



DRAGON[®] NATURALLY SPEAKING[®]

HELPING ALL STUDENTS REACH THEIR FULL POTENTIAL

A White Paper for the Education Industry from Nuance Communications
March 2009

INTRODUCTION

Technology is rapidly changing the way students of all ages and abilities live and learn. Today, the vast majority of K-12 schools in the U.S. incorporate computer hardware and software into their curriculum — both as an assistive technology for students with physical and learning disabilities and as a tool for preparing general education students for the 21st century workforce.

For decades, U.S. federal laws — including Section 504 of the Rehabilitation Act of 1973 and the Individuals with Disabilities Education Act — have mandated support services for children with physical and learning disabilities. As a result of these measures, 6.7 million K-12 students (13.8% of all K-12 students) in the U.S. now receive special education services due to physical or learning disabilities that impact accessibility.

To date K-12 school districts have spent more than \$1.5 billion on technology and other instructive support. As the benefits of assistive technology become more widely recognized, special education departments are investing in solutions that enable and enhance the learning process. In recent years, speech recognition software has gained broad acceptance as a cost-effective accessibility tool for a wide range of students. In addition to providing an alternative input method for students with physical disabilities, speech recognition software has been shown to help students with learning disabilities make significant advances in the areas of reading, writing and spelling.

Speech recognition is also gaining traction in the general education arena. Because people of all abilities are using speech to interact with mainstream technology — computers, handheld devices, navigation systems, gaming consoles, and more — students need to be trained in using voice interfaces. As a result, more and more middle and secondary schools are adopting speech recognition technology as part of their business education curriculum. This training is intended to help students boost productivity, prepare for tomorrow's workforce, and prevent increasingly common repetitive stress injuries.

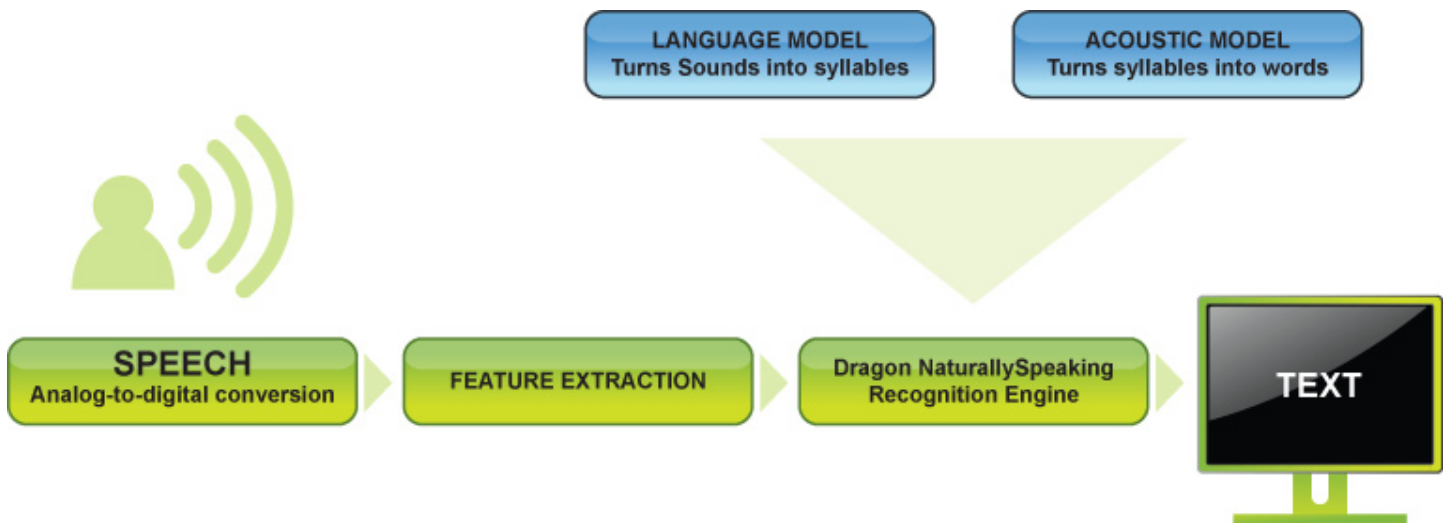
This white paper outlines how speech recognition is being used today to enhance the educational process for students and teachers alike. It provides detailed information on how the technology can be successfully leveraged as a(n):

- Assistive technology for students with physical and learning disabilities
- Remedial tool for improving the reading and writing skills of students of all abilities, but especially those with language-based learning disorders
- Integral part of business curriculum at the middle and secondary school levels
- Productivity-enhancing tool for teaching professionals

WHAT ADVANTAGES DOES DRAGON BRING TO TODAY'S STUDENTS?

