

Why handwriting remains essential in 2021 and the future

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THE DEBATE ABOUT HANDWRITING

Few traditional learning skills in schools are debated as vigorously today as the value of handwriting, particularly cursive (“joined up”) handwriting. Teachers report being overwhelmed with more to do, from navigating complex social issues to teaching new ideas and developments that consume increasing amounts of the school day^[1, 2]. With some parents and students protesting that handwriting is obsolete, unreadable, and inefficient, should time be spent on handwriting instruction in an increasingly digital age?

As computing has expanded throughout all levels of education, the answer seems obvious that handwriting is a relic of the past. But laptops and tablets have not produced the anticipated learning advantages expected for writing and reading. Assessors from the National Center for Educational Statistics discovered in 2007 that writing proficiency and reading abilities had slipped below minimum standards for a majority of students, with only 33% of 8th graders and 24% of 12th graders writing above the basic required level. Tests in 2017 of approximately 3000 students, all of whom had experience using laptops for writing in their language classes, revealed that writing proficiency had dropped even further. Students were writing less and expressing fewer nuanced or complex ideas. Mechanics and composition in these groups had deteriorated even farther below previous levels, continuing the downward trend. The scores in 2017 were the lowest of any testing period in the past ten years, coincidentally as laptops became widely available for language skills classes in schools^[3,4].

These dismal results accelerated the volume of research being conducted on reading, writing, and learning. From these studies, handwriting has emerged as a significant aid to learning for both children and adults in areas as diverse as reading, comprehending, reflecting on reading, recalling words and meaning, skillful writing, and mathematics. Further, researchers discovered that handwriting increased students’ self-esteem, self-efficacy, and empathy as their skill developed.

As a result, 25 states in 2021 now require handwriting instruction and practice in language programs in the elementary school curriculum. Other state legislatures, school boards, and parents are grappling with questions about the type of handwriting instruction that should be taught in their school, if any.

This paper is intended to answer a few important questions raised about handwriting from the most current research. These studies explain how handwriting remains a vital skill for learning, development, and adaptability as technology continues to spread.

THE BENEFITS OF HANDWRITING AS REVEALED BY SCIENCE

What advantages does handwriting provide that cannot be delivered just as well, if not better, by typing on keyboards or using point-and-click devices?

Writing by hand engages the writer with information and ideas differently than typing on keyboards and using digital devices. Handwriting prompts writers to synthesize information, which enables them to form new associations, expand thinking processes, and achieve new insights for broader awareness and problem solving^[5]. Findings from repeated studies at universities in the US, Europe, Australia, Japan, and China over the past fifty years confirm that those who are well-practiced in handwriting accomplish reading, writing, memory, and comprehension tasks more quickly and deeply than those who type on keyboards, tap, or use point-and-click devices. Since time to teach is at a premium in schools today, many students have begun to rely on computers and keyboarding, and fail to acquire these essential skills.

A selection of studies showing the effects of handwriting on learning are listed below. Specifically, researchers have discovered that handwriting has a more powerful and beneficial effect on learning in these areas than learning with digital devices:

- Reading, including more accurate and faster letter recognition, identification, categorization, comprehension, interpretation of meaning, and retention^[6-15]
- Spelling^[16-18]
- Language learning^[19-21]
- Abstract and complex thought processes^[22]
- Cognitive flexibility and fluid thought needed for problem solving^[23]
- Information synthesis and retention^[24-28]
- Composition, including length and quality of written expression ^[29-36].

Note: Improved composition by writing longhand is not limited to early learners. Several well-known published authors and playwrights, including Joyce Carol Oates, J. K. Rowling, and Quentin Tarantino, insist that handwriting improves the quality and development of their ideas as they create and refine their prose^[37]. Award-winning author Joshua Ferris prefers writing his first drafts on graph paper with a pen, explaining that the slower process helps him to craft better sentences. He reported that the often unnoticed, subtle light pulsations emanating from a monitor disturb his thought process ^[38].

- Mathematics. Studies have shown that students who practice writing words and numbers acquired mathematical skills and understanding more quickly than those who do not receive the same writing practice ^[39-41].

