

Speech Recognition as AT for Writing

A Guide for K-12 Education

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Universally Available

Speech recognition used to be hard to get and not very good. Now anyone with a smartphone or tablet has access to it and it works quite well. Students can use it whenever they want!

But speech recognition is still an assistive writing feature for some students. Therefore, it could be considered as assistive technology for these students using a data-driven assessment process. The requirements of high-stakes testing may require this in order to provide it as a testing accommodation.

It's important to note, however, that speech recognition is usually NOT the only writing strategy in a student's toolbelt. Consider it along with other tools that match specific writing tasks and environments.

For example:

Writing Task	Contextual Factors	Tool-belt of Strategies*
note-taking in class	can't talk out loud during a lecture	- pencil and paper - copies of teacher notes - audio recording
one word answers on a worksheet (e.g. fill-in-the-blank)	usually needs to be done in class	- pencil and paper - scanned worksheet and typing
sentence answers on a test	must be done in class or in a separate location at school	- typing - typing with word prediction - speech recognition - human scribe
sentence answers on assignment (e.g. vocab sentences)	can be done in class or at home	- typing - typing with word prediction - speech recognition - human scribe
essay writing - one paragraph or more	can be done in class, separate location, or home	- typing - typing with word prediction - speech recognition - human scribe
science lab report, social studies report	can be done in class, separate location, or home	- typing - typing with word prediction - speech recognition - human scribe

See Assess It! section for more on data collection.

* See Ira Socol's Toolbelt Theory for more on this perspective.

<http://speedchange.blogspot.com/2011/01/toolbelt-theory-test-and-rti.html>

How this guide is organized

This guide follows a simple process

1. Consider It!

2. Try It!

3. Assess It!

4. Implement It!

Consider It!

To consider speech recognition as assistive technology, it helps to use a process. Here, the variables of the SETT Framework (Zabala, 1995) are used to create a task-specific consideration process (see Socol's Toolbelt Theory):

1. Consider the TASK: Are the writing demands are significant? Expectations vary from region to region, but most standards currently DO require a lot of writing, even in the younger grades.
2. Consider the ENVIRONMENT: Would use of speech recognition match the environment?
 - a. Yes, when talking out loud would not be disruptive. The assignment may need to be finished at home or in a quiet location at school (the back of the classroom actually works fine for some students).
 - b. Yes, when environmental noise does not affect recognition accuracy. A noise canceling microphone can filter talking but a lot of surrounding noise would make recognition worse.
3. Consider the STUDENT'S SKILLS: Is there a gap between the student's current writing skills and the curricular expectations? Can the student learn the skills needed to functionally use speech recognition?

Generally, speech recognition works well for students who can express thoughts and ideas better verbally than in writing. It has a good chance of working if the student can learn or already has the following skills:

- a. Consistency of enunciation, volume & pitch
- b. Syntactical speech patterns
- c. Ability to inhibit "uhms" and "ahhs"
- d. Ability to express ideas in verbal language
- e. Attention to auditory and visual details
- f. Ability to multitask
- g. Ability to edit
- h. Ability to problem-solve
- i. Ability to self-monitor
- j. Ability to tolerate frustration
- k. Motivation to use technology as an alternative writing method

So how do you know if speech recognition will work? The only way to know is to **try it!**

You could consider speech recognition when it seems to match:

1. The writing demands
2. The environment
3. The student's skills

Remember: A student can be taught these skills. Just because they don't have them now doesn't mean speech recognition shouldn't be considered.

Try It!

The key to trying speech recognition with students is to TEACH them the process. Yes, the goal of the test-drive is to determine whether or not speech recognition will work as an assistive technology. But you have to teach students the speech recognition writing process first. Don't worry, you'll collect plenty of data along the way.

Before you begin...

Before you begin..

- Plan individual sessions
- Invite others to attend the sessions
- Decide which technology to try
- Set up the technology
- Understand the speech recognition writing process

Plan to work with the student individually.

This is not a tool that is easily taught to a whole group at once so plan on individual sessions with the student.

The total number of sessions depends on a combination of the student's current skill set and the writing demands of the curriculum. Plan on at least two sessions. Some students will need more.

