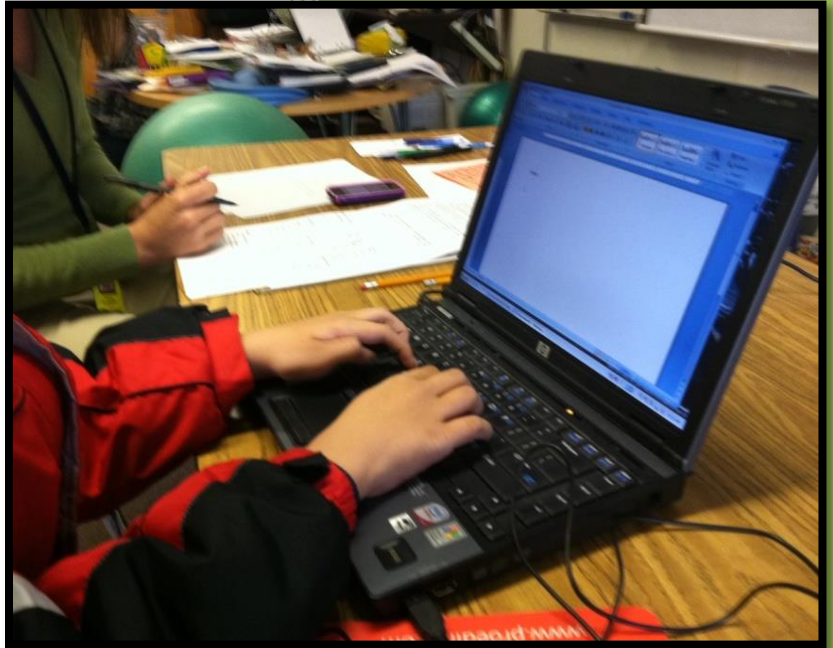# SCHOOL-BASED ASSISTIVE TECHNOLOGY WRITING EVALUATION:
An Interdisciplinary Approach

By Paul Visvader,
Jennifer Leonesio,
Erika Brandstatter,
Anja Kintsch,
Rosemary Bogart

SCHOOL-BASED ASSISTIVE TECHNOLOGY WRITING EVALUATION:

An Interdisciplinary Approach

Paul Visvader, Jennifer Leonesio, Erika Brandstatter, Anja Kintsch, Rosemary Bogart
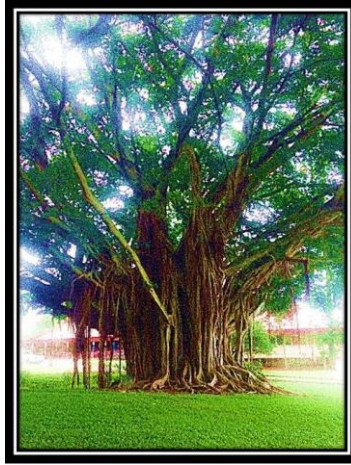
Compiled and written by Paul Visvader <kaona186@gmail.com>

Boulder, Colorado

"Share the aloha…"

Dedicated to the memory of Anja Kintsch (1968-2010)

The author wishes to thank those who have generously given permission to use the following material:

Sections from P. 3-5 which are adapted from The WOLD Sentence Copying Test (©2001 Optometric Extension Program Foundation, Inc., http://www.oepf.org/product/wold-sentence-copying-test).

Sections from P. 6-9 which are adapted from the Step-by-Step Assessment Guide to Code Breaking by J. Richard Gentry © 2008.

(The original version of this book was posted online as "BVSD Assistive Technology Writing Evaluation: an Interdisciplinary Approach" ©2011—It is revised and published here with permission)

Table of Contents

    A.   School-Based AT Writing Assessment Protocol

    B.   Sample Referral Form

    C.   Grade level "No Excuse" sentences

    D.   Graphic organizer resources

    E.   Speech recognition/ Voice-to text technology

    F.   Text-to-speech resources

    G.   Typing tutorial resources

    H.   Font samples

    I.   Spellcheckers—a discussion

    J.   Spellcheck and word prediction comparison

INTRODUCTION

Students who have difficulty with expressing their thoughts and feelings through writing are at a significant disadvantage in the school system. They struggle to access and interact with grade-level academic material and cannot communicate what they know. For many years, we on the Boulder Valley School District's Assistive Technology Team or "AT Team" have been helping many of these students by assessing their specific needs and providing appropriate technological accommodations. The ideas and procedures contained in this manual have gradually become organized and formalized through trial and error, reviewing research, corresponding with other professionals, and, most importantly, following our students as they advance though grades, change teachers and schools, and transition into adulthood.

Our AT Team consists of an occupational therapist, a special education teacher, and a speech language pathologist, all with special training in the use of assistive technology, software, and communication systems/devices. The interdisciplinary approach is essential to gathering accurate information about a student's learning profile—the difficulties a student experiences may have origins in the sensory, fine motor, cognitive/academic, or language domains—or a combination of any of these.

Our AT Writing Evaluation process is initiated by the school team or family who might be wondering whether any type of technology exists that would be of some benefit to their student. Alternatively, they may have heard of some type of technology that they feel might be an excellent "fit," or, they may want to brainstorm possibilities for various writing accommodations. In any of these cases, our **School-Based Assistive Technology Writing Evaluation** procedures can provide quantitative data and a solid evidence-based rationale for various assistive technology strategies, some of which might not be immediately evident.

The AT Writing Evaluation procedure can be broken down into several steps: the referral process, data gathering, drawing from resources in the "AT Toolbox," feature matching, generating recommendations and a report/action plan, and finally, following-up and training, as needed. Each of these steps will be considered in detail in this manual. Once the student has been evaluated and assistive technology strategies have been put into place, s/he becomes part of the AT Team caseload and will be followed from grade to grade and school to school until s/he graduates from the system or no longer needs our services.

THE REFERRAL PROCESS

When the school team and the student's family decide to initiate the AT Writing Evaluation process, a standardized referral form is filled out with information pertaining to the student's learning style (writing, reading, math, study skills), computer skills, communication abilities, and physical access. A sample referral form is included in the Appendix. There is a section at the end of the referral form for the family to indicate their concerns—this is especially important to insure that everyone is "on the same page" as far as perceptions regarding the student's strengths and challenges, as well as expectations for conducting the AT Writing Evaluation. Signatures are obtained from all team members and the family, and the referral form is sent, together with a copy of the most recent IEP (and any school-based or private evaluation reports that may shed light on relevant issues) to our team so that we can schedule an appropriate time for the evaluation to take place.

DATA GATHERING: RECORDS REVIEW, BACKGROUND INFORMATION

After the referral form and IEP materials have been obtained and the evaluation has been scheduled, all of the materials are reviewed carefully and a rough strategy for conducting the evaluation can be formulated. A number of questions and issues need to be addressed before the evaluation takes place. How is the student currently functioning with respect to written language output? Is s/he making use of a scribe? Is the student old enough for formal keyboarding? (Keyboarding is not usually taught in our district until the 3rd or 4th grade) What type of learning style does the student seem to present with according to the paperwork? What are his/her strengths and challenges? Are there any technologies (software or hardware) that should be brought to the evaluation to either demonstrate to the team and family or to try out with the student?

In addition to obtaining relevant paperwork, we contact the school team's Speech-Language Pathologist and Occupational Therapist to gather any pertinent information, impressions, suggestions, and recommendations ahead of time in order to gain a more accurate picture of what to expect. Paperwork descriptions, while accurate and representative in the majority of cases, may sometimes be misleading.

DATA GATHERING: INTERVIEWS

Our writing evaluations can take anywhere from 1-2 hours and they usually begin with a short conference with the school team and family—perhaps a half hour to 45 minutes. We explain who we are and what we do, give details about the evaluation process, report writing, and follow-up, and then

we facilitate a more detailed discussion about specific issues. How is the student doing in school? Is s/he functioning at grade level or substantially below? How much help is s/he receiving? What types of accommodations have proven useful? Have any assistive technology strategies been tried yet, and if so, have they proven to be beneficial? Has the student "bought into" any of these strategies or is s/he resistant? What types of strategies have been tried at home, and are they effective?

We also examine any writing and/or typing samples the teacher or paraeducator may have and judge them on length, organization, word usage, penmanship (or typing accuracy), spelling, and fulfillment of the assignment. If the sample is a final draft, we try to get a sense for how much help the student had during various stages of the process: brainstorming, organizing, composing, spelling (and using mechanics), editing and revising, etc.

At this point, we call for the student to come in and join us and we typically converse for several minutes to establish a working rapport. During the initial portion of the conversation we introduce ourselves and explain our purpose in being there, then gradually elicit his/her own perspectives on personal strengths and challenges, and find out what types of things s/he enjoys doing (and doesn't enjoy doing). We then describe the specific tasks involved with the AT Writing Evaluation and stress that it is not "for a grade," but that it is important to try hard anyway since it is all about alleviating writing difficulties and "making life easier."

DATA GATHERING: PROTOCOL TASK 1—HANDWRITING FROM COPY

Our first task is "Writing from Copy" and for this we use an optometry test (used by many Occupational Therapists) called the *WOLD Sentence Copy Test* (©2001 Optometric Extension Program Foundation, Inc., http://www.oepf.org/product/wold-sentence-copying-test). This test is very short (less than 3.5 minutes) and requires the student to hand copy a 29-word sentence from a typed model at the top of the page to a wide-ruled section at the bottom of the page. We tell the student to copy the sentence using either printing or cursive (whichever is most comfortable) "as quickly and as neatly as you can." The test is timed and the handwriting speed is normed in letters-per-minute according to grade level ability.[1] We also calculate words-per-minute to be able to compare speeds with the other tasks in our writing evaluation.

The WOLD sentence that the student copies is grammatically correct; however, the subject matter is "fanciful" and it would be difficult for the student to memorize or "chunk" significant portions of the passage as a strategy to speed up copying performance.   For this reason, the WOLD is a relatively pure sentence copying task with few, if any, confounding variables.   In addition to the normed handwriting

---

[1] Although the norms for this test are somewhat old, they correlate well with more recent studies.

speed, we can informally assess copying accuracy, fine motor precision, penmanship and legibility, concentration and focus, posture, visual tracking, pencil grasp, and physical tone or tension. We can also make observations about the student's visual motor abilities, including whether s/he visually "fixates" on the target passage letter-by-letter, word-by-word, or phrase-by-phrase while copying.

In order to illustrate more concretely the different sections of our Writing Evaluation Protocol[2], it will be useful to consider a specific example—a student we will call "Cathy" (this student's name and profile are changed slightly to maintain confidentiality). Cathy was a sixth grade student who was extremely dyslexic and received special education services under a "Specific Learning Disability" designation. The school team referred her for an AT Writing Evaluation in hopes of improving her written communication skills. On the WOLD Sentence Copy Test, Cathy was able to copy the sentence in 2 minutes and 15 seconds (2:15). We can convert the number of seconds to a decimal-based part of a minute easily by using the chart in the second box on the protocol marked "Key: 5 secs = .08 mins." Looking at the little chart, we can see that 15 seconds is .25 of a minute, so therefore Cathy took 2.25 minutes to copy the whole sentence. Since the sentence is 29 words (or 110 letters) and she copied the whole passage, we can easily set up the following two proportions to find her words-per-minute and letters-per-minute. Let x = words per minute, and let y = letters per minute:

$$\frac{\text{copying time}}{\text{total words copied}} = \frac{1}{x}$$

$$\frac{2.25}{29} = \frac{1}{x}$$

$$2.25x = 29$$

$$x = 12.9 \text{ words per minute}$$

$$\frac{\text{copying time}}{\text{total letters copied}} = \frac{1}{y}$$

$$\frac{2.25}{110} = \frac{1}{y}$$

$$2.25y = 110$$

$$y = 48.9 \text{ letters per minute}$$

---

[2] A blank copy of the protocol is included in the Appendix to this book.

4

Cathy copied the sentence at 12.9 words per minute (which corresponds to 48.9 letters per minute—a 4th grade level according to the WOLD Sentence Copy Test norms) with 100% accuracy, good attention and focus, legible penmanship,[3] and a left handed mature tripod grasp. Here is how we filled out the first page of the protocol for Cathy:

WOLD Sentence Copying Test (©2001 Optometric Extension Program Foundation, Inc.). Utilized to determine if the child has the ability to rapidly and accurately copy a sentence from the top to the bottom of a page. A necessary skill to keep up with classmates.

