



LAPIN YLIOPISTO
UNIVERSITY OF LAPLAND



University of Lapland

This is a self-archived version of the original article. It may differ somewhat from the publisher's final version, as the self-archived version is typically the accepted author manuscript.

Embodied learning with and through different writing methods

Korte, Satu-Maarit; Körkkö, Minna

Published in:

Embodied Learning and Teaching using the 4E Cognition Approach

DOI:

[10.4324/9781003341604-9](https://doi.org/10.4324/9781003341604-9)

Published: 21.05.2024

Document Version

Publisher's PDF, also known as Version of record

Citation for pulished version (APA):

Korte, S.-M., & Körkkö, M. (2024). Embodied learning with and through different writing methods. In T. Schilhab, & C. Groth (Eds.), *Embodied Learning and Teaching using the 4E Cognition Approach: Exploring perspectives in Teaching Practices* (pp. 54-62). Routledge. <https://doi.org/10.4324/9781003341604-9>

Document License
CC BY-NC-ND

6 Embodied learning with and through different writing methods

Satu-Maarit Korte and Minna Körkkö

Introduction

Why do people write? In today's world, writing is essential not only to succeed at school and work but also to function as an active member of society. It stems from our need and desire to communicate with others, and we can use writing to express our feelings, reflect on our experiences, and share our thoughts (Graham, 2018; Graham et al., 2020). Moreover, at school, when writing has become automatic after the first years of learning to write, the objective of the writing action changes, and writing is used to support learning (Frangou, 2020; Gillespie Rouse et al., 2017). While writing generally fosters learning and development, creative writing is seen as a process in which the writer can make sense of his/her experiences and emotions, create and build meanings, and gain knowledge, which leads to reflection and thinking about life from new perspectives (Martin et al., 2021). Writing can also be collaborative and, hence, a social activity in which we learn with and from each other, leading to the expansion of our intellectual and creative resources.

Manual writing tools, such as the pen, have been a means of communication and expression for thousands of years. Hailed as the beginning of automation, the typewriter has been a means of producing characters for about 100 years (Frangou, 2020). The use of computers has increased rapidly in recent decades, and most recently, touchscreen tablets and smartphones have challenged the dominance of computers and have rapidly come into use alongside them. The latest generation favours digital tools for reading and writing over traditional pen and paper (Bouriga & Olive, 2021; Mangen, 2018). Accordingly, contemporary society's needs have led to the progressive introduction and application of information and communications technologies (ICTs) in education. In the renewed Finnish National Core Curriculum for Basic Education, which was implemented in 2016 (Opetushallitus, 2014), cursive handwriting instruction was replaced in all subjects by ICT use. According to the curriculum, students must actively practice their skills in both traditional and multimedia learning environments that make extensive use of digital technology.

In this chapter, we examine the latest research related to writing using different methods for different age groups. We conclude the chapter by reflecting on writing in light of the 4E theoretical framework, comparing the key findings, and offering recommendations on writing instruction as part of literacy learning in order to meet society's future needs.

Connections between writing and writing methods

Writing is the expression of thoughts through visual symbols, which always occurs through some medium. In the field of writing research, Christina Haas (1996) proposed a hypothesis for an inextricable link between writing and writing methods (how writing is executed), whereby each writing tool influences the writing process differently, depending on how it operates. An example is how the process of letter formation differs considerably between handwriting and word-processing programmes. For the former, letters are drawn by hand, one at a time, with attention alternating between the writing medium and the written text until the process becomes automatic (Alonso, 2015). When typing on a computer keyboard, all ten fingers can be used, and as keyboard skills become automatic, attention shifts from the keyboard to the computer screen (Alonso, 2015). The number of fingers used for typing on touchscreen devices varies depending on the size of the screen, but young people commonly use their thumbs when typing on smartphones (Frangou, 2020; Nicolau & Joaquim, 2012).

