Speech Recognition as AT for Writing

A Guide for K-12 Education

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Contents

Universally Available

Speech recognition (SR) used to be hard to get and not very good. Now anyone with a smartphone, tablet, or Google Docs has access to SR 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 using a data-driven assistive technology assessment process. The requirements of high-stakes testing may require this in order to provide it as a testing accommodation.

Toolbelt Theory

It's important to note, however, that speech recognition is usually NOT the only writing strategy in a student's toolbelt. Consider SR 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 AT process:

1. Consider It!

2. Try It!

3. Assess It!

4. Implement It!

Consider It!

Speech recognition is universally available to all students, but it legally becomes AT when it is used to increase the functional capability of students with disabilities. Since disability is not located in the person but rather in the interaction between the person doing an activity and the physical, social, cultural and institutional aspects of their context: (see ICF and HAAT model)

1. Consider the **TASK-DEMANDS**: What writing tasks are expected by the curriculum and classroom teacher? What are the outcome expectations? What are the specific task-demands of these assignments and assessments? Would speech recognition match?

2. Consider the **STUDENT'S PERFORMANCE**: What is the gap between current performance and curricular expectations? Which specific task-demands of writing are difficult for the student? Would speech recognition reduce or remove the difficult task-demands?

   Generally, speech recognition works well for students who have difficulty achieving the output demands of writing (transcription) but who can express thoughts and ideas well verbally (expressive language). The following skills and attitudes are also helpful but they can be developed through training (*see Try It! section*):

   - Motivation to use technology for writing
   - Consistency of breath, volume, pitch
   - Clear enunciation
   - Ability to inhibit "uhms" and "ahhs"
   - Ability to problem-solve
   - Ability to self-monitor
   - Ability to tolerate frustration
   - Attention to visual details
   - Ability to decode or use text-to-speech for editing

3. Consider the **CONTEXT**: Would use of speech recognition match the environment?
   - Yes, when talking out loud would not be disruptive or socially unacceptable. 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).
   - Yes, when environmental noise does not affect recognition accuracy. A noise-canceling microphone might help but a lot of surrounding noise would make recognition worse.

> See Assess It section for a list of specific writing task-demands that speech recognition might assist.

> 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.

So how do you know if speech recognition will work?

The only way to know is to TRY IT!

Try It!

The **key** to trying speech recognition with students is to TEACH the speech recognition writing PROCESS. Yes, the goal 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 before you can determine its overall effectiveness as a writing tool.

Before you begin...

Plan to work with the student individually.

It's easier to teach the speech recognition writing skills and collect data when you work with a student individually.

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. High school students might need only one session.

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 regularly works with the student. They will learn how to support implementation as you model the speech recognition writing process with the student.

Finding places to work in the school setting

It can be challenging to find a place to work where noise and distractions won't interfere with learning to use speech recognition. A corner of the library, small shared spaces between classrooms, and empty conference rooms are some of the locations we've used. But you might need to get creative if you need to stay in the classroom! One option is to teach the whole class.

Teaching speech recognition to a whole class

Can you teach speech recognition to a whole class or small group? Yes! Look for the adapted group lesson plan at the end of the Try It section. Teaching speech recognition to a whole group of students minimizes the potential stigma of pulling a student out of class and can help with implementation if the teacher is willing to allow speech recognition as a writing tool for all students. But it will be more difficult to collect individual performance data.

Try It!

Decide which technology to try first. There are quite a few speech recognition choices available on multiple device platforms and many of them are free, cloud-based features of mainstream technology products, which means no software installation is required. There are pros and cons to the different speech recognition platforms available.