# of words (29 if no omissions): **29** **Time: *2:15 (2.25 minutes)***	Key: 5 secs = .08 mins 10 = .17 15 = .25 20 = .33 25 = .42 30 = .5 35 = .5 40 = .67 45 = .75 50 = .83 55 = .92	Grade equiv:	WPM (words per minute)	LPM (letters per minute)
WPM: *12.9* # of letters (110 if no omissions): **110** **LPM: *48.9***		2	7.9-10.5	30-40
		3	10.5-11.1	40-42
		4	12.1-13.2	46-50
		5	13.3-15.8	50.5-60
		6	14.4-17.7	54.5-67
		7	15.6-19.5	59-74
		8	16.6-21.1	63-80

Legibility Rating: 1) Almost completely illegible 2) Parts illegible 3) Difficult to read but decipherable with context 4) Legible (although not necessarily neat)	Rater 1: **4** Rater 2: **4** Rater 3: **4** Average: **4**	Mechanics Observation: ☐ Full punctuation ☐ Partial ☐ None ☐ Full capitalization ☐ Partial ☐ None	Copying Text (fixations) Observation: ☐ Letter by letter ☐ Word by word ☐ Phrase by phrase

Considerations:

- Spacing and Letter Formation: *good*
- Posture: *good posture; left handed mature tripod grasp*
- Vocalization or Subvocalization: *none noted*
- Concentration, Attention and Fatigue: *good focus and concentration*
- Frustration level: *none*

---

[3] This is determined based on an average of our three team members' penmanship legibility ratings on a scale from 1 to 4—from "almost completely illegible" through "legible, although not necessarily neat."

DATA GATHERING: PROTOCOL TASK 2—HANDWRITING FROM DICTATION AND GENTRY SPELLING ANALYSIS

Our second task is Writing from Dictation and the Gentry Developmental Spelling Analysis. This timed activity approximates the task of classroom note taking by requiring the student to handwrite a short passage that is read aloud. Although technically this is a fine motor task, it also provides some quick information on spelling, knowledge of writing conventions, auditory processing, language processing, sustained attention, and working memory.

The dictated target passages were formulated to include as many grade-level "No Excuse" spelling words as possible.[4] Within each grade level, there are several passages of varying length to choose from, based on student ability. In addition, we could decide to read only the first sentence of a passage if the student appears to be having difficulty and is taking more than about 3-4 minutes or so. For example, if we were evaluating a fifth grader who was only able to copy 8 words per minute on the WOLD Sentence Copy Test, we would most likely dictate only the first sentence of one of the 5th grade passages (e.g., on passage 5.1 in the Appendix--20 total words instead of 43). In comparison, a high school student who is able to copy 15 words per minute on the WOLD would surely be able to get through the entire 43-word writing passage.

When we evaluated Cathy, the first thing we looked at was her speed on the WOLD Sentence Copy Test. Her speed was 12.9 words per minute so we assumed that she could handle our longest dictation passage (43 words). Cathy wrote the passage in 4:10 (4.17 minutes) which corresponds to 10.3 words per minute. (We used the same proportion-based formula to calculate this as we did on the WOLD.) Please refer to this section of her protocol on page 8.

The next thing we examined was spelling accuracy. No Excuse word lists are available for only grades 1-5. If a student is in grade 1-5, we simply tally up the total number of No Excuse words s/he spells correctly and compare it to the total number of No Excuse words in the whole passage and come up with a percentage correct. For example, if there are 10 No Excuse words in the passage and s/he spells 5 of them correctly, our percentage would be 5 divided by 10 or 50% correct (.50 = 50%). However, if we are evaluating a student in grades 6-12, we dictate an appropriate length 5th grade passage, but score the spelling on the total number of words in the passage rather than just the grade-level No Excuse spelling words. Because Cathy was in 6th grade and the No Excuse words top out at 5th, we based the spelling accuracy measure on total words (43) rather than the number of No Excuse words (14). In this case, Cathy spelled 15 of the 43 words correctly, giving her a spelling accuracy of 15 divided by 43, or 35% correct (.35 = 35%).

---

[4] Sample sentences are included in the Appendix.

An additional spelling rating is included at the bottom of the page: Richard Gentry's "Gentry Writing Scale"[5] to assess the level of the student's spelling skills and the patterns of his/her misspellings. Dr. Gentry has a system of spelling evaluation broken down into Five Phases: Phase 0 is a student who scribbles and does not yet write his/her name ("Nonalphabetic Writing"). The scale progresses up through Prealphabetic Writing and Partial Alphabetic Writing to Full and Consolidated Alphabetic Writing (please see the chart in the excerpted protocol section on the following page). A separate line at the bottom represents students that use correct spelling or conventional English orthography. Although she was in the 6th grade, Cathy was still developmentally between a phonetic and a transitional spelling stage—Phases 3 and 4 according to Dr. Gentry's schema. This can be very useful information for the teacher to have, and may also help determine whether the student could benefit from spellchecking software, or whether word prediction or some other strategy might be more appropriate.

Another important consideration is legibility—as with the WOLD, our three team members examine the handwriting sample and assign a score from 1 (almost completely illegible) to 4 (legible, although not necessarily neat). These scores are then averaged to derive an overall team rating. Sometimes it is difficult to separate legibility from "comprehensibility" or "intelligibility" if the student's spelling is significantly impacted and the handwritten words are spelled very differently from the target words. However, we are concerned here with just fine motor skill and precision: are the letters themselves recognizable? How are the letters and words spaced? Do the words float above or below the ruled lines of the paper? Looking at additional classroom work samples might also be useful in order to determine whether legibility changes with the demands of different types of writing assignments: free writing, brainstorming, taking tests, outlining, generating a first (or final) draft, doing homework, etc.

The next box on the protocol is the passage reader's observation of how efficiently the student can listen to the dictated portion of the passage, process the information, remember it, and write it down--a quick "snapshot view" of the student's auditory processing, language processing, and working memory. Is the student able to write the passage word-by-word, a few words at a time, or phrase-by-phrase? Some students need several repetitions of each word or short phrase. Others remember huge chunks the first time they hear them. While this task is a rough simulation of the act of note taking in the classroom, it is obviously not a "real-world" representation of this skill since the passage reader speeds up and/or slows down in response to how quickly the student is writing. Nevertheless, it can shed light on possible strategies and accommodations that might be useful, especially as the student enters middle school and high school (e.g., getting copies of notes, recording the lecture, using a Smart Pen, etc.) In Cathy's case, she wrote out the whole passage phrase-by-phrase and needed no repetitions.

The next box in the AT Writing Evaluation Protocol is an assessment of the student's use of writing mechanics—are words capitalized appropriately and is punctuation present or absent? It is sometimes useful to compare this measure with the same measure on the typing task (the next one in the assessment). On this measure, Cathy used full capitalization and only partial punctuation.

---

[5] Dr. Gentry has a wealth of information on his excellent website at: http://jrichardgentry.com/ and in his many books (see especially his *Step-by-Step Assessment Guide to Code Breaking*).

Here is how we would fill out the second page of our protocol for Cathy:

Writing from Dictation

Sentence # used: #5.1

Total # of Words in sentence: **43**		Key: 5 seconds = .08 minutes	Spelling:
		10 = .17	Grade Level (K-5) _____
		15 = .25	'No Excuse' Words
		20 = .33	
Time: 4:10 (4.17 minutes)		25 = .42	% spelled correctly:
		30 = .5	
		35 = .5	Total # of words ____43____
		40 = .67	(grades 6-12)
Words Per Minute: 10.3		45 = .75	% spelled correctly: **35%**
		50 = .83	
		55 = .92	

Handwriting Legibility Rating:		Passage Reader's Observation:	Mechanics Observation:
1) Almost completely illegible	Rater 1: **4**		☐ Full punctuation
		☐ Read aloud word by word	☐ Partial punctuation
2) Parts illegible	Rater 2: **4**		☐ No punctuation
3) Difficult to read but decipherable with context	Rater 3: **4**	☐ Read aloud phrase by phrase	☐ Full capitalization ☐ Partial capitalization
4) Legible (although not necessarily neat)	_____ Average: **4**		☐ No capitalization

Richard Gentry's "Gentry Writing Scale": (see http://jrichardgentry.com)
- ☐ Phase 0. Nonalphabetic Writing (student scribbles, is unable to write letters and is unable to write his/her name)
- ☐ Phase 1. Prealphabetic Writing (precommunicative spelling--student invents spelling in random letters with no matches to sounds)
- ☐ Phase 2. Partial Alphabetic Writing (semiphonetic spelling--student invents a majority of spellings with correct beginning letter-sound correspondences or partial letter-sound representations such as HMT DPD for Humpty Dumpty or BT for boat)
- ☐ Phase 3. Full Alphabetic Writing (phonetic spelling--student invents a majority of spellings using a letter for each sound such as KAM for came, NIT for night, TABL for table, and BABE for baby.
- ☐ Phase 4. Consolidated Alphabetic Writing (transitional spelling—student uses many conventional spellings, and the majority of invented spellings includes phonics patterns for each syllable—EVREWHAIR for everywhere, SPESHIL for special, YOUNIGHTED for united, etc.
- ☐ **Spelling correct/conventional** (student knows the English orthographic system and its basic rules)

Considerations:
- Spacing and Letter Formation: *good*
- Posture: *good posture; left-handed mature tripod grasp*
- Vocalization or Subvocalization: *none noted*
- Concentration, Attention and Fatigue: *good focus and concentration*
- Frustration level: *none noted*

DATA GATHERING: PROTOCOL TASK 3—TYPING FROM DICTATION

Our Typing from Dictation task requires the student to listen to and type the same short passage that was used previously in Writing from Dictation. We look at his/her overall keyboarding skills and familiarity with the key locations—does s/he use one finger to hunt and peck? Is s/he a proficient ten-finger typist? We make sure to turn off all the keyboard proofing options (auto spell check, capitalization, etc.) before we have the student begin typing. This way we can note whether the student knows how to hit the space bar and the shift key, and s/he is not tipped off to any misspelled or mistyped words. We analyze the typed passage and compare spelling accuracy and writing mechanics with the results from the previous task.

If the student has significant spelling challenges (e.g., a Gentry Level c. 0-2) and we already know that spelling is the issue that makes his/her writing unreadable, then we might actually bypass this dictation task and instead do a typing from copy activity (possibly using the sentence from the WOLD Sentence Copy Test) to evaluate the student's keyboarding skills. There is no need to frustrate the student needlessly if we already have enough information on spelling.

Here are Cathy's results:

Typing from Dictation

Sentence # used: #5.1

Total # of Words typed: 43	Key: 5 secs = .08 minutes	Passage Reader's Observation:	Spelling:
	10 = .17		Grade Level (K-5) _____ 'No Excuse' Words
	15 = .25		
	20 = .33	☐ Read aloud word by word	% spelled correctly:
Time: 4:45 (4.75 minutes)	25 = .42		
	30 = .5		
	35 = .5	☐ Read aloud phrase by phrase	Total # of words ___43___ (grades 6-12)
	40 = .67		
	45 = .75		
Words Per Minute: 9.1	50 = .83		% spelled correctly: 42%
	55 = .92		

Typing Style:	Mechanics Observation:	Gentry Writing Scale Phase:
☐ One finger, hunt & peck	☐ Full punctuation	☐ Phase 0 Nonalphabetic
☐ Two finger, hunt & peck	☐ Partial punctuation	☐ Phase 1 Prealphabetic
☐ Multiple finger typist	☐ No punctuation	☐ Phase 2 Partial alphabetic
☐ Beginning 10 finger typist	☐ Full capitalization	☐ Phase 3 Full alphabetic
☐ Ten finger typist	☐ Partial capitalization	☐ Phase 4 Consolidated alphabetic
	☐ No capitalization	☐ Spelling Correct / Conventional

Considerations:

- Typing mechanics (space bar for spacing, shift key for capitals, etc.): *emerging*
- Posture: *good*
- Vocalization or Subvocalization: *none*
- Concentration, Attention and Fatigue: *good*
- Frustration level: *no problems noted*

For the typing-from-dictation task, Cathy was able to type 9.1 words per minute, which is about one word per minute less than her handwriting; however, her spelling accuracy went from 35% correct with handwriting to 42% with typing. Her familiarity with the keyboard was good (a "beginning ten-finger typist"), but her typing speed was slow enough (i.e., less than about 10 words per minute) so that a good word prediction program might be a possibility for help with spelling.