Scheduling options depend on the student and situation:

- Schedule multiple days in the same week
 - If you need to make a decision quickly,
 - If you know the student will need intensive support, or
 - If the immediate writing demands are high (e.g. the student has a lot of writing assignments to complete).
- Schedule sessions across several weeks
 - If the student shouldn't be pulled out of classes repeatedly,
 - If you expect the student to learn the process quickly,
 - If the immediate writing demands are low, or
 - If you can give the student some "homework" in between sessions.

Invite others to attend the sessions.

The student may need lots of support for on-going training and implementation. Invite a parent, a teacher, an occupational therapist, a paraprofessional or anyone else who can regularly support the student. This not only helps with follow through, it also is a great way to increase the student's comfort level.

Try It!

Decide which technology to try first. There are pros and cons to the different speech recognition tools available.

Smartphone/Tablet		
Pros		Cons
No external microphone needed		Recognition can be less accurate
No voice profile training		Requires a data plan or WIFI connection
Portable to multiple environments		Difficult to print directly from device
Works with a variety of note-taking apps		Have to teach student to flip between apps
Cool factor, everyday technology		
Student can use own device if BYOD		

Try mobile technology first because it's easier to implement.

Laptop/Desktop		
Pros		Cons
More accurate recognition		Sometimes requires voice profile setup
Can dictate into familiar word processing software (e.g. MS Word or Google Docs)		Sometimes requires use of external microphone
Bigger screen for editing errors		Not as functional in some environments
Text to speech available to assist		Looks different
More voice commands available		

Try laptop or desktop software because it may be more accurate and make editing easier.

Try It!

See Appendix A for a detailed guide to setting up a voice profile with Dragon NaturallySpeaking®.

Setup the technology

Install the mobile app or laptop/desktop software before you meet with the student. Mobile technology doesn't require much setup at all. Just teach the student how to use the app. Full featured software, such as Dragon NaturallySpeaking® on a laptop/desktop, sometimes requires the creation of a voice profile before you can use it, although in newer versions this is not always true.

Understand the speech recognition writing process

Writing with speech recognition software is different from handwriting or typing and requires the integration of a different set of skills. You must *explicitly teach* this process to students.

Here is a task analysis of the speech recognition writing process.

1. THINK about your topic and what you want to write.
2. Mentally compose your sentence.
 - a. You may need to talk it through (silently or out loud) to get it to sound right.
 - b. Decide which punctuation is needed at the end and whether any punctuation is needed in the middle (e.g. commas, quotation marks).
 - c. Hold the sentence (or part of it) in memory.
3. Turn on the microphone
4. SAY your sentence with clear enunciation but in a natural manner (not too slow or too fast). Verbally add the correct punctuation at the end.
5. Turn off the microphone.
6. CHECK the recognition accuracy. Students with weak decoding skills should use text-to-speech software to assist the editing process. In Dragon NS, you can also use the "play that" command to compare the transcription to an actual recording of what you said.
7. FIX the recognition errors manually or verbally.
8. Repeat the process for the next sentence.

Tip: Use this short version to teach the process to students:

1. Think It
2. Say It
3. Check It
4. Fix It

This process requires integration of many underlying skill sets:

1. Language
2. Generation of ideas
3. Short-term memory
4. Oral articulation
5. Fine motor
6. Decoding
7. Editing & revising
8. Computer operation

Try It!

A Scaffolded Approach to Teaching the Speech Recognition Writing Process

Teach the process by removing some of the complexity at first and then slowly adding it back in.

One metaphor for this approach is a **scaffold**. How much scaffolding is needed and how much time it will take before you can remove the scaffolding depends on the student's pre-existing skills and her ability to learn new skills. Another metaphor is **cognitive load**. Academic writing is a task with a high cognitive load. Reduce the cognitive load by starting with writing tasks that are easier.

Consider interviewing the student at the start of the first session. This often helps their comfort level as well as helps to gain information about them and their interests.

1. Model the speech recognition writing process.

- a. Use a "think aloud" strategy to explain the process of choosing a topic and mentally composing a topic sentence.
- b. Dictate the sentence and demonstrate operational skills.
 - i. Turn on the microphone.
 - ii. Dictate clearly and dictate punctuation.
 - iii. Turn off the microphone.
 - iv. Model the review/edit process. Read the written sentence out loud (or demonstrate text-to-speech feature) to model how to carefully check recognition accuracy.
- c. Demonstrate how to correct recognition errors. If there are none, demonstrate how to change a word (e.g. change "blue" to "green"). Demonstrate text-to-speech for audio support during the editing process.
- d. Model saving and sharing/printing the document.