Smartphone/Tablet (e.g. iOS, Android)		
Easily portable to multiple environments		Sometimes difficult to print directly from device (use Cloud-based docs)
No external microphone needed (although one can be added)		Recognition can be less accurate (although this is not always true!)
Cloud-based speech processing is more		Requires a WIFI or cell-phone connection
Works with a variety of note-taking apps		Small screen can make it difficult to write longer essays
Mainstream technology - student can often use their own device		Not all students own a smartphone

Laptop/Desktop (e.g. Chromebook, Mac, PC)		
Bigger screen and use of mouse makes editing easier		Not as portable (desktops)
Easier to pair with other AT software (e.g. text to speech for editing)		None
Can install SR software that doesn't require an Internet connection		Might need to train a voice profile to get sufficient accuracy

Setup the technology (as needed)

Mobile technology doesn't require much setup at all. Make sure the mobile app or laptop/desktop software required is installed or available before you meet with the student. Full featured software, such as Dragon NaturallySpeaking® on a laptop/desktop, sometimes requires the creation of a voice profile before you can use it. No voice profile training is needed for cloud-based SR features that are built into mainstream products.

See Appendix A for a detailed guide to setting up a voice profile with Dragon NaturallySpeaking®. We left this in the guide even though most schools are using the cloud-based SR features found in mainstream technology.

Try It!

Understand the speech recognition writing process

Writing with speech recognition software is different from conversational speaking and different from handwriting or typing. It requires the integration of a different set of skills. **You must *explicitly teach* this process to students.** If you have never used speech recognition for writing before (short SMS text messages don't count!), practice writing at least a paragraph before you work with 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, including punctuation needed.
3. Hold the sentence (or part of it) in memory.
4. Turn on the microphone
5. **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.
6. Turn off the microphone.
7. **CHECK** the recognition accuracy. Students with weak decoding skills should use text-to-speech software to assist the editing process.
8. **FIX** the recognition errors manually or verbally.

> Students with weak expressive language skills and decoding skills will need to repeat this process for each sentence. Users with good expressive language and who can detect recognition errors rapidly might dictate several sentences without stopping.

> 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

We teach our students a **short four-step version** of this process. Cut out the graphic (see pages 27 & 28) and put it in front of the student as you work with them. Elaborate on the steps as needed:

1. **Think it**: Before you talk, stop and think! This is actually the hardest step, so take your time.
2. **Say it**: Talk naturally and clearly. Try not to talk like...a...robot!
3. **Check it**: Use text-to-speech as a reading support. There will be no spelling mistakes so your ear or your eyes have to catch recognition errors.
4. **Fix it**: Decide whether to fix a few words or re-dictate the whole sentence more clearly. Use an editing checklist and other AT tools as needed.

> 1. Think it!
> 2. Say it!
> 3. Check it!
> 4. Fix it!

Try It!

A Scaffolded Approach

Academic writing is a task with a high cognitive load. Begin teaching the speech recognition writing process by removing some of the complexity at first and then slowly adding it back in.

A common 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 existing skills and how quickly they learn new skills. Good teachers expand or collapse the scaffolds as needed.

Scaffolded Steps to Teach the Speech Recognition Writing Process

1. **Model** the speech recognition writing process.

2. Student writes a **personalized sentence** you provide.
   * Coach enunciation until the sentence is right.
   * Try different software or hardware options as needed.

3. Student writes **3-4 sentences** on a personal topic.
   * Teach editing process after each sentence.
   * Teach punctuation and editing commands as needed.

4. Student writes and edits **1-2 paragraphs** from motivating pictures or other personal topics.

5. Student writes and edits 5-10 sentences using single words from an **academic vocabulary** list.

6. Student writes multiple paragraphs after completing a **pre-writing organizer** using only key words or phrases.

7. Student completes an **academic writing assignment** using speech recognition.

8. Student completes an **independent writing assignment** using speech recognition (homework or at school).

Remember, these steps are scaffolds. Expand or collapse as needed depending on the student. **The goal is to develop the student's operational and functional skills** enough to determine the effectiveness of speech recognition as assistive technology.

Each of these steps is explained on the following pages.

Slowly Increase Cognitive Load

1. Model the process
2. Single sentence
3. Several sentences
4. Simple paragraphs
5. Academic vocab
6. Formal paragraphs
7. Academic writing
8. Independent

AT Competencies

1. Operational
2. Functional
3. Strategic
4. Social

Try It!

If you don't know the student, start by having a conversation with them. Interview the student about their interests so you can help them write about them later (see step 3).

