



The truth about cursive handwriting: Why it matters in a digital age



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Introduction

Today, the Common Core Standards no longer require elementary students to learn cursive handwriting. As a result, some schools are dropping handwriting instruction from the curriculum. As of May 2016, only 15 states require the teaching of cursive handwriting in their Core Curriculum Standards. The remaining states, districts, principals, school boards, and teachers must choose for themselves whether or not to teach cursive handwriting or any form of handwriting at all. With legislatures debating Common Core and educational standards in their states and districts, parents must make decisions about their elementary students' education now. This paper is an attempt to describe the arguments for and against cursive handwriting education in US schools today.

Arguments against cursive handwriting instruction

Critics consider cursive handwriting to be an ancient, unnecessary skill that should not compete with reading, composition, math, and science for the limited instructional time available. Opponents of handwriting instruction describe its advocates as neo-Luddites, arguing that students should learn to do all their work on keyboards. They insist that students need to compose, edit, think, and write using computers, reasoning that expressing ideas and thoughts quickly and efficiently is what matters most in today's learning and professional environments. Some school districts have consigned the skills of writing with pencils or pens to art classes, if they are taught at all. (1)

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The critics of cursive handwriting instruction present the following main objections:

1. Voice-recognition electronics are being developed and refined to eliminate the need for reading and writing. [Fact, but will they eliminate the need for reading and writing? If they do, is an illiterate society desirable?]

2. Teaching handwriting instead of keyboarding takes away from literacy, math, critical thinking, technology skills and citizenship instruction and does not prepare individuals for the workplace. [This opinion based on the heavy emphasis on standardized testing, in itself an area of debate. With computers being developed to read handwriting, it may be more important than ever to ensure that students can write legibly.]
3. Children are more literate than ever. [False; The National Center for Education Statistics reports that 65% of all fourth graders in the US read at or below grade level, and the deficit increases in subsequent grades.](2)

evidence exists that suggests that these skills develop better with handwriting than by keyboarding alone

4. Handwriting is an obsolete technology; the pen is being replaced by the keyboard as quills and fountain pens were replaced by the typewriter. [Not in all cases; writing is often the simplest and most accessible method of recording information]
5. Ideas and thoughts are what matters. [Ideas and thoughts, particularly higher level critical thinking and problem-solving, are increasingly needed as technology advances; paradoxically, evidence exists that suggests that these skills develop better with handwriting than by keyboarding alone (3)]
6. Students need to compose, edit and think on the computer. [Students who practice these skills in longhand produce more complex higher level nuanced thought (4), and recall and identify concepts in greater depth than those who rely solely on keyboarding] (5)
7. That cursive proficiency correlates to verbal/cognitive skill is a “Luddite” delusion. It’s like lamenting the decline of a quill pen or elementary Latin instruction. [Despite the increase in the quantity of writing due to computer technology, quality of writing appears to be in a steep decline.

The National Association of Colleges and Employers Job Outlook reported that employers who required skilled writing from their employees were noticing a decreasing level of quality in the writing skills of employees whose education involved using computers for composing written work. (6) Language learning has been shown to be mastered more quickly with handwriting than keyboard use] (7)

Steve Graham EdD, professor of education at Arizona State University and expert on handwriting instruction across the world, is quoted as saying that “the argument for keeping cursive around centers more on tradition than practicality. For classroom educators, the cost for teaching cursive is precious time. ‘Why teach two forms of writing when one will do the trick? Something’s gotta give. Cursive handwriting is under pressure’” (8). With schools focused on preparing students for standardized tests, there is often not enough time to teach handwriting (9).

Arguments in Favor of Cursive Handwriting

Supporters of cursive handwriting cite research from education, psychology, and neuroscience that has uncovered educational differences between handwriting and keyboard use with important implications for children’s learning (10, 11, 12).

hand-eye coordination is a major developmental feature [of handwriting].

