# Assistive Technology and Writing

by Dave L. Edyburn

Children's development as writers has been studied extensively (Clay, 1979; Graves, 1983; Merchant, 2006; Tolchinsky, 2006). As a result, the research offers clear milestones for parents and teachers to observe a child's writing development and concepts of print. As summarized in Table 1, children's initial efforts to write involve learning to grasp writing instruments and scribbling. As children physically mature, they develop the fine-motor skills to properly hold a writing instrument and manipulate it with some control. Later, their cognitive development enables them to notice features of text, such as straight lines and curves, which they try to imitate as they work toward tracing and copying letters. During the preschool years, children develop to the point where they are able to print letters and numbers from memory (without a model to copy). Learning to write one's name is a significant milestone that typically occurs around ages 4 to 6. As children continue to learn to write and spell simple words, writing begins to provide a functional purpose.

Children with disabilities are likely to be developmentally delayed in achieving each of the milestones described above. For many children with significant disabilities, "developmental delays in communication, language, cognition, physical mobility, social skills, and play skills present challenges to becoming literate" (Sadao & Robinson, 2010, p. 123). As a result, it is important to be attentive to barriers that prevent any child from accessing and engaging in the emergent literacy activities appropriate for their peers. Assistive technology (AT) should be explored whenever a child encounters significant barriers that prevent him or her from accessing and engaging in developmentally appropriate learning activities.

The provision of AT devices and services is predicated on the need for interventions that overcome a performance problem encountered by an individual with a disability (Blackhurst, 2005; Cook, Polgar, & Hussey, 2008). For individuals with learning disabilities (LD), in the context of expectations for writing, AT may be sought to provide access to preliterate writing activities such as scribbling, copying letters, and writing one's name. Or, it may involve interventions that seek to compensate for poor handwriting by altering the task from writing by hand to keyboarding or dictation.

Table 2 illustrates a range of strategies and technology tools that might be used by students who struggle with the physical process of text production (Edyburn, 2013). In general, these types of problems and interventions are quite common in the field of AT (Sadao & Robinson, 2010; Sitko, Laine, & Sitko, 2005). One explanation points to the preponderance of occupational therapists involved in the evaluation and provision of AT. Occupational therapy interventions tend to involve therapy to teach or reteach handwriting skills or provide instruction on how to use compensatory approaches to overcome access barriers associated with poor fine motor skills.

However, in the new age of Common Core State Standards (CCSS) for English Language Arts (ELA) *(http://www.corestandards.org/the-standards/download-the-standards)*, the term *writing* refers to much more than the physical act of writing on paper. Writing is viewed as a complex metacognitive skill that requires an individual to express him or herself in a manner that makes thinking visible (Torrance & Galbraith, 2006). The importance of helping students achieve higher writing standards has contributed to a variety of new resources to assist teachers in designing classroom writing projects that incorporate technology and writing strategy instruction to meet the new ELA standards (Herrington, Hodgson, & Moran, 2009; Hicks, 2013; National Writing Project, 2010; Owocki, 2013; Stephens & Ballast, 2010).

Since diverse students in every classroom will demonstrate a range of skills, abilities, and weaknesses relative to writing, one promising tactic for providing technology tools for students with LD involves embedding support tools into the curriculum using principles of Universal Design for Learning (UDL) (Rose & Meyer, 2002). That is, the kinds of tools that have been found useful for helping some students with disabilities who have

**TABLE 1. Preacademic Milestones in Children's Development as Writers**

| Preacademic Skill | Impact on Academic Skill |
|---|---|
| Child grasps writing instruments; scribbles | Child learns that writing instruments produce marks |
| Child holds writing instruments with fingers; scribbles | Child develops fine motor skills and intent to communicate |
| Child imitates specific strokes in isolation | Child learns skills necessary for forming letters |
| Child traces or copies from models that combine strokes to form letters or numbers | Child learns how to produce forms that can be recognized as letters or numbers |
| Child writes letters or numbers without a model | Child learns to produce letters without a model |
| Child writes letters in combination; left to right sequence | Child learns to write complete words |

Adapted from: Edyburn, 2013, p. 268.

**TABLE 2. Assistive Technology Interventions for Students Who Struggle to Communicate in Print Because of Difficulties in the Handwriting Process**

| Instructional Challenge | Strategy | Technology Options |
|---|---|---|
| A student has difficulty writing legibly and/or efficiently. | Provide an adapted writing instrument such as a pencil grip. | The Pencil Grip<br>http://www.thepencilgrip.com/ |
| | Allow the student to keyboard assignments instead of writing by hand. | Handheld computer<br>Laptop computer<br>Tablet computer |
| | Use speech to text tools (dictation) to bypass the hand-generation of text. | Dragon Naturally Speaking<br>http://www.nuance.com/dragon/ |
| | | iDictate<br>http://www.idictate.com |
| | | Speak-Write<br>http://www.speak-write.com |

difficulties with writing may also have application for many other students. Since we do not typically know in advance which students will benefit from which tools, it is appropriate to introduce all students to a wide range of tools and observe how the tools affect academic performance.