- **It's three times faster than typing** - Most people speak over 120 words per minute, but the average keyboard user types less than 40 words a minute. By delivering the ability to create documents and emails about three times faster than typing, Dragon helps special education students keep up with their non-disabled peers — even in a mainstream educational setting.
- **It's up to 99% accurate** - Dragon learns to recognize the student's voice with minimal training and delivers increasingly accurate recognition results the more it's used. Plus, it never makes a spelling mistake—a real advantage for students with certain learning disabilities. Dragon can easily learn new terms, which can be added individually or quickly imported from existing text.
- **It's a proven tool for improving core reading and writing reading skills** - Speech recognition can serve a remedial function for improving core reading and writing abilities for students of all abilities. Researchers attribute these benefits to the heightened, strategic engagement with print and language that users experience while dictating and correcting errors.
- **It's the interface of the future** - Computing industry pundits like Bill Gates have said that future technology will increasingly leverage speech and touch interfaces. Learning to use products like Dragon will better prepare students to take full advantage of emerging technology—in the classroom, at home and in the workplace.

HOW DOES SPEECH RECOGNITION WORK?



Speech recognition software products use the human voice as the main interface between the user and the computer. Speaker –dependent speech recognition systems, such as Dragon® NaturallySpeaking® from Nuance Communications, create an individual voice profile for each user of the system. The voice profile contains information about the unique characteristics of each person’s voice along with a customized set of words, known as a vocabulary, and user-specific information including software settings and personalized voice commands.

When users create their voice profile, Dragon starts with general models of how English is spoken in the US, and adapts to how individuals speak (acoustic model) and which words they use (vocabulary and associated language model). This approach accommodates users with varying accents and speech patterns; it also permits the users to dictate naturally—freely using any acronyms, jargon, abbreviations or phrases. It’s easy and convenient for institutions, or individual users, to create and import “vocabulary lists” for the subjects they teach or study, as well as the categories of items they might dictate, like names of campus buildings, names of students and staff, etc. These lists can easily be shared, saved, or automatically refined.

The software regularly refines the user’s voice profile, and employs it to accurately determine the words spoken, and choose between words that sound alike. Every time a Dragon user corrects a “misrecognition,” the software updates his voice profile to enable better recognition accuracy over time.

DELIVERING REAL BENEFITS FOR ALL STUDENTS

With continuing hardware and software improvements, speech recognition technology is becoming an increasingly cost-effective educational and productivity tool for a wide range of students. It lets a student talk to a computer and watch his spoken words quickly appear in documents, emails or instant messages. It’s faster than typing and it never makes a spelling mistake. As a result, speech recognition tools can generate a new excitement for writing and learning for students who were previously unable to write or produce written work — especially those facing physical or learning challenges.

Tools like Dragon NaturallySpeaking can help students quickly and easily transfer ideas from their minds onto paper — a basic task that is often painful, or even impossible, for some students. When students can dictate their papers and examination responses to a computer, they’re more likely to exploit their full language capabilities.

Dictation, however, is just the beginning. Speech recognition software provides a powerful interface that speeds and simplifies student interaction with their PCs, applications, and files. It empowers students to write and format papers and presentations, conduct Internet-based research, communicate with peers and teachers, and make full use of popular Windows applications — all by voice.

Dragon helps students of all abilities to better exploit their full academic potential by enabling them to:

Command and control virtually any Windows application

Students can use voice commands to dictate, edit and control applications including Microsoft Word, PowerPoint, Excel, Outlook Express, Internet Explorer, and AOL.

Send email and IMs to collaborate on group or classroom projects—entirely by voice

Students can use their voice to compose and send both email and instant messages to classmates and teachers, enabling full participation in group projects that require ongoing communication, collaboration, and sharing of information.