Writing with any method is a complex cognitive function that combines conceptual, linguistic, and physical processes (Van Wijk, 1999). Content information and the means for expressing any kind of information in words are encoded grammatically into coherent sentences, which are then processed into motor activity to produce text that can be read (Frangou, 2020). As the writing process becomes automatic, the associated cognitive load changes, freeing up resources to allocate to text design, for example (Yeganeh Doost et al., 2017). Different writing methods, as well as control over these methods, can affect the strength of the memory traces of something written. This is due to the sensory and motor experiences of the writing process, which differ depending on the writing method (Frangou, 2020). Both can result in the same text, but it may be remembered differently by the writer.

Previous studies on writing methods and recollection are inconsistent in their results. Studies based on psychological or cognitive neuroscience approaches have noted a memory-enhancing effect of handwriting that does not arise when typing on a keyboard (Mangen et al., 2015). In contrast, some studies using a multidisciplinary approach to education and behavioural science have found that keyboard use makes text easier to recall (Bui et al., 2013). Whatever their conclusion, the studies mainly focused on single letters, words, or short notes; therefore, the generalisability of the findings is questionable, especially in a school context where the intention is to memorise larger

ensembles than individual words, revealing the need for research on authentic learning environments (Frangou, 2020).

Writing as an embodied activity

The embodied theory of learning highlights the intertwined nature of physical activities and cognitive mechanisms, suggesting that the activation of the body and gestures can positively impact learning (Wilson & Golonka, 2013). Writing can be defined as a biophysical, psychomotor, and cognitive process that produces a final text (Van Galen, 1991); therefore, writing can be considered from the perspective of embodied learning. Essential elements of embodied cognition, the 4Es, are involved in learning to write: embodied, enactive, extended, and embedded learning (Lund et al., 2019). Embodied learning refers to learning as a cognitive and bodily process; enactive learning is learning that is both active and interactive; extended learning includes learning with or through a medium, such as technology, a pen, or a laptop; embedded learning occurs within physical and sociocultural learning environments. Recent studies (e.g., Frangou et al., 2018; Mangen et al., 2015) suggest that the memory-enhancing effect of handwriting arises from embodied cognition: handwriting activates sensory-motor processes that promote recall. Meanwhile, certain studies have highlighted that typewriting requires higher information processing and thus greater cognitive effort, negatively impacting short-term memory (Bouriga & Olive, 2021).

Growing research examines the embodied learning experiences of students and the development of embodied learning environments, for instance, when learning languages (Kosmas & Zaphiris, 2020), mathematics (Georgiou & Ioannou, 2021), biology (Chettaoui et al., 2022), and reading and writing (McClelland et al., 2015). These studies apply various technologies to investigate writing as an embodied act. The findings so far indicate that an embodied pedagogy that combines physical activities with cognition has the potential to improve students' attention, self-control, academic achievements, and engagement. The settings of the existing studies varied but noted similar factors contributing to students' learning. These included, for instance, congruence between body movements and the learning content, multimodal interaction, embodied technology features, and a learning approach that favours students' activity and collaboration.

The concept of embodied cognition in learning to write is relatively new, and only a limited number of models within educational research illustrate how the body and cognition relate (e.g., Frangou, 2020). Further studies must be conducted on learning to write, aiming to investigate how writing skills can be enhanced by applying more embodied and body sense-activating features in writing instruction. Given the promising results of existing research on embodied pedagogy, it is worth studying how the embodied approach could be better linked to research on writing and the development of new instructional methods for writing.

Writers of different ages

In this section, we present two studies for deeper discussion on the effects of different writing methods. These two studies investigated the influence of writing methods on the recall of written stories in different age groups. The studies aimed to identify and describe the writing-related factors that affect knowledge retention.

In both studies, participants transcribed three dictated texts, alternating the writing modes for each text. The pairing of texts and writing modes was randomly assigned and differed between participants so that each text was ultimately written an equal number of times in each mode. The texts were logical stories that did not require prior knowledge. In the first study, the participants' short-term recollections were measured after 30 minutes, and in both studies, the participants' long-term recollections were measured after 1 week. Each time, they were asked to freely recount anything they recalled about the stories. Each story had the same number of memorable details that were recorded as the participants mentioned them. A total of 166 children, adolescents, and university students participated in the studies (see Table 6.1).