These findings have led experts to agree that introducing keyboards as the primary writing tool before reading skills are well-established, usually in the middle grades, can *reduce* literacy development by interfering with mechanisms that foster reading proficiency ^[42].

Handwriting strengthens memory at all ages

The positive effects of handwriting on memory and mental acuity have been identified in studies with young children,^[43-48] middle-schoolers,^[49] college students,^[50-53] and young and older adults^[54-55].

On tests of recall and understanding of concepts, research shows that those who take notes by hand outperform those who type notes on a laptop or Apple iPad or tap them into a smart phone^[56]. The studies showed consistently better results from those who wrote by hand compared to those who typed or tapped the information, even if the keyboard and tap device users were digital natives proficient with the technologies used in the research.

Handwriting appears to increase adaptability to new technology as well, smoothing the transition to keyboarding in advanced grades^[57], while building language skills, literacy, creativity, self-knowledge, and focused attention, all of which are necessary for success in fast-paced, technologically driven academic and work environments.

Simply stated, handwriting fosters academic success.

Findings from research on brain activity during handwriting and keyboarding

When studying brain activity with fMRIs, researchers discovered that writing by hand stimulates brain areas that focus attention. This stimulation activates and coordinates activity in the cognitive, visual, auditory, motor, and emotion centers in the brain, enabling knowledge to be more deeply embedded in memory for understanding and ease of recall^[58-61].

These researchers have also found that the brain patterns produced by disconnected, staccato-like motions used in keyboarding have the opposite effect of handwriting on thought production: they *separate* thought from vision and action, making thinking more difficult and reducing the writer's ability to plan, express, and correct ideas. What's more, researchers observed these brain patterns during keyboarding in typists at all keyboard skill levels, from young children to expert adults^[62-71], suggesting that these brain functions do not change with experience.

Efforts to learn by separating vision from hand actions, as in keyboarding where typists are trained to focus on the output and not on the hands, has been shown to decrease learning and increase mental effort in recent studies of children and adults at the University of Sydney. Stimulation from tracing letters and forms (triangle, star, and others) by hand produced better learning than efforts without it, and participants reported lower stress from using their hands for the tasks. Researchers explained that humans appear to be "biologically wired ...to pay closer attention to the space near our hands," so that creating traces by hand "receive[s] processing priority... [and] 'chunks' ... new material into one piece of information, making it easier for us to learn"^[72].

At this time, hundreds of studies, most conducted within the past two decades, have come to the same conclusion: **no skills or methods have been found that are better than handwriting use and practice for building the brain structures necessary for literacy, communication, and understanding**^[72-76].

The effect of handwriting on mood and psychological development

Studies show that success with handwriting builds self-confidence and motivation and helps writers to develop creativity, defined by cognitive scientists as fluid thought that enables us to “think out of the box” and develop improved problem-solving skills ^[77-80].

Scholars and educators alike have observed students becoming excited about their prospects for success in school and accomplishments and as they begin to write by hand. At the same time, handwriting builds their awareness of themselves and others as unique individuals, as few other skills do.

Handwriting helps students expand self-understanding as they learn to express their ideas, feelings, and reactions at the moment, creating a “selfie in written form...”^[81]. [H]andwriting can provide pupils with a sense of who they are, a journey of exploration. In the shape and construction of the [hand-written] words, it can open their imagination, reflect their identity, [and help them] to develop self-esteem^[82]. Handwriting provides a channel for reflecting on the unique impressions displayed in the content and the appearance of their own writing and the writing of others. By recognizing differences and similarities in the writing, students have unique access to the perspectives of the person behind the writing, challenging and transcending stereotypes, including self-limiting ideas of themselves. “We breathe life into our thoughts when we commit them [by hand] to paper. Be they words, images, or notes, few tools facilitate the transition between the inner and outer worlds so seamlessly as the tip of a pen” ^[83].

In addition to broadened perspectives, some experts have noted the ability to handwriting to “develop pupils’ ability in the subjects, giv[ing] them confidence in themselves” ^[84]. Other studies have shown that the social skills of empathy^[85], self-regulation^[86], self-awareness and feelings of self-worth are reinforced by handwriting practice ^[87] as well.