Search for information on the Web or on their computer

Students can use simple spoken commands to find information on the Internet or files on their computer. They can locate information quickly and easily by simply saying things like, “Search the Web for global warming articles,” “Search Wikipedia for George Washington Carver,” or “Search computer for Charles Dickens.”

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Edit and format documents by voice

Dragon provides direct commands for formatting, deleting, and copying words and passages. For example, a student could italicize a book title by saying, “Italicize The Adventures of Tom Sawyer.” Students can even use voice commands to format a whole passage of text by quoting its first and last word(s). Dragon also enables students to control the form, spacing and capitalization of items written in various contexts (i.e., inserting a space before or after, capitalizing the next word, or using alternate forms like “fig.” instead of “figure” before numerals).

ACCESSIBILITY FOR PHYSICALLY IMPAIRED STUDENTS

Speech recognition products like Dragon have helped students with a range of physical disabilities — paralysis, quadriplegia, spinal cord injuries, cerebral palsy, multiple sclerosis, apraxia, visual impairments, repetitive stress injuries, and more — that make typing painful, if not impossible. Here’s how Dragon can help:

Hands-Free PC Use

Adding speech recognition capabilities to the PC enables these students to work virtually hands free when creating documents, accessing data, or navigating their desktop. Tools like Dragon provides a more efficient means of controlling a computer that is less physically and cognitively taxing than other alternative input methods.

Accommodations for Language and Speech Impairments

Using speech recognition takes away the mechanical aspects of typing or handwriting and therefore removes many of the challenges many people face when trying to intelligently express their thoughts in writing. In addition, as speech recognition has improved over the years, more and more students with articulation and pronunciation problems can use the software to complete daily tasks.

Assistive Technology for the Visually Impaired

Dragon offers speech output capabilities so that students can have text read aloud to them. The system works with most popular screen readers, such as JAWS, helping visually impaired students to work more effectively.

Productivity from anywhere, at anytime

Installed on a laptop computer, speech recognition can be used by students at home as well as in multiple classroom locations throughout the school day. With Dragon, physically challenged students are not confined to a single workspace for homework and studying. They can dictate into any Nuance-certified handheld device for automatic transcription when syncing with their PC — a capability that is particularly helpful for note taking and research. In addition, students can use Dragon with a wireless (including Bluetooth) headset to experience the same highly accurate recognition results without being hampered by wires.

Children who wrote using speech recognition technology for as little as as 10-1/2 hours showed significant improvement in reading, decoding, spelling and comprehension ... You could no longer differentiate their writing when they used speech recognition from writing by students without learning difficulties

**VOICE RECOGNITION SOFTWARE:
The Great Equalizer**

Marshall H. Raskind, a learning disabilities researcher at the Frostig Center in Pasadena, Calif., found that voice recognition software could make a significant difference for many people with dyslexia. "It's the great equalizer," he said.

After studying the use of the software by dyslexic students for 10 years and publishing four joint papers on his findings, Dr. Raskind has concluded that speech recognition not only allows dyslexics to communicate more efficiently, but may even help them overcome their condition.

"Children who wrote using speech recognition technology for as little as 10-1/2 hours showed significant improvement in reading, decoding, spelling and comprehension," Dr. Raskind said. "We were blown away by this. The results are preliminary. But it is very encouraging."

The results generated by the 29 Northridge students in the study who used Dragon were impressive. "You could no longer differentiate their writing when they used speech recognition from writing by students without learning difficulties," he said. "The quality of their writing was far superior."

Summarized from "Speaking to read: The effects of speech recognition technology on the reading and spelling performance of children with learning disabilities" by Marshall H. Raskind and Eleanor L. Higgins, published in Annals of Dyslexia, Volume. 49, Number 1/ December 1999.

ASSISTIVE TECHNOLOGY FOR STUDENTS WITH LEARNING DISABILITIES

Research studies and practical experience continue to show the of speech recognition for helping students with learning disabilities — dyslexia, dysgraphia, working memory issues and other cognitive challenges — that interfere with their ability to read, write and spell. Speech recognition tools like Dragon can generate a new excitement for writing and learning among students who were previously unable to write or produce written work due to learning disabilities. The technology accomplishes this feat by:

- Enabling them to more easily transfer their ideas into print
- Circumventing the most frustrating aspects of text generation, including brainstorming, outlining, and spelling
- Providing remedial reading assistance for both decoding and comprehension

Dragon enables students with a wide range of learning disabilities to reach their full potential. It allows students to create work through speech and vastly improves output for students living with disabilities involving written language.