2. Give the student a sentence to write.

- a. Use a personalized fill-in-the-blank sentence. For example, "I live in a [blue] house on a [quiet] street."
 - i. Ask the student what color house they live in and whether the street they live on is noisy or quiet. This will help them to understand that composing sentences involves making

Scaffolded Steps

1. Model
2. Give a sentence
3. Enunciation
4. Personal topic
5. Editing process
6. Punctuation
7. Voice commands
8. Writing practice
9. Academic writing
10. Homework

Try It!

word choices. You are also starting with a personal topic, which is easier to write about.

- ii. Say the sentence to the student with their choices: e.g. "I live in a tan house on a noisy street." or "I live in a brick apartment on a quiet street."
 - iii. Ask the student to orally repeat the sentence. Watch for student's ability to remember the whole sentence. If they struggle to remember the whole sentence, break it into phrases (e.g. first half, second half).
 - iv. Ask student to dictate the sentence (or first phrase) into microphone. You may have to remind them how to turn it on.
- b. Avoid letting the student read sentences from a book.
- i. This strategy has some merit because it does provide pre-made sentences while the student focuses on learning to operate the software.
 - ii. HOWEVER, it may not model the writing process effectively.
 1. If the student has difficulty decoding, reading from a book will lead to unnatural, non-fluent speech. The software is designed to work best with fluent speech.
 2. The student would have to switch visual focus from the book to the screen to check each sentence. The tendency, then, will be to dictate multiple sentences in a row, which makes correcting recognition errors more difficult.
 3. Reading from a book by-passes the memory component of mentally formulating sentences. While this might be helpful for some students, you won't get the data you need to determine whether the student has the skills needed to use speech recognition for composing.
 - iii. There are always exceptions to the rule. Reading sentences might be the right strategy in some cases. But try to move toward mentally composed sentences as soon as possible.
- c. If the student is distracted by seeing words appear on the screen, try having the student look away from the computer screen while they dictate.

3. Work on enunciation to improve accuracy.

- a. Read the transcribed sentence with the student to look for recognition errors (or demonstrate how to use text-to-speech

Try It!

- to listen to sentence).
- b. If there are recognition errors, do not fix them yet. Start a new line and ask the student to dictate the same sentence again below the first.
 - i. Prompt them to speak more slowly (but without dragging) and more clearly.
 - ii. Model fluent and naturally clear enunciation.
 - c. Compare the two sentences. If there are still recognition errors, start another line and ask the student to dictate the same sentence a third time. Coach enunciation and fluency.
 - d. Compare the three sentences. If one is more accurate, ask the student why.
 - i. Help them understand that the way they enunciate directly affects recognition accuracy.
 - ii. If using Dragon NaturallySpeaking® on a computer, have the student listen back to the audio recording of their dictation (Play That) and ask them to notice how they are enunciating the sentence.
 - e. If recognition accuracy does not improve, give the student another sentence to say with easier words. Repeat the comparison process.
 - f. If the student is not able to achieve at least 80% recognition accuracy, do not keep drilling.
 - i. Adjust the microphone position.
 1. With mobile devices, make sure that the microphone is not covered by the protective case and that the student is not holding the device too far away.
 2. With headset microphones, make sure the microphone is about an inch from the mouth and that the receiver is facing the mouth.
 - ii. (Dragon NS on computer: Run the microphone setup again.)
 - iii. Consider the quality of the student's dictation.
 1. Speech recognition works best when speech articulation is within typical limits because speech engines are based on average speakers, especially mobile speech recognition technology that does not use a custom voice profile.
 - a. If you started with a mobile device, you may need to switch to computer software that includes script training.

Try It!

- b. If you are already using a custom voice profile, consider doing more training or starting over to create a new voice profile.
- 2. Consider how the student's body posture is affecting their breath control. Adjust seating and positioning as needed.
- 3. If the student has atypical articulation, speech recognition software might still work if the student is willing to do extra script training and can produce phonemes in a consistent manner. Balance the need to do extra work with the need to use speech recognition.
- g. Current speech recognition software is designed to work best with continuous dictation. It uses the context of the whole phrase or sentence to correctly transcribe individual words (e.g. *there* vs. *they're*). However, in some cases discrete dictation (word by word) is necessary to achieve accuracy. With younger students, discrete dictation can be a teaching tool that eventually leads back to continuous dictation.
- h. Don't get stuck at this stage. You can continue working on enunciation as you move on.

