

Emergent themes were coded in the same manner (i.e. major level 1, minor level a, sub level i).

Qualitative results

Qualitative analysis found (after acknowledging challenges) that teachers were universal in their support of the software in their classroom. Teachers modeled the software for students using the instructional materials from the publisher. They found the materials of high quality and student friendly. Introduction to the software varied as some teachers used a cooperative learning strategy known as the jigsaw technique or student-led walkthrough of the software. Teachers reported no noticeable differences in the way different social groups used the software once they were familiar with it. Groups did emerge across the classroom based on skill level for reading and writing.

Overall, teachers observed positive student outcomes and noted that an increase in instructional time, due to increased student self-reliance, was beneficial to their classrooms. Teachers reported anticipating continued use of R&WG during the next school year as they had created a conceptual model to guide them in what was successful in their classroom and could explore features other project teachers had reported were successful. Successes were abundant and teachers unanimously supported the continued use of the software in their classrooms for the next academic year. In at least one district, school funding was being reviewed to expand R&WG into all third, fourth and fifth grade classrooms. Many successes such as academic achievements and improved in-classroom management of student behavior occurred universally. Academically, teachers found the software to be of most value in student work that required reading and writing skills. The software was most effective when used from the beginning of a writing project to the end, including the editing cycle. Although methods varied, teachers encouraged the use of word prediction, dictionary use for meaning, listening to new words that were not recognized (but were familiar when spoken), and editing student writing in all forms. All teachers reported effective use of editing although teachers varied in the amount of editing required with the software before turning to traditional teacher writing conferences or peer editing.

Classroom management for effective learning changed as students implemented the new learning tools. Another universal observation was the additional time teachers gained to facilitate learning as they were no longer reading websites to students or helping them pronounce words and phrases. Student “experts” were designated for peer help with learning and using the software. Students found that learning the combination of tools in R&WG enabled them to independently understand the material on websites and other written materials and not depend on teacher, or peer, assistance. Teachers also noted the increased student efficacy when increasing their personal level of responsibility for their learning.

Teachers were unanimous in their agreement that instructional time was recovered during web activities by student mastery of the tools. Teachers found they were doing more “idea facilitation” than helping students read web sites.

Teachers reported positive changes for English language learners (ELL) with writing skills. ELL students had the software repeat pronunciation of individual words, phrases, and sentences. Students were in control of the writing environment and could use it to best suit their needs to manipulate language. The software also had a Spanish-to-English translation available.

In the qualitative review of themes from all data sources, the words “excited,” “excite,” or “exciting” were used no less than 26 times by teachers to describe student and/or teacher reaction to the software overall or specific functions in the software. In follow-ups teachers agreed that in most places “excite” was synonymous with “engaged.” This study failed to produce effective use of StT for all students. This was due to several different environmental and physical challenges. Teachers reported the two common challenges were: training the program to recognize student voices was too lengthy (about 10 minutes per student) and the selection to be read was above the participant’s reading level. Success with student reading and the software was seen with recording student narrations as MP3 files and adding to multimedia presentations and other projects.

Educational Significance

Prior to this study relatively little had been reported about the implementation and continued use of TtS and StT software in primary grades in general education classrooms. Computer AT has been used to help students with special needs for over two decades (Forgrave, 2002; Quenneville, 2001). After twenty years of AT in the classroom there are no definitive guidelines for the selection of AT for every special need. With the rapid change of software in the general market place it is increasingly difficult for teachers to stay current with advances (McKenna & Walpole, 2007; Mears, 2006). The challenge for teachers working with students with learning disabilities (LD) is finding effective software (Hasselbring & Bausch, 2005). If a student is in a wheelchair sitting at the front steps of the school the need for a wheelchair ramp is obvious. If a student with a learning disability is standing at the doorway to the classroom it is not so obvious what is needed. T. Hasselbring and M. Bausch identified this project tenet, “...teachers are searching for ways to educate students with disabilities more effectively. Yet too many teachers are unaware of the potential of assistive technologies to empower students struggling to work independently at their grade level” (2005).

Multiple studies have reported benefit from TtS and StT software for students with LD. These studies generally include a small number of students that work intensively for mastery of software directly with researchers over a short period of time, generally three to four weeks in summer school or nine weeks during the school year (Beacham & Alty, 2006; Boon, Fore, & Ayres, 2005; Englert, Zhao, & Dunsmore, 2007; Forgrave, 2002; Fuchs, Fuchs, & Hamlet, 2006; Hetzroni & Shrieber, 2004; Higgins & Raskind, 2004; Jerome & Barbetta, 2005; Lancaster, Lancaster, & Schumaker, 2006; Montgomery & Marks, 2006; Quenneville, 2001; Whittaker, 2003).

Other researchers have suggested positive benefits should be possible when effective strategies for teaching LD students are used in general education classrooms (Barack, 2006; Erickson, 2004; "Recommended Practices and Parent Perspectives Regarding AT Use in Early Intervention," 2006; "Using assistive technologies to ameliorate reading difficulties," 2007) yet the research base does not contain studies conducted across multiple schools in classrooms with sufficient technology resources (hardware, software, and human) to support all the students in the classroom. Dave Edyburn (2006b) expressed the need for varied technology tools and cognitive supports for struggling general education students. These tools can be of great benefit whether the supports are in place for an academic career or only during skill(s) mastery (Edyburn, 2006b). By introducing TtS and StT software in early elementary grades those students that may use AT software throughout their academic career, as a cognitive prosthesis, will become familiar with technology and have access long before being identified for special services.

In this study qualitative data showed teachers were comfortable using software designed for assistive technology implemented using guidelines for UDL. Not only were teachers comfortable with the software, they used student "experts" as helpers to aid implementation. Teachers reported instructional benefits, classroom management benefits, and an increase in student engagement. These results confirm previous findings from small scale studies. Quantitative data from the state high stakes communication arts assessment showed a positive trend for higher scores for students using the software. These results confirm the positive effects reported for single user and small scale implementations.

Further Research

The implication for increased self-efficacy of all students is rich for investigation. Struggling students and ELL are reported in command of the learning environment and can ask questions as often as needed without peer, or teacher, awareness. It is strongly suggested by teachers that engagement by all learners is increased as individual learning styles are effectively supported by software. Investigation into UDL implementation could further identify effective strategies for diverse learners.

Teacher self-efficacy is also rich for investigation in this environment. Teachers reported several positive changes in practice that could contribute to an increase in teacher self-efficacy. Return of instructional time may be the strongest indicator of a change in practice.

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