Transforming thoughts into written words

Students with language-based learning problems or working memory difficulties can benefit from using voice recognition software to transfer their ideas into printed words. Since these students have trouble expressing their thoughts on paper, they often convey less sophisticated ideas in their written work, use a simplified vocabulary, or avoid writing tasks altogether. Learning disabilities researchers consistently found that use of speech recognition technology can make a significant difference for dyslexic students because it enables them to communicate more efficiently and effectively.

Enable greater independence

In the past, many students with learning disabilities have depended on other people — parents, teachers, instructors or friends — to transcribe their papers and other assignments as they dictate. This traditional approach, however, presents some serious drawbacks. First, it makes the student dependent on another person to accomplish academic tasks. Secondly, it hampers writing skills development; without a draft to read and reread as each sentence development, the student lacks a comprehensive sense of the writing flow.

Speech recognition software provides an attractive alternative to a dictation buddy. It allows students to speak into their computers at a natural pace and watch their spoken words appear on the screen as text. Students with learning disabilities are now able use voice recognition to gain new levels of independence as writers, readers and learners.

Free up cognitive space

For many students with language-based learning disabilities, getting the first couple of sentences down on the page can be the most difficult part of the writing process. For example, dyslexic student often face reading and spelling challenges, which present enormous hurdles to written expression. Difficulties with working memory prevent other students from managing more than one aspect of the writing task at a time. As a result, completion of reports and other writing assignments can be a frustrating and extremely time-consuming endeavor.

Dragon NaturallySpeaking frees up cognitive space in the brain to jumpstart the writing process, allowing these students

“Educators should not hesitate to integrate technology features into instruction for students who struggle with academic tasks. These approaches can support learning by building literacy and language skills and independence... Use speech recognition technology to help struggling writers and spellers get their ideas on paper. The immediacy of the dictation process reinforces the vocabulary and use of writing conventions and punctuation... If you haven’t tried speech recognition software lately, you’ll find vastly improved capabilities, reduced training requirements and better microphones available at very reasonable costs. “

“Research Matters/Technology to Help Struggling Students” by Heidi Pacuilla and Steve Fleischman, Educational Leadership, Feb. 2006, Volume 63, Number 5

Dragon can generate a new excitement for writing and learning among students who were previously unable to write or produce written work due to learning disabilities.

“To ensure a computer literate society, each child must be able to communicate using a variety of digital tools. As the ‘tools’ change, communication skills will be the driver. We need to teach the appropriate use of communication tools as our nation continues to evolve into the Information Age. The traditional Keyboarding class is the perfect home to introduce the new digital input technologies.”

Cindy Agnew, a principal figure behind the Washington State DigiTools curriculum

to get their thoughts on the page without worrying about reading and spelling. As students dictate their thoughts, Dragon automatically turns speech into correctly spelled text. Furthermore, Dragon’s playback function enables students to hear - rather than read - what they’ve written, so they can make edits as needed. By listening to their writing, some students become more aware of issues like missing verbs, awkward phrasing or poor sentence structure that require revision.

In fact, studies have shown that students with learning disabilities who used speech recognition tools to independently produce typed essays were able to complete assignments with results that were indistinguishable from the work of their non-disabled peers. (See sidebar)

Improve reading and spelling

Research also suggests that the use of speech recognition by dyslexic students has actually generated significant improvement in reading, decoding, spelling and comprehension. It gives students the opportunity to practice their reading skills and can positively influence sound-character awareness. Studies have shown that Dragon promotes improved spelling and word recognition as students watch the words they speak get transcribed, word by word, on the computer screen. This “say-and-see” approach helps students better understand the relationship between what a word looks like and how it sounds.