4. Compose sentences on a personal topic.

- a. Interview the student about their pets or after-school interests. Draw out details.
- b. Ask the student to compose sentences about their pet, family, or personal interests (e.g. video games).
 - i. Steer the student away from using proper names, which will cause recognition difficulties.
 - ii. Ask the student to practice saying their sentence before turning on the mic so you can steer them away from simply making lists. If their sentence is very short (e.g. "I have a dog."), encourage them to expand it a little (e.g. what color dog?). You are informally assessing their language skills and ability to orally compose written sentences as you do this.
 - iii. The student should dictate one sentence at a time, checking each one for accuracy and fixing errors as needed.
 - iv. As the student becomes comfortable with the process, they may not want to practice their sentence out loud. Allow them to compose silently but then, if they stumble a lot, point out how this negatively affects recognition accuracy.

Try It!

5. Teach the editing process in context.

- a. Coach the student to carefully check the transcribed sentence for recognition accuracy or use a text-to-speech feature to listen for recognition errors.
 - i. Proof-reading is a difficult skill, even if you have good decoding skills. Teach the student how to do it. The student may need to point to each word.
 - ii. Using text-to-speech software for proof-reading is also difficult. Teach the student how to do it effectively. Make sure the speech rate is slow. The text-to-speech feature built into Dragon NaturallySpeaking® doesn't highlight each word. You may need to use another text-to-speech tool that does if the student really struggles with decoding.
- b. Demonstrate both verbal and manual correction strategies.
 - i. If using Dragon NaturallySpeaking® on a computer, introduce the voice commands needed to make corrections ('select xyz' and 'choose...'). You will have to help student choose the correct words from the list, especially if they have trouble decoding (there is no text-to-speech option for these).
 - ii. Model manual correction (using the keyboard) for punctuation and small words that the student knows how to spell.
- c. Continue the coaching the correction process.
 - i. Verbally supply the necessary commands in the context of correcting real errors until the student is able to recall them on her own.
 - ii. Help the student balance composition and editing. If there are too many recognition errors and the editing process takes the focus away from composition, correct some of the errors yourself to keep the learning process moving.
 - iii. If a sentence has too many errors, it may be better to start over. Coach the student to dictate the sentence more clearly and more fluently. If the second dictation greatly improves accuracy, point this out to the student. Re-doing the whole sentence is an editing strategy.
 - iv. However, if the student wants to re-do the whole sentence each time there is an error, you need to intervene. Remind them that they need to think about what to say before turning on the microphone. A complete re-do should be

Tip: Use accessibility features to provide text-to-speech support on mobile devices.

Try It!

reserved for occasional enunciation flubs or when the student really wants to change the construction of the sentence. Otherwise, they should try to edit single words. (The exception is students with very weak decoding skills.)

6. Train punctuation in context

- a. All students will need to practice dictating punctuation unless they have had prior experience doing this with a scribe. They probably won't know how to do this naturally. Remember that young students are developmentally still learning the conventions of writing, so may not know how to use some punctuation yet.
 - i. Model the use of punctuation. If the student wants to list a few items, model how to dictate commas. If the student wants to use quotation marks, model the use of "open quote/close quote" command. Ignore punctuation the student isn't ready for developmentally.
 - ii. Use *non-verbal* prompts if the student continues to need reminders or if the student responds better to non-verbal prompts.
 1. Create a small punctuation chart that you can point to.
 2. Agree with the student on a gesture prompt (e.g. punch index finger as if typing a period)
- b. Allow student to add ending (or other) punctuation with the keyboard during the review/editing process. Some students have trouble remembering to dictate punctuation but can independently add it when visually reviewing the sentence.

7. Teach a limited number of voice commands in context.

- a. NOTE: This section applies mostly to laptop/desktop software. Mobile software doesn't typically respond to voice commands other than punctuation marks.
- b. Unless the student needs to use a lot of voice commands (e.g. as a substitute for mouse or touchscreen control), the number of voice commands needed for writing is pretty small.
- c. Teach necessary voice commands in context when they are naturally needed (e.g. correction commands during the review/edit process).
- d. Redirect students who want to learn extra voice commands. Some students are easily distracted by voice commands, especially in Dragon NaturallySpeaking®, which has a lot of

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them. Remind students that they can still use the keyboard for formatting (e.g. adding bold or underlining). Redirect students to the primary task, which is the composition of a rough draft.