These studies show that handwriting offers benefits that extend far beyond the act of writing. Neuroscientists have described the biological and psychological benefits of using handwriting. Dr. William Klemm, senior professor of Neuroscience at Texas A&M University, writes “hand-eye coordination is a major developmental feature [of handwriting]. [...] As such learning progresses, the brain is creating new circuitry to evaluate what is seen and the speed and timing of movements. This circuitry then becomes a lasting part of the brain and can be recruited for use in other eye-hand coordination tasks.” (13)

Dr. Frank Wilson, neurologist and author of *The Hand: How its Use Shapes the Brain, Language and Human Culture* (14) supports handwriting instruction: “Although the repetitive drills that accompany handwriting lessons seem outdated, such physical instruction will help students to succeed (15).” His research describes the contribution of flexible hand movements to the evolution of human perspectives, thought, and speech capabilities, and in “developing deep feelings of confidence and interest in the world-all-together, the essential prerequisites for the emergence of the capable and caring individual.” (15)

Letter and word recognition, comprehension, abstract thought, and memory are shown to improve with handwriting

Current research suggests that coordinating visual perception and graphomotor planning during writing with the physical sensations of finger and hand movements influences learning. Letter and word recognition, comprehension, abstract thought, and memory are shown to improve with handwriting (16). As a result, handwriting makes learning faster and more efficient in areas from reading and writing to math and music (17, 18, 19, 20).

Proponents present the following arguments in favor of cursive handwriting:

Neural development increases and expands in areas of language, memory, word recognition, and emotion with handwriting.

- (1) Writing in cursive (once learned) is faster than printing, and can be produced with less difficulty with sufficient practice. (21, 22)
- (2) Written note-taking produces much higher rates of comprehension and information retention in lectures and group meetings. (23)
- (3) Students can read handwritten comments made by teachers on assignments or other materials written in cursive. [Fact]
- (4) Early efforts at writing and development of fine motor skills used in writing signal readiness for learning and predict later achievements in reading, writing, and math. (24)

(5) Neural development increases and expands in areas of language, memory, word recognition, and emotion with handwriting. (25, 26, 27, 28)

(6) Handwriting builds a sense of writer identity and self-efficacy. (29)

(7) Typing on a keyboard is not the same kind of physiological process as handwriting. A different part of the brain is activated for keyboard typing that does not have the rich connections found in areas of the brain activated by handwriting (30)

(8) Electronic devices can fail or be unavailable. As of 2013, computers were available in only 79% of American homes, with the fewest in homes with African-American or Hispanic children (31) They observe that handwriting is a complex skill that enhances the coordination of motor, perceptual, and cognitive abilities. A brief overview of the processes that must be coordinated to write by hand illustrates their point:

- Visual, auditory, and visuomotor perception
- Gross and fine motor coordination
- Directionality
- Sequencing skills
- Recall
- Letter knowledge
- Tool hold
- Lines
- Sitting and paper position
- Cursive script
- Tracing and copying
- Joining letters
- Self-evaluation
- Numerals (32)

What's wrong with using keyboards for writing?

As neuroscientists observe the brain changing and developing as it works (33), they affirm that movement, mental activity, and the genes involved in learning are interdependent (34). In particular, they have found that neural connections are developed and strengthened when children write in longhand (35).

Dr. Virginia Berninger, professor of educational psychology at the University of Washington, explains that “because handwriting necessitates physical sequential strokes to form just one letter (as opposed to a single strike in hitting a single key), massive regions in the brain are activated, including areas of thinking, language and temporary information storage and management” (36). With more brain areas activated, the executive functions of adaptation, planning, aesthetics, and foresight are more fully engaged while writing by hand, and the distinctly human qualities of beauty and emotion are enhanced. (37, 38, 39, 40).

Dr. Karin James, assistant professor of psychology and neuroscience at Indiana University, proposes that the brain operates differently when creating images instead of pressing keys. “[T]yping seems to be different than handwriting,” she says. “You’re actually creating those forms with your hands. That seems to be making a difference.... It seems there is something really important about manually manipulating and drawing out two-dimensional things we see all the time” (41).

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These benefits from handwriting are not limited to early learners. Researchers have found that adults recognized letters or characters learned through typing less accurately than those written by hand. fMRI studies showed that compared to handwriting, typewriting activated fewer brain areas used for language and spatial, visual, and temporal perception in both children and adults (42). Further, handwriting has been proposed as a useful exercise to slow the cognitive effects of aging. (43)

Why cursive?