AN EMERGING COMPONENT OF SECONDARY SCHOOL BUSINESS CURRICULUM

Across the nation, speech recognition is being integrated into traditional middle school, secondary and post-secondary business courses, which typically address keyboarding, computer applications, data input, and business technology. In fact, it is a vital component of newly developed digital communications courses in states like Washington, Nebraska, North Carolina, Virginia, Mississippi, and Indiana, which have already added speech recognition skills to the instructional mix in coordination with the national standards on input technologies like keyboarding.

Business Education initiated the blending of speech and handwriting recognition with keying input instruction shortly after the National Business Education Association (NBEA) updated its IT curriculum standards in 2001. According to those guidelines, students should “develop proper input techniques (e.g., keyboarding, scanning, speech recognition, handwriting recognition, and the use of a touch screen or mouse), including safety methods to avoid repetitive strain injury.” (Page 85, National Standards for Business Education, www.nbea.org, ISBN 0-933964-56-0)

In 2003, the National Business Education Association (NBEA) Policies Commission took a powerful position on the injury prevention issue with the following statement:

“We believe that students must be made aware of the health benefits of an integrated approach to text and data input. Research indicates that carpal tunnel syndrome and other repetitive strain injuries may be linked to occupations that require repetitive use of the hands (i.e., keyboarding and mouse operations). Varying the use of computer-input technologies reduces the risk of repetitive motion injuries.”

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Over the past several years, early adopter states like Washington, which replaced its long-standing CTE Keyboarding

Curriculum with a new course called Digital Communication Tools or “DigiTools” for short, have worked to develop new standards for what to teach when blending keyboarding with emerging input technologies. According to the speech recognition portion of Washington’s new standards, DigiTools students will:

- Demonstrate ability to use voice input and voice recognition tools
- Enunciate and read clearly using speech recognition technologies
- Develop voice recognition skills at acceptable, pre-defined speed and accuracy levels
- Apply proper voice recognition techniques to input data and produce personal and business documents

Dragon NaturallySpeaking is the preferred choice for schools integrating speech recognition into traditional middle school, secondary, and post-secondary business courses, which typically address keyboarding, computer applications, data input and business technology. Why? Because Dragon is:

Dragon NaturallySpeaking is the preferred choice for schools integrating speech recognition into traditional middle school, secondary, and post-secondary business courses, which typically address keyboarding, computer applications, data input and business technology.

- **Remarkably easy to use:** Most users are up and running in less than 15 minutes. It installs quickly and requires no special script reading. On-screen help and tutorials enable students to master the input process in no time.
- **A proven productivity tool:** Users can create documents three times faster than typing. By learning to use speech as an alternate input method, secondary students gain the opportunity to achieve greater productivity and efficiency in their school work and acquire a valuable skill that gives them a competitive edge as they advance in their education and careers.
- **Highly accurate for the vast majority of speakers.** Dragon delivers recognition accuracy rates of up to 99 percent. Plus, the latest version incorporates new acoustic models and adaptation techniques for better coverage of non-native and regional accents.
- **Available in many languages.** Dragon is available in many language versions to help students who may be receiving bilingual education services. Language versions include:
 - English with support for the following dialects: US, UK, Australian, Indian and Southeast Asian English
 - Dutch
 - French
 - Spanish
 - Italian
 - German

A VALUABLE TOOL FOR TEACHERS

Today's teachers face an incredible workload. In addition to classroom teaching, many serve on one or more administrative committees and councils. Most are involved in separate weekly meetings for each student on an IEP. Some perform curriculum coordination duties or are involved in coaching or after-school enrichment programs. All of them must communicate with students, parents and peers. And then there's the evaluation of student work.

Teachers can receive hundreds of essays, reports, exams or homework assignments from students every week. Each paper requires timely review and detailed feedback. Dragon NaturallySpeaking provides a valuable tool for streamlining the assessment of student assignments. With Dragon, teachers can read and respond to students' essays quickly and easily. They can add more comments and detailed notes because they're not constrained by time-consuming hand-written feedback - not to mention poor penmanship.

By using Dragon with a wireless headset, teachers reviewing assignments and providing dictated feedback are no longer tied so closely to the desk and computer. They can move around as they dictate notes to students or sit back and relax as they add comments to papers.

