Measuring Effectiveness: Technology to Support Writing

By Sally Fennema-Jansen

The purpose of this article is to summarize research and practice regarding technology supported writing interventions. Specific emphasis is placed on spelling checkers, speech synthesis, and word prediction.

• **Students with learning disabilities** frequently experience difficulty with writing (Graham, 1990). Writing is a complex task that requires a person to integrate a number of different skills including generating ideas, organizing and elaborating on ideas, selecting words, considering the needs of the audience, while monitoring the entire process (Schwartz & MacArthur, 1990). For some students, attention to the process of composing is more difficult because they have not mastered the skills needed to produce the text, and therefore, need to attend to the physical process of handwriting and the mechanics of spelling, punctuation, and grammar (Schwartz & MacArthur, 1990; Graham, 1990).

• **The use of technology** is one approach that has been used to address the needs of struggling writers. There are many technology supports available, some of which are used to assist with the process of composing (e.g., webbing and outlining programs) and others that assist with text production. The focus of this guide is limited to three types of technology used to address the mechanics of text production: spelling checkers, word processors with speech synthesis (ìtalkingî word processors), and word prediction programs.

• **A review of the research** related to the effectiveness of these three technologies will be presented. However, as is demonstrated by the research, the effectiveness of an intervention will vary from student to student. Research can guide us toward interventions that have been demonstrated to be effective, but what really matters is whether or not the intervention is effective for the individual students with whom you are working and for whom you are making instructional decisions. Therefore, information is presented related to the assessment of outcomes associated with the use of spelling checkers, speech synthesizers, and word prediction programs. The suggested list is certainly not exhaustive, but does offer a place to start in the attempt to answer, "Is this technology making a difference?"

• **A note of caution** is in order. Simply providing a student with a piece of software, even if it is effective for that student, is generally not sufficient! Because students with learning disabilities frequently struggle with multiple aspects of the writing task, technology rarely addresses all of the students writing needs. Strategy instruction should be combined with instruction in the use of technology to better meet the needs of students.

Steps to Measuring Effectiveness

Student Needs:

- What is the concern with this students writing? (e.g., words are illegible, poor spelling, writes very little, etc.)
- What tasks is the student required to complete? How frequently do these occur?
- Determine students writing needs through samples of students work and observation

Choices and Implementation:

- Which outcome measure(s) will best address the students needs?
- The table "Measurement Options for Work Sample Analysis and Observation of Writing" provides a number of measures that could potentially be used as a basis for objective measurement.
- Which tool (or tools) is most likely to assist this student with the writing process?
- Consider device/software features when making this selection.
- Provide training and strategies individualized to meet the students needs.
- Providing a student with technology without the proper instruction in how to use the technology limits ones ability to determine whether or not that technology truly has the potential to benefit the student.

Measuring the Outcomes:
(Modified from Harris & Graham,1996)

Usage: Is the student actually using the technology? Determine whether or not, and how efficiently the student is using technology, by observing the student while he or she is engaged in the writing process.

Effectiveness: Is the use of technology having a positive effect on performance? Measure the impact of the technology by using selected measures. Compare work samples completed with and without the use of the device or software.

Students Perspective: Does the student see the technology or software as being valuable and manageable? Ask the student such questions as:

- What did you like about the technology?
- What did you not like about this technology?
- Did the technology help you write better? Why or why not?
- Will you continue to use the technology? Why or why not?
- What did you like about the procedures used to learn the technology?
- How could we change the teaching procedures to make them better?

Performance Data: Charting student performance data to observe patterns of performance.

Word Prediction

Description

Word prediction programs were originally designed for students with physical disabilities, to minimize the number of keystrokes required to type a word (MacArthur, 1998a). Word prediction programs offer the user a list of words based on the previous words, as well as based on the letter(s) typed (Klund & Novak, 1996).

Research on Effectiveness

Word prediction improves spelling and legibility for some students.

Research has demonstrated that the use of word prediction has made significant differences in the spelling and legibility of writing for some students with learning disabilities but not for others (MacArthur, 1998b; MacArthur, 1999). The reason for this difference has not yet been explained. MacArthur (1999) suggests that it may relate, in part, to motivation. Also, some students fail to attend to the list of predicted words or fail to select a correctly predicted word. Writing ability alone does not appear to explain the difference.