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

1. **Model the speech recognition writing process.**
    a. Use a "think aloud" strategy as you choose a topic to write about and mentally compose your topic sentence.
    b. Dictate the sentence and model operational skills.
        i. Turn on the microphone.
        ii. Dictate clearly and dictate punctuation.
        iii. Turn off the microphone.
    c. Read the sentence out loud (or demonstrate use of text-to-speech) to model how to carefully check recognition accuracy.
    d. Demonstrate how to correct recognition errors if there are any.
    e. Model saving and sharing/printing the document.

2. **Student writes one personalized sentence.**
    a. Create a personalized fill-in-the-blank sentence. For students with intellectual and developmental disabilities, keep the sentence very short but avoid reducing to a single word if possible because speech recognition software needs context to be accurate. Examples:
        ▪ "*I live in a ___ (color) house on a __ (noisy/quiet) street.*"
        ▪ "I have ___ (number or no) siblings and ____ (number or no) pets."
        ▪ "My favorite food is ___ (name of food) because _____ (what they like about it)." or just "I like ____ (food)."
    b. Interview the student to fill in the blanks. For the first example above, ask the student what color house they live in and whether the street they live on is noisy or quiet.
    c. Say the sentence to the student with their choices: e.g. "I live in a <u>tan</u> house on a <u>noisy</u> street." or "I live in a <u>brick apartment</u> on a <u>quiet</u> street."
    d. Ask the student to orally repeat the sentence. Notice the 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) or choose or shorter sentence.
    e. Demonstrate how to turn on the microphone.
    f. Ask the student to dictate the sentence (or first phrase) into microphone.

Try It!

g. After dictation, read the transcribed sentence with the student to look for recognition errors (or demonstrate how to use text-to-speech to listen to sentence). If there are recognition errors, <u>do not</u> fix them yet. You'll use the same sentence in the next step to fix the errors through better enunciation.

h. Coach enunciation until the sentence is correct.

    i. Start a new line of text in the document.

    ii. Model how to speak more clearly and more carefully (but with natural fluency).

    iii. Ask student to dictate the same sentence again.

    iii. Compare the two sentences. If one is more accurate, ask the student why. Help student understand that enunciation directly affects recognition accuracy.

    iv. If there are still recognition errors, repeat the comparison process with the same sentence or give the student another sentence to say with easier words.

i. If the student is <u>not</u> able to achieve at least 80% recognition accuracy, do not keep drilling. Instead, **try different software or hardware options.**

    i. Adjust the microphone.

        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. Plug in a headset microphone for better positioning.

        2. With headset microphones, make sure the microphone is about an inch from the mouth and that the receiver is facing the mouth.

    ii. Try different software or software settings.

        1. If you started with mobile speech recognition technology, try laptop or desktop software instead.

        2. Try software that has a script for training a user-specific voice profile.

        3. Tip: Dragon NS has a Dictation Mode that can increase accuracy for some students.

    iii. Consider the quality of the student's dictation.

        1. Consider how the student's body posture is affecting their breath control. Consult with an OT or PT and adjust seating and positioning as needed.

Tip: If using Dragon Naturally Speaking® 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.

Tip: 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.

Try It!

   2. If the student has atypical speech 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.

j. **What if accuracy doesn't improve?**
   i. Have you spent a significant amount of time teaching the skills needed to use SR? Go to the next step before giving up!
   ii. Have you tried at least 3 different SR software products? Do any of the products have adjustments or training features to increase accuracy?
   iii. Have you tried several different microphone setups, including an external mic with noise canceling features?
   iv. Is the individual significantly frustrated and unmotivated? Do they want to stop using SR?

   If yes to all four, then SR is probably not a good match. Consider recorded speech (i.e. audio recording app), spelling tools (contextual spell checker, word prediction, grammar checkers) or a human scribe (caution: reduced independence).