SUMMARY FOR CATHY

Writing output comparison table

Assessment	Speed	Spelling correctness	Writing Mechanics
Handwriting – copying (WOLD)	12.9 WPM	n/a	n/a
Handwriting - dictation	10.3 WPM	35%	Partial punctuation Full capitalization
Typing - dictation	9.1 WPM	42%	Partial punctuation Full capitalization

Comparison between Handwriting and Typing
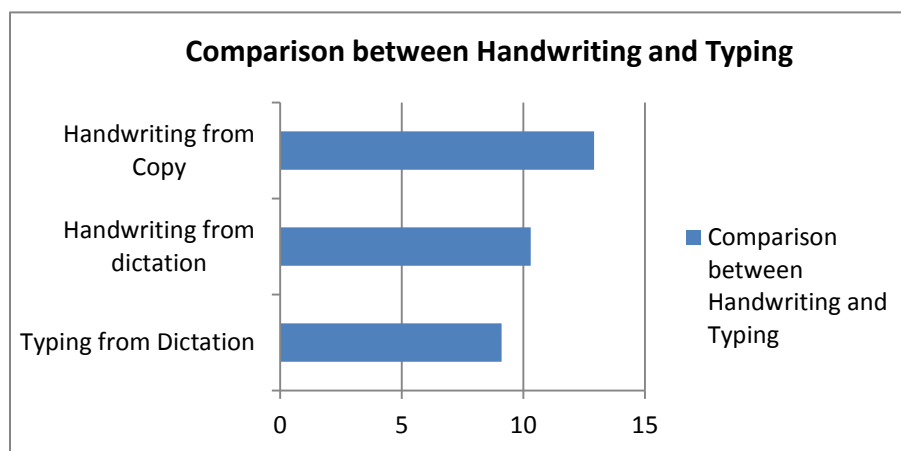
DATA GATHERING: OPTIONAL PROTOCOL TASKS

Depending on the results of our first three tasks, we might do some quick extension testing with various assistive technology tools (these tools are described more fully in the next section).

We can analyze whether a spell check program alone would be effective for error correction, or whether word prediction might be needed. We usually start with Microsoft Word or Google Docs spell check and see first whether the student can visually scan the choices and pick the correct word, or whether spell check plus a read-back feature might be necessary so that s/he can hear the chosen text read aloud and correct mistakes. We also make note of whether the correct choices come up at all in the spell check array or whether the student's spelling patterns are too far off the mark. We may also trial other spellcheck options such as Ginger at this point if the Microsoft Word or Google Docs spell check features are not effective (Ginger is one of the most powerful spell checking tools available).

Another possibility might be word prediction—typing a letter or two and then choosing the appropriate word from the list that appears. We introduce word prediction by demonstrating how to create an arbitrary target sentence and then having the student experiment with it for a few minutes. Once s/he gains some familiarity with this strategy, we take our target passage and have him/her try to produce it again with as few mistakes as possible (prompting as needed). Once again, we make note of whether the student can visually scan the choices and pick the correct word, whether s/he needs to hear the choices read aloud, and whether the correct choices appear at all, based on the spelling patterns.

A data sheet for this type of "spelling microanalysis" is provided as the final document in the Appendix (called "Spellcheck and Word Prediction Comparison").

Other optional protocol tasks might include:
- speech recognition (usually using Siri or Dragon Dictation on an iPad, the Voice Typing feature in Google Docs (Tools> Voice Typing), or Read & Write for Google),
- a graphic organizer,
- a demonstration of text-to-speech, or
- some experimentation with text/document appearance modification, etc.

If we trial speech recognition, we make sure to take careful note of the words the student actually SAID, and then compare these to the transliterated passage to check for accuracy. We prompt the student by saying, "Speak slowly and clearly, like a radio announcer."

In our assessment with our student Cathy, we had her try MS Word spell check and Co:Writer word prediction. Spell checking improved her spelling accuracy to c. 80% and word prediction to greater than 90% (though it slowed her text production down considerably). Using Co:Writer, she was able to visually or auditorily recognize most of the correct word choices as they appeared.

"THE KEY QUESTION"

Our data gathering typically ends with a student-preference question: "If you had to write an essay or report, would you prefer to print, use cursive, type, use word prediction, or...?" Student input and buy-in is absolutely CRUCIAL to determine whether the assistive technology strategy that seems most appropriate during the evaluation will be accepted or abandoned over the long term. Many factors can play into this—accessibility, portability, ease of use, and of course, the elusive "coolness" factor—will the student appear different and/or be accepted by his/her peers while using this technology?

THE AT TOOLBOX

Now that we have gathered data about the student's learning style and writing/typing performance, we can brainstorm about possible technologies to suggest or recommend—drawing from our "AT Toolbox" to see what might be appropriate: voice recording, graphic organizers, speech recognition, text-to-speech, word prediction, typing tutors, spellcheckers, text-and-picture software, alternative keyboards, portable word processors, etc.

- **Voice recording**—If the student has wonderful ideas for writing projects but gets bogged down with the writing process and loses inspiration, one possibility might be to simply have him/her dictate sentences and record them for later playback. Some possibilities: a digital recorder, an iPad app such as AudioNote, a Google app or extension such as Read & Write for Google (i.e., the Voice Note feature), or even an "old-fashioned" cassette recorder—whatever is available. The student can either hand in the recorded artifact as evidence of his/her mastery of the targeted content knowledge, or else, play back and transcribe choice portions of the recording onto paper, for later expansion, editing, and revision.
- **Graphic organizers**-- Many of the students we work with already use some sort of paper-based graphic organizer as a pre-writing strategy to generate and organize ideas and brainstorm before actually beginning to write the assignment. There are a number of software programs and apps that will do this as well, and some have ready-made templates for specific types of assignments: persuasive essays, literary comparisons, historical episodes, lab reports, etc. Some (e.g., Inspiration) will automatically convert the visual concept-diagrams to outline form. This strategy is useful for students who think visually or need help with organization. A number of graphic organizer tools (some available as downloadable freeware) are listed in the Appendix.
- **Speech recognition**—This term refers to software that converts auditory speech to visual text—so called "voice-to-text" software. For many reasons this would be the ideal AT writing solution—you speak, it flawlessly transliterates what you say. Unfortunately, there are problems with this strategy: inaccuracy (especially with young people's voices), and the need for clear speech articulation and lots of patience to self-correct as you go. Generally, we have found this tool to be more appropriate for older

students, but the technology has improved substantially over the past several years, and an increasing number of younger students have seen some success with speech recognition, at least for certain writing tasks. A handout with a more complete discussion (with specific implementation suggestions) is included in the Appendix.

- **Text to speech**—This tool enables the student to hear a playback of whatever text is on the computer screen to determine whether the words match his/her intended message. A list of available text-to-speech programs (some available as downloadable freeware) are listed in the Appendix. Text readers are grouped with screen readers and talking word processors—there are many choices from the simplest with only a few voices to choose from, to the most complex (and expensive) with lots of extra features.

- **Word prediction**—This is the type of software program in which you type a letter, various word choices pop up, and you pick the one you want. It was originally designed for people with injuries or physical disabilities in order to cut down on the number of keystrokes. We recommend it for students who are poor spellers (all they need is the first one or two letters in the word) and students who have fine motor difficulties and type slowly (generally less that about 10 words-per-minute, but this is not a hard and fast rule). There are a number of excellent possibilities for word prediction software programs (and word prediction iPad apps), and each one has different features and ways of customizing the user interface. A source for comparison among iPad apps is listed in the Bibliography along with several other pertinent articles.

- **Typing tutor programs**—Sometimes we simply recommend that students improve their typing speed, especially if they are good spellers and have solid basic skills at keyboarding. Two possibilities that we usually mention are Roller Typing (particularly good for older elementary school students) and Read Write and Type (incorporates phonemic awareness). There are many other online possibilities like Dance Mat Typing and other downloadable freeware programs (see the Appendix for a listing).

- **Text-and-picture software**—For some students that might need added reinforcement for the words that are typed, a program that pairs the text with pictures might prove useful—either stylized line drawings or actual digital pictures. Several possibilities: Writing with Symbols (now "SymWriter"), PixWriter, Picture It, First Author, and the "symbolate" feature in the most recent versions of Boardmaker. Some of these programs also feature "word boards" or word banks containing specific vocabulary that the student can use create sentences.

- **Spell checking**—Spell checking features have long been available for many of the popular computer-based word processing programs. Most spell checkers will be able to catch single-word discrepancies—actual misspellings such as beleive/believe or schedual/schedule. However, consider this text: "Eye used my pea see two find too miss stakes that aye maid wen eye was righting this peace. It cud knot find awl of them, though. Watt dew ewe no?" Not many spell checkers would be able to catch the mistakes in this little passage because they are not actual misspellings but are contextual mistakes (using incorrect homophones). In the past decade or so contextual spellcheckers and grammar checkers have been developed so that you can check spelling in the body of your text and the mistakes will be noted based on the surrounding words. An informal comparison of some of the most popular spellcheckers is provided in the Appendix.

- **Hardware strategies**—Two categories of hardware tools that might be considered for certain students are *alternative keyboards* and *portable word processors.* Alternative keyboards such as mini-keyboards, enlarged keyboards, ABC keyboards, or various ergonomic keyboards can be useful for students with specific physical, cognitive, and/or fine motor challenges. (Key caps stickers can also make keyboard letters more salient for students with visual difficulties.) Over the years, we have seen Intellikeys keyboards to be extremely versatile: you can easily change the overlays to match the particular assignment and even create custom overlays. Portable word processors such as the AlphaSmart, Writer, Forte, Fusion, Neo, Netbook, Chromebook, or laptop can be useful for students who need to type and/or access particular assistive technology software (e.g., word prediction or text-to-speech) in multiple locations or classrooms during the school day.

For students using a regular desktop or laptop computer, you can adjust the keyboard and mouse settings to facilitate access. For example, for the keyboard, you can slow down the key repeat delay and repeat rate, or use "sticky keys" (where multiple simultaneous key hits like Control-Alt-Delete can be sequenced individually instead). For the mouse, you can slow down (or speed up) the mouse speed, the double-click speed, or change the size or shape of the pointer. All of these features can be accessed in the Control Panel (Windows), the System Preferences (Mac) and the Accessibility settings (Chromebook). For students with more significant physical disabilities, access can be provided via adapted mice, trackballs, joysticks, head pointers, eye tracking devices, etc. Switch access (with scanning) might also be an option: hand switches, head switches, sip and puff switches, etc. A more comprehensive account of this type of alternative access is, unfortunately, beyond the scope of this manual.

- **Modifying visual appearance**—For some of our students (especially students with visual challenges) changing the type of font, or modifying its size, color, or spacing may be beneficial. There are now several fonts available that are specifically designed for individuals with dyslexia (e.g., Open Dyslexic 3 and Dyslexie) although some students prefer the more readily-available Verdana, Helvetica, Courier, Arial, or Computer Modern Unicode, which are also quite clear.[6] The page color background can also be modified according to individual preference (sometimes beneficial for students with Scotopic Sensitivity Syndrome) or text masking can be introduced (particularly useful for students with attention or visual tracking difficulties). These features can be accessed in the Control Panel (Windows) or the System Preferences (Mac), or else within the particular word processing program the student may be using: Word, Pages, Google Docs, etc. Add-ons or special extensions that modify visual appearance are also available for common browsers (e.g., Firefox and Google Chrome).

---

[6] Allan Wilson from the CALL Scotland Centre has an interesting recent discussion on his blog (see Bibliography).

FEATURE MATCHING

At this point, we have completed the School Based AT Writing Evaluation and learned something of the student's learning and writing profile. We have considered the tools in our toolbox. In order to generate specific suggestions or recommendations, we need to "feature match" the appropriate technology with the student profile we have generated. In order to conceptualize this, it may help to use a flow chart or "decision tree" that summarizes the range of possibilities to consider. It is important to keep in mind that things are, and should be, a "work in progress." Flexibility is paramount, and initial strategies can be tried, abandoned, or modified as the student grows and matures, and classroom situations and requirements change over time.