8. Provide additional writing practice while slowly increasing the cognitive load.

- a. Provide motivating pictures to write about.
 - i. Find some interesting picture prompts. They might connect to the student's personal interests or connect to an academic topic they've been studying.
 - ii. Ask the student to discuss the details of the picture and determine a topic sentence.
- b. Use vocabulary words to practice single sentences.
 - i. Find a list of generic grade-level vocabulary words or ask the student's teacher for a list of current vocabulary words.
 - ii. Give the student a word from the list that they know and ask them to create a sentence with it. This is just like the task of creating sentences from spelling words, except that you want to use words that match the student's speaking vocabulary rather than their spelling abilities (if their spelling is weak).
 - iii. Coach the student to extend their sentences if they tend to dictate short ones.
- c. Work on organizing ideas prior to writing.
 - i. Pick a non-academic topic to write about. Tip: Ask the student what they think about speech recognition (e.g. the pros/cons and uses for school).
 - ii. Model organization by scribing the student's ideas onto an organizer.
 - This is a good opportunity to model the use of various graphic organizer or software for organization.
 - Model the use of keywords on the graphic organizer rather than writing out full sentences so that speech recognition is still used to create the rough draft.
 - i. Coach the student to turn the key words from the organizer into a paragraph using speech recognition.
- d. Pick an easy informational topic to write about.
 - i. Ask the student to identify an area of interest that is informational rather than personal (e.g. whales).
 - ii. Help the student complete a writing organizer.

Increasing the Load

- a. Write about pictures.
- b. Use vocabulary words to create single sentences.
- c. Work on organizing ideas prior to writing.
- d. Pick an easy informational topic.

Try It!

- iii. Coach the student through the process of turning key words from the map into full sentences using speech recognition.

9. Ask the student to complete an academic writing assignment using speech recognition. You will probably use this to collect post assessment data.

- a. Ask the teacher to provide an academic writing assignment the student actually needs to do (preferred option) or create a grade-appropriate academic writing assignment.
- b. Ask the teacher to have the student complete a graphic organizer using only keywords in class before your session. If this is not possible or desirable (e.g. you may want to monitor this process individually), spend time creating a graphic organizer with the student.
- c. Coach the student through the process of turning keywords from graphic organizer into complete sentences. Do not coach this process if you want to assess independent skills.
- d. Coach the student to use transition words, use larger vocabulary words, and write longer sentences. Do not coach if you want to assess independent skills.

10. Provide a homework assignment.

- a. If the training sessions are spaced several days apart and the student will have speech recognition technology available in between the sessions, assign some homework for practice.
- b. Ask the student to complete a writing assignment on their own and then talk about it at the next session.
 - i. Give an assignment at the level they can complete independently. They may not be ready to use it for academic work yet.
 - ii. Have someone support the student with their homework assignment. Ideally, this would be the support person who attends the training sessions with the student. This gives them an opportunity to support the student without your help.

Assess It!

Even though you must teach the speech recognition writing process in order to introduce it to the student, the overall goal of the sessions is to determine whether speech recognition will be recommended for long-term implementation with progress monitoring.

Do this by comparing the student's current writing performance with the data collected during the test-drive sessions (pre/post data design). The student should be invited to be part of this data collection process so they can help determine for themselves whether or not speech recognition is a tool they want to use for school. Data can be captured through observation and from simple measurement tools.

1. Collect baseline data (pre-test). Ideally, the student's current teacher or case manager has this information for review. If not, you may need to do some additional data collection using simple measurement tools and by interviewing the student.

- a. What is the student's current writing method?
 - i. Pencil/pen and paper
 - ii. Keyboarding
 - iii. Word prediction
 - iv. Scribing
- b. What is the student's current productivity in writing?
 - i. Use Written Productivity Profile (DeCoste, 2004) to compare handwriting to typing speeds using short probes.
 - ii. Collect student's CBM writing scores? (if applicable)
 - iii. Does the student complete academic writing assignments within the given time expectations?
- c. What is the student's current level of writing conventions?
 - i. Spelling
 - ii. Capitalization
 - iii. Punctuation
- d. What is the student's current pre-writing process?
 - i. What pre-writing process is being taught in the classroom?
 - ii. What graphic organizers are used to support the pre-writing process?
 - iii. How easily can the student generate ideas?
 - iv. Can the student distinguish between main ideas and supporting details?
 - v. Can the student organize ideas and details logically?