Even those who support handwriting education in our schools may question the emphasis on cursive handwriting. Adults who learned cursive handwriting as children may adapt a form of printing for communication. For most adults, use of cursive handwriting, printing, or keyboarding is a matter of choice if the necessary equipment is available.

Some may complain that learning handwriting is particularly difficult for male students and therefore should be scrapped. Their complaint, however, is relatively new. In the mid-1700s, Benjamin Franklin stated that young men who wanted to attend the Academy of Philadelphia had to “write a legible hand.” Fine penmanship was seen as a mark of fine breeding (44) and lent importance to the work of government.

Maria Montessori introduced cursive writing to students who were 5 to 6 years old, a practice that continues in Montessori schools today.

Until World War I, secretary positions were often filled by men chosen for their literary skill and speed in handwriting documents. The title Secretary for government cabinet officers is a reminder that previous generations expected skillful handwriting from men who dealt with matters of state.

Platt Rogers Spencer, considered the father of American penmanship, first published his Spencerian script in 1848 and taught his model of penmanship throughout the United States (45). With time, people found the elaborate Spencerian script too slow to write, and more simplified scripts were designed. By the early 1900s, the Palmer and Zaner-Bloser methods of penmanship were the most common. From the 1980's onward, D'Nealian became the most common script taught in schools (46).

Before 1940, most adults wrote in cursive rather than printing. Many European countries taught only their own forms of cursive in elementary schools. For example, Maria Montessori introduced cursive writing to students who were 5 to 6 years old, a practice that continues in Montessori schools today (47).

In American schools, manuscript printing (a combination of capitals and lowercase letters, also called ball-and-stick printing) became used more widely in the 1930's and 1940's to accompany the look-see-say method of reading that was promoted at that time. Soon after printing was introduced, educators discovered that writers who printed exclusively were unable to read materials written in cursive.

This lack of ability was found to be a significant disadvantage for students entering an increasingly industrialized urban workforce. Teachers objected to their students being unprepared for future careers because of their inability to write cursive handwriting and read it. Nearly 100 years ago, these teachers considered the lack of cursive instruction a “dumbing down” of the education process (48), a debate that has new support today with the results of recent research.

Isn't writing and reading more efficient and thorough when done on the computer?

cursive writers and printers produced more complex, nuanced compositions with a higher quantity of words and better spelling

Researchers have addressed the complaint that handwriting was too time-consuming and mentally taxing to create quality compositions. Dr. Berninger and her colleagues demonstrated that children in grades two, four and six were able to write more words faster and express more ideas when writing by hand rather than the keyboard (49). Similar results were found in a British study (50).

In addition to efficiency, other research points to improved quality when handwriting is used. Recent research showed that students who used cursive handwriting for a significant portion of their written work generated more words of higher quality and used better syntax than writers who print. However, both cursive writers and printers produced more complex, nuanced compositions with a higher quantity of words and better spelling than those who composed their work exclusively on keyboards or digital devices (51).

The difference between work written by hand and typed in the early grades was found to be significant: a 2007 study found that work produced on keyboards lagged two years behind the writing development shown by those who wrote their work by hand. (52). As a result of findings like these, French schools have adopted the practice of teaching cursive handwriting exclusively until automaticity of handwriting movements develops. Keyboarding instruction is not offered until cursive writing is well established (53).

The benefits of handwriting for early reading are well-established by current research as well. In an experiment involving letter recognition conducted by Dr. Karin James at Indiana University, the brains of four- and five-year-olds were scanned before and after they had been taught selected letters. One group of children was taught to recognize chosen letters visually while the second group was taught to write them. After four weeks,

brain scans showed that one group of writers had significantly greater spikes in brain activity in areas associated with reading than the visual recognition group. (54).

laptop note-takers performed significantly worse on the conceptual questions

In an extension of this study, Dr. Karin James and Dr. Laura Engelhardt of Columbia University found that an area of the brain that was associated with reading was “was recruited during letter perception only after handwriting-not after typing or tracing experience,” suggesting that reading is fostered by handwriting, but not by hand movements related to letter production. (55)

Benefits of handwriting extend to students through college as well. A study of college students taking notes during lectures showed that those who handwrote lecture notes outperformed peers who typed notes during lectures. Research by Dr. Pam Mueller of Princeton and Dr. Daniel Oppenheimer of UCLA found students who typed lecture notes performed worse on tests involving higher-level thinking and comprehension than students who took notes by hand. They reported that “the two types of note-takers performed equally well [when] recalling facts, [but] laptop note-takers performed significantly worse on the conceptual questions” (56).