Writing and the achievement gap

Writing about positive values by hand has been shown to produce improved mood and strengthen achievement ^[88]. A study that has been repeated several times across the United States with large samples of 7th and 8th grade minority pupils found that those who participated in 15-minute handwriting exercises achieved statistically higher grades and improved school engagement when compared to similar students in classes that served as controls ^[89]. Similar results were found for female college physics students ^[90].

The role of handwriting in building the connection between readers and writers

Literary scholars have observed that handwriting is superior to typing for stimulating the imagination of the reader to engage with the writer ^[91]. The lines, shapes, and connections of the handwritten script weave a deeper meaning into the message ^[92], conveying presence, authenticity, and intention, evoking stronger reactions than typed or digitized texts and signatures, no matter how accurate the rendering ^[93].

The features of handwriting, whether contained in a historical document, a treasured recipe from a previous generation, a love letter, or a note passed by a classmate, enable the reader to “visualise and sense [the authors] as living entities even if they are separated by space or time. One can ‘feel’ their closeness” ^[94].

Observations about the power of handwriting to foster personal development and connectedness have strong implications for children and youth of today. Psychologist, researcher, and professor at San Diego State University, Dr. Jean Twenge reports that a deep sense of isolation and detachment from others, with attendant depression and anxiety, results from excessive use of digital platforms in school, work, and social media with acute consequences for many people, particularly adolescents ^[95].

WHAT ABOUT KEYBOARDING?

Many educators, parents, and students are concerned that we may be jeopardizing future opportunities and the needs of our children if we do not promote widespread use of computer technology beginning in the earliest grades, if not before. Scientists and scholars who support handwriting agree that keyboards and other digital technologies are essential tools for advanced educational achievement, productivity, and inventiveness today. But laptops and tablets have failed to deliver on promises of increased learning for many students, as described previously. What’s more, they may not be the tools of choice in the future.

In contrast to commonly held beliefs about the universal benefits of computers, studies have revealed that replacing writing and note-taking by hand with laptops may contribute to poorer learning, concentration, and recall, with the most negative effects found for boys and struggling learners ^[96], who are among the groups of greatest concern to educators. In one study, researchers found that 42% of students who used laptops in college classes were found to be engaged in off-task activities during class (“multitasking”) including surfing the web, instant messaging, watching movies, responding to social media, checking email, and playing video games, all of which interfere with learning for those engaged in multitasking and those around them. Subsequent studies at other locations found similar results ^[97-99].

One of the main arguments for keyboard use – that is, that keyboards increase ease and speed of writing - has not been supported by research with elementary school children. Multiple studies have shown that writing longhand is faster than keyboarding in the early grades when reading and writing skills are being established.

Scientists who followed students with and without learning disabilities from grades 1 to 7 discovered that those who wrote by hand produced words faster, expressed more thoughts, and conveyed more complex ideas than pupils who lacked experience with consistent handwriting practice^[100-101].

HANDWRITING AND CULTURAL STEREOTYPES

What about boys? Aren't handwriting requirements unfair to them?

Every motor skill – riding a bike, playing an instrument, learning a sport, or properly brushing one's teeth, to name a few – requires instruction, coaching, practice, and rewards. Handwriting is no different. Like other complex motor skills, handwriting draws on cognitive and motor faculties and requires the same instruction, coaching, and practice as other motor skills. Contrary to some beliefs, girls and boys do not develop complex motor skills automatically with maturation^[102].

Ironically, the handwriting styles used in schools in the 1930's – 1970's, most commonly Zaner-Bloser and Palmer methods, were developed to increase access of men to office positions. The word *penmanship* originated from the widely-held view that fluid, attractive writing was a desirable skill for men engaged in commerce, law, journalism, and other professional occupations. Changes in society and the workforce led many to believe that handwriting is primarily a skill for girls to develop and use^[103]. Such ideas presume that girls and boys have biological differences in regard to handwriting.

Differences in performance between boys and girls have been widely observed in which girls have been shown to outperform boys in handwriting speed and legibility, writing content, and spelling at all grade levels once the skills are learned^[104], and that boys perform better than girls at spatial reasoning tasks^[105]. The basis for these differences is unclear, with some researchers pointing to gender differences in brain maturation, particularly in the language centers^[106], while others propose that the differences stem from cultural and social stereotypes since they diminish with sufficient instruction and support^[107-109].