For some students, technology tools will serve as a temporary scaffold to be abandoned once the skill is acquired and developed to a level of automaticity. Other students may become reliant on the tool finding that they need a specialized tool whenever they complete a specific task. Whereas some educators and parents may find this dependency alarming, we must remember that all professionals are dependent upon some sort of productivity tool (i.e., carpenter–hammer; scientist–microscope; accountant–spreadsheet). The ultimate goal is to aid each student in finding a collection of tools that supports exceptional writing performance so that writing is not viewed as an aversive activity.

Space limitations prevent focusing on the entire writing process and the role that technology can play in supporting struggling writers. As a result, the purpose of this article is to highlight three specific tasks that are particularly troublesome for students with learning disabilities: learning to engage in regular writing, planning, and preparing a first draft. The goal is to provide readers with resources that will inform both research and practice.

### Evidence-Based Interventions

Teachers and administrators are increasingly expected to implement evidence-based practices in the classroom as a tactic for raising academic achievement. Therefore, it is relevant to briefly summarize the research concerning effective writing instruction (see Table 3). Understanding general principles about effective writing instruction established through research will help teachers utilize tools effectively when there is an absence of research about the efficacy of a specific technology product.

Teachers and administrators interested in accessing the latest research findings are encouraged to consult What Works Clearinghouse *(http://ies.ed.gov/ncee/wwc/)* and the practical companion website: Doing What Works *(http://dww.ed.gov)*. Additionally, recent meta-analysis syntheses by John Hattie (2012) provide an accessible guide for teachers and administrators interested in interventions that positively impact student academic achievement.

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**TABLE 3. Summary of Research Concerning Effective Writing Interventions**

| Research Findings | Source |
|---|---|
| Meta-analysis demonstrated a medium effect size (d=0.50) when students used technology in their writing; gains significantly greater than when they wrote using paper and pencil. | Goldberg, Russell, & Cook, 2003; MacArthur, 2009 |
| Teachers need to provide specific strategy instruction if students are going to improve their writing. | Gersten & Baker, 2001; Graham, MacArthur, & Fitzgerald, 2013 |
| Large effect sizes have been found for writing instructional programs that involve collaboration with teachers (d=0.76) and with peers (d=0.70). | Gersten & Baker, 2001 |
| Assistive technologies that provide alternative access to writing are helpful for some students. | MacArthur, 2009 |

**TABLE 4. Instructional Technology Interventions for Daily Writing**

| Instructional Challenge | Strategy | Technology Options |
|---|---|---|
| Students are unable to focus their attention and mind to engage in writing. | This site provides a single word prompt; the writer has 60 seconds to write about it. | Oneword http://oneword.com/ |
| | This site sends you a friendly email asking, "How did your day go?" that serves as a daily writing prompt. | OhLife http://ohlife.com/ |
| | This site is a free online digital journal. Daily journaling is a great way to develop writing skills. | Penzu http://penzu.com/ |
| | This site sends a weekly creative writing challenge. Students are asked to write a 100-word response that is posted to a public blog. | 100 Word Challenge http://100wc.net/ |

### Developing the Mindset to Write Daily

To develop the cognitive skills to transfer ideas from the mind to paper or screen, teachers often engage students in a daily writing task such as journaling or responding to prompts or story starters. Table 4 provides a variety of technology-based strategies and tools for helping students develop the mindset for practicing short periods of daily writing.

Over time, daily writing practice helps writers develop their skills and confidence in ways that silence the critic inside of their heads. The long-term benefit of daily writing activities is to help students acquire the skills necessary to think, compose, and organize their thoughts, and capture them on paper or screen. Whereas teachers and parents may be tempted to focus exclusively on the content of the daily writing, the real value of these activities is that they develop habits of the mind that promote thinking and executive functioning. When students regularly engage in the process of writing, they have the potential to develop written fluency through the automaticity of the skills associated with idea generation, handwriting or keyboarding, spelling and punctuation, work habits, and confidence as a writer. Speelman and Kirsner (2005) note that exceptional executive functioning is dependent on the mastery of the discrete skills to free cognitive energy for higher order thinking tasks. As a result, students with LD who fail to achieve success with the component skills, and learn how to integrate them, will find all phases of the writing process to be challenging. Daily writing is an important developmental step in the process of becoming an effective writer.

### Planning

Many students mistakenly believe that the majority of time spent on a writing project should be spent on writing a draft. However, when more time is spent preparing to write, the actual time spent writing is often reduced.

Historically, teachers have instructed students about how to use an outline to help them plan their writing. However, most adults readily admit that they waited to write their outline until after they completed writing their paper. Why is that? Jimmy writes the outline for his dinosaur report after he writes the report itself because it is not until *after* the paper is written that he understands the subtopics, sequence, and relationships. It is sad that our parents and grandparents will also admit to writing their outline after their report was completed. Isn't it time we recognize that outlines are a prewriting tool for experts and that novices need different types of tools to plan their writing?

Table 5 summarizes a variety of technology tools that support brainstorming and planning for a writing project. An

**TABLE 5. Instructional Technology Interventions for Planning**

| Instructional Challenge | Strategy | Technology Options |
|---|---|---|
| Students struggle to plan the focus of their writing because they do not understand their topic or the subtopics at the outset. | Provide students with digital planning tools that support the active manipulation of visual information. | Cmap http://cmap.ihmc.us/ |
| | | Draftbuilder http://www.donjohnston.com |
| | | Inspiration http://www.inspiration.com |
| | | Kidspiration http://www.inspiration.com |

important consideration for twenty-first century learners is the use of graphic organizers to brainstorm ideas in a visual format (DiCecco & Gleason, 2002; Grant, 2009; Lorenz, Green, & Brown, 2009; Rock, 2004).

Graphic organizers allow the learner to capture ideas as they emerge and then to alter the organization of the information as he or she gains new insights about the sequence of ideas, relationships, and, ultimately, what to exclude. The visual manipulation of ideas is an active planning process. It should be noted that these tools automatically generate an outline based on the graphic organizer that is created. As a result, students can toggle back and forth between the linear (outline) format and the graphical format. Once students learn the process of brainstorming and graphic organizers, they will be able to apply this strategy to the proverbial "back of the napkin" as they capture their ideas and inspiration.

### Preparing a First Draft

The task of preparing a first draft is a painful process for all writers. Part of the problem that inexperienced writers face is that they cannot observe the cognitive process of playing with thoughts and trying to record them on paper or screen. The hardest part of writing is getting ideas from one's head to paper.

Today, most professionals compose all of their written work using a word processor. However, this is not necessarily true in all schools due to insufficient technology infrastructure and a lack of understanding about the efficacy research on writing. Table 6 provides a summary of the many kinds of technology-based writing tools that can be used to support student writers as they write.

Up to this point, researchers have been overly concerned about measuring the efficacy of specific writing tools with inadequate attention to the features that make various word processors similar or different. And, given the rate of change in the marketplace, it is probably unreasonable to believe that researchers will establish the unique contribution of any one product to a student's writing performance. As a result, it may be most appropriate to de-emphasize our interest in a specific tool and simply allow students to select from a menu of writing tools and help them explore the options that are available. The ultimate goal is not to ensure that diverse learners all use the same tool but rather regularly use a word processor to write.

### Future Research

Whereas research has provided significant insights into how assistive and instructional technology can be used to enhance

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**TABLE 6. Instructional Technology Interventions for Writing a Draft**

| Instructional Challenge | Strategy | Technology Options |
|---|---|---|
| Students need a writing environment that is more flexible than drafting on paper. | Use a standard word processor to type the first draft of their paper or report. | Microsoft Word<br>http://office.microsoft.com |
| | | LibreOffice<br>http://www.libreoffice.org/ |
| | Use a specialized word processor that offers word prediction and audio support. | Co:Writer<br>http://www.donjohnston.com |
| | | WordQ<br>http://www.goqsoftware.com |
| | Use a collaborative word processor to allow two or more students to co-author a paper or report. | Google Drive<br>http://drive.google.com |
| | Use a word processor that offers a simplified interface to reduce the cognitive demands on the writer. | Max's Toolbox<br>http://shop.fablevisionlearning.com/maxs-toolbox/ |
| | Use a word processor that features both pictures and text to support emergent writers. | Clicker6<br>http://www.cricksoft.com |
| | | PixWriter<br>http://www.suncastletech.com |
| | Use dictation software/services to dictate the first draft in order to bypass problems in handwriting, poor keyboarding skills, or frustration in spelling correctly. | Dragon Naturally Speaking<br>http://www.nuance.com/dragon |
| | | iDictate<br>http://www.idictate.com |
| | | Speak-Write<br>http://www.speak-write.com |

the writing process, there is much more to be learned. Below are some important lines of scholarly inquiry for future research:

- New models of writing activities that focus on writing for digital communication, such as digital social studies (Bedard & Fuhrken, 2013) and scripts for animated movies *(http://goanimate4schools.com/)*, rather than word processing to print paper-based reports.
- Improved models of writing assessment (Olinghouse & Santangelo, 2010) that are more sensitive to students' ability to author complex texts.
- Understanding the multi-faceted interaction of multilingual students, writing tools, and writing outcomes (Graves, Valles, & Rueda, 2000; Silio & Berbetta, 2010) and the need for product design that includes AT or universal design features that support culturally and linguistically diverse students.

## Conclusion

The ability to write clearly and effectively is considered one of the most important outcomes of education. However, students with LD struggle to achieve these outcomes because of the many ways in which their disability may have an impact on the many sub skills (i.e., handwriting, spelling, vocabulary, language) that must be simultaneously managed with metacognitive resources.

Parents and educators must be fervent in searching for technology-based writing tools that assist, scaffold, and support student writers in each phase of the writing process. One characteristic of the Information Age is that there are more tools available than ever before. While we know a great deal about instructional interventions concerning learning to write, much more remains to be discovered concerning the combination of writing technology tools that will allow struggling writers to find pleasure in the writing process such that they will willingly engage in the difficult, but rewarding process of thinking on paper and communicating through media.

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