Baseline Data

1. Current method
2. Productivity
3. Conventions
4. Pre-writing
5. Quality

Assess It!

Test-Drive Data

1. Tech interest
2. Verbal skills
3. Accuracy
4. Independence
5. Productivity
6. Quality

- e. What is the student's current level of final product? Use a writing rubric to score a variety of traits. For example:
 - i. Focus
 - ii. Organization
 - iii. Flow
 - iv. Voice
- f. What is the quality of the student's current final product?
 - i. What grades do they receive?
 - ii. What scores do they receive when the teacher uses a writing rubric to judge the various content elements?

2. Collect test-drive data (post-test). Use the following questions to guide your data collection. See Appendix B for sample data charts. This data will be collected multiple times as the student learns the speech recognition process and multiple types of data can be collected from the same writing practice activity.

- a. To what degree is the student interested in using technology to do school work?
 - i. How do they rate their general interest in and use of technology?
 - ii. What is their prior knowledge or experience with speech recognition?
 - iii. How willing are they to learn a new tool? How willing are they to use technology in the social context of school? (e.g. would they use technology that peers don't have?)
 - iv. How do they like speech recognition? Ask this after they have had some experience with it. Ask it at the end of each session.
- b. What are the student's verbal skills?
 - i. How well can they recall a given sentence?
 - ii. How well can they create a sentence from a keyword?
 - iii. What is the quality of their verbal sentences?
 1. Length of sentence.
 2. Level of vocabulary used.
 3. Complexity of syntax.
 - iv. How easily can they learn to verbally add punctuation?
- c. How accurate is speech recognition for this student?
 - i. How accurate are the first few sentences?
 - ii. How much does the student learn to increase accuracy through better diction habits? (enunciation, pace)

Assess It!

- iii. What is the percentage of recognition accuracy? Adapt CBM probes to calculate percentage.
 - 1. Give a prompt and a time frame (e.g. 3 minutes).
 - 2. Include editing process in the time frame.
 - 3. Calculate percentage from correct words/total words.
 - 4. Compare different speech recognition devices if desired (e.g. mobile SR vs. computer SR)
- d. How independent is speech recognition for this student?
 - i. How quickly does the student learn and remember the procedures and commands? Use a checklist.
 - ii. How well can the student detect and then edit recognition errors on their own?
 - iii. How well can the student problem-solve unexpected glitches on their own? (e.g. accidentally erasing everything with a voice command, microphone not working)
 - iv. How well can the student use speech recognition to write on their own? If you assign a writing task and then walk away for a while, can they stay focused enough to finish it?
- e. How productive is speech recognition for this student?
 - i. Extend the Written Productivity Profile (Decoste, 2004) to include the use of speech recognition as a writing method.
 - 1. If student uses word prediction to increase spelling accuracy, add a probe for word prediction.
 - 2. Add a probe for speech recognition and include editing in the time limit.
- f. What is the quality of the final product using speech recognition?
 - i. Have the student use speech recognition to complete an academic assignment without significant assistance and then ask their teacher to score it using the regular classroom writing rubric. How does this score compare to the baseline score?
 - ii. Use Readability Level in MS Word to get a quick, rough estimate of writing quality (sentence length, word length). How does this score compare to a baseline score using only the keyboard (no speech recognition)?

See Appendix B for sample data collection charts.

Implement It!

1. Create an implementation plan.

- a. List all types of writing assignments the student will be expected to do and document which writing tool the student will use for each writing task. Match tools and strategies to task and environment.
 - i. Speech recognition for longer writing assignments.
 - ii. Word processor paired with another tool (i.e. word prediction) for shorter writing assignments or when speech recognition is not appropriate.
 - iii. Paper-based assignments the student can do by hand or when speech recognition is not appropriate.
 - iv. A human scribe may still be needed for some situations.
- b. Document the speech recognition tool(s) the student is using with specific brand names.
- c. Document the specific locations where speech recognition can be used.
 - i. At home on a family-owned (or school-owned) computer or mobile device.
 - ii. Specific locations and devices at school such as:
 1. A desktop in classroom or resource room.
 2. A laptop in location that won't disturb others and where student can concentrate.
 3. Mobile devices can be used in a variety of locations that won't disturb others and where student can concentrate.
- d. Document who will provide ongoing support and who the student should contact if something goes wrong.
- e. Document the training and support needed to make sure the student can independently use the tool(s) and can self-advocate when needed.
- f. Follow up on a regular basis.
 - i. Discuss the plan at team meetings.
 - ii. Collect more data as the student and grade-level expectations change.
 - iii. Make changes based on data as needed.