Despite these opposing hypotheses, researchers agree that role models, coaching, mentoring, and parental encouragement have been shown to narrow the gender gap in skills and occupations and contribute to dispelling powerful stereotypes^[110]. Studies show that the cognitive load and initial anxiety that occur when first learning motor skills, including handwriting, decrease with appropriate teaching, practice, and encouragement^[111] as skill, speed, and fluidity develop.

Recent research indicates that girls' negative self-assessments about their spatial reasoning activities (expressed in remarks such as "I'm not good at that") and typical classroom spatial reasoning tasks often do not appeal to girls. By challenging girls' low expectations of themselves and creating more appealing spatial activities, girls have performed as well as boys^[112] through a range of lessons, activities, and camps, even though they may experience difficulties at first.

Unfortunately, cultural stereotypes influence the activities that educators offer to boys, too, resulting in less instruction, lower expectations, and fewer opportunities and resources provided to boys for painting, drawing, and writing.

Just as with girls, when anxiety and low expectations are reduced in boys through appropriate instruction and reinforcement, role models who model handwriting skills, and interesting handwriting activities for practice, they, too, can succeed ^[113]. By applying the same type of support, practice, and rewards that we shower on sports, most boys today, even those with moderate learning disabilities, can master contemporary handwriting skills ^[114].

HANDWRITING AND TECHNOLOGY – EVERYTHING OLD IS NEW AGAIN

Those who argue that handwriting is going away and will be replaced by keyboarding and mouse input devices may be surprised to learn that the giant Microsoft Corporation does not agree.

In an interview before a major IT conference in 2016, Microsoft's Chief Envisioning Officer, Dave Coplin, predicted that the future will not include the QWERTY keyboard and mouse input devices that have dominated word processing for the past decades. Instead, he forecasts hand gestures, handwriting, devices to detect thoughts directing the formation of letter shapes, and voice recognition will be used as computer data input methods within a few years. He anticipates that keyboards will become relics like 8-track tapes, obsolete equipment that is rarely used, replaced by more intuitive and responsive tools, such as our own hands, voices, and thoughts ^[115-116].

Software companies are already racing to develop hand-controlled input devices that respond and look like pens. In light of these developments, students with handwriting skills will be at an advantage when hand-gesture and handwriting-based technological innovations become widely adopted. Given this view of anticipated future technology, why would we train children exclusively on technology that is likely to change or be replaced altogether within the next decade and neglect the skills that they will use?

HANDWRITING INSTRUCTION – WHAT’S NEEDED, WHAT’S NOT

Which handwriting style – cursive (“joined up”) writing or manuscript (“ball and stick”) printing - is best for teaching children to write?

Handwriting styles can be difficult to learn at first, regardless of the form used. At this time, scientists have not concluded whether cursive or manuscript printing is better or easier to learn.

Some researchers maintain that manuscript “ball-and-stick” and cursive “joined up” handwriting provide the same benefits to students in the elementary grades. Other experts disagree, advocating for a simplified “joined up” script style that may be easier for most children, including those with mild to moderate dysgraphia^[117-120]. A simplified cursive handwriting format is used in preschools, kindergarten, and early grades in several European countries, including France and portions of the Netherlands.

Denise Eide, a former ELL teacher with extensive experience with struggling readers and writers, now a reading specialist and curriculum writer for *Logic of English*, explains that “[c]ursive handwriting requires significantly fewer fine-motor movements than manuscript [printing]. The pencil does not need to be lifted up and down between letters, and placing the pencil to begin each letter is greatly simplified by the fact that ...l lowercase cursive letters begin on the baseline, whereas manuscript letters begin in seven or eight different places” Eide has observed that letter reversals and spacing problems occur less frequently in children who use cursive writing^[121], an observation shared by other reading specialists^[122].