Word prediction software may be more helpful for some tasks than for others.

Matching the demands of the task to the word prediction programs dictionary size is an important consideration when selecting a program and a dictionary within the program. Therefore, when the required vocabulary is more advanced, the use of customized dictionaries may result in greater gains in spelling and legibility. Students may benefit from some programs and features more than from others, and this may vary with the task (MacArthur, 1999).

Advances in word prediction programs may increase success for some students.

MacArthur (1999) indicates that about 60% of the errors made by students in his study were on words that never appeared in the list of suggestions because the initial letter was incorrect. The most recent version of one word prediction program, Co:Writer 4000, offers the option of "Flexible Spelling" which may impact students success.

As stated in the program manual, "Co:Writer's "Flexible Spelling" feature is designed to aid beginning writers who are in the phonetic or transitional stages of spelling. Co:Writer uses a system of rules that are based largely on analysis of writing samples by students from kindergarten through third grade. These rules encompass phonetic substitutions, common letter confusions, letter reversals, letter omissions, letter additions, letter doubling and singling, etc. If FlexSpell is turned on, Co:Writer will be 'flexible' in its interpretation of what the user types, knowing that, for example:

dragon	might be spelled	jragon
beautiful	might be spelled	butfl
balloon	might be spelled	bloon
birthday	might be spelled	darthbay."

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Word Processors with Speech Synthesis

Description

Speech synthesis translates text into speech, so that the computer can read the text to the writer. Options are generally available for having the text read by letter, word, sentence or section selected by the user. Many programs highlight the text as it is read.

Research on Effectiveness

Although limited, research on students with and without disabilities indicates that the use of word processors with speech has potential benefits.

Listening to text allows the student to use their "general language sense" to monitor their writing (MacArthur, 1999, p. 152). Borgh & Dickson found that students without disabilities did more revising with the use of speech synthesis than without (as cited in MacArthur, 1999). Rosegrant reported that, in a comparison study, students using a word processor with speech synthesis spent more time writing, wrote more drafts, made more revisions in vocabulary and syntax, and produced papers that were longer and better sequenced than those without speech synthesis (cited in MacArthur, 1999). MacArthur (1999) found the use of a word processor with speech and word prediction resulted in improved spelling and legibility for four out of five students with learning disabilities; however, no differences were found in the length of the text produced or the rate of composition.

Speech synthesis shows promise for assisting students during proofreading of text.

Raskind and Higgins (1995) compared three methods of proofreading by college students with learning disabilities. Results indicated that students found the greatest number of errors using the speech synthesizer, the second highest number by having the text read to them, and the smallest number without assistance. Although the differences were significant, they were not large, and the majority of errors went undetected. MacArthur observed that elementary students with learning disabilities also benefited from listening to their text using a speech synthesizer in order to make revisions (MacArthur, 1999). During proofreading, the use of speech synthesis may help students to "directly access the text without preoccupation with decoding" (Raskind & Higgins, 1995, p.151).

Speech synthesis has important limitations.

As MacArthur points out (a) synthesized speech is not always as easy to understand as natural speech; (b) synthesizers may pronounce misspelled words correctly; and (c) the "careful listening required places some burden on working memory" (1999, p. 152).

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Spelling Checkers

Description

Spelling checkers compare individual typed words with words in the programs dictionary, suggesting alternative spellings for the writer to select (McKeown, 1992).

Research on Effectiveness

Although research on the effectiveness of spelling checkers is limited, there are some important points that can be gleaned from the research that is available.

Spelling checkers are often helpful.

Spelling checkers can assist students with learning disabilities in identifying and correcting spelling errors. MacArthur, Graham, Haynes, & DeLaPaz (1996), in a study involving 27 students with learning disabilities, found that, without the use of a spelling checker, students identified 27.9% of their errors, and corrected 9.3% of those errors. Using a spelling checker, students identified 63% of their errors, and corrected 36.5% of them.

Spelling checkers may help some students more than others.

