

Writing

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Abstract

Writing is a crucial means of communicating with others and thus vital to success and survival in modern society. This article provides an overview of recent research and key findings about writing, including the roles of cognitive and social processes during writing, and educational research on how to improve writing proficiency. Writing processes rely on virtually all aspects of cognition (e.g., working memory, motivation, affect, self-regulation, prior knowledge, problem solving) and are naturally embedded in social contexts. Social factors include writers' objectives, audience, genre, and mode of writing. For example, the increased use of the Internet has rendered writing for informal purposes more frequent and writing mechanics (e.g., deleting, spell checking) and search for information more efficient. Research on educational interventions to improve writing points to the importance of providing students with instruction and practice using writing strategies, writing practice with feedback (e.g., instructor, automated), and collaborative writing (including peer feedback). The authors recommend that more time be devoted to writing instruction, the need for technology to support teachers and students, and a need for increased funding to support teachers in their efforts to providing writing instruction. Given the inherent complexity of writing, it is important to help students learn how to write across various situations and demands. Therefore, it is vital that students are taught how to write across various situations with varying purposes and demands. This necessitates reading many types of text genres (e.g., narrative vs. informational writing), writing frequently, and revising based on feedback. Over the past two decades, there has been a substantial increase in research on writing processes, including methods to improve writing. However, there remains a substantial need for additional experimental work to understand writing processes as well as more evidence on which types of interventions are most beneficial in helping students to improve their writing. Feedback from both cognitive and sociocultural researchers should inform future revisions of the standardized guidelines and assessments with the long-term goal of developing a clearly defined set of standards for academic excellence in writing.

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Summary

Writing is a crucial means of communicating with others and thus vital to success and survival in modern society. This article provides an overview of recent research and key findings about writing, including the roles of cognitive and social processes during writing, and educational research on how to improve writing proficiency. Writing processes rely on virtually all aspects of cognition (e.g., working memory, motivation, affect, self-regulation, prior knowledge, problem solving) and are naturally embedded in social contexts. Social factors include writers' objectives, audience, genre, and mode of writing. For example, the increased use of the Internet has rendered writing for informal purposes more frequent, and writing mechanics (e.g., deleting, spell checking) and search for information more efficient. Research on educational interventions to improve writing points to the importance of providing students with instruction and practice using writing strategies, writing practice with feedback (e.g., instructor, automated), and collaborative writing (including peer feedback). The authors recommend that more time be devoted to writing instruction, the need for technology to support teachers and students, and a need for increased funding to support teachers in their efforts to providing writing instruction. Given the inherent complexity of writing, it is important to help students learn how to write across various situations and demands. Therefore, it is vital that students are taught how to write across various situations with varying purposes and demands. This necessitates reading many types of text genres (e.g., narrative vs. informational writing), writing frequently, and revising based on feedback. Over the past two decades, there has been a substantial increase in research on writing processes, including methods to improve writing. However, there remains a substantial need for additional experimental work to understand writing processes as well as more evidence on which types of interventions are most beneficial in helping students to improve their writing. Feedback from both *cognitive* and *sociocultural* researchers should inform future revisions of the standardized guidelines and assessments with the long-term goal of developing a clearly defined set of standards for academic excellence in writing.

Keywords

writing, literacy, cognitive, sociocultural, educational, working memory, motivation, self-regulation, strategies, new literacies, technology, computer-assisted writing, automated writing assessment

What is Writing?

Writing can be defined as the use of symbols to convey thoughts or ideas. In particular, it is a translation of thoughts and ideas, sounds, or images into some sort of physical trace. We typically think of writing as something we do with paper and pencil, or a computer, but writing can also be achieved with charcoal on rocks or even paint on a wall. We write almost every day: reminders to ourselves, a note to a friend, an email to a colleague, a report for school or work. Writing affords communication across a community of individuals. We also write to ourselves, to remember things or to consolidate our understandings. We sometimes (but too rarely) write to learn and to help others learn new information. Sometimes writing is a freeform translation of thoughts into words, and in turn into the symbols that communicate those words; other times, writing is a planned and edited translation of thoughts that can help to improve the quality of a communication. Writing can also play an important role in composition, which can involve multiple medias and modes of communication, such as drawings, sound clips, music, and videos.