3. **Student writes 3-4 sentences on a personal topic.**

   a. Ask the student to compose sentences about their pet, family, or personal interests.
   i. Interview the student to draw out details. Steer the student away from proper names that will cause recognition difficulties (especially video game characters!).
   ii. At first, ask the student to practice their sentence out loud before turning on the mic. 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.

   b. **Teach the editing process after each sentence.**
   i. Coach the student to visually check the transcribed sentence for recognition accuracy (tracking with a finger might help) or to use a text-to-speech feature to listen for recognition errors if decoding is difficult for them.
   ii. 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.

c. **Teach punctuation**

   i. Most students will need to practice dictating ending punctuation unless they have had prior experience doing this with a scribe.

   ii. Use *non-verbal* prompts if the student continues to need reminders.

   iii. Allow the 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.

   iv. Model the use of mid-sentence punctuation as needed. 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. However, ignore punctuation that the student isn't ready for developmentally.

d. **Teach a limited number of voice commands in context.**
   This section applies mostly to laptop/desktop software. Mobile software doesn't have many voice commands.

   i. Teach editing voice commands in context when they are naturally needed.

   ii. Redirect students who want to learn extra voice commands. Remind students that they can still use the keyboard for editing and formatting unless they have physical difficulty with computer access.

4. **Student writes and edits 1-2 paragraphs from motivating pictures or other personal topics.**

The purpose of this step is simply to provide extra practice while keeping the cognitive load relatively low. This step might be the end goal for students with intellectual and developmental disabilities.

   a. Model the use of a pre-writing organizer as needed.

   b. Continue to coach the SR process, emphasizing the need to **THINK IT before you SAY IT so that when you CHECK IT you don't have to FIX IT**.

   c. Gradually fade coaching as the student follows the four tasks

> Tip: Help the student balance composition and editing. Correct some of the errors yourself to keep the learning process moving.

> Tip: Use software features to analyze the readability level of the student's sentences. Microsoft Word has this option or search for an online tool that gives a readability score.

Try It!

of the speech recognition writing process independently.

    d. Collect data on independence and writing quality.

5. Student writes and edits 5-10 sentences using single words from an academic vocabulary list.

The purpose of this step is to push the student to create the more complex sentences that will be needed for academic writing.

    a. Search online for a list of grade-level vocabulary words or ask the student's teacher for a list of vocabulary words.

    b. Pick a word from the list that they know and ask the student to create a sentence with it. Repeat for 5-10 sentences.

    c. Observe the syntax and structure of the sentences the student creates. Coach the student to create lengthier and more complex sentences if needed and observe the student's performance. The ability to create grade level sentences is a good indicator that speech recognition will work as assistive technology for academic writing.

6. Student writes multiple paragraphs after completing a pre-writing organizer using only key words/phrases.

The purpose of this step is to practice using speech recognition to compose an organized essay.

Tip: To get personal feedback from the student, have them write about the pros and cons of speech recognition. See Extended Writing task in the DeCoste Writing Protocol for other ideas.

    a. Help the student identify an interesting topic.

    b. Have the student to complete a pre-writing organizer.

        i. This is a good opportunity to model the use of various graphic organizer or software for organization. Consider using a digital organizer so students can practice dictating short phrases (ideas).

        ii. Coach the use of keywords/phrases on the graphic organizer rather than writing out full sentences so that speech recognition is still used to create the rough draft.

    c. Coach the student through the process of turning key words from the map into full sentences using speech recognition. If they have trouble with this, go back to step 5 for additional practice.

7. Student completes semi-independent assignment using speech recognition.

    a. In between sessions with the student, assign some writing for practice (at school or home if SR is available).

Try It!

  b. Give an assignment the student can do independently. They may not be ready to use it for academic work yet.

  c. Make sure the technology is available for use.

  d. Make sure someone is available to support the student with their homework assignment as needed. Ideally, this person will have observed your 1:1 sessions with student.

8. Student independently completes an academic writing assignment using speech recognition.

The purpose of this step is to collect data on the effectiveness of speech recognition as AT for writing. A few students will be able to move directly to this step after a brief introduction.

  a. Use an assignment the student needs to do for class.

  b. Arrange for the student to complete the pre-writing organizer in class using key words/phrases if possible.

  c. Do not coach the writing process unless the student gets stuck. As you observe, collect data on operational skills.

  d. If possible, have the teacher grade the assignment so you get the most accurate pre/post assessment data. If this is not possible, grade the assignment using a writing rubric that is the same or similar to the one used for classroom assignments.