Individual differences have been noted, based in part on the severity of the spelling errors, on the performance of the students in using the checker, and on the performance of the spelling checkers themselves (MacArthur, et al., 1996; Dalton, Winbury, & Morocco, 1990).

Some spelling checkers are better than others.

Programs vary in their ability to identify the correct spelling for words commonly misspelled by students with learning disabilities. MacArthur, et al. (1996) found significant differences when they compared the performance of 10 spelling checkers on words taken from the writing of students with learning disabilities. Because new programs are available since this study was published, when selecting a spelling checker for a student, analyze the usefulness of various programs to determine which will best meet the student's needs.

Spelling checkers don't recognize errors that are other words spelled correctly.

In two studies, spelling checkers failed to identify 26% and 37% of the students errors because the errors were other words correctly spelled (MacArthur, et al., 1996).

Students need instruction in the use of the spelling checker.

Instruction in the use of the program itself as well as in selection strategies may benefit some students (Dalton, et al., 1990; MacArthur, et al., 1996; McNaughton, Hughes, and Ofiesh, 1997). For example, when the spelling checker is unable to identify the correct spelling for a word, the student can try typing the word phonetically to see if the spelling checker is more successful (MacArthur, et al., 1996).

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Options for Measuring the Effectiveness of Technology to Support Writing

Measure	Description	Procedure	Source
Total words	A simple count of the number of words produced.	A count of words written in prose form, including garbled (or unrecognizable words). Omit story titles, sound effects (e.g., zoom) and end markers (e.g., The End).	Rousseau, 1990
Legible words (Percent: legible words/total words)	The percentage of the total words written that can be correctly decoded when viewed out of context.	Starting at the end of the paper, hide all words except one and judge whether the exposed word is immediately recognizable and legible. Mark illegible words. Then read paper from the beginning to check if any words that were marked as legible out of context, are a different word. Mark these as illegible. Homophones (e.g., there and their) are marked as legible, but as spelling errors.	Hasbrouk, Tindal, & Parker, 1994
Correctly spelled words (Percent: correctly spelled/total words)	The percent of words spelled correctly.	Consult a dictionary when in doubt about whether or not a word is spelled correctly. Homonyms must be spelled according to the usage in the sentence. (For ìcorrect word sequences: Words written in the incorrect tense are considered misspelled. Punctuation and capitalization and minor grammatical errors (me/I of a/an) are ignored. Numerals are ignored. Known slang words that are spelled with ìreasonably close phonetic spellingî are considered correct.)	Fifield, 1998; Tindal & Parker, 1989; Hasbrouk, Tindal, & Parker, 1994
Correct word sequences (Can take an average of the number of correct sequences in a string, over the number of different strings)	"Sequences of words that are spelled correctly, grammatically correct, semantically reasonable, capitalized if the first word in a sentence, and followed by punctuation if the last word in a sentence."	Place a caret between any two words that meet the criteria stated in the description and count the number of carets. Correct beginning and ending punctuation replace correctly spelled words for scoring word sequences at the start and end of sentences. Count correct words at the beginning and end of the entry. Example: "^ I ^ am ^ a ^ snake. ^ I ^ like tigrs. I ^ like vallintamsday."	Hasbrouk, Tindal, & Parker, 1994; Tindal & Parker, 1989
Legible word sequences	Description is the same as ìcorrect word sequencesî above, except that words need not be spelled correctly, however, they must be legible.	See "correct word sequences" above, for general procedure, but include a caret between words that are immediately recognizable and legible when viewed out of context. The example, "^ I ^ am ^ a ^ snake. ^ I ^ like ^ tigrs. ^ I ^ like vallintamsday." has 9 legible word sequences.	MacArthur, 1998
T-Units	A subject (noun) and a predicate (verb) that can be the equivalent to a simple sentence or a single statement that can stand alone (may be implied).	There are no T-units if letters and words are illegible. The presence of a verb signals a T-unit (verbs cannot be implied). Verbs that act as descriptors should be counted.	Fifeild, 1998
Complete sentences	Contain at least one independent clause, a subject (noun) and a predicate (verb) and the statement can stand alone.	Includes correct punctuation and capitalization.	Fifield, 1998

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