These results carried over to a test given on the material a week later. Even after reviewing their notes, students who recorded lecture notes by hand comprehended and recalled more concepts on the second test than those who typed lecture notes on their laptops. (57)

Doesn't handwriting make learning harder for students who struggle to learn?

New scripts, such as the New American Cursive Alphabet (58), have been created to eliminate unnecessary strokes. These simplified writing systems are easier for all students, enabling them to write legibly with less frustration in a shorter time, and may be particularly beneficial to those with motor difficulties. Dr. William Klemm observes that cursive is faster than ball-and-stick printing, and “more likely to engage students by providing a better sense of personal style and ownership” (59).

Sandy Scheffkind, Pediatric Program Manager, for the American Occupational Therapy Association (AOTA) observes that the new forms of cursive handwriting are useful for children who have difficulties with fine motor skills. She reports that “dexterity, fluidity, [and] the right amount of pressure to put with pen and pencil on paper [are challenging tasks]” and that simplified cursive handwriting styles are much easier for her clients to use than printing. (60).

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Dr. Virginia Berninger and her associates have determined that both typically developing learners (60, 61, 62) and those with learning challenges, such as dyslexia (63, 64, 65) benefit from using handwriting for a significant amount of their work. Deborah Spear, M.ED, Clinical Supervisor at Atlantic Seaboard Dyslexia Education Center in Great Falls, VA uses cursive handwriting instruction in her work with students with dyslexia. She reports that cursive is easier for students to learn than the stop-and-start motions of print script because “all letters in cursive start on a base line, and because the pen moves fluidly from left to right” (66).

Dr. William Klemm concurs: “because cursive letters are more distinct than printed letters, children, especially dyslexics, may learn to read more easily” (67). He maintains that cursive writing should provide more benefits for reading than printing for a host of reasons, including greater attentional demands required to form letters properly and higher demands on the visual recognition system to identify and decode a broader range of letter and word representations. He observes that cursive is faster than ball-and-stick printing, and “more likely to engage students by providing a better sense of personal style and ownership” (68).

Practice with cursive handwriting is also useful for children who have difficulties with fine motor skills. Sandy Schefkind, Pediatric Program Manager, for the American Occupational Therapy Association (AOTA) reports that “dexterity, fluidity, [and] the right amount of pressure to put with pen and pencil on paper [are important].” She finds that printing can be more difficult than cursive handwriting for some of her clients (69).

Would psychological and artistic values be affected with a switch to writing only with computer?

printing can be more difficult than cursive handwriting for some.

Beyond the benefits of handwriting in aiding learning, coordination, and fostering higher level thought and expression, some are clear about the psychological and artistic value of writing in cursive. When novelist Robert Stone was asked if he mostly types his manuscripts by William Woods for the Paris Review, he replied, “Yes, until something becomes elusive. Then I write in longhand in order to be precise. On a typewriter or word processor, you can rush something that shouldn’t be rushed—you can lose nuance, richness, lucidity. The pen compels lucidity” (70).

Robert Stone is not the only writer to make this observation. Members of a professional writing group, Heritage Writers (Stockton, CA) said that most of them wrote in longhand. An editor commented in support of this practice: “when I’m asked to look at work for submission, I can always tell the difference between writing produced electronically and storytelling that has evolved from pen and paper. I agree absolutely that thoughtful, hand-crafted writing is better.” (71)

Julia Cameron (*The Artist's Way*) and Natalie Goldberg (*Writing Down the Bones*) are authors who teach writing. Both require their students to write “Morning Pages,” three pages of free-association writing in the morning to release blockages and enhance creativity. Cameron reported those who typed their morning pages noticed that they “did not do quite the same thing on the word processor” as they did when they wrote the pages by hand (72). After seeing these results, they returned to completing their morning pages with handwriting.