> See the **Quick Reference Sheet** at the end of this guide for a shortened version of these steps.

How to adapt these steps for a whole group lesson

Step 1 (Modeling): Model for the whole class using a projector. Post a large version of the 4-step process at the front or give each student their own handout (see pgs 27-28) Consider demonstrating text-to-speech for the Check It step.

Step 2 (Personalized sentence): Call on several individual volunteer students to come up to the front and dictate one personalize sentence. This maintains group focus while providing additional modeling.

Step 3 (3-4 sentences): Provide a group writing prompt and directions for scattering students around the room. Tip: Face students outwards to minimize cross-talk or providing noise canceling mics for each student. Students can also work in pairs.

Step 4 (1-2 paragraphs about motivating topic): Make this the end goal of the lesson. If possible, plan with the teacher ahead of time to connect this step to a classroom assignment that counts, but isn't too hard academically (e.g. a journal writing assignment).

Assess It!

The overall goal of the individual training sessions is to determine whether speech recognition will be recommended as assistive technology for long-term implementation with progress monitoring.

Student Preferences Matter

First, it is important that the student contribute to the assessment process as much as possible. User preferences are an important factor in AT outcomes (Scherer, et al, 2011). In your initial conversations with the student and throughout the training sessions, collect data on the following:

- How do they rate their general interest in technology?
- What is their prior knowledge or experience with speech recognition?
- How willing are they to learn a new tool?
- How willing are they use technology in the social context of school? (e.g. would they use technology that peers are not using?)
- How do they like speech recognition? Ask this at the end of each session.

> Tip: In Step 3 or 6, have the student WRITE about the pros and cons of speech recognition and whether they are interested in using it.

Understand How Speech Recognition is Functioning as AT

Second, it is important to understand how speech recognition might be functioning as assistive technology. Although speech recognition is universally available as productivity technology, it becomes assistive technology for students with disabilities when it is used to reduce or remove specific task-demands that are difficult because of functional impairments.

Writing is one of the most difficult academic tasks because it requires the simultaneous integration of many different task-demands. Speech recognition will not reduce or remove all of them.

Speech recognition could be used to reduce or remove the following task-demands:

> Tip: See Section One of the DeCoste Writing Protocol (DeCoste, 2014) for a good description of the task-demands of writing, including visual motor and orthographic motor integration.

- Fine motor control (e.g. hold pencil, type)
- Cognitive demands of visual motor integration (VMI) and orthographic motor integration (OMI)
- Encoding (spelling)
- Initial capitalization

Speech recognition will probably NOT reduce or remove the following task-demands:

- Executive functioning
- Proofreading (but text-to-speech could be applied to this task-demand)
- Content areas of writing (ideas, organization, voice, word choice)

Assess It!

Know How to Measure Task-Demand Outcomes

Third, it is important to have some measurement tools to assess the effectiveness of speech recognition on the specific task-demands. Fortunately, a lot of simple measurements tied to observable outcomes have already been developed for writing.

Outcomes that might be improved with speech recognition		
Task-Demand	**Observable Outcome**	**Measurement**
Fine motor and cognitive demands of VMI and OMI	Legibility	Letter formation accuracy and quality
	Productivity	Words per minute (see DeCoste Writing Protocol)
	Word and sentence length	Readability score
Encoding	Spelling and syntax	Spelling accuracy CWS score from writing CBM
	Vocabulary	Total # of grade level words or readability score
Initial capitalization	Conventions	CWS score from writing CBM

Outcomes that might NOT be improved with speech recognition		
Task-Demand	**Observable Outcome**	**Measurement Tool**
Executive functioning	Sustained attention	Time on task
Proof-reading	Detecting recognition errors and fixing them	Spelling accuracy or CWS score from writing CBM
Content areas of writing	Ideas, organization, voice, word choice, presentation	Writing rubric (e.g. 6+1 Traits)

Assess It!