2. Build in practice time.

- a. Use frequent, simple writing assignments such as a daily journal or story writing.
- b. Use short, motivating writing activities such as:
 - i. Answering personal interest questions in full sentences.

Implement It!

- iv. Writing an email or letter.
- v. Writing text messages (SMS) to friends (if appropriate).
- vi. Writing a social media post (if appropriate).

3. Integrate speech recognition with the writing process.

- a. The pre-writing steps are essential because the speech recognition writing process relies on fluent dictation of phrases and sentences. The student needs to know what they want to write before they get out the technology.
 - i. Try a variety of graphic organizers.
 - ii. Emphasize the use of 1 or 2 keywords while organizing ideas rather than writing phrases or full sentences.
 - iii. If the student uses scribing as an accommodation (dictation to a human), use this strategy as an opportunity to practice the skills need for speech recognition.
- b. Accommodate the classroom writing process.
 - i. While other students are using traditional tools to write rough drafts, let the student use class time to work on their organizer so they can use speech recognition later on at home or in another location that won't disturb other students.
 - ii. Let the student move to a different location to use speech recognition during class time.

4. Provide on-going implementation support.

- a. Set up additional training/practice sessions if needed.
- b. Create a support group of speech recognition users. Share tips with one another, ask and answer questions.
- c. Create a parent group of speech recognition users. Meet 1-2 times throughout the year to ask questions and share ideas.
- d. Make resource guides and videos available (websites, etc).
- e. Email speech recognition tips to support people and parents on a regular basis.
- f. Create and use designated people in your building that can guide staff and students to answers and resources when needed (AT Point People).
- g. Create a contract with the student to encourage appropriate use, clarify what tool to use when, and who to ask for help when needed.

Writing Steps

1. Brainstorm
2. Organize
3. Rough draft
4. Edit/Revise
5. Final Draft

Appendix A: Dragon Setup

Initial voice profile setup for Dragon NaturallySpeaking®.

You don't need this step if you are trying out mobile technology.

a. Teach microphone skills

- i. Explain the noise cancelling microphone to the student.
- ii. Teach proper positioning of the microphone.
 1. Secure placement of microphone headset. You don't want it to slide off the head because that changes the mic positioning. Attach it to a baseball cap if the headband is too big for the student's head.
 2. Teach positioning of the microphone. When a foam wind screen is covering the mic, teach student the "pinch test" to properly orient the two-sided mic. Only one side is correct and it needs to face the student's mouth. Teach the "thumb test" to position the mic about a thumb's width away from the mouth. Use a mirror to show the student what it looks like.

b. Create the user profile. Add the student's name and choose the appropriate English accent. "Standard" or "Teen" are often the best options.

c. Do the microphone setup. In older versions, there are two steps.. In version 13, there is only one step.

- i. Students do not have to read the provided script! Ask them to recite the days of the week continuously (or anything else) until they hear the beep (about 30 seconds).
- ii. If the test fails, reposition the microphone and run the test(s) again.

d. Choose a training script to maximize decoding accuracy. Older versions offer this step during setup. Version 13 does not but you can choose this option later. A variety of scripts are offered but "Stories for Children" is the only script with a lower reading level. It's usually further down the list.

e. Choose a reading strategy to facilitate the process.

- i. Fluent readers can usually read the script cold. If they make

Technical Tips for Dragon NaturallySpeaking®

1. Dragon will adjust the number of available features based on the amount of RAM and processing speed available.
2. You can increase recognition accuracy by manually limiting recognition. Put Dragon in Dictation Mode.
3. Use Dragon Pad instead of MS Word if Dragon runs slowly. Dragon Pad a light-weight word processor with minimal features. Also helps students stay focused on writing vs formatting.

Appendix A: Dragon Setup

a significant decoding mistake, you can always hit the redo button.

- ii. Non-fluent readers who struggle with decoding can be assisted with the following strategies:
 1. Cold read / hot read strategy: Pause the microphone at each page to let the student practice reading the text first (*cold read*). Turn on the microphone when they are ready (*hot read*). This works for students who only struggle with big words, who tend to skip little words, or who just need practice before they can read the text naturally (it should sound like speaking, not hesitant reading).
 2. Echo strategy: With the microphone on, read short phrases of the text to the student and have them echo each phrase. This works for students who struggle to decode most of the words but who have good auditory processing.
 3. Combination strategy: Pause the microphone, have the student practice decoding the easier parts of the text and verbally provide the correct words for them to echo when they hesitate too long. Turn on the microphone for the hot read but continue providing verbal support when they hesitate. This works for some students whose weak auditory processing makes it difficult to echo more than a word or two at a time.
 4. Pre-teach the script: If the above strategies do not enable the student to read with sufficient accuracy, print out the desired script and pre-teach the story away from the computer. It takes some technical know-how but in version 12, the scripts can be found here:
C:\ProgramData\Nuance\NaturallySpeaking12\Data\Training\enx\Data33.bin. Open with them with Notepad.

To see a video of the echo strategy, go to vimeo.com/92157317

Search the Internet for more technical tips on Dragon Naturally Speaking.

Appendix B: Data Collection

1. Student Self-Assessment: Use interview questions or Likert scale. A nice graphic is included in the Protocol for Accommodations in Reading (DeCoste, 2012; available from www.donjohnston.com).

I love it	I like it	I'm not sure	I don't like it
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2. Assess Productivity: Extend the Written Productivity Profile probes (DeCoste, 2004; available from www.donjohnston.com).

WPP Modes	Handwriting	Typing	Typing + Word Prediction	Speech Recognition
Copying	wpm	wpm		
Dictated	wpm	wpm	wpm	
Independent	wpm	wpm	wpm	wpm

3. Assess Verbal Skills: Use observation and a scoring rubric.

Goal	0 points	1 point	2 points	3 points
Turn 1-2 key words from planner into full sentences using speech recognition.	Student cannot dictate a complete sentence related to the key words.	Student dictates a short, complete sentence from key words. May contain 1-2 syntax errors. May need to prompt for punctuation.	Student dictates a medium length, complete sentence. No syntax errors and correct punctuation without prompts.	Student dictates a medium to long complete sentence using higher level vocabulary and/or complex sentence structure with no errors.

4. Assess Recognition Accuracy: Adapt CBM written expression scoring techniques. A variety of manuals are available on the Internet. To make the speech recognition score more realistic, tell the student to correct recognition errors within the 3 minute time limit.

CBM Scoring Technique	Handwriting	Typing	Speech Recognition
Correct Spelling	% correct in 3 minutes	% correct in 3 minutes	% correct in 3 minutes
Correct Word Sequences	CWS in 3 minutes	CWS in 3 minutes	CWS in 3 minutes

Appendix B: Data Collection

5 Assess Independence: Use a procedural checklist. This example is for Dragon NaturallySpeaking® on a computer. Create your own for other speech recognition technology.

Steps	Completed with Prompts	Completed Independently
1. Plug in microphone		
2. Launch Dragon		
3. Choose voice profile		
4. Adjust microphone		
5. Open DragonPad or Word		
6. Turn on mic		
7. "Go to sleep" to pause		
8. Verbally or mentally rehearse sentence before turning on mic		
9. "Wake up" to dictate		
10. Dictate clearly		
11. Use typical commands while dictating (e.g. "scratch that", "new paragraph")		
12. Check for recognition errors visually or using text to speech ("read that")		
13. Correct recognition errors using keyboard or verbal commands		
14. Resume dictation with cursor in correct location		

6. Assess Final Product (content quality): Use classroom, district or state standards writing rubric to compare writing samples done without and with speech recognition (pre/post). Have teacher grade work using classroom writing rubric so expectations are consistent.

You might also use Readability statistics in MS Word as a quick gauge of quality (sentence length, vocabulary).

Appendix C: A brief list of apps

A brief list of apps for smartphones & tablets

iOS devices

- Built-in on the keyboard (newer devices)
- Dragon Dictate app (free) on iPods or iPads
- Paperport Notes app (free) on iPads only

Android devices

- Built-in on the keyboard (depends on version)
- Swype Keyboard app (paid)

A brief list of software for laptops & desktops

Windows

- Built in (Control Panel)
- Dragon Naturally Speaking
- WordQ/SpeakQ

Mac OS

- Built-in (System Preferences)
- Dragon Dictate

Chrome OS

- Dictanote
- Voicenote
- Dictation.io

About the authors



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