One Southern California artist, teacher, and graphologist, Lena Rivkin, observed in *The Lost Art*, “When you write in cursive you cannot multitask. The mere act of cursive writing forces you to be in the moment with your thoughts and intent” (73).

What do researchers say about removing handwriting instruction from the curriculum?

While critics claim there is not enough research supporting the retention of cursive handwriting in the curriculum, no research has conclusively established that cursive handwriting instruction and practice should be discouraged. Supported by studies that identify the benefits obtained by handwriting, many educators, researchers, and scientists are campaigning against the trend to eliminate the teaching of cursive. Given current research showing its positive effects, might it be irresponsible to remove handwriting instruction completely without understanding what the outcomes might be?

...it might not be fine, you might be setting up a child's brain to interpret letters and words in a very different way

Digital literacy scholars and cognitive neuroscientists Dr. Anne Mangen of the University of Stavanger and Dr. Jean-Luc Velay of Aix-Marseilles University caution against replacing handwriting with typing: “decoupling of motor input and haptic and visual output enforced by the computer keyboard as a writing device ... is seriously ill-advised” (74). Dr. Karin James concurs, stating that “it might be fine [to give the option not to teach handwriting anymore], but we don’t know that. And the research is pointing to that it might not be fine, you might be setting up a child’s brain to interpret letters and words in a very different way” (75).

Dr. Norman Doidge, psychiatrist and researcher in the area of neuroplasticity, offered his concern in remarks to the National Association of School Boards of Education:

“Some neuroscientists say if cursive disappears, those cognitive skills will simply be replaced by new ones, just as they always have since humans began leaving their marks on cave walls. No doubt the lost cognitive skills will be replaced by new ones. But, isn’t it irresponsible to promote such changes without understanding if these changes are beneficial or harmful to the learner?...It is quite possible that by relaxing...handwriting standards and also by reducing practice time for penmanship, we may have hampered and in some cases damaged the learning process” (76).

Dr. Jane Yank, kinesiologist and researcher in the area of handwriting agrees, noting that making marks by hand has produced tremendous advantages to humans, evolving in a reciprocal relationship with developing cognitive centers in the brain and refinements in hand structure (77), producing uniquely human capacities for knowledge, inventiveness, creativity, empathy (78) and social awareness (79), all of which are critical elements of education. She asserts that replacing handwriting with key-pressing and touch technologies may have far reaching negative effects for each of these critical areas of human activity [J. Yank, personal communication, June 5, 2016.]

Considering the growing body of knowledge about the unique contributions of handwriting to human development, literacy, the life of the mind, (80), and social engagement (81, 82), should we risk our children’s education by ignoring it?

About AHAF

The American Handwriting Analysis Foundation is a 501(c)6 nonprofit educational organization founded in 1967. In 2013, in response to information published about cursive handwriting training being removed from public school curricula in more than forty states, AHAF formed the Campaign for Cursive committee ("C4C"). Since then, C4C has worked to provide information about handwriting to the public.

For additional information:

www.ahafahandwriting.org

www.cursiveiscool.com

<https://www.facebook.com/CampaignForCursive>

<https://www.facebook.com/Cursive-is-Cool-254006231286933/>



References

- (1) Brown, J. (2015). [Ohio district preservers cursive by teaching it in art class.](#) Education Week, May 1st, 2015.
- (2) [National Center for Education Statistics. The nation's report card: A first look: 2013 mathematics and reading.](#)
- (3), (4) Saperstein Associates 2012. "Handwriting in the 21st Century. Research Shows Why Handwriting Belongs in Today's Classroom: A Summary of Research." [Handwriting in the 21st Century: An Educational Summit.](#)
- (5) Mueller, P.A. & Oppenheimer, D. M. (2014). [The pen is mightier than the keyboard: Advantages of longhand over laptop note taking.](#)*Psychological Science.*
- (6) National Association of Colleges and Employers. (2011). Job Outlook Survey 2011. In Douglas, Y. & Miller, S. (2016). [Syntactic complexity of reading content directly impacts complexity of mature students' writing.](#) *International Journal of Business Administration*, 7(3).
- (7). Lund, R. E. (2016). [Handwriting as a tool for learning in ELT.](#)*English Language Teaching Journal*, 70(1), 48-56.
- (8). Shapiro, T. R. (April 4, 2013). [Cursive handwriting is disappearing from public schools.](#) *Washington Post.*
- (9) US Department of Education (October 24, 2015). [Fact Sheet: Testing Action Plan.](#)
- (10) Christensen, C. A. (2005). [The role of orthographic-motor integration in the production of creative and well-structured written text for students in secondary school.](#) *Educational Psychology*, 25(5), 441-453. doi: 10.1080/01443410500042076