Pre/Post Comparisons

Fourth, it is important to do pre/post comparisons to determine the effect of AT on different task-demand outcomes (Smith, 2000). Simply use the outcome measurements to compare the student's pre/post performance on the task-demands that are most relevant to your assessment.

Task-demand	Pre	Post	Difference	Recommend implementation?
Legibility				yes / no
Productivity				yes / no
Spelling and conventions				yes / no
Word and sentence length				yes / no

Independence

How much time should elapse between the pre and post scores? Not much. You can start collecting post data through-out the *Try It!* process on the smaller variables (and share this data with the student so they understand its potential for them). But generally, the most meaningful "post" scores are obtained after the student has acquired enough operational and functional skills to use a tool fairly independently. This way you know that the tool is causing the change rather than your prompting and coaching. The best way to measure independence is simply to document how independently the student can complete each step of the process (see Appendix B for an example).

Final Product Outcomes

Of course, the end goal is to improve the student's final writing product by integrating speech recognition into the whole writing process: brainstorming, organizing, drafting, revising, editing, and publishing. A writing rubric is really the only writing outcomes measure that takes into account the integration of all these factors. A pre/post comparison of writing rubric scores will show whether speech recognition is having an effect on the outcome of the final product. You will need to get to at least Step 6 of the scaffolded *Try It* process to obtain this score.

If teaching whole group lesson, this is the only data collection you *can* do. Use the group lesson for training only. Use comparable classroom writing assignments to get pre/post comparison data.

Implement It!

Create an implementation plan.

1. 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.
    a. Document the speech recognition tool(s) the student is using with specific brand names.
    b. 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. A mobile device in a variety of locations that won't disturb others and where student can concentrate.
    c. Document who will provide ongoing support and who the student should contact if something goes wrong.
    d. Document the training and support needed to make sure the student can independently use the tool(s) and can self-advocate when needed.
    e. 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.

Build in practice time.

a. Use frequent, simple writing assignments such as a daily journal or story writing prompt.
b. Use short, motivating writing activities such as:
    i. Answering personal interest questions in full sentences.
    ii. Writing an email or letter.

Implement It!

   iii. Writing text messages (SMS) to friends (if appropriate).

   iv. Writing a social media post (if appropriate).

 c. When speech recognition is not available, have student continue to dictate their sentences to a scribe or audio recorder as if they were using speech recognition (e.g. Think It first, then Say It in full sentences that include dictated punctuation).

Integrate speech recognition with the writing process.

> **Writing Process**
>
> 1. Brainstorm
> 2. Organize
> 3. Rough draft
> 4. Edit/Revise
> 5. Final Draft

 a. Transcription (writing a draft) is only *part* of the whole writing process. The pre-writing steps are essential because the speech recognition writing process relies on fluent dictation of phrases and sentences. The student should know what they want to write before they start drafting with SR technology.

   i. Try a variety of organizers.

   ii. Emphasize the use of 1 or 2 keywords on the organizer rather than trying to handwrite full sentences, otherwise the student will end up trying to read their sentences as they dictate.

 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.

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 (e.g. AT Point People or Liaisons).

 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.

Appendix A: Dragon Setup

Initial voice profile setup for Dragon NaturallySpeaking®. You don't need this step if you are trying out Internet-based technology, such as Voice Typing in Google Docs (under Tools menu) or Siri on iOS devices.

1. **Teach microphone skills**
   a. Explain the noise cancelling microphone to the student.
   b. Teach proper positioning of the microphone.
      i. 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.
      ii. 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.
2. **Create the user profile.** Add the student's name and choose the appropriate English accent. "Standard" or "Teen" are often the best options.
3. **Do the microphone setup.** In older versions, there are two steps.. In version 13, there is only one step.
   a. <u>Students do not have to read the provided script!</u> Ask them to recite the days of the week continuously (or anything else) until they hear the beep (about 30 seconds).
   b. If the test fails, reposition the microphone and run the test(s) again.
4. **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.
5. **Choose a reading strategy** to facilitate the process.
   a. Fluent readers can usually read the script cold. If they make a significant decoding mistake, you can always hit the redo button.
   b. Non-fluent readers who struggle with decoding can be assisted with the following strategies:

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 changing to 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

i. **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).

ii. **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.

iii. **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.

iv. **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.