The flow chart on the following page is divided into two primary "branches" based on the overall profile of the student:

- Does the student present with a physical and/or sensory (e.g., visual) issue that impedes writing?
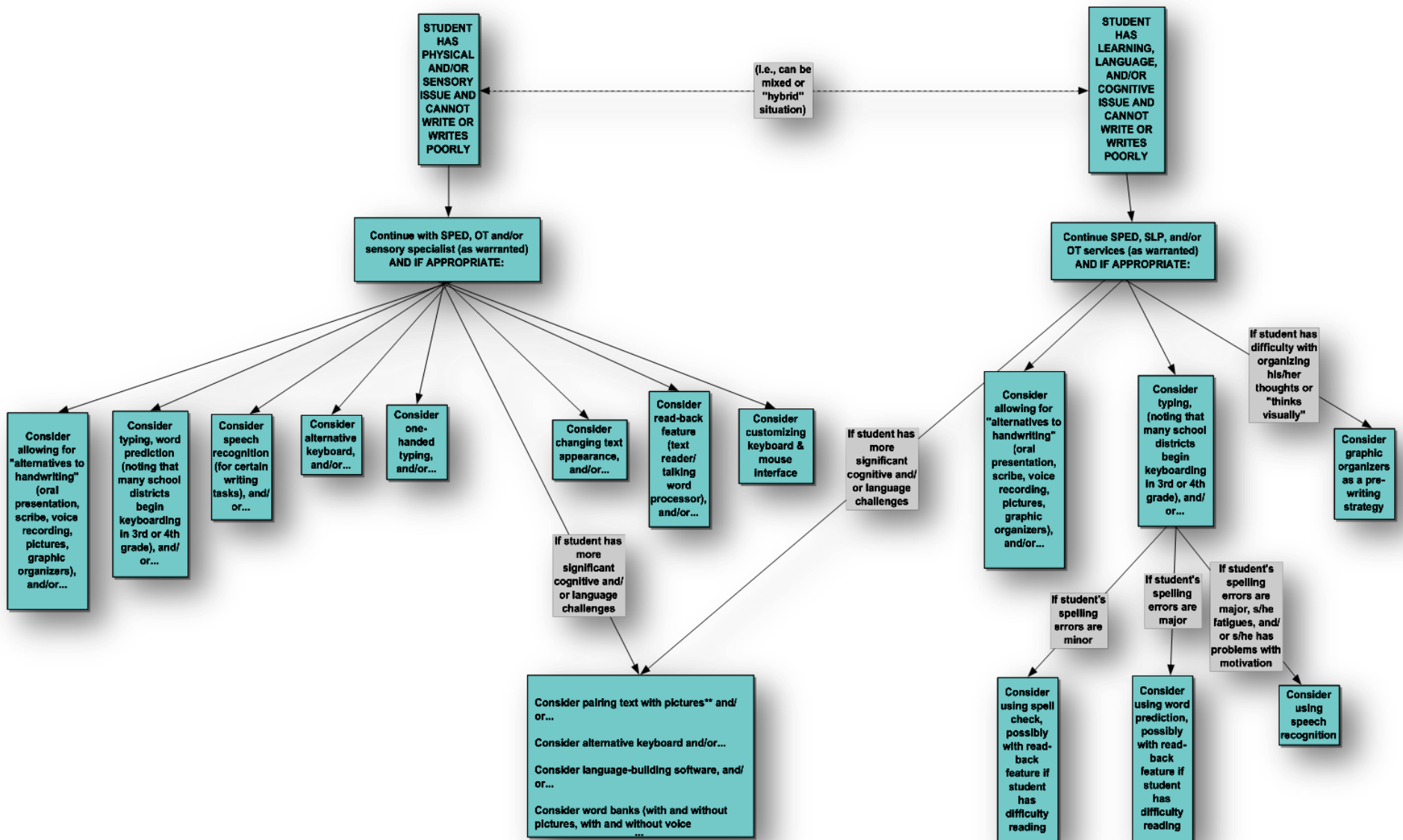- Does the student present with a learning, language, and/or cognitive issue that impedes writing?

Some students will be clear-cut examples—perhaps they have a significant physical or sensory impairment with no other issues. Other students will have a more complex profile and have branches that overlap: a student with a physical and communicative challenge, for example. Or a student may have a sensory impairment and communicative issue. Motivation may also be important to consider. (This type of "hybrid" possibility is marked with a dotted line in the flow chart.) Knowing your student's unique profile is essential!

One important point to discuss is the optimal age to begin keyboarding (this has become a controversial issue in the past several years). Many school districts do not begin teaching formal keyboarding until the 3rd or 4th grade, believing that handwriting plays an integral role in child brain development and cognitive ability.[7] On the other hand, it is true that many families introduce all kinds of technology to their children at a very early age, and iPads, tablets, laptops, and game controllers are now ubiquitous. Like it or not, some of our young students are using sophisticated technology even in preschool!

Without necessarily favoring any particular side of the issue, we might consider that if, after extensive direct instruction, a younger student simply cannot hold a pencil or marker (even with adaptations), or else has significant difficulty remembering how to form the letters, then using a some form of computer-based assistive technology might prove to be a useful accommodation--at least temporarily or in certain specific circumstances. Handwriting instruction and practice can certainly continue, of course (at the team's discretion, informed by the OT's assessment and recommendations), but it is also important that the student have as much access to grade-level academic work as possible. Again, flexibility is key!

---

[7] See the relevant references listed in the Bibliography. Additional discussions are available online.

AT WRITING EVALUATION FLOW CHART

STUDENT HAS PHYSICAL AND/OR SENSORY ISSUE AND CANNOT WRITE OR WRITES POORLY

(i.e., can be mixed or "hybrid" situation)

STUDENT HAS LEARNING, LANGUAGE, AND/OR COGNITIVE ISSUE AND CANNOT WRITE OR WRITES POORLY

Continue with SPED, OT and/or sensory specialist (as warranted) AND IF APPROPRIATE:

Continue SPED, SLP, and/or OT services (as warranted) AND IF APPROPRIATE:

Consider allowing for "alternatives to handwriting" (oral presentation, scribe, voice recording, pictures, graphic organizers), and/or...

Consider typing, word prediction (noting that many school districts begin keyboarding in 3rd or 4th grade), and/or...

Consider speech recognition (for certain writing tasks), and/or...

Consider alternative keyboard, and/or...

Consider one-handed typing, and/or...

Consider changing text appearance, and/or...

Consider read-back feature (text reader/ talking word processor), and/or...

Consider customizing keyboard & mouse interface

If student has more significant cognitive and/ or language challenges

Consider allowing for "alternatives to handwriting" (oral presentation, scribe, voice recording, pictures, graphic organizers), and/or...

Consider typing, (noting that many school districts begin keyboarding in 3rd or 4th grade), and/or...

If student has difficulty with organizing his/her thoughts or "thinks visually"

Consider graphic organizers as a pre-writing strategy

If student has more significant cognitive and/ or language challenges

Consider pairing text with pictures** and/or...

Consider alternative keyboard and/or...

Consider language-building software, and/or...

Consider word banks (with and without pictures, with and without voice ...

If student's spelling errors are minor

If student's spelling errors are major

If student's spelling errors are major, s/he fatigues, and/ or s/he has problems with motivation

Consider using spell check, possibly with read-back feature if student has difficulty reading

Consider using word prediction, possibly with read-back feature if student has difficulty reading

Consider using speech recognition

16

- *First "branch": Student cannot write or writes poorly because of a physical and/or sensory (e.g., visual) issue.*

STUDENT HAS PHYSICAL AND/OR SENSORY ISSUE AND CANNOT WRITE OR WRITES POORLY

Continue with SPED, OT and/or sensory specialist (as warranted) AND IF APPROPRIATE:

Consider allowing for "alternatives to handwriting" (oral presentation, scribe, voice recording, pictures, graphic organizers), and/or...

Consider typing, word prediction (noting that many school districts begin keyboarding in 3rd or 4th grade), and/or...

Consider speech recognition (for certain writing tasks), and/or...

Consider alternative keyboard, and/or...

Consider one-handed typing, and/or...

Consider changing text appearance, and/or...

Consider read-back feature (text reader/ talking word processor), and/or...

Consider customizing keyboard & mouse interface

If student has more significant cognitive and/or language challenges

Consider pairing text with pictures** and/or...

Consider alternative keyboard and/or...

Consider language-building software, and/or...

Consider word banks (with and without pictures, with and without voice output-"AAC software")

If a student has a physical or sensory issue of any significance, some form of assistive technology may be almost essential for producing written work, at least at some point. Of course, situations vary, but "alternatives to handwriting" should probably always be considered. If the goal of the assignment is to demonstrate content knowledge, then why not allow the student to verbalize the information, either in real time for the teacher, or else in some sort of digital (or even old-fashioned analog) recorded form? There are many free apps for tablets and/or Chromebooks that would work beautifully for this task. Having another person scribe is certainly another possibility, although over the long term, we would

likely hope to maximize the student's independence. Using pictures, graphic organizers, presentation software (or apps) of various kinds might also be possibilities, depending on the circumstances.

If the student can access a keyboard of some kind, typing can certainly be considered.[8] Adapted keyboards come in all shapes and sizes and can accommodate many types of typing styles. Mini keyboards and one-handed keyboards are particularly useful for some students, whereas others have benefited from using larger surface striking areas. The Intellikeys keyboard has long been a favorite because of its versatility: you can switch the key layout instantly, and even create customized configurations of your own, based on individual student need. If the traditional QWERTY layout is too difficult for the student, the Dvorak layout might also be an option: it is a "simplified" keyboard, and proponents claim that it cuts down on finger motion and is relatively easy to learn (although there has been no recent research to document this). Most operating systems allow a user to quickly switch from QWERTY to the Dvorak layout.

Another option might be to use some of the onboard accessibility features for the computer or device the student is using. For example, Windows machines have the "Ease of Access" Control Panel, Macs have an "Accessibility" menu in System Preferences, iPads have an extensive array of Accessibility Features available in the General Settings, and Chromebooks have Accessibility Features in the Advanced Settings. Online company documentation provides clear and thorough descriptions of all of these features, and there are also many helpful YouTube demonstration videos that are available.

Two other excellent possibilities for students in this first category are word prediction and speech recognition, since they are both designed to minimize keystrokes. These tools can be used independently or together (i.e., each tool pulled up when needed, even within the same sentence) with the option of also adding a read-back feature (the combination of tools creates a powerful synergy).

CASE STUDY: One student (I will call "Meredith") we assessed in first grade had an actual physical deformity and was missing most of her fingers. Meredith was bright and capable, so we suggested that she try word prediction, and an Intellikeys alternative keyboard with a keyguard. It took her awhile to type out her message, even with the enlarged Intellikeys overlays so we incorporated Co:Writer word prediction as part of her assistive technology "package" in order to minimize the number of keystrokes she needed to make. We also introduced speech recognition (Dragon Naturally Speaking) as a possibility, even though it was definitely not accurate enough for her to work on classroom assignments. Our reasoning was that at some point in the future, her voice (and speech articulation patterns) will likely mature and the software will become more and more accurate with later versions. It will be to her advantage to have at least some familiarity with this tool so that she can easily incorporate this as a compensatory strategy in the future.

---

[8] In our local school district, we do not usually start students keyboarding until 3rd or 4th grade so that if the student is younger than this, we usually suggest that s/he continues to work with the Occupational Therapist on improving handwriting skills. There are certainly exceptions to this, however, especially when the student has physical or sensory issues.

- *Second "branch": Student cannot write (or writes poorly) and has a learning, language, and/or cognitive issue.*
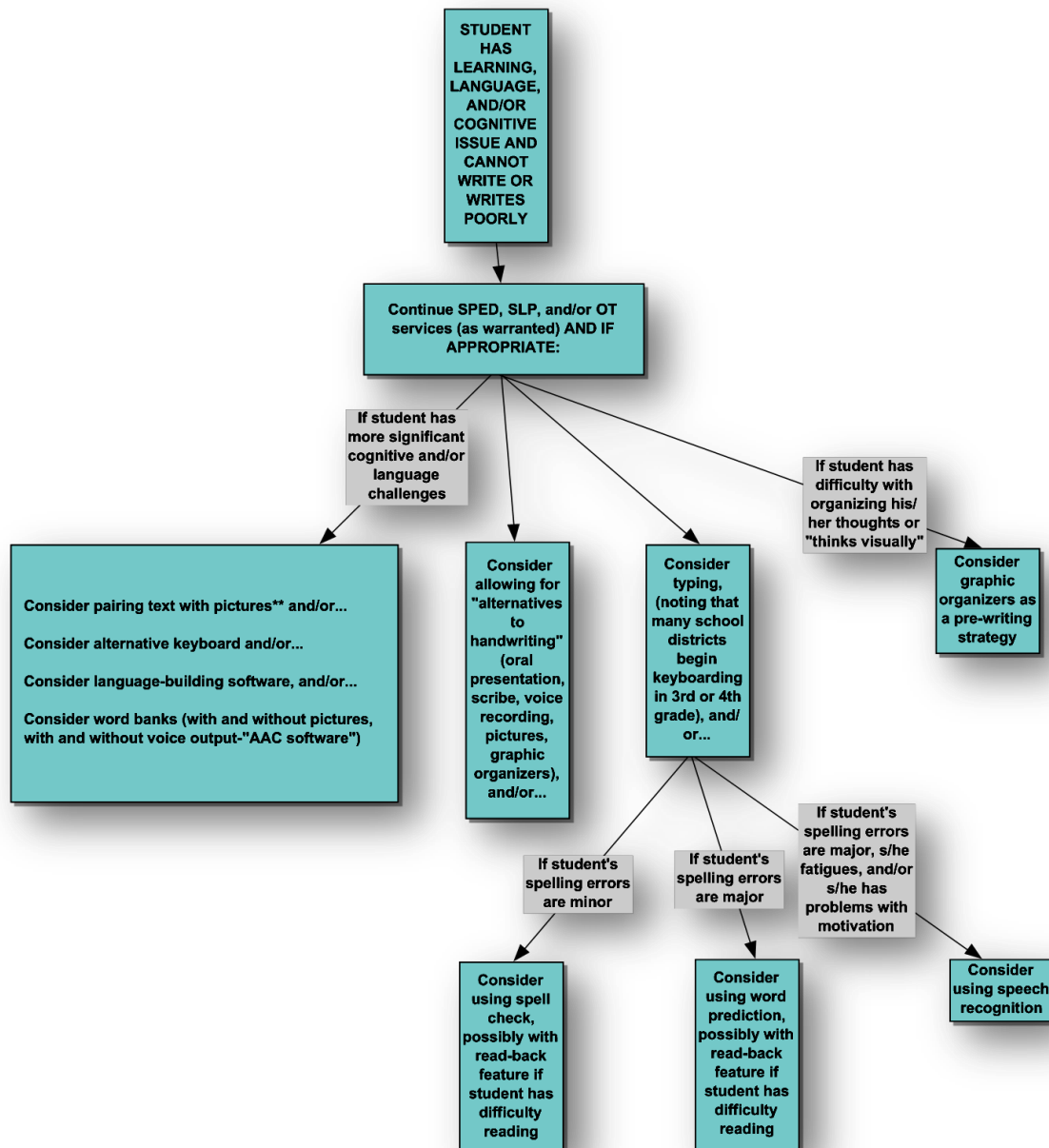
With students who have a learning, language, and/or cognitive issue, we can always encourage the use of "alternatives to handwriting"—scribing, oral presentation, digital voice recording, use of pictures, use of "cartooning" software such as "Comic Life," etc. For students in 3rd grade or above, we can usually assume they have been introduced to keyboarding in class, so we might introduce strategies to help