- (11) Harvey, C., & Henderson, S. (1997). Children's handwriting in the first three years of school: Consistency over time and its relationship to academic achievement. *Handwriting Review*, 11, 8-25.
- (12) Dinehart, L. (2014). [Handwriting in early childhood education: Current research and future implications.](#) *Journal of Early Childhood Literacy* 15(1). doi: 10.1177/1468798414522825
- (13) Klemm, William R., D.V.M, Ph.D, "[Cursive Writing Makes Kids Smarter.](#)" *Memory Medic*, March 14, 2013.
- (14) Wilson, F. (1999). *The hand: How its use shapes the brain, language, and human culture*. NY: 1998.
- (15). Spencer, L. (2010). [Learning to write/writing to learn.](#)
- (16). Mangen, A. and Velay, J-L. (2010). [Digitizing literacy: Reflections on the haptics of writing.](#) *Advances in Haptics*, Mehrdad Hosseini Zadeh (Ed.), doi: 10.5772/8710.
- (17). Dinehart, L. (2014). Ibid
- (18). Medwell, J., Strand, S., & Wray, D. (2009). The links between handwriting and composing for Y6 children. *Cambridge Journal of Education*, 39(3), 329-344. doi: 0.1080/03057640903103728
- (19). Steffani, S. & Selvester, P. M. (2009). [The relationship of drawing, writing, literacy and math in kindergarten children.](#) *Reading Horizons*, 49(2). 125-142.
- (20). Jones, D., & Christensen, C. A. (1999). The relationship between automaticity in handwriting and students' ability to generate written text. *Journal of Educational Psychology*, 91(1), 44-49.
- (21). Berninger, V., Abbott, R., Swanson, H. L., Lovitt, D., Trivedi, P., Lin, S., Gould, L., Youngstrom, M., Shimada, S., and Amtmann, D. (2010). Relationship of word- and sentence-level working memory to reading and writing in second, fourth, and sixth grade. *Language, Speech, and Hearing Services in Schools*, 41,179-193.

- (22). Mueller, P.A. & Oppenheimer, D. M. (2014). Ibid.
- (23). Grissmer, D., Grimm, K., Aiyer S., Murrah, W., Steele, J. [Fine Motor Skills and Early Comprehension of the World: Two New School Readiness Indicators](#). *Developmental Psychology*. 2010. Vol. 46, No. 5. 1008-1017.
- (24). Dinehart, L. (2014). Ibid
- (25). James, K. H. (2009). Sensori-motor experience lead to changes in visual processing in the developing brain. *Developmental Science*, 13(2), 1-10. doi: 10.1111/j.14677687.2009.00883.x
- (26).Berninger, V. W., & Abbott, R. D. (2010). Listening comprehension, oral expression, reading comprehension, and written expression: Related yet unique language systems in grades 1, 3, 5, and 7. *Journal of Educational Psychology*, 102(3), 635-651. doi: 10.1037/a0019319
- (27). Berninger, Virginia W., et al.: 2006. [Early development of language by hand: composing, reading, listening and speaking connections; three letter writing modes; and fast mapping in spelling](#). *Developmental Neuropsychology*. Vol. 29 No.1. Pages 61-92.
- (28). Berninger, V. W., Abbott, R. D., Abbott, S. P., Graham, S., & Richards, T. (2002a). Writing and reading: Connections between language by hand and language by eye. *Journal of Learning Disabilities*, 35(1), 39-56.
- (29). Snyders, C.S.B. (2014). [“I wish we could make books all day!”](#)An observational study of kindergarten children during writing workshop. *Early Childhood Education Journal*, 42 405-414.
- (30). Longcamp, M., Boucard, C.I., Gilhodes, J., Anton, J.L., Roth, M., Nazarian, B, & Velay, J-L. (2008) Learning through Hand- or Typewriting Influences Visual Recognition of New Graphic Shapes: Behavioral and Functional Imaging Evidence. *Journal of Cognitive Neuroscience*, 20(5), 802-815.
- (31). Child Trends Data Bank (2015). [Home computer access and internet use](#).