Appendix B: Data Collection

1. **Student Self-Assessment**: Use interview questions or Likert scale to gauge the student's interest. A kid-friendly Likert scale graphic is included in the DeCoste Writing Protocol. Compare different tools.

I love it	I like it	I'm not sure	I don't like it

2. **Pre/Post Comparison of Relevant Task-Demands:** Pick the task-demands that are most relevant to your assessment.

Task-demand	Pre	Post	Difference	Recommend implementation?
Legibility	An OT can use formal tools such as ETCH or Handwriting Without Tears Print Tool.	Legibility will always be 100%. Measure recognition accuracy instead.		yes / no
Productivity	Use DeCoste Writing Protocol: Composed Text or Extended Writing tasks to obtain average WPM score.	Use DeCoste Writing Protocol: Composed Text or Extended Writing tasks to obtain average WPM score. Student should correct recognition errors within time limit.		yes / no
Spelling and conventions	Score writing sample for correct spelling or use Correct Word Sequence technique developed for Curriculum-Based Measurement probes (CBMs).	Score writing sample for correct spelling or use Correct Word Sequence technique developed for Curriculum-Based Measurement probes (CBMs).		yes / no
Word and sentence length	Use readability score, available in MS Word or an online scoring tool.	Use readability score, available in MS Word or an online scoring tool.		yes / no

3. **Assess Independence**: Use a procedural checklist. This example is for Dragon NaturallySpeaking® on a computer. Create your own for other speech recognition technology, which many not require as many steps.

STEPS	Completed with prompts	Completed Independently
1. Plug in the microphone		
2. Launch Dragon		
3. Choose your 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 ("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.		

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

How to Teach the Speech Recognition Writing Process

These steps are scaffolds. They can be expanded or collapsed as needed. How much scaffolding is needed depends on the student.

If you do not know the student, have a conversation/interview with the student first to help with comfort level and to provide content to write about.

1. **Model the process** using the program or app from start to finish. Make sure to explicitly model the 4 process steps (Think It, Say It, Check It, Fix It) and all operational steps (i.e. turn on the mic, speak punctuation, etc).

2. Start with a **single sentence** you provide, student fills in with personal information and says the sentence out loud.
   - For example: I live in a _____ (color) house on a _____ (quiet/noisy) street.
   - **Coach enunciation until the sentence is correct**. Have the student repeat this sentence (a few times if needed) on a new line. Do not correct errors. Compare attempts. Coach to improve recognition each time (i.e. adjust mic, voice speed, articulation, positioning, etc.)

3. Have the student **write 3-4 sentences on a personal topic**. Encourage the student to expand their sentences as needed.
   a. **Teach the editing process after each sentence.** Coach the student to visually check the transcribed sentence for recognition accuracy. Consider using a text-to-speech feature to support this.
   b. **Teach punctuation**. Students will need practice with this and may need a visual or gestural cue to speak their punctuation or type it after dictation.
   c. **Teach a limited number of voice commands** (as needed).

4. Have the student **write and edit 1-2 paragraphs from motivating pictures or personal topics**.
   a. Student can talk their ideas out loud first. Model the use of a graphic organizer (i.e. write down key words or phrases the student shares out loud prior to dictating).
   b. Continue to coach THINK IT, SAY IT, CHECK IT, FIX IT.
5. Have the student write and edit **5-10 single sentences on an academic topic**. Find a list of grade level vocabulary. Give the student a word from the list that they know and ask them to create a sentence with the word. Encourage the student to expand their sentences as needed. Repeat for 5-10 sentences.
6. Have the student **write multiple paragraphs after completing a graphic organizer**. Have the student write about a topic of interest or an academic topic. The student will use a graphic organizer to organize their ideas, then turn the key words/phrases into full sentences.
7. Have the student **complete a semi-independent assignment** using speech recognition. In between sessions, provide students with an assignment to complete a writing piece (does not have to be a required academic assignment if they are not ready yet). Make sure someone is available to provide support as needed. This can be done at school or home (if SR is available to the student).
8. Have the student **complete an academic writing assignment** independently using the program. Use this sample and future writing samples to collect data.