with keyboarding, either with hardware (e.g., alternative keyboards such as a mini-keyboard or an Intellikeys keyboard), or with software designed to teach keyboarding skills (typing tutorials) or minimize keystrokes (e.g., word prediction or speech recognition).

We see many students who are poor spellers, students who have difficulty generating and organizing their thoughts, and students who are slow at getting their thoughts onto paper in a well-expressed, grammatical fashion. We usually recommend trying various types of software since these students have at least some familiarity with keyboarding and using the computer. We might suggest typing tutor software (to refine keyboarding skills and increase speed), spellcheck features or word prediction, text-to-speech software (talking word processors), organizational software, and, sometimes, speech recognition. Keep in mind that these tools can be used in combination—speech recognition and a text reader, for example, or speech recognition, word prediction, and a text reader. The tools can be turned on or off as needed, even within the same sentence (e.g., if the student comes across a tricky word, s/he can try word prediction, then speech recognition, and then have it read back to make sure it's correct).

If the student has "emerging" literacy skills, or has significant cognitive and/or language challenges (or relates better to pictures rather than words), we may suggest trying software that pairs the text with pictures: Writing with Symbols, SymWriter, PixWriter, First Author, or the symbolate feature in Boardmaker. Some of these offer the possibility of creating word banks, so that the student does not have to spell out entire words and can simply choose them from a custom array to create sentences.

CASE STUDY: We evaluated a student I will call "Benjamin," a fourth grader who received special education services under a "Speech Language Disability" designation. Benjamin had great ideas but had difficulties with writing speed, legibility, and spelling (as well as reading). His handwriting was quicker than his typing (11-13 words per minute for handwriting as opposed to 7 words per minute for typing) but both were indecipherable because of very poor spelling. Since Benjamin's speech articulation was not clear enough to warrant trialing speech recognition software, we looked instead to word prediction (Co:Writer) to help improve both his typing speed and his spelling. Since his reading was also an area of challenge we suggested using the auditory feedback feature in the Co:Writer word prediction program so that the word choices could be read to him sequentially. We also suggested using a text-to-speech program (in this case, Write:OutLoud or WYNN) so that he could make sure that the words that he had chosen were the ones that he intended to communicate. In addition, we suggested using a typing tutor program to increase his speed and his keyboarding skills, as well as a digital voice recorder so that he could be sure that his ideas would be recorded in some fashion and he would not forget them.

- ***A short discussion about motivation…***

Almost all of the students we evaluate have at least some resistance to writing. Since it is a very difficult task for them in some way, there would be little reason to like it! There are a small number of students, however, who have a disability that warrants special education services, and who can physically write, but for one reason or another refuse to. This is a difficult category indeed, and it is debatable whether this strictly falls under the purview of "assistive technology," since the issues have more to do with stimulating motivation than providing access. Nevertheless, there are a handful of strategies that can help these students, and make the production of text, if not "enjoyable," at least, less of a chore.

The "alternatives to handwriting" approach would likely be an excellent initial suggestion: if the goal is to demonstrate content knowledge, why not accept the assignments in another form OTHER than writing: oral presentation, voice recording, pictures, etc.? Other options might be to try some form of multi-modal presentation format (e.g. Powerpoint, Comic Life, etc.) and/or a graphic organizer.

CASE STUDY: We met a young 5th grader I will call "Johnny" with very mild Autism Spectrum Disorder. Johnny had an encyclopedic knowledge about several subjects (i.e., trains and science fiction movies) but refused to write about them (or anything else). After consulting with him and his school team and doing our writing evaluation, we determined that his writing and typing skills were at grade level but he simply hated writing. We spoke with him and suggested the possibilities of using voice recording and the alternative presentation software Comic Life and PowerPoint (for the PC) and the Google Extensions Prezi and VoiceThread (for his Chromebook) to help him generate enthusiasm and interest and express some of his ideas. We also trialed speech recognition (with the iPad Dragon Dictation app) since his speech was clear and consistent, and determined that although the sample was not 100% accurate in all cases, it was close enough for it to be a realistic alternative possibility to handwriting. As Johnny liked computers and technology, he was intrigued with the idea of speaking and having the text come out on the screen. (The errors in transliteration were actually humorous for him as well.) These strategies were at least a place for him to start, and our hope was that he would feel empowered by seeing his ideas recorded into an artifact of some kind, and (over the long term) be more amenable to handwriting and keyboarding in a more typical fashion.

FINAL STAGES

The final part of the AT Writing Evaluation consists of reconvening with the school team and family (if they have stayed through the assessment) to present our results, review various strategies and possible alternatives, and discuss our recommendations. This portion of the evaluation is particularly important as questions sometimes arise and can be addressed immediately. The assistive technology action plan for follow-up activities can be discussed and set up, hardware delivery and software installation can be scheduled, and student and staff trainings can be arranged.

After the evaluation has been completed, the AT Team case manager for the student's school generates a comprehensive written report containing background information, issues discussed at the evaluation, the assessment data, a discussion of various assistive technology strategies and their pros and cons, the actual recommended strategies, and a timetable for implementation. This document becomes part of the student's IEP and will follow him/her as s/he progresses through grades and schools (and districts, if the student moves) and is a source of important information to special education teachers and staff who work with the student. Past this point, we check in periodically with the team and the student to see how things are going and to determine whether we need to adjust our strategies for any reason. Again, in our view, it's always a "work in progress" and flexibility and creative thinking are crucial!

BIBLIOGRAPHY AND SOURCES

Print Resources

AbilityNet. (2014, January). Dyslexia and Voice Recognition. Retrieved April 11, 2014, from AbilityNet: www.abilitynet.org.uk

Association for Psychological Science. (2014). Longhand note taking improves academic performance, long-term comprehension. Medical News Today. Retrieved from: http://www.medicalnewstoday.com/releases/275985.php

Anson, D., Moist, P., Przywara, M., Wells, H., Saylor, H., & Maxime, H. (2006). The effects of word completion and word prediction on typing rates using on-screen keyboards. *Assistive technology*, *18*(2), 146-154.

Brodwin-M, G. (2004). Computer assistive technology for people who have disabilities: Computer adaptations and modifications. *Journal of rehabilitation*, *70*(3), 28-33.

CALLScotland. (2014). Speech Recognition. Retrieved April 11, 2014, from CALLScotland: http://callcentre.education.ed.ac.uk/What-we-do/Projects/Speech-Recognition/

Evmenova, A. S., Graff, H. J., Jerome, M. K., & Behrmann, M. M. (2010). Word prediction programs with phonetic spelling support: Performance comparisons and impact on journal writing for students with writing difficulties. *Learning Disabilities Research & Practice*, *25*(4), 170-182.

Gardner, T. J. (2008). Speech Recognition for Students with Disabilities in Writing. *Physical Disabilities: Education and Related Services*, *26*(2), 43-53.

Herold, M., Alant, E., & Bornman, J. (2008). Typing speed, spelling accuracy, and the use of word-prediction. *South African Journal of Education*, *28*(1), 117-134.

Kintsch, A., & DePaula, R. (2002). A framework for the adoption of assistive technology. *SWAAAC 2002: Supporting Learning Through Assistive Technology*, 1-10.

Loeffler, S. (2005, December 16). Voice recognition for written language skills: A comparative study between the learning disabled and physically disabled populations. Denver, CO: Unpublished document for the ATP Post Graduate Study Grant Program, UCHSC.

MacArthur, C. A. (1999). Word prediction for students with severe spelling problems. *Learning Disability Quarterly*, *22*(3), 158-172.

MacArthur, C. A. (2009). Reflections on research on writing and technology for struggling writers. *Learning Disabilities Research & Practice*, *24*(2), 93-103.

Maples, W. C. (2003). The Wold Sentence Copy Test academic performance. *Journal of Behavioral Optometry*, *14*(3), 71-76.

Mezei, P.J. & Heller, K.W. (2012). Effects of Word Prediction on Writing Fluency for Students with Physical Disabilities. *Physical Disabilities: Education and Related Services,* 31, 3-26.

Mirenda, P., Turoldo, K., & McAvoy, C. (2006). The Impact of Word Prediction Software on the Written Output of Students with Physical Disabilities. *Journal of Special Education Technology*, *21*(3), 5-12.

Montgomery, D. J., & Marks, L. J. (2006). Using technology to build independence in writing for students with disabilities. *Preventing School Failure: Alternative Education for Children and Youth*, *50*(3), 33-38.

Parette, H. P., Boeckmann, N. M., & Hourcade, J. J. (2008). Use of Writing with Symbols 2000 software to facilitate emergent literacy development. *Early Childhood Education Journal*, *36*(2), 161-170.

Rosenberger, R. (2013, October 7). Dictation Technology Will Change Writing Instruction. Retrieved April 11, 2014, from Edutopia: http://www.edutopia.org/blog/dictation-technology-changing-writing-instruction-robert-rosenberger

Silió, M. C., & Barbetta, P. M. (2010). The Effects of Word Prediction and Text-to-Speech Technologies on the Narrative Writing Skills of Hispanic Students with Specific Learning Disabilities. *Journal of Special Education Technology*, *25*(4), 17-32.

Supon, V. (2009). Cursive writing: are its last days approaching? *Journal of Instructional Psychology, 36*(4), 357-359.

Tam, C., Reid, D., Naumann, S., & O'Keefe, B. (2002). Perceived benefits of word prediction intervention on written productivity in children with spina bifida and hydrocephalus. *Occupational Therapy International*, *9*(3), 237-255.

The Optometric Extension Program Foundation. WOLD Sentence Copying Test. http://www.oepf.org/product/wold-sentence-copying-test

Trnka, K., & McCoy, K. F. (2008, June). Evaluating word prediction: framing keystroke savings. In *Proceedings of the 46th Annual Meeting of the Association for Computational Linguistics on Human Language Technologies: Short Papers* (pp. 261-264). Association for Computational Linguistics.

Tumlin, J., & Heller, K. W. (2004). Using word prediction software to increase typing fluency with students with physical disabilities. *Journal of Special Education Technology*, *19*, 5-14.

Zar, J. H. (2000). Candidate for a pullet surprise. *Journal of Irreproducible Results*, *45*(5/6), 20-20.

Zumalt, J. R. (2013). Voice recognition technology: Has it come of age? *Information technology and libraries*, *24*(4), 180-185.