Steve Collis, a French/English teacher at Northern Beaches Christian School and Head of Innovation at the school's innovation arm, the Sydney Centre for Innovation in Learning from Sydney, Australia, started a website called "HappySteve," which is devoted to the topics of teachers, technology and learning. A fan of speech recognition overall and Dragon NaturallySpeaking in particular, Steve uses the technology regularly in carrying out his teaching tasks. In discussing speech recognition for teachers, Collis wrote:

I use voice recognition mainly for the boring bits, e.g. writing teaching programs, giving feedback to numerous different students about the same task, emailing various people on a similar topic. There is little creative fun in this sort of typing. It is repetitive and dull. Voice recognition is at its best for this. It lets me fly through it as quickly as I can talk, without getting tired fingers. Take, for instance, essay marking... Students make the same mistakes over and over again. It is soul-destroying writing "start each paragraph with a topic sentence" or "ensure you integrate quotes into your sentences rather than just putting them by themselves" over, and over, and over again. I suppose you could use macros [voice commands] for this. And of course typing these comments is easier than handwriting them. Easier than all these, is voice recognition.

When it comes to using speech recognition as a teaching and administrative tool, the sky is the limit. Innovative teachers continue to find new, useful applications for speech recognition technology that benefit both their students and themselves. When a double-dyslexic student at a Vermont school was struggling with note-taking in a difficult biology class, the teacher wanted to help. She went to the school's assistive technology group and created her own Dragon voice file. From that point forward, the teacher used a digital recorder to record her lectures so the student could then go and transcribe the lecture into text.

This approach worked wonders. The student could focus on listening to the lecture instead of taking notes during class for greater absorption and understanding of the content presented. At the same time, she had access to written notes that she could reference for homework assignments and test preparation. And beyond an hour's investment in voice training, this pay-off required no extra work on the part of the teacher.

One secondary school history teacher who uses Dragon to comment on student projects has reduced the amount of time it takes him to grade papers by 40% over the traditional method of providing handwritten comments. In addition to saving time and improving the quality of feedback, Dragon provided a permanent electronic copy of all his comments -- an extremely helpful resource when it comes time to write end-of-semester evaluations and individual college recommendations.

SUITABLE ACROSS EDUCATIONAL SETTINGS

Dragon NaturallySpeaking is suitable for use in a broad range of educational settings. Dragon is easy to install and set up - even for non-technical users. Once the software is installed, it's equally simple to create and maintain a user profile for each user (student or staff member), modify settings such as auto-formatting options (if desired), hook up the microphone, and check the sound volume and quality.

How is Dragon being deployed in K-12 schools today?

- **On the go.** Installed on laptop computers, Dragon can be used by students -and teachers- at home as well as in multiple classroom locations throughout the school day
- **On PCs or Macs.** Schools that have standardized on Apple Macintosh computers can still take advantage of Dragon's industry-leading speech recognition technology. MacSpeech Dictate uses Nuance's world-renowned Dragon speech recognition engine. Dragon is the brains and the brawn behind MacSpeech Dictate's proven accuracy.
- **In mainstream classrooms.** Dragon can be installed on one or more computers in traditional or inclusion classroom setting for use by students of all abilities, including those on Individual Education Plans.
- **In Special Education or Life Skills classrooms.** Dragon can be used by full-time life skills or special education students who come for individualized help over the course of the school day.
- **In computer labs.** Dragon can be installed on all computers in a middle or secondary school business education classrooms or computer application labs where students learn state-of-the-art digital communication technologies.

Because budgets are being stretched to the limit, many schools are using older, resource-constrained computers. Fortunately Dragon offers built-in capabilities that help ensure the software will perform well on the older PCs and Macs installed in many districts. For example:

- During installation, Dragon automatically analyzes the PC's resources and changes default settings as needed to increase accuracy
- Dragon provides the ability to disable or "turn off" some of the software's more advanced capabilities to boost performance as guided by Dragon's Performance Assistant.

ABOUT NUANCE COMMUNICATIONS, INC.

Nuance is a leading provider of speech and imaging solutions for businesses and consumers around the world. Its technologies, applications and services make the user experience more compelling by transforming the way people interact with information and how they create, share and use documents. Every day, millions of users and thousands of businesses experience Nuance's proven applications and professional services.

For more information, please visit: www.nuance.com.