If speech recognition is effective as AT for writing, **implement** and **monitor effectiveness and regular use** over time.

Speech Recognition Writing Process

1. Think it!

2. Say it!

3. Check it!

4. Fix it!

1. Think it!

2. Say it!

3. Check it!

4. Fix it!

1. Think it!

2. Say it!

3. Check it!

4. Fix it!

1. Think it!

2. Say it!

3. Check it!

4. Fix it!

1. Think it!

2. Say it!

3. Check it!

4. Fix it!

1. Think it!

2. Say it!

3. Check it!

4. Fix it!

1. Think it!

2. Say it!

3. Check it!

4. Fix it!

Student's Guide for Speech Recognition

Fill this out and review with the student while teaching the SR process

There are 4 steps to remember when writing with SR

1. Think it!
2. Say it!
3. Check it!
4. Fix it!

1. **Mentally compose your sentence**

2. **Say your sentence clearly**

3. **Check the speech recognition accuracy**

4. **Fix any mistakes or delete & try again**

Tips for using speech recognition for writing

- It will take time, practice, and patience to use SR efficiently
- Write key words and ideas on a graphic organizer before you start
- Try to find a place away from distractions
- Consider using ear buds with a mic or a noise-canceling headset mic
- After you turn on the mic, pause for 2 seconds before you speak
- Use clear, consistent speech
- Talk at at regular pace and volume, speaking word endings clearly
- Talk in longer phrases or whole sentences instead of word by word
- Do not chew gum while you are speaking
- Do not say "um" or make other sounds while you are speaking.
- Speak your punctuation (say "period" or "comma" or "exclamation point" or "question mark")
- Try not to look at the screen while dictating if that distracts you
- Turn off the microphone between sentences
- Use a text-to-speech feature for the "Check It" step to make sure you are reading the words on the screen accurately

Student's Guide for Speech Recognition

My speech recognition plan:

Today I worked with (include name, title and contact info if needed):

_____

I used speech recognition on (list the device and specific app you tried):

_____

I can find speech recognition on this tool by going to (list steps to find and open):

_____

The type of assignments I will use speech recognition for are:

_____

The next (or current) writing assignment I will use speech recognition for is:

_____

If I need a quiet place to use speech recognition, I will go to:

School: _____ Home: _____

When speech recognition is not an option, I could use other supports as needed:

Type of writing assignment: _____ Tool: _____

Type of writing assignment: _____ Tool: _____

Type of writing assignment: _____ Tool: _____

If I have any questions or need help, I can go to (include name and contact info):

_____

Practice Tips

If I do not have an assignment to complete using speech recognition, I can do daily or weekly writing practice to work on my skills. Some ideas include: a daily journal, write a story or play, write about a photo or video, complete a book review, compose an email.

If I have a smartphone, I may consider getting extra practice by speaking my texts and emails (including punctuation).

Editor's Checklist

for documents written with speech recognition

Editing Steps

1. Read each sentence. Does it sound right?

- Fix incorrect words. The computer makes mistakes.
- If the computer has trouble getting a word right, try re-dictating the whole phrase or sentence instead of just one word.

2. Read each paragraph. Does it make sense?

- Fix the flow by adding punctuation and missing words.

3. Re-read the whole thing one more time. Will someone else understand what you are trying to communicate?

- Make it clear by changing words, adding sentences or putting sentences in a better order.

Use technology

1. Use text-to-speech to listen to each sentence.

- Highlight only one sentence at a time or turn on the option to stop reading at each period.
- Follow along with your eyes and your finger so you can find incorrect words.

2. Use text-to-speech to listen to each paragraph.

- Highlight the whole paragraph or turn on the option for continuous reading.
- If the computer voice does not pause or take a breath for a while, you need to add punctuation!

3. Use text-to-speech to listen to your whole document.

- Concentrate on listening to the meaning of the words, not the sound of the computer voice.

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