Online Resources

Ashton, Darla. (February 8, 2014). Technology for Special Education Needs: Word Prediction iOS apps. Retrieved from: http://techspedneeds.blogspot.com/2014/02/word-prediction-ios-apps.html

CALL Scotland. (1983-2014). Communication and Assistive Technology for People with Disabilities. http://www.callscotland.org.uk/Home/

Dyslexie Font, B.V. http://www.dyslexiefont.com/

Gentry, J. Richard. (2005-2011) JRichardGentry.com Web resource at: http://jrichardgentry.com/

Nankee, C., Stindt, K. & Lees, P. (2009). Assistive Technology for Writing, Including Motor Aspects of Writing and Composition. In Wisconsin Assistive Technology Initiative, Assessing Students' Need for Assistive Technology, 1-28. Web resource at: www.wati.org/content/supports/free/pdf/Ch5-WritingMotorAspects.pdf

Open Dyslexic Free and Open Source Dyslexia Typeface. http://opendyslexic.org/

WETA-TV. (2010). LD OnLine. Web resource at: www.ldonline.org

APPENDIX:

PROTOCOL FORM, REFERRAL FORM, GRADE-LEVEL SENTENCES, TOOL BOX MATERIALS

School-Based Assistive Technology Writing Assessment Protocol

WOLD Sentence Copying Test

(©2001 Optometric Extension Program Foundation, Inc.). -Utilized to determine if the child has the ability to rapidly and accurately copy a sentence from the top to the bottom of a page. A necessary skill to keep up with classmates.

# of words (29 if no omissions): Time: WPM: # of letters (110 if no omissions): LPM:	Key: 5 secs = .08 mins 10 = .17 15 = .25 20 = .33 25 = .42 30 = .5 35 = .5 40 = .67 45 = .75 50 = .83 55 = .92			
		Grade equiv:	**WPM** (words per minute)	**LPM** (letters per minute)
		2	7.9-10.5	30-40
		3	10.5-11.1	40-42
		4	12.1-13.2	46-50
		5	13.3-15.8	50.5-60
		6	14.4-17.7	54.5-67
		7	15.6-19.5	59-74
		8	16.6-21.1	63-80

Legibility Rating: 1) Almost completely illegible 2) Parts illegible 3) Difficult to read but decipherable with context 4) Legible (although not necessarily neat)	Rater 1: Rater 2: Rater 3: Average:	**Mechanics Observation:** ☐ Full punctuation ☐ Partial ☐ None ☐ Full capitalization ☐ Partial ☐ None	**Copying Text (fixations) Observation:** ☐ Letter by letter ☐ Word by word ☐ Phrase by phrase

Considerations:
- Spacing and Letter Formation:
- Posture:
- Vocalization or Subvocalization:
- Concentration, Attention and Fatigue:
- Frustration level:
  Comments:

Writing from Dictation

Sentence # used:

Total # of Words in sentence: Time: Words Per Minute:	Key: 5 seconds = .08 minutes 10 = .17 15 = .25 20 = .33 25 = .42 30 = .5 35 = .5 40 = .67 45 = .75 50 = .83 55 = .92	Spelling: Grade Level (K-5) _____ 'No Excuse' Words % spelled correctly: Total # of words _____ (grades 6-12) % spelled correctly:

Handwriting Legibility Rating: 1) Almost completely illegible 2) Parts illegible 3) Difficult to read but decipherable with context 4) Legible (although not necessarily neat)	Rater 1: Rater 2: Rater 3: ———— Average:	Passage Reader's Observation: ☐ Read aloud word by word ☐ Read aloud phrase by phrase	Mechanics Observation: ☐ Full punctuation ☐ Partial punctuation ☐ No punctuation ☐ Full capitalization ☐ Partial capitalization ☐ No capitalization

Richard Gentry's "Gentry Writing Scale": (see http://jrichardgentry.com)

☐ Phase 0. *Nonalphabetic Writing* (student scribbles, is unable to write letters and is unable to write his/her name)

☐ Phase 1. *Prealphabetic Writing* (precommunicative spelling--student invents spelling in random letters with no matches to sounds)

☐ Phase 2. *Partial Alphabetic Writing* (semiphonetic spelling--student invents a majority of spellings with correct beginning letter-sound correspondences or partial letter-sound representations such as HMT DPD for Humpty Dumpty or BT for boat)

☐ Phase 3. *Full Alphabetic Writing* (phonetic spelling--student invents a majority of spellings using a letter for each sound such as KAM for came, NIT for night, TABL for table, and BABE for baby.

☐ Phase 4. *Consolidated Alphabetic Writing* (transitional spelling—student uses many conventional spellings, and the majority of invented spellings includes phonics patterns for each syllable—EVREWHAIR for everywhere, SPESHIL for special, YOUNIGHTED for united, etc.

☐ **Spelling correct/conventional** (student knows the English orthographic system and its basic rules)

Considerations:
- Spacing and Letter Formation:
- Posture:
- Vocalization or Subvocalization:
- Concentration, Attention and Fatigue:
- Frustration level:
  Comments:

Typing from Dictation

Sentence # used:

Total # of Words typed: Time: Words Per Minute:	5 **seconds** = .08 **minutes** 10 = .17 15 = .25 20 = .33 25 = .42 30 = .5 35 = .5 40 = .67 45 = .75 50 = .83 55 = .92	**Taking Dictation Reader's Observation:** ☐ Read aloud word by word ☐ Read aloud phrase by phrase	**Spelling:** Grade Level (K-5) _____ 'No Excuse' Words % spelled correctly: Total # of words _____ (grades 6-12) % spelled correctly:
Typing Style: ☐ One finger, hunt & peck ☐ Two finger, hunt & peck ☐ Multiple finger typist ☐ Beginning 10 finger typist ☐ Ten finger typist	**Mechanics Observation**: ☐ Full punctuation ☐ Partial punctuation ☐ No punctuation ☐ Full capitalization ☐ Partial capitalization ☐ No capitalization		**Gentry Writing Scale Phase:** ☐ Phase 0. Nonalphabetic ☐ Phase 1. Prealphabetic ☐ Phase 2. Partial alphabetic ☐ Phase 3. Full alphabetic ☐ Phase 4. Consolidated alphabetic ☐ **Spelling correct/conventional**

Considerations:
- Typing mechanics (space bar for spacing, shift key for capitals, etc):
- Posture:
- Vocalization or Subvocalization:
- Concentration, Attention and Fatigue:
- Frustration level:
  Comments:

3

*Student Preference: (print, cursive, typing or word prediction)

*Additional Trials/Observations: (Word Prediction, Spell-Check, Speech Recognition, etc.)

ASSISTIVE TECHNOLOGY REFERRAL: LITERACY EVALUATION

What do you hope the student will be able to do as a result of this evaluation? Which IEP goals will be addressed?

_____

_____

_____

_____

_____

_____   _____   _____

Legal Name of Child/Student   **Date of Birth**   **Current Date**

_____   _____   _____

School   **Grade**   **Case Manager**

- **Instructions to case manager:**

    Please send (or scan and email):
    1) *The completed referral form with school team and parent signatures (don't forget to fill out the relevant parts of the "Notice Regarding Reevaluation" on page 6)*
    2) *A copy of the student's current IEP, and*
    3) *Any relevant evaluation reports (hospital, clinic, specialist) to: XXXX*

    As soon as all paperwork is received, an evaluation can be scheduled. Evaluations usually take about an hour and a half and consist of consultation with school staff and parents followed by observation/assessment of the student.

- **Instructions to parents:**

    1) *Please fill out page 5 entitled "To be Completed by Parents"*
    2) *Please fill out and sign the relevant parts of the "Notice Regarding Reevaluation" page (page 6) and return all these to the case manager*

    Please note: the "Parent and Child Rights in Special Education Procedural Safeguards Notice" booklet can be found at:

    http://www.cde.state.co.us/sites/default/files/documents/spedlaw/download/2011proceduralsafeguards.pdf

    and in Spanish at:

    http://www.cde.state.co.us/sites/default/files/documents/spedlaw/download/2011proceduralsafeguards-spanish.pdf

ASSISTIVE TECHNOLOGY REFERRAL: LITERACY EVALUATION

School Specialists:

NAME:	SIGNATURE:
Special education teacher:	
Speech therapist:	
Occupational therapist:	
Physical therapist:	
Classroom teacher(s):	
Other:	

What interventions have been tried? **REQUIRED before submitting an AT Literacy Referral---(May be trialed via Read & Write for Google, WYNN, etc. Check with your AT contact if unsure)

- ❏ Word Prediction
- ❏ Typing & Using Spellcheck
- ❏ Graphic Organizers
- ❏ Highlighting Tools
- ❏ Voice Dictation/Audio Recording
- ❏ Voice to Text

- ❏ Text Reader
- ❏ Audio or E-Books
- ❏ Text Manipulation (font, font size, background color, margins adjustment, line & word spacing, etc.)
- ❏ Other:

Results from trial?

What would you like to see this student be able to do?

Student Learning Profile

Concerns with Writing Skills:
- ❏ Writing speed
- ❏ Legibility
- ❏ Spelling
- ❏ Fluency
- ❏ Other:

Primary means of written communication:
- ❏ Print
- ❏ Cursive
- ❏ Typing
- ❏ Dictation/Scribe
- ❏ Voice to Text
- ❏ Other:

ASSISTIVE TECHNOLOGY REFERRAL: LITERACY EVALUATION

Concerns with Handwriting:

- ❑ Speed (too fast or slow)
- ❑ Letter formation
- ❑ Spacing between letters or words
- ❑ Use of lines on a page

Is handwriting legible to readers?
- ❑ Yes
- ❑ No

Is student able to copy from board?
- ❑ Yes
- ❑ No

Is endurance a problem with written work?
- ❑ Yes
- ❑ No

Comments:

Concerns with Math skills:
- ❑ Number Concepts
- ❑ Computations
- ❑ Abstract Thinking
- ❑ Memorization of Facts

Concerns with Reading Skills:
- ❑ Letter Identification
- ❑ Sound-Symbol Correspondence
- ❑ Reading Speed and Fluency
- ❑ Text Comprehension

Concerns with Study Skills:
- ❑ Note Taking
- ❑ Organization
- ❑ Homework Completion

Comments:

Student Physical Access& Sensory Profile

Student vision:

Student hearing:

Does the student have physical limitations that impact learning ability?

❑ Yes	❑ No	Can the child isolate finger movements?
❑	❑	Any concerns with fatigue while writing?
❑	❑	Does the child experience hand tremors?
❑	❑	Can the child maintain appropriate posture for writing?
❑	❑	Can the child hold a pencil efficiently?
❑	❑	Can the child correctly form letters?
❑	❑	Does the child put spaces between words while writing?
❑	❑	Can the child write between the lines on lined paper (if so, what size)?

❑ Yes ❑ No   Can the child read back his own writing?

❑   ❑   Can the child type (if so how quickly?)

❑   ❑   Does the child type using two hands?

❑   ❑   Does the child use correct 10 finger technique?

Other comments:

Student Communication Profile

Student currently communicates via:
- ❑ Voice/speech. Quality:
  - ❑ Clear
  - ❑ Sometimes difficult to understand
  - ❑ Usually difficult to understand

Additional comments:

Is it difficult for familiar people to understand the student's basic needs?
    ❑ Yes   ❑ No   ❑ Sometimes   Please explain:

Does the student understand more than he/she is able to express?
    ❑ Yes   ❑ No   ❑ Sometimes   Please explain:

Student Computer Access

Access to:
- ❑ Windows Desktop or Laptop
- ❑ Chromebook
- ❑ Mac Computer or Laptop
- ❑ iPad
- ❑ Other:

Student has access to technology:
- ❑ Always
- ❑ Sometimes
- ❑ Rarely

Does student bring a device from home?
- ❑ Yes _____
- ❑ No

What other things have been tried or are being used to help the student overcome physical limitations in order to effectively learn and communicate?

ASSISTIVE TECHNOLOGY REFERRAL: LITERACY EVALUATION

To be completed by parents:

General

What skills do you believe are important for your child to develop?

Are there significant factors about your child's strengths, learning style, coping strategies, or interests that the team should consider?

Are there any other significant factors about your child that the team should consider?

Student computer access at home:
- ❏ Macintosh
- ❏ Windows
- ❏ Other _____

Does your child receive outside therapies? (Check all that apply)
- ❏ Speech/Language
- ❏ Occupational Therapy
- ❏ Physical Therapy
- ❏ Vision
- ❏ Hearing
- ❏ Psychologist
- ❏ Other _____

_____ _____ _____ _____ _____
Legal Name of Child/Student　　　　　Birth Date　　School　　　　　　　　　　　　　　Grade　　　Current Date

NOTICE REGARDING REEVALUATION

As part of any reevaluation, the IEP team and other qualified professionals, as appropriate, are required to review existing data pertaining to your child, including previous evaluations, information provided by parent(s), current classroom-based evaluations and observations by teachers and related service providers to determine continued eligibility for special education and related services or to conduct a review for appropriate programming and placement.

Existing Data Reviewed:

_____
_____

☐ After reviewing existing data, the School District is recommending that your child be evaluated in the following areas:
Assistive Technology

The reason(s) the School District proposes the evaluation(s) described above are as follows:

_____

_____

The School District requires your written consent in order to complete the recommended evaluation(s). Please sign below and return this form within ten working days to the school representative listed below. In the event that this signed consent form is not returned within ten working days, the school representative will attempt to contact you at least twice by telephone for your decision. If no response is received, the school representative will assume consent and proceed with the recommended action.