Writing has been used for at least thousands of years. Sumerians used wedge-shaped characters impressed on clay tablets over 5,000 years ago. For centuries, only the elite few knew the art of writing. In the 21st century, most people know some form of writing. Some estimates indicate that only 12% of the people in the world could read and write two centuries ago, whereas today, the proportion is reversed: only 15-17% of the world population remains illiterate. On the one hand, this is good news. Most individuals across the globe can read and write. On the other, that means that there are over 750 million people who are not literate, and many people do not possess sufficient skills to produce high quality writing. For example, according to the 2011 National Assessment of Educational Progress (NAEP), nearly a quarter (21%) of seniors in the U.S. were unable to meet the standards for basic proficiency in academic writing and only 3% of students performed well enough to be considered advanced writers. Hence, few students in the U.S. show mastery of the writing process. The picture is grimmer for minorities compared to white students (NAEP, 2011), and even more dire in less well-developed countries. In today's society, where reading and writing are crucial to survival, this is a problem that needs to be solved.

Key Questions and Findings in Writing Research

Writing is hard. Writing is also a complex process that involves multiple, interacting *cognitive processes* that are constrained by a host of *sociocultural* factors. One of the challenges of developing models of writing therefore is that a comprehensive theory must involve virtually all aspects of cognition (e.g., memory, motivation), as well as sociocultural aspects of the context surrounding the writer, collaborating writers, and audience (Graham, 2018; McNamara & Allen, 2018; Purcell-Gates, Jacobson, & Degener, 2004). Faced with these inherent complexities, the majority of research has focused on isolated aspects of writing, generally influenced by particular perspectives. In

the following sections, we provide brief descriptions of research and current understandings of principal factors that impact writing processes. We focus on three perspectives on writing (cognitive, social, and educational) that have emerged as central in writing research.

A Cognitive Perspective

Many researchers have adopted a traditional cognitive approach to studying writing from the perspective of the individual, focusing on the impact of writers' cognitive processes during writing and on the final product. One of the most influential cognitive models of the writing process came from Hayes and Flower (1980), who described the individual levels of information processing involved in text production. The model describes interactions amongst multiple *writing processes* (e.g., planning, translating), the *task environment* (e.g., assignment, audience), and information in the writer's *long-term memory* (e.g., topic knowledge). Within each of these components, sub-components are specified relating to writers' actions or knowledge. For example, *writing processes* is divided into four sub-processes: planning, translating, reviewing, and monitoring, which can each be further subdivided.

One of the most important contributions of this model is the idea that writing does not progress linearly: multiple processes are engaged at various points throughout the writing process. For example, a writer may choose to reengage in the planning process after producing certain portions of a text, either for the purpose of reformulating a section or to structure ideas for a new section. Likewise, the writer may iteratively engage in the revision process, updating portions of the text before the entire product has been completed.

A number of years after its conceptualization, Hayes (1996) published an updated version of the model to incorporate recent research on writing and cognitive science. The two most notable differences between the original and revised models were the addition of a working memory (WM) component and an emphasis on writing motivation. These aspects of writing have been the focus of a good portion of research conducted from the cognitive perspective, and thus we describe research on the roles of WM and motivation in the following two sections.

What are the roles of memory and knowledge in writing?

Human memory is often divided conceptually into two parts: the **short-term**, limited-capacity focus of attention and the **long-term**, more permanent memory for events, concepts, and skills (Healy & McNamara, 1995). Working memory (WM), or the short-term, active portion of memory, has served as a centerpiece for many cognitive models of the writing process (Hayes, 1996, 2006; Kellogg, 1996, 2001). For example, in Kellogg's (1996) model, WM capacity must be distributed amongst processes related to planning conceptual content, translating images and propositions into connected sentences, and reviewing the content and text produced. To illustrate this point, researchers have compared writers to computers that have too many programs running in the background (Torrance & Galbraith, 2006) or switchboard operators trying to juggle multiple phone calls (Flower & Hayes, 1980). Essentially, a writer is not capable of

simultaneously processing all of the information that is needed to produce a coherent text, and thus WM can be easily overloaded.

In turn, writing skills and knowledge (from long-term memory) can help to relieve demands on working memory. Text production processes become increasingly fluent as writers develop (Alamargot & Fayol, 2009; Berninger, Abbott, Abbott, Graham, & Richards, 2002; McCutchen, Covill, Hoyne, & Mildes, 1994). Skilled writers are better able to coordinate multiple ideas at the same time (Scardamalia, 1981), and more quickly process information such as potential content, aspects of the writing situation, and language. Greater fluency in these writing sub-skills frees up WM resources while writing (McCutchen, 2000) and reduces the impact of distraction from secondary tasks (Ransdell, Levy, & Kellogg, 2002). As such, lower-level writing processes (e.g., writing words and sentences) may demand less WM capacity as writers develop, such that more cognitive resources can be devoted to higher-level aspects of writing such as rhetorical considerations of genre, audience, and goals (Babayigit & Stainthorp, 2011; Berninger, Cartwright, Yates, Swanson, & Abbott, 1994; Hoskyn & Swanson, 2003; cf. Allen, Snow, Crossley, Jackson, & McNamara, 2014; Jeffrey & Underwood, 1996).