Increased handwriting speed (to a point!) is associated with higher quality of text as the brain becomes able to focus less on the process of writing and more on the content^[123-124]. One factor contributing to slower handwriting is the cognitive effort involved in recalling words and spelling which is complicated further by illegibility or errors in forming letters^[125]. Recent studies of elementary school pupils showed that a typical cursive writer exhibits greater writing fluency and is able to focus more of their cognitive effort on quality of ideas and composition than the print writer who must divide their cognitive effort between composition and precision in stroke placement, resulting in reduced speed and expression of fewer ideas. Similar findings have been observed in 5th and 6th graders^[126].

The greater speed and ease of writing connected letters have convinced some handwriting experts to advocate for a uniform “joined up” (that is, simplified cursive) writing system for young learners until handwriting proficiency is established, typically between 8-10 years of age. By this time, most children who begin to write before or during kindergarten will have strengthened muscle memory, allowing both automaticity and individuality in writing to begin to emerge^[127].

Despite these findings, most scientists have not made determinations on the form of writing that should be taught, citing a lack of research that compares the two approaches. Most researchers and educators agree, however, that the curls and flourishes of older cursive handwriting styles are unnecessary and inefficient. Further, reports suggest that switching from one form to another – printing to cursive, for example, which is the typical progression in handwriting instruction in schools in the United States – is needlessly challenging and interferes with the child’s developing mastery of writing and composition skills.^[128-129]

Although the cursive vs. printing question is far from settled, scholars agree that handwriting will adapt to new socio-cultural realities as it did when the death of handwriting was predicted by earlier technological innovations – the printing press, the typewriter, the telephone, and voice recorders, to name a few ^[130] - and remains an essential tool for information, expression, and communication.

How can teachers encourage handwriting?

Much early learning in kindergarten and the early grades involves fine motor skills ^[131]. These skills foster self-awareness and social maturation while promoting learning ^[132] and developing the musculature, tactile sense, coordination, and hand strength needed for handwriting.

Tools and methods for teaching handwriting should not be complex. Researchers support the use of simple tools that provide tactile experience for handwriting practice ^[133].

Breaking writing tasks into manageable steps and providing consistency in instruction across instructors and grades are strategies that have been recognized as effective teaching methods for handwriting ^[134]. As handwriting has begun to be taught more widely, resources for teaching and engaging pupils’ interest are being developed and made available by handwriting specialists and occupational therapists.

Teaching the teachers

To enable the benefits of handwriting for students, however, attention must first be given to the needs of current and future teachers. A recent survey showed that teachers have a low degree of confidence in their own handwriting skills because they were not provided with handwriting instruction methods that are appropriate for their future classes ^[135]. Inservice trainings and university courses for veteran teachers and teacher candidates are needed to help them develop their handwriting education methods instead of forcing them to rely on their memories of how they learned when they were elementary school students themselves ^[136-137].

THE FUTURE OF HANDWRITING

With the academic, cognitive, creative, psychological, and social advantages provided by handwriting and its anticipated role in future technology, handwriting use and practice remains relevant for children and adults.

At the same time, we have a responsibility to ensure that students in our communities are able to write effectively with all the tools available to them, both low- or high-tech, from handwriting with paper and pencil to keyboards and advanced digital devices. Students need to learn keyboarding and computing skills today, but they should be introduced to these methods only after they have mastered basic reading and handwriting. To do otherwise places the foundation for student learning and productivity at risk, limiting students' ability to expand their skills and adapt to technology that will replace keyboarding and current word processing systems in the future.

UCLA researcher and professor of psychology, Dr. Patricia Greenfield, reminds us that "No one medium can do everything. Every medium has its costs and weaknesses; every medium develops some cognitive skills at the expense of others. Although the visual capabilities of TV, video games, and the Internet may develop impressive visual intelligence, [these gains are offset by] the cost ... to deep processing: mindful knowledge acquisition, inductive analysis, critical thinking, imagination and reflection" ^[138].

Considering the decreased writing and reading proficiency that has accompanied the rise of laptop and tablet use in our schools and colleges, perhaps it's time to note the costs of discarding handwriting as a foundational skill and reconsider the push to digitize all aspects of education from the early grades through high school ^[139-140].

As handwriting practices are adapted to new communication needs, tools, and socio-cultural trends, handwriting will partner with advanced technology and continue providing benefits to writers at every age. By teaching handwriting and encouraging its use through the nation's schools, we are equipping our children and adults for success in the future.

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