Parent Signature: _____ Date: _____

Parents of a child with a disability have certain legal rights. A parental rights document is enclosed. Please read it carefully; if you have any questions regarding the reassessment process or your rights, please contact:

School representative: _____ Phone: _____

☐ A copy of the procedural safeguards has been given to the parents in their native language, or mode of communication.

☐ As the parent/guardian, I recognize that the team feels it has sufficient information, however I request reevaluation to determine my child's eligibility and/or educational needs in the following areas:

_____

Parent Signature: _____ Date: _____

Grade Level No Excuse Sentences (No Excuse words are boldfaced)

First Grade:

#1.1   How **are you** and your dog doing after **the** cat cut him **on** his nose? **He** was mean **for** doing **that**. *(7 spelling words, 21 words)*

#1.2   **It was you** who told me **that** it **is** hot **in** here. **He** said that **the** heat is **on** and **we are** hot. *(11 spelling words, 23 words)*

#1.3   **He** likes **to** climb **on the** tree **that is in** my back yard. **You** can climb **it** now **for** fun. *(10 spelling words, 20 words)*

Second Grade:

#2.1   **There** is **an** apple for **each one** of the girls. **When** you give them **all** out, **they will** need to know **if** the apples are **from** me. *(10 spelling words, 27 words)*

#2.2   **They said** that **there can be** no more candy for us **from this** bag, **but** they **were** wrong. **We have all** the candy, **but will not** eat it now. *(15 spelling words, 29 words)*

#2.3   I **will** hear **from** you **about your** party **as** soon as I **can**. Jack **said there were** lots of kids that came, **but not their** dogs **or** cats. *(13 spelling words, 28 words)*

Third Grade:

#3.1   **After she called** out, **people** came **down** to **see** if it really was **him**. **Only** one man **could make so many** come. Some even jumped **into very** cold **water just** to get a **look**. *(17 spelling words, 34 words)*

#3.2   **People** all **over these** parts **just know him**. He **has** a **long** history of doing **very** funny shows. But **who** can **find** him **after** he has **made** his jokes and jumps **down** from the stage? *(14 spelling words, 35 words)*

#3.3   **After** he **called** me I **did** not **know** what to do. I **could** not go **out** to **see who** had **made** the **people so very** angry. *(12 spelling words, 26 words)*

#3.4   I **would like** to **use very little water** when I **make** this cake. I **know** that **most people** have **more than** that, but I **only** want **two** cups and **then** some salt. *(15 spelling words, 32 words)*

Fourth Grade:

#4.1   I **thought** that **together** we could do **something different**. I **always** wanted to **put** my name somewhere **important**, like on a **house** or **school**. What in the **world** do you **want** to do? *(11 spelling words, 33 words)*

#4.2   I **often think** about **another school** I **went** to **until** this **last** year. I **might tell** you about **something important** I **saw** there, but I really **should show** you the **next** time we are **together**. *(16 spelling words, 35 words)*

#4.3   I **think** that the **children** are **going together** to a **place** by the **old school**, where I **often** like to **go** and **read** a book. Mom and dad **went** there **last** week and **say** that they **never saw** so many **different** kinds of plants in the **same** area. *(17 spelling words, 48 words)*

#4.4   **Take such great** care to **give** the **children** what is **important**. We play **our own part** in things and it is not **too small**. *(11 spelling words, 24 words)*

Fifth Grade:

#5.1   **Toward morning** when the **light** of the **sun** shines in my **face** I begin to **hear** the sounds of **life**. **Today** I am **sure** to get up because in this **country** one must earn **money since** we can't **live** off of dreams **alone**. *(14 spelling words, 43 words)*

#5.2   My **father began** to **change** his mind about moving our **family** from the **city** to the **country**. He **heard several** people say that **it's** not possible to go a **whole year without** work. *(12 spelling words, 33 words)*

#5.3   At this **point** I do not want to **play** in your **room** with you if you will not **let** me have a **turn**. **It's** been **several** minutes **since** I have had the chance to **try** to **move** my piece **across** the board. *(11 spelling words, 42 words)*

#5.4   One **morning**, **father** and **mother took** the **family** to the **country** to **fish** by the **sea**. They drove the **car** and when **night** came, they saw they **didn't** have any **money**. We all said, "**Live** and **learn**." *(14 spelling words, 37 words)*

Graphic Organizers

Free Graphic Organizer Resources:

- Popplet—online graphic organizer resource, www.popplet.com

- Lucid Chart – free Google extension graphic organizing resource. www.lucidchart.com

- Mindomo-- mind-mapping tool, has Microsoft Word-like features. http://www.mindomo.com/

- XMind-- Free mind-mapping software: http://www.xmind.net

- Bubbl.us-- Brainstorming and Organizing Tool good for visual thinkers/learners, easy to use, customizable features, sharing capabilities--   https://bubbl.us

- Prezi- Unique way to present information/ideas and concepts,interactive flow chart, moderate to use--   http://prezi.com/

- Read/Write/Think Index of Tools-- A list of possible tools available on the Read/Write/Think website (c/o Verizon Thinkfinity).   http://www.readwritethink.org/classroom-resources/student-interactives/

- Read/Write/Think Webbing Tool-- Allows you to create simple graphic organizers, easy to use-- http://interactives.mped.org/view_interactive.aspx?id=127&title

- Read/Write/Think Story Map Tool - Quickly create a visual of complex information, easy to use-- http://www.readwritethink.org/files/resources/interactives/storymap/

- Read/Write/Think Interactive Timeline—Create timelines, easy to use-- http://www.readwritethink.org/files/resources/interactives/timeline/index.html

- Gliffy--Create and share diagrams on the Web http://www.gliffy.com/

- Belvedere - Downloadable graphic organizer, designed for k-12 population, moderate to use. http://belvedere.sourceforge.net/

- Graphic Organizer Templates - 40 downloadable templates to use in a word processing program, quick, easy to use http://www.learnalberta.ca/content/ssass/html/graphicorganizers.html

- Great Source iWrite: Graphic Organizer Templates - click on "Writer's Tools" and then narrative, expository, persuasive, response to literature or research templates to use in a word processing program. Easy to use. http://www.greatsource.com/iwrite/students.html

- Eduplace- Provides many graphic organizers ready to download. http://www.eduplace.com/graphicorganizer/

- Edhelper- Offers simple graphic organizers for elementary. http://www.edhelper.com/teachers/graphic_organizers.htm

Graphic Organizers

- Free Mind - mind-mapping tool http://freemind.sourceforge.net/wiki/index.php/Main_Page

- Exploratree - thinking guides and more (definitely worth exploring)
  http://www.exploratree.org.uk/

- Recall Plus - Students can organize their notes, create flashcards, make use of 3D tools and more in this great mind mapping tool. It is downloadable. http://recallplus.com/index.php

- Best4C-(for upper grades) http://www.best4c.com/

- CMAP - concept maps   http://cmap.ihmc.us/

- Character Scrapbook- Analyze characters with this organizer from Scholastic
  http://teacher.scholastic.com/activities/scrapbook/

- Text2MindMap- Create a simple idea web by simply typing the ideas into an outline
  http://www.text2mindmap.com/

- CAST Science Writer- Helps students write a science lab report using chunking, prompting, and graphic organizers http://sciencewriter.cast.org/welcome

- Intel Visual Ranking Tool- Analyzing & prioritizing information.
  http://educate.intel.com/en/thinkingtools/Visualranking/

- Intel Cause and Effect Tool- Create diagrams or causal maps
  http://www97.intel.com/en/ThinkingTools/SeeingReason

- Intel Defending Arguments Tool- Analyzing & evaluating data.
  http://www97.intel.com/en/ThinkingTools/ShowingEvidence

Graphic Organizer Software for Purchase:

- Webspiration- Graphic organization good for visual thinker/learners, EASY to use, advanced feature, sharing capabilities, customizable, developed by creators of Inspiration/Kidspiration
  http://www.mywebspiration.com/

- Inspiration/Kidspiration—Premier graphic organizing software (Kidspiration is for younger students). Features many templates for various tasks (Language Arts, Social Studies, Science, etc.) http://www.inspiration.com ***Now also an iPad app.

SPEECH RECOGNITION/ VOICE TO TEXT TECHNOLOGY
("You speak to it; it types")

Speech recognition or voice-to-text technology would seem to be the ultimate assistive technology accommodation for students who have difficulty with the writing process. You speak—it transliterates what you say (or follows your voice commands) rapidly and accurately. A quick comparison: an adult with typical fine motor skills can handwrite perhaps 30-35 words per minute at a maximum. An average typist can type 50-80 words per minute. A person using voice-to-text technology can easily dictate 140-150 words or more per minute! Then why isn't this technology more widely used, especially for individuals who have difficulty with fine motor skills? In a word: **inaccuracy**!

Voice-to-text technology has improved dramatically over the years but still can be very glitchy, especially with young people's voices (and inconsistent speech articulation, etc.), and particularly in noisy environments. It requires a LOT of patience and perseverance, strong motivation to write (and edit), and very clear speech articulation. As a result, our Assistive Technology Team seldom recommends it, especially for elementary school students. The difficulty is that the software makes a "best guess" as to what you are saying and comes up with actual words, whether or not they make sense syntactically. For example, here is a recent trial of the Dragon Naturally Speaking computer software:

Target: When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow.
Dictation result: Rana some rinks drake's raindrops in the air, the act like a prison and form in Reno.

And here are a few recent samples using the iPad Dragon Dictation app:

A sixth grader:
Target: Limpy is a fuzzy, yellow, baby duck. He belongs to a fisherman. The fisherman lives in a little house by the bay. Every morning children go swimming in the bay.
Dictation result: What he is an fuzzy yellow baby duck she is mail on us to the fisherman is the Fisher at red's in a little house by the day of morning are early-morning children go swimming in the bag.

A third grader:
Target: Hi grandma I love you because you are the best and you are the best ever.
Dictation result: Hello hello I love you think Café bed bath along the camera and the.

Consider: How would a student even begin to edit or revise this?

THAT SAID...

Despite inherent glitches and inaccuracy with this technology, it MAY be advantageous for certain students (particularly students with significant fine motor challenges) to try using speech recognition/voice-to-text to help them with the writing process, at least for part of the time. Each student is unique and what works for one, may not work at all for another...

SPEECH RECOGNITION/ VOICE TO TEXT TECHNOLOGY
("You speak to it; it types")

There are several easy possibilities for accessing speech recognition/voice-to-text technology:
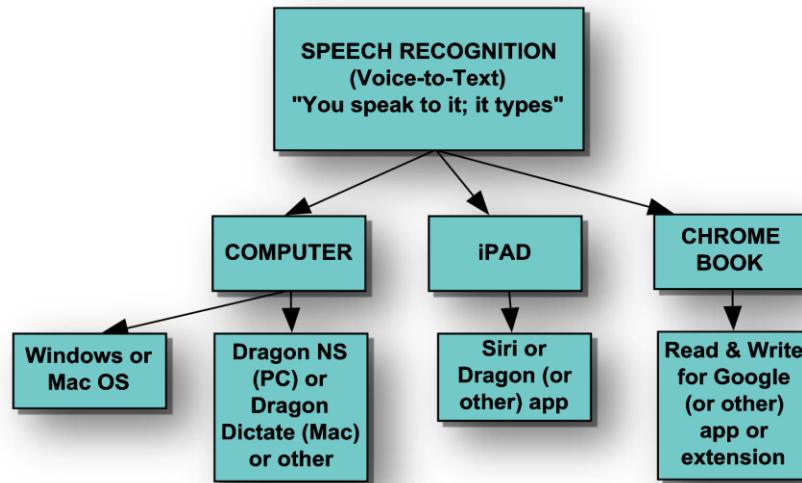
ON THE COMPUTER:

There are several choices for using speech recognition on a computer or laptop: the onboard Windows or Mac operating systems, third party software such as Dragon Naturally Speaking or Dragon Dictate, the Google Docs Voice Typing feature (**Tools> Voice Typing**), or various Google apps or extensions. The most recent Windows operating systems have a speech recognition feature that can be accessed via the following pathway: **Control Panel> Ease of Access> Speech Recognition.** This opens up a user-friendly wizard that leads you through the process of setting up the microphone properly (for greatest accuracy) and training the computer to recognize your speech patterns (by reading a series of short passages and voice commands aloud). On Macs, you can enable Dictation through System Preferences.

The other possibility for computer access is to purchase third-party software such as the latest version of Dragon Naturally Speaking or Dragon Dictate. Once this software is installed and opened, it leads the user through an "enrollment wizard"—the process of adjusting the microphone and dictating a series of passages to help the software achieve greatest accuracy.