- (32). Taylor, J. (1985). The sequence and structures of handwriting competence: Where are the breakdown points in the mastery of handwriting? *British Journal of Occupational Therapy*, 48(7), 205-207. Reported in Dobbie, L., & Askov, E. N. (1995). Progress of handwriting research in the 1980s and future prospects. *The Journal of Educational Research*, 88 (6), 329-351.
- (33). Doidge, Norman (2007). *The Brain That Changes Itself*. Viking Penguin: USA.
- (34). Ridley, Matt. (2006). *Genome: Autobiography of a species in 23 chapters*. NY: Harper Collins.
- (35). Nakamura, K., Kuo, W.J., Pegado, F., Cohen, L., Tzeng, O.J., & Dehaene S. December 11, 2012). Universal brain systems for recognizing word shapes and handwriting gestures during reading. *Proceedings of the National Academy of Sciences U S A*, 50, 20762-7. doi:10.1073/pnas.1217749109. Epub 2012 Nov 26.
- (36). Bounds, G. (October 5, 2010). How handwriting trains the brain: Forming letters is key to learning, memory, ideas. *Wall Street Journal*.
- (37). Henry S.R.K., Wai S. L., Meilin, G. & Hui, C. (2012). Cognitive effects of English brush handwriting: the case of visual-spatial aptitude. *Asia Pacific Journal of Counselling and Psychotherapy*, 33(2). 190-201
- (38). Kao, H.S.R. (2006). Shufa: Chinese calligraphic handwriting (CCH) for health and behavioural therapy. *International Journal of Psychology*, 41(4), 282-286.
- (39). Shaffer, L. H. (1982). Rhythm and timing in skill. *Psychological Review*, 89(2), 109-122
- (40). Băncilă, V. G. (2012). The forensic importance of handwriting pathology in major psychiatric disorders. *International Journal of Criminal Investigation*, 2(3), 199-219.

- (41) Stokes, K. (2011). [Why Schools Should Keep Teaching Handwriting, Even If Typing Is More Useful.](#) Indiana Public Media.
- (42). Longcamp, M., Boucard, C.I., Gilhodes, J., Anton, J.L., Roth, M., Nazarian, B, & Velay, J-L. (2008) Learning through Hand- or Typewriting Influences Visual Recognition of New Graphic Shapes: Behavioral and Functional Imaging Evidence. *Journal of Cognitive Neuroscience*, 20(5), 802-815.
- (43). Welds, K. (n.d.?) [Cognitive Value of Handwriting in the Digital Era.](#)
- (44-47). Manley, Edda, "History of Handwriting," 2013.
- (48). Manley, Edda, "Handwriting for the Success of Our Nation," May 17, 2014.
- (49) Berninger, V. W., Abbott, R. D., Jones, J., Wolf, B. J., Gould, L., Anderson-Youngstrom, M., Shimada, S., & Apel, K. (2006). Early development of language by hand: Composing, reading, listening, and speaking connections; three letter-writing modes; and fast mapping in spelling. *Developmental Neuropsychology*, 29(1), 61-92.
- (50). Connelly, V., Gee, D. & Wals, E. (2007). A comparison of keyboarded and handwritten compositions and the relationship with transcription speed. *British Journal of Educational Psychology*, 77, 479-492
- (51). Christensen, C. A. (2005). Ibid.
- (52). Connelly, V., Gee, D. & Wals, E. (2007). Ibid
- (53). Morin, M-F., Lavoie, N., & Montesinos-Gelet, I. (2012). The effects of manuscript, cursive or manuscript/cursive styles on writing development in Grade 2. *Language and Literacy*, 14(1), 110-124.
- (54). James, K. H. (2009). Sensori-motor experience lead to changes in visual processing in the developing brain. *Developmental Science*, 13(2), 1-10. doi: 10.1111/j.14677687.2009.00883.x

- (55). James, K. H. & Engelhardt, L. (2012). The effects of handwriting experience on functional brain development in pre-literate children. *Trends in Neuroscience and Education*, 1(1), 32-42.
- (56). Association for Psychological Science. (April, 2014). [Take Notes by Hand for Better Long-Term Comprehension.](#)
- (57). Mueller, P.A. & Oppenheimer, D. M. (2014). Ibid.
- (58). Hatfield, 2007
- (59). Klemm, W. (2013). Ibid.
- (60). Zezima, K. (April 27, 2011). "The case for cursive," *The New York Times*.
- (61). Berninger, V. W., Abbott, R. D., Jones, J., Wolf, B. J., Gould, L., Anderson-Youngstrom, M., Shimada, S., & Apel, K. (2006). Early development of language by hand: Composing, reading, listening, and speaking connections; three letter-writing modes; and fast mapping in spelling. *Developmental Neuropsychology*, 29(1), 61-92.
- (62). Christensen, C. A. (2005). Ibid.
- (63). Medwell, J., Strand, S., & Wray, D. (2009). The links between handwriting and composing for Y6 children. *Cambridge Journal of Education*, 39(3), 329-344. doi: 0.1080/03057640903103728
- (64). Connelly V, Campbell S, MacLean M, Barnes J. (2006). Contribution of lower-order skills to the written composition of college students with and without dyslexia. *Developmental Neuropsychology*, 29, 175-196.
- (65). Montgomery D. (2012). The contribution of handwriting and spelling remediation to overcoming dyslexia. In *Dyslexia - A Comprehensive and International Approach* (Taeko N. Wydell and Liory Fern-Pollak, Eds). The Author(s).
- (66). Nielsen, K., Abbott, R., Griffin, W., Lott, J., Raskind, W., & Berninger, V. (2016). Evidence-based reading and writing assessment for

dyslexia in adolescents and young adults. *Learning Disabilities. A Multidisciplinary Journal*, 21, 38-56. NIHMS 752395 PMCID: PMC4739804 doi: 10.18666/LDMJ-2016-V21-I1-6971

(67). Shapiro, T. R. (2013). Ibid.

(68). Klemm, W. (2013). Ibid.

(69). Klemm, W. (2013). Ibid.

(70). Woods, W. C. (Winter, 1985). Robert Stone, [The art of fiction](#) No. 90. *Paris Review*, 98.

(71). Madcubans (2011, November 3). [Web comment to L. Rourke, [Why creative writing is better with a pen](#). The Guardian, 2011, November 3.

(72). Cameron, Julia, *The Artist's Way* (2002), Penguin Press: U.S.A.

(73). Rivkin, Lena, "The Lost Art," [campaignforcursive.blog](#), March 16, 2012.

(74). Mangen, A. and Velay, J-L. (2010). Ibid.

(75). Stokes, K. (2011). [Why Schools Should Keep Teaching Handwriting, Even If Typing Is More Useful](#). Indiana Public Media.

(76). Spencer, L. (April 12, 2012). "[Does Cursive Handwriting Need to Be Taught in a High Tech World?](#)"Chicago Tribune Local (April 12, 2012), In National Association of State Boards of Education, (2012).[The handwriting debate](#). *Policy Update*, 19(7). 2012.

(77). Yank, J. (2010).[Effects of visual feedback in handwriting movements in a pursuit loop-drawing task](#). Doctoral dissertation.

(78). Esposita, S. (2015). [Handwriting: An instrument of understanding and empathy](#).*Symposia Melitensia*, 11, 45-55.

(79). Klein, R. (2001). Fully modern humans. In G. M. Feinman & T. D. Price (Eds.), *Archaeology at the millennium: A sourcebook*. NY: Kluwer Academic.

(80). Grigorenko, E.L., Mambrino, E. & Preiss, D. (2012). *Writing: A Mosaic of New Perspectives*. NY: *Psychology Press*.

(81). Klein, R. (2001). *Ibid*.

(82). Haddock, V. (2007, February 25). [We shouldn't write off handwriting just yet.](#) *San Francisco Chronicle*, p. E-1.