Increased writing skills, knowledge about writing, vocabulary knowledge, and world knowledge can help to increase WM resources. Perhaps more importantly, skills and knowledge are crucial to writing performance. Writers with more knowledge of writing strategies, reading skills, word knowledge, domain knowledge, and world knowledge are better writers, and are more likely to enjoy writing (Allen et al., 2016; Graham, 2018).

What is the role of motivation in writing?

If you are unmotivated to write, then you probably do not write (at least not often). Writing can be a grueling, unpleasant task. Motivation is intrinsically tied to whether the person has sufficient skills and knowledge to complete the task (Schunk, Pintrich, & Meece, 2008; Wigfield, 1994). Motivation can also be linked to internal factors, such as the drive to complete the task, or external factors, such as the goal of obtaining a certain grade in a class. These factors influence the extent to which a person is willing to begin and persist in goal-oriented tasks (Bandura, 1986).

There are several theoretical accounts of motivation (e.g., expectancy value theory; Wigfield & Eccles, 2000; goal theory; Linnenbrink & Pintrich, 2003). Bandura's (1986, 2012) social cognitive theory of motivation focuses on the relations between individual, behavioral, and environmental factors. A crucial individual factor is self-efficacy, which refers to individuals belief in their ability to successfully perform a task. The relations between writing performance and self-efficacy have been extensively studied (Harris & Graham, 2009; Schunk & Zimmerman, 1994), generally showing moderate correlations (Pajares, 2003). Self-efficacy, in turn relates to behavioral factors, such as choices, effort, and persistence (Bandura & Schunk, 1981; Bong, 2001). Environmental factors, such as feedback from others about the quality of writing, can influence self-efficacy for writing and future behaviors.

Self-efficacy is closely tied to self-regulation. According to Zimmerman and Risemberg's (1997) *social cognitive model* of writing, self-regulation refers to a set of cognitive, behavioral, and motivational strategies that individuals use to set, assess progress on, and achieve goals. Writers are assumed to monitor and react to feedback on their self-regulatory strategies used to control their actions, the writing environment, and their internal thoughts and processes (Zimmerman & Kitsantas, 1999). Self-regulatory strategies allow writers to manage and coordinate the complex processes required to successfully complete a written product (Graham & Harris, 2000). Self-regulation can include behaviors as simple as choosing a quiet environment for writing, and as complex as self-evaluation of progress. More proficient writers are assumed to use a wider range of self-regulatory strategies than novice writers.

Motivation, self-efficacy, and self-regulation are tightly related, but they are also unique constructs with independent influences on writing quality (Pajares & Johnson, 1996). Notably, the bulk of the literature on the relations between these constructs and writing are correlational. Individuals who are more motivated, have greater confidence in their writing, and exert more behaviors to control the writing process, are more likely to succeed when writing. These constructs are also related to other more malleable factors such as writing skills and strategies, as well as situational factors such as the context of the writing task. Hence, it is important to avoid the temptation of attributing motivation and self-efficacy to an individual. When the task is intrinsically or extrinsically important, and when the individual possesses the skills, knowledge, and energy to complete the task, then motivation and self-efficacy are likely to follow.

A Sociocultural Perspective

Sociocultural researchers advocate that literacy should be considered within the perspective of the cultural, community, and familial influences of a person's environment (Au, 2000; Purcell-Gates & Tierney, 2009). In contrast with cognitive perspectives that might treat social factors solely as contexts or constraints, sociocultural factors comprise major facets of writing and composition processes: sociocultural processes of composing interact with or *transact* with cognition (Nystrand, 2006).

According to sociocultural perspectives, understanding literacy necessarily requires considering an individual's surrounding environment (Faigley, 1985). A narrow view of literacy (e.g., one that only addresses a subset of a population or context) inherently lacks sensitivity to diversity, sociocultural interactions, and social inequalities within diverse populations. Throughout their lives, individuals develop specific forms of discourse that allow them to participate within their own communities and other communities. Writing, and in particular, composing, is not unidirectional, moving from sender to receiver. Socio-cultural frameworks emphasize considerations of the ways in which the receiver shapes authors' thinking and composition processes (Rowe, 2010). Accordingly, ecologically valid writing theories, assessments, and interventions must take the context and purposes of writing into account as part of the composition process (Newell, Beach, Smith, & VanDerHeide, 2011).

What is the role of context on writing?

The premise that writing (and literacy more broadly) cannot be thought of in isolation of the surrounding environment can largely be attributed to the work of Vygotsky (1978, 1987). He claimed that we cannot understand how humans learn or develop without considering the effects of society and culture. In this view, learning is not simply a passive, independent action; rather, it is constructed in a dialogue involving multiple individuals wherein more knowledgeable or skilled group members (e.g., a tutor) promote and scaffold others' learning.

Drawing upon these ideas, the sociocultural perspective conceives of writing as *situated* within a context, *improvised* (not just produced from templates), *mediated* by social conventions, and *acquired through socialization* within a particular community. For example, there are multiple differences in goals and criteria comparing writing within the classroom, outside the classroom, and in a professional setting. Writing is therefore inseparable from the task context (e.g., genre, objective, sources) and the social environment (e.g., peers, classroom, teachers, co-authors). Genres are conventional structures that reflect the given society within which they are utilized as well as the historical changes and development within specific societies (Bazerman, 1988; Bazerman & Prior, 2005). Cultural practices within particular groups of people also influence individuals' perceptions towards literacy. Cultures differ in the writing tasks that they require, the format of writing that they value, and their perceptions and attitudes towards the audience.

Overall, unlike the cognitive view of writing, sociocultural perspectives suggest that writing is a purpose-driven process that is governed by expectations of a specific community. In turn, students' awareness of differences in rhetorical demands across writing contexts is crucial to the writing process. Factors such as writers' cognitive skills are not necessarily denied, but they are not emphasized (and usually not examined) by sociocultural writing theorists. Writing is informed by a host of factors, including the purposes for engaging in writing, the expectations surrounding these purposes, the writer's knowledge of discourse, the available writing tools and other cultural variables. Together, these influences interact to reflect the social context within which the writer is motivated to communicate through a writing activity.

What is the role of contemporary media on writing?

Society has been profoundly impacted by technological developments, such as computers and the Internet. Contemporary media has had a particularly strong impact on the nature of our writing. The notion of *new literacies* focuses on the ways technology shapes literacy (Kist, 2005, Leu, Kinzer, Coiro, Castek, & Henry, 2013). For example, computers render writing processes (e.g., deleting, spell checking) more efficient and accurate. Further, the Internet makes it easier to search for information, store and search for documents, and use multimedia. The process of writing is intrinsically non-linear. Writers plan, draft, and revise in non-linear fashions. Word processing technologies *combined* with the internet have facilitated and increased, non-linear, intertextual, multilayered, and multimodal writing.

The Internet also engenders a broader range of social practices while writing, including greater communication between co-authors, increased ease in passing documents from one author to another, and online collaborative writing (Fernheimer, Litterio, & Hendler, 2011; McCarthy, Grabill, Hart-Davidson, & McLeod, 2011). Modern mediums increase the rapidity of the writing process: chats are sent instantaneously; emails are exchanged in rapid succession; documents are shared and exchanged hourly. These exchanges compare to sending a note or letter that might arrive days later or typing a manuscript to receive feedback weeks or months later.

Research on new literacies seeks to discover common principles of Internet use, including social practice and multimodality. Modern technological affordances require new and different writing practices, skills, and strategies and raise new requirements and demands in collaboration while writing (Orlikowski & Yates, 2002). Students learn how to write across a wider range of mediums and genres. As such, technological changes call for a more complex research agenda, with a greater focus on the intrapersonal, institutional, and contextual demands that shape writing objectives (Driscoll & Wells, 2012; Leu, Slomp, Zawilinski, & Corrigan, 2016; Slomp, 2012).

New literacies further argue that the modern communication practices and the skills they call upon are not adequately considered among the constructs included in large-scale writing assessments (Slomp, Corrigan, & Sugimoto, 2014; Stagg, Peterson, McClay, & Main, 2011). There has been an increased focus in research on writing outside of school since the 1990s. Yet, current assessments are largely removed from the literacy practices of literate people in modern society. Whereas many situated writing practices represent a blend of forms and sources of knowledge and skills, these factors are not considered within most modern assessments.

The ideas raised by the new literacies field are compelling. Yet, strong empirical evidence is not yet available. For example, it is not clear whether new literacies skills contribute to individuals' writing quality over and above other factors associated with writing skill. Although researchers in this area highlight the importance of specific task and environment factors, basic writing processes are often ignored. Additionally, new literacies research typically promotes the importance of writing genres and skills relevant to real-world tasks, yet they still communicate these ideas using traditional, academic writing, retaining the practice of having introductions, bodies, and conclusions, with claims and evidence. Thus, while many researchers in this area critique the misalignment between traditional assessments on writing and the "real world", they also still engage in the same practices that are traditionally called upon in these large-scale assessments.

Nevertheless, the importance of new literacies is undeniable. From one perspective, it is unlikely that writing tweets and emails transfers to passing a writing exam. However, from another, students may learn to recognize the appropriateness of rhetorical styles across different genres and mediums and increase flexibility in the use of discourse patterns. Capturing differences in writing as a function of genre and modes can contribute to a more comprehensive model of writing. For example, within the genre of persuasive writing, skilled writers do not simply rely on a specific template for high-quality writing each time they produce text. Rather, skilled writers are more flexible in cohesion and rhetorical styles across multiple essays (Allen et al., 2014, 2016, 2018).

Recognition of audience is a critical component of writing skill. Hence, students may become more adept at thinking about audience as they compose texts directed at a variety of audiences.

An Educational Perspective

Both cognitive and sociocultural theories of writing highlight the complexity of the writing process. Individuals learning to write must juggle a number of factors in parallel, ranging from the individual words they choose to the rhetorical demands of their audience. Despite this complexity, however, individuals across the world are expected to develop strong writing skills in order to achieve success in academic settings and the workplace (Powell, 2009). Students are rarely given explicit instruction regarding the most effective writing strategies and processes. Additionally, teachers are often limited in their opportunities to provide feedback on student writing due to limited time and increasing class sizes (National Commission on Writing, 2003).

Recently, writing has received increased attention by researchers, educators and policy makers alike. One impetus was the introduction of the Common Core State Standards (CCSS; National Governors Association & Council of Chief School Officers, 2010) in the U.S.. Unlike many educational standards and assessments in the past, the CCSS place a strong emphasis on students' ability to write proficiently. Therefore, as these standards become integrated into schools, higher expectations are placed on teachers to ensure that their students can write at proficient levels. Sociocultural researchers, on the other hand, provide important insights into the rhetorical demands and sociocultural contexts in which specific forms of writing are most successful.

How do cognitive approaches to writing research inform education?

Cognitive researchers typically examine writing at the level of the individual; hence, findings from studies provide important insights into the most effective methods for remediating writing deficiencies caused by excessive processing demands placed on individual writers. A principal educational concern expressed by cognitive writing researchers is the limited capacity of WM to regulate writing processes (Kellogg, 2008). It is assumed that the problem-solving, knowledge-transforming process only takes place when a writer can direct and control their attention throughout the writing process. Accordingly, successful writing necessitates the coordination of these demands through two primary means: developing automaticity for certain tasks (e.g., typing, decoding) and using appropriate strategies, such as outlining or freewriting (McCutchen, 1996).

Cognitive-based writing interventions tend to focus on techniques that will alleviate demands, such as consistent, deliberate practice (Kellogg & Raulerson, 2007), cognitive apprenticeship (Kellogg, 2008), and explicit instruction and practice of writing strategies (Roscoe et al., 2014; Graham & Perin, 2007a). Such training tasks are assumed to increase automaticity in certain skills and enhance regulation for other, more complex skills. Students can develop automaticity of certain processes through explicit instruction and deliberate practice, which should lead to a reduction in demands on WM resources. Following this reasoning, if certain processes can be automatized (e.g., idea generation or organization), writing strategies should be effective. And indeed, writing strategies, such

as planning and revising allow students to focus their attention on a specific set of writing problems, thus reducing the difficulty of the writing process. In fact, Graham and Perin's (2007) meta-analysis of over 120 writing interventions and supported the assumption that strategy instruction is the most successful form of writing instruction (Crossley & McNamara, 2017).

How do sociocultural approaches to writing research inform education?

Sociocultural researchers are predominantly concerned with the communicative purposes underlying writing tasks and how these may be shaped by societal and cultural influences. Therefore, the majority of interventions within this framework either attempt to engage students in contextualized, real-world communicative activities or provide explicit instruction on discourse properties that are related to a specific community group. Writing pedagogy has commonly focused on the traditional timed, argumentative essay wherein a student is given a question or problem and asked to develop an argument in response. By contrast, sociocultural theories of the writing process have prompted a move in different directions with the emphasis placed on the social nature of writing.

This research agenda moves away from a focus on the individual cognitive processes involved in writing (e.g., WM, problem solving) and more heavily on writing as a communicative device (Van Lier, 2000). Sociocultural researchers, therefore, suggest remediation techniques for writing improvement that include collaboration among peers, peer feedback, collaborative writing activities, and explicit instruction of different genres of writing (especially high-stakes genres, such as college admissions essays or standardized tests; Donovan & Smolkin, 2006; Seow, 2002). Such activities help to ensure students greater opportunities to communicate meaningfully with their audience.

Another important consideration regards cultural variables. Language is one variable contributing to success in school. Typically, school success depends on students' ability to use a standard grammar and dialect. However, students who come from different backgrounds (either from a different language background or from a different dialect) are disadvantaged in many ways. First, developing structured texts that are grammatically correct according to their instructors' point of view is challenging. Second, language differences can lead students to feel inferior and as if they do not belong in the school (McCafferty, 2002). This lack of confidence is an important variable to consider for writing research, particularly given the relation between students' self-efficacy and writing performance (Shell, Colvin, & Bruning, 1995).

Traditional pedagogical approaches commonly represent the values and ideas current amongst the dominant class, thus disadvantaging students from other groups (Finnegan, 1999). Consequently, schools potentially serve to maintain power structures among students, rather than create equality (Allen, 2012; Rogers, 2000). Sociocultural perspectives focus on increasing equity among students from diverse backgrounds. This viewpoint encourages educators to reflect on the expectations and value systems of their students and the typical classroom. For example, in a report on the potential social implications of school systems in the next millennium, Rogers (2000) suggested that educators begin to critique the current literacy practices in our classrooms and create new dialogues related to the purpose of literacy, teaching, and learning. She suggests that such

a dialogue may help to close disparate achievement gaps. Further, it may encourage the use of literacy practices that support social change, equality among different groups, and social justice.

Recommendations

Recommendations for Teachers and Policy Makers

Writing has been a crucial part of education for centuries. As such, most states and nations publish standards that specify K-12 developmental and curriculum expectations for writing. The United Kingdom, for example, publishes statutory guidance for English programs of study for the National Curriculum in England¹. Recently, writing instruction has received increased attention by researchers, educators, and policy makers in the United States due to the introduction of the Common Core State Standards (CCSS; National Governors Association & Council of Chief School Officers, 2010). The CCSS are not governmental mandates as in the UK, however, but rather suggested guidelines (albeit controversial) to help enhance and unify standards across the states.

While standards are informative and can be helpful to educators, it is well beyond the objectives here to describe developmental expectations or delineate the multiple instructional techniques to improving writing instruction. Moreover, there are any number of standards and guidelines across the world on writing instruction.

Here, we limit our suggestions to three overarching recommendations to teachers and policy makers. We refer to these as a call for TT&F for writing.

- **Time**
- **Technology**
- **Funding**

Time. Providing students with motivating opportunities to compose their written works takes time, for students, teachers, and the administration. Students must devote time and effort to both reading and writing. For teachers, incorporating sufficient and appropriate writing activities within the classroom requires expertise, preparatory time, and classroom time. And policy makers must take the time and resources to consider ways to alleviate stressors that teachers face in meeting these challenges.

Perhaps the most significant drain on resources comes from the time required to grade the assignments and provide informative feedback. Students gain most from individualized, high-level rhetorical feedback combined with multiple rounds of revision (Graham & Harris, 2013; Kellogg & Raulerson, 2007). Students also need sufficient encouragement and scaffolding throughout these writing stages (Beach & Friedrich, 2006; Ferris, 2003), which in turn calls for more teacher time.

Teachers, however, lack sufficient classroom time or resources to dedicate adequate time to each individual student (Higgins, Xi, Zechner, & Williamson, 2011). While more time and instruction are needed for students to learn how to write effectively,

large class sizes make it increasingly difficult for educators to provide students with adequate feedback on their writing (National Commission on Writing, 2003; Snyder & Dillow, 2012). Further, many teachers are not provided with adequate training to teach writing and provide feedback (Graham et al., 2014; Kiuahara et al., 2009). Hence, policy makers need to prioritize the need to provide teachers with adequate time for professional development on writing. Writing is a complex skill that relies on multiple intertwined processes including linguistic abilities, self-regulation, idea generation, and writing strategies (Flower & Hayes, 1981; Harris & Graham, 2009; Kellogg & Whiteford, 2009), rendering it one of the most complex skills to teach. Without professional development, many teachers may rely on intuition, rather than implementing evidence-based writing interventions.

Technology.

Providing feedback on writing is challenging in terms of time and providing frequent individualized writing feedback to all students becomes exceedingly difficult, especially for secondary school teachers who may have four to six classes per day. One solution to these logistical challenges is the use of automated essay scoring (AES) systems and automated writing evaluation (AWE) systems (Allen & Perret, 2017; Crossley & McNamara, 2017; Higgins et al., 2011). AES systems use computer algorithms based on natural language processing (NLP) techniques to mimic human ratings of essay quality; AWE systems additionally provide formative feedback to students about their writing. AES has the potential to provide an efficient means to rapidly score large corpora of writing, enabling instructors to assign more writing practice without substantial burdens on their workload (Dikli, 2006; Page, 2003). Such systems afford students with increased opportunities for writing practice combined with immediate, automated evaluation and feedback, and (in some cases) explicit instruction (Dikli, 2006; Roscoe, Allen et al., 2014; Warschauer & Grimes, 2008; Weigle, 2013; Xi, 2010).

Technology should not be viewed, however, as a panacea for writing instruction. Firstly, most teachers did not go into the teaching profession to oversee students' use of computer programs; most are more interested in being intrinsically involved in the learning process. Second, automated grading and tutoring systems are more likely to be effective if they are blended within the classroom instructional curriculum and content. Technologies for writing instruction are not intended to replace effective writing instruction, but rather, support such instruction by allowing students with more opportunities to practice writing. Writing technologies should also allow teachers with more time to focus on providing students with instruction on higher level rhetorical and pragmatic aspects of writing, which automated systems are less likely to cover.

Funding.

National and state writing standards call for more time and more instruction for students to learn how to write effectively. How can this be achieved given that governmental funding for public education continues to decline (Leachman, Masterson, & Figueroa, 2017)? With lower funding, professional development decreases and class sizes increase. In the face of average class sizes of over 20 students, it is difficult for

educators to provide students with adequate writing instruction. This was true over a decade ago (National Commission on Writing, 2003) and the situation has worsened rather than improved. The public and governments must recognize the need to devote more funding to education, and in particular, to writing instruction. Funding is also necessary to support teachers use of technology: they need instruction in the use of technology, but more importantly, they require IT support. In general, more resources need to be allocated to education, and writing instruction is a crucial component of a students' development which necessitates deliberate, well planned resources.

Recommendations for Students and Parents

If there is one thing to take away from writing research, it is that writing ability is not a gift. It is a skill that is honed with practice. Writing ability is also tightly connected to a host of other skills, including knowledge about the world, knowledge about the topic, reading skills, problem-solving skills, and metacognitive skills, among others. Writing involves and integrates all of cognition, and thus, can appear daunting. How can you improve such a complex skill? Here, we boil it down to just three recommendations, the triple-R to continuously improve writing:

- Read
- Write
- Revise

Read.

An important rule of thumb is to read. There is a strong correlation between students' ability to read and write (Shanahan, 1987). Of course, correlations do not imply causation. But it is clear that the more that you read, the more words that you know (Nagy, Herman, & Anderson, 1985; Sternberg, 1987). The more that you read, the more that you know about different types of text genres (e.g., narrative vs. informational writing), and thus the structures of various text genres. Students' vocabulary (i.e., knowledge of words; Staehr, 2008) and knowledge of the world (i.e., general knowledge; Rowan, 1990) are key to writing ability. One means of learning more about the world is to read. Hence, reading increases knowledge of the world and specific topics (Mar, Djikic, & Oatley, 2008; Stanovich, West, & Harrison, 1995).

Of course, *reading is challenging*. When you read, the words do not simply go into your head. Reading comprehension requires actively connecting ideas within the text and linking ideas to what you already know (McCrudden & McNamara, 2018; McNamara & Magliano, 2009).

Importantly, writing about what you read improves both your ability to understand text (i.e., reading ability) and writing ability (Graham & Hebert, 2011). That is, reading and writing are symbiotic.

Write.

You must write to learn to write. But students do not receive sufficient amounts of experience and practice in writing. Many students are likely to graduate from high school

without ever writing and revising an essay or report. By contrast, some students receive a top-notch education, and so their teachers or tutors have given them the instruction they need to learn to write. But, if you (or your child) are in an academic environment where writing is not a priority, you must create your own opportunities to write. Moreover, writing requires knowing how to respond to varying demands across varying situations; hence, you need to generate a variety of types of writing (e.g., summaries, short responses to questions, explanations, arguments, persuasive essays, integrative reports).

But, writing is hard and so few people are motivated to write. What motivates writers to write better? One source of motivation is communication, and the usual route of communication for professional writers (e.g., scientists, journalists) is publication. So, why would a student be motivated to write? One source of motivation is increased ability to communicate and obtain what one needs and wants. Quality of life is enormously improved by the ability to write a coherent letter (even through email) to a potential employer an insurance company to make claims, a write to a government official, and the list goes on. Another source of motivation is to succeed – graduate from high school, go to college, obtain a well-paying job, or pursue a career (Torche, 2011). Obtaining a college education can translate to a 67 percent increase in potential incomeⁱⁱ, which in turn translates to enhanced living conditions and health (Adler et al., 1994). Learning to write is key to success in professional life.

Revise.

Key to improving writing is revision. Generally, we divide stages of writing into first draft, second draft, and so on. However, revision occurs constantly during the writing process. It occurs at the word level (e.g., correctly spelling, replacing terms), at the sentence level (e.g., correcting grammar, modifying syntax, paraphrasing, verifying accuracy), at the paragraph level (e.g., reordering sentences, increasing cohesion, writing a thematic sentence), and at the text level (e.g., reordering paragraphs, increasing connections between paragraphs, checking responsiveness to the task). These revisions do, and must occur continuously while writing. No writers produce a perfect draft without revising.

Moreover, key to writing is revision based on feedback. It is important to receive feedback on your writing, from parents, peers, or teachers. There are no (or few) professional writers who do not seek and receive feedback from their peers, collaborators, or mentors. One cannot learn to write without writing and receiving *feedback*. Many students, however, may not have access to peer or expert feedback on writing. In that case, automated writing assessment systems offer students the ability to write with immediate, adaptive feedback on their writing (McNamara, Crossley, & Roscoe, 2013; Myers, 2003). Many of these systems are free of charge (Crossley & McNamara, 2017). They provide students with opportunities to write (e.g., explanations, summaries, essays) and receive feedback on the quality of the response. The greatest improvement in writing ability occurs when students incorporate this feedback deliberately and make substantive changes to their drafts, going beyond correcting spelling and grammar (Roscoe, Snow, Allen, & McNamara, 2015).

Conclusion

Overall, writing is a complex cognitive and social process that is primarily intended to help individuals *communicate* with themselves or others. We write to convey ideas, information, history, directions, instructions, and even to help us make sense of our own ideas and thoughts. This communication process is naturally embedded in a social context and relies on virtually all aspects of our cognition (e.g., WM, motivation, affect, self-regulation, prior knowledge, problem solving). For example, individuals who have greater memory resources tend to write more efficiently and those who are more motivated are more likely to persist in completing a coherent piece of writing. Individuals who have more positive affect toward writing, or who are just in a more positive mood at that moment, may find it easier to persevere when writing becomes difficult. More skilled writers tend to have more knowledge about the various components of writing, including the content domain and the writing process. If a writer knows more about the target domain, genre, and audience, they are more easily able to retrieve, interweave, and organize a coherent argument or narrative. Thus, writing a story is quite different from writing an encyclopedia article. And, writing to one's peers calls for a different style than for children.

Given this complexity, it is important that we make efforts to help students learn how to write across various situations and demands. Writing is vital to success and survival in modern society. Therefore, it is vital that students are taught how to write across various situations with varying purposes and demands. Over the past two decades, there has been a substantial increase in research on writing processes, including methods to improve writing. However, there is a need for additional *experimental* work on writing. Many studies on writing have been correlational. Correlations are often examined when the natural phenomenon cannot be easily manipulated using experimental methods. This is often the case in writing research because writing ability and writing quality are difficult to experimentally manipulate. Notably, however, correlations do not imply that one phenomenon causes the other because another unmeasured factor may be responsible.

These difficulties associated with research on writing have made it virtually impossible to describe a comprehensive, integrative theory of writing. Theories have noted the importance of the various aspects of writing by including them within the model. For example, WM and motivation are included as boxes within the Flower and Hayes (e.g., 1981) models. But more needs to be done to integrate more modern (e.g., connectionist) theories of cognition (McNamara & Allen, 2018). For instance, research from both cognitive and sociocultural perspectives needs to be integrated such that both the mechanisms underlying the writing process as well as the social context of the writing task are taken into consideration. In other words, any comprehensive model of the writing process must be able to account for the interactions between the cognitive processes and the social nature of this task.

In addition to writing *research*, both cognitive and sociocultural perspectives on writing can provide important information that guides the pedagogical procedures used

by classroom teachers. Historically, educational reports and curricula have been founded on research from the cognitive framework, because of their relatively stronger empirical support. To have a real impact on future policy changes, sociocultural researchers should begin to map their philosophies on to studies with strong research designs. By integrating their philosophical framework with the methods used by cognitive researchers, sociocultural research can gain stronger traction in the educational system.

Finally, it is important to note that there have been major steps taken towards education reform, particularly with respect to writing. However, it is clear that there is still a long way to go before the states can provide equivocal education for all students. There are major issues that we must still overcome, such as appropriate procedures for implementing the standards and the specific needs of special populations. Throughout the next few years, more information should become available regarding the positive and negative consequences of implementing these standards into the classroom. These questions will become the forefront of future conversations as educators and researchers work together to maximize student learning under these guidelines. It will become crucial for researchers from different frameworks to integrate their ideas to provide the most effective writing remediation for our students. The feedback from both *cognitive* and *sociocultural* researchers should inform future revisions of the standardized guidelines and assessments with the long-term goal of developing a clearly defined set of standards for academic excellence in the United States and the world more broadly.

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ⁱ <https://www.gov.uk/government/publications/national-curriculum-in-england-english-programmes-of-study/national-curriculum-in-england-english-programmes-of-study>

ⁱⁱ <https://www.collegeboard.org/releases/2016/college-education-linked-to-higher-pay-job-security-healthier-behaviors-and-more-civic-involvement>