Strategies using the computer are likely more appropriate for longer dictations: compositions, letters, class assignments, etc.

ON THE iPAD OR iPHONE:

Apple has the "Siri" speech recognition feature as part of the last several iOS upgrades. You can also use one of a handful of voice-to-text apps such as the free Dragon Dictation (download it from iTunes).

SPEECH RECOGNITION/ VOICE TO TEXT TECHNOLOGY
("You speak to it; it types")

Siri or the iPad or iPhone apps do not require any setting up or "enrollment" procedure. Instead, your digitized speech sample is sent over the Internet to a cloud-based company database where it is compared with many thousands of stored speech samples. This process requires a wireless connection, but it is relatively quick, and the app soon displays your text in the main window. It may not be 100% accurate, (depending on how you dictated, ambient room noise, etc.), but it may be surprisingly close.

Strategies using the iPad or iPhone are likely more appropriate for short dictations: emails, lists, brainstorming ideas, etc. or possibly, for a quick initial screening to determine a student's potential for using the speech recognition strategy successfully.

ON THE CHROMEBOOK:

The Chrome Browser has several apps or extensions that feature speech recognition including Read & Write for Google Premium (which has a number of other useful features as well), SpeechPad, and VoiceNoteII. The Voice Typing feature in Google Docs is also available (**Tools> Voice Typing**).

Some general tips for helping students access and use voice-to-text technology:

- Despite possible glitches in the technology, try to "assume success," and as much as possible, try to facilitate **errorless learning** (most-to-least prompting: start off with as much support as needed, then fade it) for the student in whatever way you can. Less frustration means more buy-in!

- **Speak naturally but clearly.** Practice speaking like a newscaster or radio announcer. Aim for consistent volume and speed. Aim to say full phrases rather than individual words. First, concentrate on getting your ideas out. Then, review your text and make changes as needed.

- **Do NOT have any more programs open than necessary on your computer!** Speech recognition requires significant computer processing power to function. Programs can and do crash, and you can lose valuable data...

- **A corollary:** arrange for some way of preserving the student's original ideas so that if (when?) glitches happen, the ideas are not lost.

- **If you are using a microphone, make sure to position it correctly.** Ideally, an inch away from the student's mouth and slightly to the side.

- **Synergy is powerful!** Voice-to-text technology can be used together with other strategies: **talking word processor** software/apps such as WYNN, Write:OutLoud, Balabolka, TTS, TextToSpeech, SpeakIt!, etc. or **word prediction** software/apps such as Co:Writer or Typ-O.

SPEECH RECOGNITION/ VOICE TO TEXT TECHNOLOGY
("You speak to it; it types")

- For students with unique speech articulation (or speech fluency) profiles, consider using the iPad app(s) first, but these students may achieve greater accuracy using voice-to-text software on the computer. This software can be at least partially customized to fit more unusual speech patterns, as long as these speech patterns are **consistent**.
- Remember: there is a range of different speaking tasks as well as a range of different writing tasks. What may not work with one task may work beautifully with another. The only way to know for sure is to **TRY IT**!
- If possible, arrange for the student to use the system in a **quiet environment**. Keep in mind that extraneous ambient noise will hamper the system's accuracy.
- **Mute the microphone when not talking to the computer** (Extraneous speech or noise will get transliterated into gibberish and need to be corrected).
- **Tackle dictation in shorter phrases,** rather than a "stream of consciousness" style: This approach allows students to check what is being typed as they go, making it easier to make corrections when necessary.
- **The following sequence may be useful:**
    1. Have the student think of the sentence s/he wants to dictate.
    2. Turn on the microphone.
    3. Dictate the sentence.
    4. Turn off the microphone.
    5. Check the sentence and decide whether any corrections are necessary.
    6. If the student is making corrections by voice, have him/her switch on the microphone, correct the text and then switch off the microphone.
    7. Go back to Step 1 for the next sentence.
- Whether you are using the iPad or the computer, encourage the student to correct mistakes after every sentence or two. It is important when using the voice-to-text computer software to correct errors from WITHIN the software itself (using the error-correction procedure) so that the software increases its accuracy over time.
- ****A FINAL CONSIDERATION: after the student has trialed the voice-to-text system, determine whether it is more or less desirable than a more "traditional" means of producing text such as hand writing and/or typing. (These other modes may be slower, but more accurate) You can ask the student for his/her opinion about whether it "works" or not... A question such as the following might be very revealing: "If you had to do a writing assignment for class, would you rather write it, type it, use word prediction, or dictate it into the iPad or computer?" Even students who do well with voice-to-text technology sometimes prefer to use traditional keyboarding...***

Text-To-Speech Resources

WYNN, **Kurzweil 3000**, and **Read and Write (Gold)** are expensive but have a lot of nice features (including a feature to easily enlarge the text, put a different color background behind it, read the highlighted text, etc.)

WYNN: www.freedomscientific.com/LSG/products/wynn.asp
Kurzweil 3000: www.kurzweiledu.com
TextHelp Read and Write (Gold): www.readwritegold.com

Microsoft built-in Text-to-Speech feature:
- Next to the Quick Access Toolbar, click the "Customize Quick Access Toolbar"
- Click "more commands"
- In the "choose commands from" list, select "all commands"
- Scroll down to the "speak" command, select it, and then click "add"
- Click "ok"
- When you want to use the text-to-speech command, click the icon on the "Quick Access Toolbar"

Consider the following **less expensive (or free)** possibilities:

Natural Reader: www.naturalreaders.com/
Text Aloud: www.nextup.com/download.html
Balabolka: www.cross-plus-a.com/balabolka.htm

A few **iDevice** options:

TextToSpeech
Speak it!
Voice Generator
Speak It To Me
TTS
Speak Bot
iSayIt

Suggested Typing Tutorials

Dance Mat	Web based-Free	http://www.bbc.co.uk/schools/typing/
Typing Web	Web based-Free	http://www.typingweb.com/typingtutor/
Free Typing Games	Web based-Free	http://www.freetypinggame.net/
Learn 2 Type	Web based-Free	http://www.learn2type.com/
KeyBlaze	Web based-Free	http://www.nchsoftware.com/typingtutor/index.html
Glencoe	Web based-Free	http://www.techconnect.glencoe.com/techconnect/keyboarding/start.htm
Power Typing	Web based-Free	http://www.powertyping.com/
Kiran's Typing Tutor	Web based-Free	http://www.kiranreddys.com/download/
TypeOnLine	Web based-Free	http://www.typeonline.co.uk/
Kid's Typing Skills	Web based-Free	http://www.kidwaresoftware.com/kidtype.htm
Tux Typing	Web based-Free	http://tux4kids.alioth.debian.org/tuxtyping.php
TypingTest.com	Web based-Free	www.typingtest.com
Roller Typing	CD--$$$	http://www.edven.com/rollertyping.html
Type To Learn 4 (Home version)	CD--$$$	http://www.amazon.com/
Read, Write and Type	CD-- $$$	http://www.amazon.com

FONT SAMPLES

This is a sample of the Arial Font (11 point size):
The quick brown fox jumped over the lazy dogs. 1234567890 THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS.

This is a sample of the Calibri Font (11 point size):
The quick brown fox jumped over the lazy dogs. 1234567890 THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS.

This is a sample of the Courier New Font (11 point size):
The quick brown fox jumped over the lazy dogs. 1234567890 THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS.

This is a sample of the Tahoma Font (11 point size):
The quick brown fox jumped over the lazy dogs. 1234567890 THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS.

This is a sample of the Dyslexie Font (11 point size):
The quick brown fox jumped over the lazy dogs. 1234567890 THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS.

This is a sample of the Open Dyslexic Font (11 point size):
The quick brown fox jumped over the lazy dogs. 1234567890 THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS.

This is a sample of the Open Dyslexic Bold Font (11 point size):
The quick brown fox jumped over the lazy dogs. 1234567890 THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS.

This is a sample of the Verdana Font (11 point size):
The quick brown fox jumped over the lazy dogs. 1234567890 THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS.

SPELLCHECKERS—A Discussion

- Below is a comparison for a number of spellcheck programs for both contextual test passages as well as a word list of words in isolation.

- Some observations—Microsoft Word (both 2007 and 2010 versions) is quite good for both words-in-isolation and words-in-context and it is likely the most appropriate strategy in most cases since it doesn't require any "special" software beyond what is on most computers. A program such as Write:OutLoud is excellent for words-in-isolation (it uses the Franklin Speller engine); however, it is not as good a choice for words-in-context. Ginger software requires an Internet connection and has the best rating for words-in-context, and since it is designed to be used with Microsoft Word (and other word processing programs), it has the best rating for words-in-isolation as well.
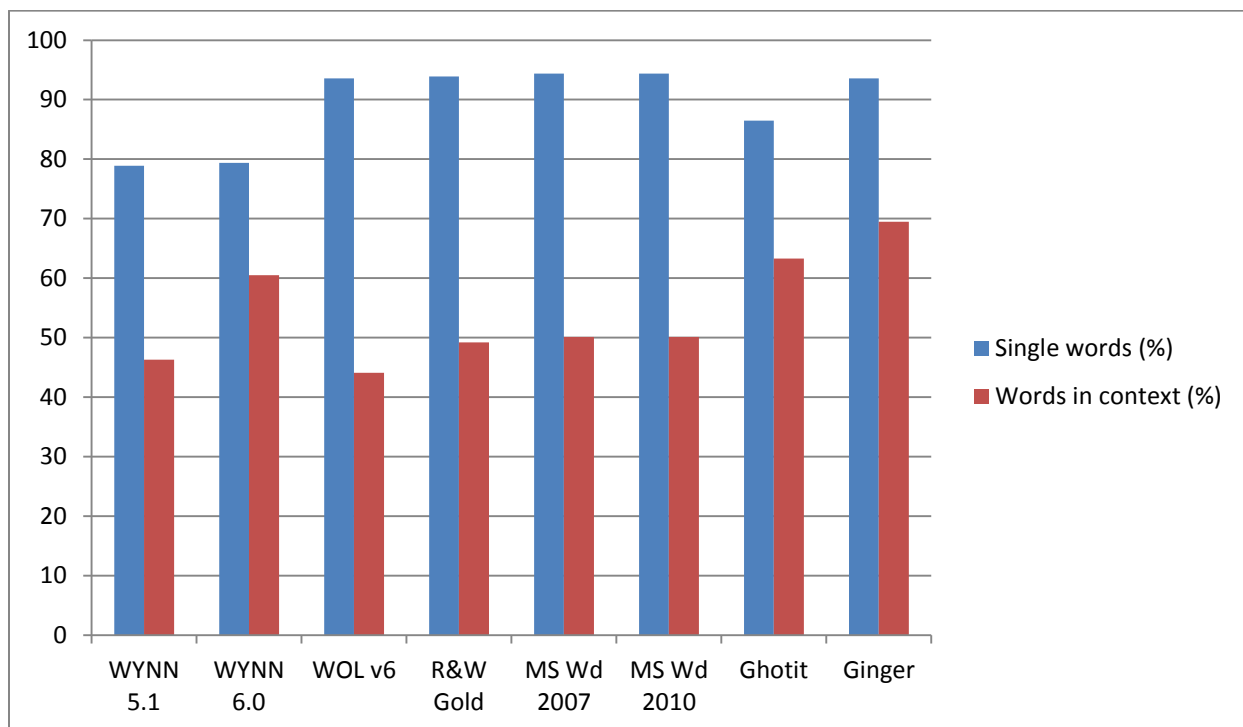
- The results above are good general "rules of thumb." Ideally we could "custom-test" a student's individual misspelling patterns (and we would be able to do the Writing Evaluation and run the student's actual misspelled words through various spellcheckers and see if the correct choices appear--and further: if the student is able to pick the right choice). A possible form to use for this purpose is included on the next page.

SPELLCHECK AND WORD PREDICTION COMPARISON

Student:

Misspelled Word	MS Word spellcheck		Google spellcheck		Ginger spellcheck		Read & Write for Google word prediction			Co:Writer word prediction			Other:		
	Correct choice?	*Able to ID?*	*Correct choice?*	*Able to ID?*	*Correct choice?*	*Able to ID?*	*Correct choice?*	*# of letters typed*	*Able to ID?*	*Correct choice?*	*# of letters typed*	*Able to ID?*	*Correct choice?*	*# of letters typed*	*Able to ID?*

IS A "READ BACK" FEATURE HELPFUL? ☐ Yes ☐ No **STUDENT PREFERENCE:** _____

SPELLCHECK AND WORD PREDICTION COMPARISON

COMMENTS AND OBSERVATIONS: