

Beyond the Keyboard: A Review of Speech Recognition Technology for Supporting Writing in Schools

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Speech Recognition (SR) has been used as a technology tool to support students with writing, but how has student use of SR been documented in schools and to what extent has it been studied? This article presents a review of thirteen empirical studies conducted between 1995 to 2018 on the use of SR in K-12 and higher education environments. The goals of this paper include: (a) identifying the research designs and methods researchers have used, (b) understanding how SR has been used by students and (c) learning about the impact of SR on student writing ability. Results indicated that researchers have used a variety of research designs and methods to study outcomes of SR use. Overall findings suggested that SR can support students by offering a means to improve the quality and fluency of their writing. An important implication of this study was that students can use SR as an alternative medium to compose text while learning new writing strategies. This is crucial, since the way in which a student completes a writing task can influence their outcome of success, and SR provides students will yet another way to learn how to write beyond using a keyboard or pencil and paper.

Keywords: speech recognition, dictation technology, speech-to-text, writing, school, literature review

Introduction

In the past few decades the proliferation of digital devices has changed how we write. We are more likely to type on a keyboard than to write on paper ([Warschauer, Zheng, & Park, 2013](#)). The shift from using physical tools like paper and pen, to using digital tools such as laptops and tablets, has given us ready access to tools that can change how we write and support the process of generating written text ([Goldberg, Russell, & Cook, 2003](#); [Lenhart, Arafeh, & Smith, 2008](#); [Rogers & Graham, 2008](#)).

Writing matters. Little doubt exists that writing ability is key to student success in school, college, and career ([Graham & Hebert, 2010](#)) and may be one of the most important skills for enhancing the quality of life of students ([Dymond et al., 2006](#)). With the increasing prevalence of communication using digital tools, writing competence is expected in an increasing amount of job roles ([Graham, 2013](#)). Today's students are entering a knowledge-based economy in which the majority of jobs demand extensive written communication ([Trilling & Fadel, 2009](#)). Entry-level jobs now require a higher level of literacy skill than they did in the past decade and this trend is accelerating ([Gordon, 2009](#)).

Despite the importance of writing, there are significant concerns about literacy education in our K-12 schools. The National Assessment of Educational Progress (NAEP), also known as 'the nation's report card' asserted that roughly 75% of 8th and 12th graders were not proficient in writing ([National Center for Education Statistics, 2012](#)). This is not much of an improvement from the NAEP 2007 results, which showed roughly 70% of eighth-grade and twelfth-grade students performing at or below the basic level in writing ([National Center for Education Statistics, 2008](#)). Studies of writing instruction in elementary, middle and high schools indicated that little time was spent teaching writing, students were not engaged in academic writing, and students were frequently not using computers to write ([Applebee, 2011](#); [Brindle, Graham, Harris, & Hebert, 2016](#); [Gilbert & Graham, 2010](#)).

Features of digital environments support the writing process

Technology tools can play a pivotal role in helping struggling writers ([Lee, 2011](#); [MacArthur, 2009](#)). The flexibility of digital environments empowers students to use various features and to “design” their own personalized writing tools ([Bray, 2013](#)). When using word processing applications (e.g., Google Docs) we can avail of many options for customization that facilitate drafting text ([Goldberg et al., 2003](#); [Rogers & Graham, 2008](#)). For example, we can easily modify the font, size, color and spacing of words. Writers can also overcome challenges associated writing on paper, transcending issues of handwriting. Using digital tools, writers can capture thoughts and edit them dynamically (e.g., cut and paste to reorganize text) and overcome issues with illegible handwriting. In addition to modifying the physical look of written text on screen, digital environments offer built-in features to support writers during the various stages of the writing process. Word prediction tools facilitate the flow and can help individuals with spelling. Grammar and spell check can help identify errors and make editing a less tedious process. Using text to speech, writers can listen to what they have written, a helpful feature during the editing process. With the click of a few buttons, writers can share their work with colleagues who are provided a number of constructive feedback features that facilitate commenting and making in-text suggestions. These technology based supports for writing can provide helpful writing support for any who need it ([MacArthur & Cavalier, 2004](#)).

Speech recognition technology

Speech Recognition Technology (SR) is a powerful tool that is built into the operating systems of computers and mobile devices ([Hwang, Shadiev, Kuo, & Chen, 2012](#); [Shadiev, Hwang, Chen, & Yueh-Min, 2014](#)). SR (also referred to as voice recognition technology) enables a person to control their computer with their voice rather than via the keyboard. The most common uses of SR are ‘command and control’ and ‘dictation’ ([O’Hare & McTear, 1999](#)). With command and control, the user can initiate commands, to navigate between apps, perform a search for specific information or set a timer. With dictation, users can compose digital text on screen by speaking aloud. In the past few decades, SR has been used extensively in the medical and legal professions ([O’Hare & McTear, 1999](#)) and has been used for individuals with physical limitations preventing them from typing. In this review, the authors focus on the use of SR for writing compositions, as opposed to generating small amounts of text for a web search or text message. The goal of the study is to better understand how this technology can help students to become more proficient writers.

Although some research exists on the use of SR for writing in educational settings, most studies focused on students with learning disabilities ([Lee, 2011](#)). More information is needed on the ways this tool can support writing for a variety of learners ([Haug & Klein, 2018](#)). Research in educational settings showed that SR can assist students in developing writing proficiency by increasing spelling accuracy ([Mader, 2007](#); [Raskind & Higgins, 1999](#)) and writing speed ([Snider, 2002](#)), while also allowing students to create significantly longer and more fluid pieces of writing ([Quinlan, 2004](#); [R. Roberts, 1999](#)) with more mature vocabulary and less anxiety ([Higgins & Raskind, 1995](#); [Millar, McNaughton, & Light, 2005](#)). Researchers have observed that students using SR wrote higher quality essays ([MacArthur & Cavalier, 2004](#); [Mader, 2007](#)). Evidence also showed that SR increased student confidence in writing ([Toll, 2014](#)), which can thus increase motivation to write ([Hwang et al., 2012](#); [Shadiev et al., 2014](#)). The benefits of SR are amplified by its connection with other features of digital writing spaces such as text-to-speech (TTS), allowing writers to easily read what they have written.

Purpose and research questions

The purpose of this research review was to examine the literature on SR as a support for the writing process. This review included empirical studies and dissertations that examined the use SR technology in elementary, secondary and postsecondary settings. We examined the extant literature guided by the following research questions:

1. Which research designs and methods have researchers used to investigate use of SR technology to support writing of K-12 and postsecondary students?
2. How has SR technology been used to support writing for K-12 and postsecondary students?
3. What are the effects of using SR technology for supporting writing of K-12 and postsecondary students?

Methods

Search procedures and inclusion criteria

To identify articles for this literature review, we searched using educational databases including Academic Search Complete, ERIC, PsycInfo, and Proquest. In the databases, we used the following primary keywords for the search:

“dictation technology”, “speech-to-text”, “speech recognition” and “voice recognition”. With each of these primary keywords we included secondary keywords including: “K-12”, “school”, “education”, and “writing”. The search results in 148 studies. After reviewing the titles and abstracts of these studies, 20 studies were selected for further review to determine if the studies met all for the following inclusion criteria:

1. Studies published in peer-reviewed English language journals or doctoral dissertations
2. Studies that were published prior to September 2018, when the search took place.
3. Studies that investigated the use of SR as part of the writing process (plan, draft, revise, edit, share) in educational settings. The independent variable needed to be SR and the dependent variable had to relate to the writing process.
4. Studies that were empirically based and used experimental, mixed methods, qualitative, and single subject research designs.
5. Studies that had a sample of K-12 or post-secondary students.

As part of our search, we also conducted an ancestral search using the reference section of previous literature reviews on this topic (e.g., Shadiev et al., 2014) to check if we included all possible articles. . Consequently, we identified total of 13 studies that met the inclusion criteria for this literature review. These studies included four doctoral dissertations ([Lee, 2011](#); [Mader, 2007](#); [K. Roberts & Stodden, 2005](#); [Snider, 2002](#)) and nine articles published in peer reviewed journals ([Day, 1995](#); [Higgins & Raskind, 1995, 1999](#); [MacArthur & Cavalier, 2004](#); [Millar et al., 2005](#); [Raskind & Higgins, 1999](#); [R. Roberts, 1999](#); [Wetzel, 1996](#)).

Coding procedures and inter-rater reliability

The 13 qualifying articles are identified in Tables 1 and 2. A coding sheet was developed using Excel to code each article. First of all, we discussed and determined the coding categories that we were looking for based on our research questions. This discussion ensured that we had a shared understanding of the information we would be focused on in each study. Based on the discussion, we decided to have the following eight coding categories: research design, participants, setting, duration, SR type, SR use, dependent variables and key findings. In order to evaluate inter-coder agreement, three coders were trained and independently coded 3 articles (23%) selected at random. Inter-rater reliability was calculated using the following formula: number of agreements/number of agreements plus disagreements \times 100. Reliability, the percentage of agreement across codings, was calculated to be 95%, an acceptable level of agreement reported for literature reviews ([Orwin, Cooper, & Hedges, 1994](#)). The coders reconciled all discrepant codes by reaching consensus after a discussion on those areas.

Table 1
Design and Participants

Study	Design	Participants
(Day, 1995)	Repeated Measures	3, ages 19 -36
(Higgins & Raskind, 1995)	Experimental	29, higher ed
(Higgins & Raskind, 1999)	Experimental	52, k-12
(Haug & Klein, 2018)	Experimental	45, grade 5
(Lee, 2011)	Single Case	4, grades 3-5
(MacArthur & Cavalier, 2004)	Repeated Measures	31, grades: k-12
(Mader, 2007)	Mixed Method	3, grades: 6,7,9
(Millar, McNaughton, & Light, 2005)	Single subject	3, higher ed
(Raskind & Higgins, 1999)	Experimental	39, grades: k-12
(Roberts & Stodden, 2005)	Mixed Methods	15, ages: 19-55

(Roberts, 1999)	Experimental	12, grades 5-8
(Snider, 2002)	Experimental	16, post secondary
(Wetzel, 1996)	Exploratory Case	3, grades 5-6

Table 2
Design and Participants

Category	Findings
Design	5 experimental designs, (Haug & Klein, 2018; Higgins & Raskind, 1995; Higgins & Raskind, 1999; Raskind & Higgins, 1999; Snider, 2002) 2 single-subject designs (Lee, 2011; Millar, Mcnaughton & Light, 2005) 1 exploratory design (Wetzel, 1996), 2 mixed methods designs (Mader, 2007; K. Roberts & Stodden, 2005) 2 repeated measures designs (Day, 1995; MacArthur & Cavalier, 2004)
Participants	246 total participants (155 males, 91 females) across all studies. Of studies that reported ethnicity, 75% were caucasian. 12 of the 13 studies focused on kids that were reported to have learning disabilities. 2 articles included information about the socioeconomic status of participants (SES) and they varied from lower to upper-middle class families.
Setting	12 studies took place in the U.S., 1 in Canada (Haug & Klein, 2018). Study sites included universities, community colleges, high schools, middle schools, elementary schools, learning centers, and reading clinics. Student writing sessions took place in classrooms, computer labs, libraries, and break-out rooms. Durations of writing sessions varied from 45-50 min and were conducted bi-weekly or weekly and lasted between 2-16 weeks.
SR Type and Use	Dragon Dictate (Day, 1995; Higgins & Raskind, 1995). Dragon Naturally Speaking (Haug & Klein, 2018; Lee, 2011; MacArthur & Cavalier, 2004; Mader, 2007; Millar et al., 2005; K. Roberts & Stodden, 2005) Voice Type (Higgins & Raskind, 1999; R. Roberts, 1999; Snider, 2002; Wetzel, 1996)
Dependent Variables	Recognition accuracy, total words written, maturity of vocabulary, frequency of varied vocabulary, holistic quality, number of multisyllabic words, time, text production rate, number of elements of the genre, coherence, number of pieces
Key Findings	Student's fluency of writing increased when using SR compared to when using paper and pencil (Lee, 2011; R. Roberts, 1999) and typing (Snider, 2002). SR improved the quality of written compositions (Day, 1995; Higgins & Raskind, 1995; MacArthur & Cavalier, 2004; Mader, 2007; Snider, 2002). Student's use of SR for writing improved that student's ability to read and correctly spell words when handwriting (Higgins & Raskind, 1999). SR use allowed students to focus more on content generation than mechanics (Higgins & Raskind, 1995; MacArthur & Cavalier, 2004; Mader, 2007; Millar, 2005)

Results

In [Table 1](#) and [2](#) we report results for our 3 research questions. Table 1 includes information related to research questions 1 and 2. Table 2 presents overall findings based on the studies reviewed.

Overall features of the studies

[Table 1](#) summarizes information related to the design and participants of each of the 13 studies included in this review. Studies were published between 1995 and 2018. Each study described the use of SR for writing with students in K-12 education and postsecondary settings. Eight of the studies (61%) involved students in K-12 ([Haug & Klein, 2018](#); [Higgins & Raskind, 1999](#); [Lee, 2011](#); [MacArthur & Cavalier, 2004](#); [Mader, 2007](#); [Raskind & Higgins, 1999](#); [R. Roberts, 1999](#); [Wetzel, 1996](#)) and five of studies involved students in postsecondary settings ([Day, 1995](#); [Higgins & Raskind, 1995](#); [Millar et al., 2005](#); [K. Roberts & Stodden, 2005](#); [Snider, 2002](#)).

There were a total of 246 participants (155 males, and 91 females) across all studies. More than half of the studies (7 of 13) did not report participants' ethnicity. Of those that did report ethnicity, caucasian was by far the most in each study. Of the total amount of students with reported ethnicity, 75% were caucasian. One study ([Haug & Klein, 2018](#)) focused on students in a general class setting, the remaining 12 of the 13 studies focused on kids that were reported to have learning disabilities. Eight of the 13 studied did not provide any socio-economic data (SES). Three of the thirteen articles included information about the socioeconomic status of participants (SES) and they varied from lower to upper-middle class families. Two studies ([Haug & Klein, 2018](#)) provided schoolwide SES data, which varied from a poor district with free and reduced lunch status.

All of the studies took place in the U.S. with one study taking place in Canada ([Haug & Klein, 2018](#)). The studies were conducted at universities, community colleges, high schools, middle schools, elementary schools, learning centers, and reading clinics. Student writing sessions took place in classrooms, computer labs, libraries, and break-out rooms. The durations of writing sessions varied from study to study. Most writing sessions lasted between 45-50 min and were conducted bi-weekly or weekly and lasted between 2-16 weeks. In one study that used an experimental design ([Haug & Klein, 2018](#)), students received a pre-and post test that lasted 35 min. In each of the studies, students were required to train the technology to better understand their voice.

RQ1: Research designs and methods

Research designs included 8 quantitative designs (5 experimental, [Haug & Klein, 2018](#); [Higgins & Raskind, 1995](#), [1999](#); [Raskind & Higgins, 1999](#); [Snider, 2002](#)) and 2 single-subject designs ([Lee, 2011](#); [Wetzel, 1996](#)). Additional research designs included an exploratory design ([Wetzel, 1996](#)), two mixed methods designs ([Mader, 2007](#); [K. Roberts & Stodden, 2005](#)) and two repeated measures designs ([Day, 1995](#); [MacArthur & Cavalier, 2004](#)). The rigor of these research designs varied. Haug and Klein's ([2018](#)) study used a true-experimental design with random selection, also known as a randomized controlled trial (RCT), the type of study cited as the highest standard for research on the effectiveness of a treatment or practice ([Baron, 2004](#)).

RQ 2: How speech recognition was used

SR use was organized by two categories: (a) the type of SR used and the (b) the way it was used (See Table 1). Two studies used only Dragon Dictate ([Day, 1995](#); [Higgins & Raskind, 1995](#)). Six studies used only Dragon Naturally Speaking ([Haug & Klein, 2018](#); [Lee, 2011](#); [MacArthur & Cavalier, 2004](#); [Mader, 2007](#); [Millar et al., 2005](#); [K. Roberts & Stodden, 2005](#)) and five studies used only Voice Type ([Higgins & Raskind, 1999](#); [R. Roberts, 1999](#); [Snider, 2002](#); [Wetzel, 1996](#)). In the study by ([Higgins & Raskind, 1999](#)) all three of the programs mentioned above were used.

One study of the 13 focused on student use of SR to transcribe texts ([Millar et al., 2005](#)), while the other 12 studies focused on student use of SR to compose (draft). The studies that focused on drafting compositions included a variety of diverse writing tasks. Some studies offered little structure for what was expected and allowed students to self-select their topics ([Higgins & Raskind, 1995](#))([Higgins & Raskind, 1999](#); [Raskind & Higgins, 1999](#)) while other studies provided students with a topic or a selection of topics. Students were asked to draft narratives ([Lee, 2011](#); [Wetzel, 1996](#)), argumentative essays ([Day, 1995](#); [Haug & Klein, 2018](#); [MacArthur & Cavalier, 2004](#)), expository essays ([K. Roberts & Stodden, 2005](#); [Snider, 2002](#)), and stories ([Mader, 2007](#); [R. Roberts, 1999](#)). In a number of studies the writing prompts closely mirrored the ones found on standardized exams ([Higgins & Raskind, 1995](#)). The amount of writing with SR required by students varied from a single draft, to three drafts, to six drafts. In the one

study focused on transcription, students read texts from college textbooks by speaking them aloud into a word processor ([Millar et al., 2005](#)).

RQ 3: Effects of using speech recognition for writing

In Table 2, we present an overview of the findings across 13 studies. Key findings focused on the impact of SR on the quality and fluency of written compositions as well as some noted implications for practice.

Implications or Discussion

In this review of SR in K12 and postsecondary school settings, we examined both the research process and the findings of 13 studies that met inclusion criteria. While these studies mostly characterized SR as a promising technology to support student writers, certain variables that seemed to impact the effectiveness of SR were further examined. These included user characteristics and prior writing ability.

One variable is the user's characteristics and prior writing abilities ([MacArthur & Cavalier, 2004](#); [K. Roberts & Stodden, 2005](#)). An example of this was in MacArthur and Cavalier's (2004) study, where students that were identified as "fluent writers" based on their handwriting ability appeared to benefit less from using SR than students identified as "struggling writers". Also, students with spelling issues, for instance, seemed to receive a substantial gain ([K. Roberts & Stodden, 2005](#)) when compared to students who were good spellers.

Another variable is the error rate of SR vs typing. Findings were inconsistent, with one study finding reduced error rates with SR ([Mader, 2007](#); [R. Roberts, 1999](#)) and other finding the opposite ([Millar et al., 2005](#)). An explanation for this discrepancy may be that students did not anticipate the need to correct recognition errors before submitting their work, whereas others did ([Arcon, Klein, & Dombroski, 2017](#)). Error rate may also have changed as SR technology has become increasingly accurate as the technology has improved and evolved. Modern versions of SR are increasingly accurate in recognizing young students' voices and dealing with varied accents, whereas older versions of the technology were more likely to generate recognition errors ([Haug & Klein, 2018](#); Nuance Communications, 2010). For this reason, It is necessary to consider the limitations of the technology when drawing conclusions about error rates.

Limitations

There are several limitations to this review of literature on SR. Findings were based on 13 empirical articles, a relatively small set of studies. Most of the studies included in this review focused on participants that were reported to have learning disabilities. Only one study among our 13 ([Haug & Klein, 2018](#)) focused on students in a general class setting. Having a broader sample of students would increase transferability to the general population.

A third limitation is that the publication dates of these studies are spread over a period of 20 years where the technology being studied has evolved drastically. The first six studies reviewed were published in the late 90's, when SR became available through commercial software products used in these studies ([Day, 1995](#); [Higgins & Raskind, 1995](#); [Raskind & Higgins, 1999](#); [R. Roberts, 1999](#); [Wetzel, 1996](#)). The next five studies were published between 2000 and 2010 when SR technology was gradually developing and improving, but was still costly to purchase and limited to powerful workstation computers ([MacArthur & Cavalier, 2004](#); [Mader, 2007](#); [Millar et al., 2005](#); [K. Roberts & Stodden, 2005](#)). The most recent two studies ([Haug & Klein, 2018](#); [Lee, 2011](#)) were published during a time when SR has been incorporated into the operating systems of the phones and tablet computers, playing a pivotal role in widening the user population, and offering much more flexibility for when and where people can use SR. Additionally, the technology has transformed to include a much more refined user interface with improved predictive capabilities, faster transcription speed, decreased recognition error rates, and a reduced learning curve for use ([Huang et al., 2014](#)).

Recommendations for further research

Despite the promising outcomes reported by researchers in the 90's and early 2000's and rapid improvements in SR due to technological advancement, over the past decade, research on SR has been relatively limited. One explanation for the lack of recent studies on SR may be an assumption by researchers that SR is already well understood and effective ([Haug & Klein, 2018](#)). However, according to Peterson-Karlan (2011), SR is still far from being considered an evidence-based practice to support writing due to the scant number of high-quality experimental and single-

subject design studies conducted on the topic. Additionally, the technology has been rapidly advancing ([Xiong et al., 2017](#)), creating new opportunities for exploration by researchers. One area in particular that merits exploration is the integration of SR into the operating systems of mobile devices such as phones and tablet computers.

When studying SR, researchers should go beyond applying a “clinical” lens that views SR as an assistive tool for students labeled with learning disabilities. Instead, researchers should investigate the effectiveness of SR as a feature of everyday digital writing spaces through a “neurodiversity perspective” in regular all-inclusive type classes. A promising lens for examining SR could be Universal Design for Learning (UDL). UDL is a framework that focuses on how students learn (Gordon, Rose & Meyer, 2014). The application of this framework provides all students with access to tools that can support their learning. Through this lens, we can see that students who used SR were able to benefit from a more accessible approach to writing beyond a keyboard or pencil and paper. This evidence supports the notion that the way in which a student completes a writing task influences their outcome of success. This research direction is aligned with recommendations by the Center for Applied Special Technology (CAST, 2004) and could be used to identify the effectiveness of SR with a wider population of students to increase the generalizability of the results.

The bulk of the studies included in this review focus primarily on using SR for composition writing instead of examining its effect of various stages of the writing process (planning, revising and editing). Proven strategies, such as using a writing process approach (Graham, 2010) should be used with the most current versions of SR. Exploratory, single-case research designs similar to ([Wetzel, 1996](#)) would be useful to investigate the outcomes of SR on various stages of the writing process. Doing so might help researchers to more clearly operationalize the use of SR. Researchers should also conduct more studies with true-experimental designs similar to Huang and Klein’s ([2018](#)) study that included random selection in order to systematically expand the knowledge base and instructional practices around how SR can support writing.

Implications for practice

Researchers include a series of suggestions for teachers to better incorporate SR in the classroom. As a starting point, teachers should introduce SR by describing its purpose, modeling its use, and providing guidelines for student use ([Lee, 2011](#)). Students should be given an array of choices to write about that are interesting to them. A suggested initial practice activity is to incorporate SR with reading. Using SR to dictate some lines of text from books students have enjoyed reading can reinforce vocabulary and knowledge of sentence structures while learning to use a new tool in a more structured, non-threatening way ([MacArthur & Cavalier, 2004](#); [Millar et al., 2005](#)). Having background knowledge and experience with the topic makes writing easier. More involved practice activities include writing prompts related to the students’ lives and connected to their interests. For example, a student might bring in a photograph or object to write about. These types of prompts can increase engagement and lessen the struggle of writing. If students prefer not be limited by teacher provided prompts, they should be encouraged to write on topics of their own design ([Higgins & Raskind, 1999](#)). For these types of more involved writing tasks, advance planning such as brainstorming and concept mapping is recommended to support the organization and generation of content ([MacArthur & Cavalier, 2004](#)). Providing opportunities to talk with peers and their teacher throughout the writing process can also be helpful for students in this way.

Teachers can identify students who may especially benefit from the software by certain characteristics such as good oral expression and a positive outlook towards trying new things ([Mader, 2007](#)). Students who have spelling issues and who find it difficult to generate content are also prime candidates for reaping the benefits of SR ([K. Roberts & Stodden, 2005](#); [Wetzel, 1996](#)). Before deciding if SR is an effective tool for them, students should participate in a several instructional sessions and be provided time to practice ([MacArthur & Cavalier, 2004](#); [Mader, 2007](#); [Millar et al., 2005](#)). Direct instruction focused on correction procedures can make great strides in ensuring that students catch and correct their own recognition errors ([Higgins & Raskind, 1999](#); [Lee, 2011](#)).

([Lee, 2011](#)) recommends students to start using SR for writing as early as second grade since that is when they begin creating sentences, but researchers say that students should experiment with writing as early as possible. Young students can start using SR for basic tasks such as generating key words for a simple internet search on a topic or composing a simple text message to a friend. An important implication from the most recent study in this literature review by Haug and Klein (2018) suggests that students can successfully learn to use SR as they are taught new writing strategies (ie. plan, revise, edit, share). When giving instruction on new writing strategies, teachers should treat SR as an alternative medium for students to compose text. Students should be encouraged to choose the medium that works best for them based on the writing task (Haug & Klein, 2018). Teachers should provide students who choose to use SR with a quiet, uncrowded environment. This will minimize recognition errors and distractions, while also eliminating the awkwardness of dictating in front of others and possibly disturbing them ([MacArthur & Cavalier, 2004](#)).

Conclusion

Overall, a review of SR studies revealed how SR can effectively improve writing fluency and quality for students. Students improved in lower level writing skills such as grammar, spelling and text production (Mader, 2007; K. Roberts & Stodden, 2005; R. Roberts, 1999; Wetzel, 1996) as well as higher level writing skills such as generating and organizing ideas, forming fluid sentences, and considering word choice (Higgins & Raskind, 1995; Lee, 2011; MacArthur & Cavalier, 2004; Mader, 2007). Instructing students in the use of this alternative means of writing readily available to them, may be crucial to their success in life considering the great emphasis of writing in today's society.

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