The first study had university students writing dictated texts with a desktop computer's keyboard, an iPad's touchscreen keyboard, and a pencil. This study's main result was that the method of writing affected recall to a statistically significant degree. The university students recalled their handwritten stories statistically significantly better than the stories they had typed on a computer or iPad touchscreen keyboard, both 30 minutes and 1 week later.

In the second study, the recollections of 16-year-old teens and 10- and 11-year-old children were compared after writing dictated texts with different writing tools (Frangou et al., 2019). Both age groups wrote stories by hand

Table 6.1 Participants, equipment, and data collection methods of the studies.

	<i>Participants</i>	<i>Equipment</i>	<i>Data collection</i>
Study I Frangou et al. (2018)	<i>N</i> = 31 university students (10M, 21F)	Desktop computer and keypad, iPad & pencil	Measurement after 30-minute and 1-week delay
Study II Frangou et al. (2019)	<i>All together N</i> = 135		
<i>Pilot study</i>	<i>N</i> = 29 (ages 10-11); 19 b.2007 (8M, 11F) 10 b.2006 (6M, 4F)	Laptop computer, iPad & pencil	Measurement after 1-week delay
<i>Study 1</i>	<i>N</i> = 63 (ages 10-11); 31 b.2007 (14M, 17F) 32 b.2006 (12M, 20F)	Laptop computer, iPad & pencil	Measurement after 1-week delay
<i>Study 2</i>	<i>N</i> = 43 (age 16) b.2001 (21M, 22F)	Laptop computer, smartphone & pencil	Measurement after 1-week delay

and on a laptop. The 10- and 11-year-olds also wrote using an iPad tablet, while the 16-year-olds wrote on their own smartphones. Without being directed to do so, the teen subjects used only their thumbs to write on their smartphones. The results showed that the 11- and 16-year-olds' recall was statistically significantly associated with the writing method, with handwritten stories recalled better than those typed on a computer keyboard or a touch-screen keyboard on a tablet or smartphone. Interestingly, the writing methods used by the 10-year-olds seemed to produce no difference in recall.

Based on the conclusions drawn from these two studies (Frangou et al., 2018, 2019), systematic teaching of typing skills and balanced practice of different writing methods were recommended as teaching practices. Furthermore, the author noted that balancing different writing methods and instruction practices at an early stage is essential for enabling children to acquire the best possible skills for diverse learning and communication (Frangou, 2020).

Recent studies largely corroborate the findings and implications of the research by Frangou et al. (2018, 2019). For example, Bouriga and Olive (2021) compared undergraduate students' cognitive efforts while writing by hand and typing. The first experiment revealed a longer reaction time while transferring thoughts to the keyboard, suggesting greater cognitive effort. In subsequent experiments, a short-term memory task was added involving the recall of typed or handwritten words. The handwritten words were recalled better than the typed ones; hence, typing was considered to require more effort. This led to the authors' suggestion that schools should ensure that students learn to type efficiently, as poor typing skills can negatively influence their learning activities.

Lee (2021) compared English-speaking university students' short- and long-term memories after writing Japanese kanji with a pen on paper and with an Apple Pencil on a tablet. The short-term memory test did not reveal a difference, but the long-term test (after 24 hours) showed increased recall of kanji written on paper. The participating students observed that they needed more practice with tablet-based writing to achieve equal results, given that they had a higher level of motor programme automatization for paper-based writing. Younger children might not have this imbalance, as they have been exposed very early to digital devices.

Kiefer et al. (2015) studied 4- to 6-year-old kindergarteners' letter recognition and naming, as well as their writing performance and word reading after handwriting and typing. Typing was not identified as superior to handwriting in any task; handwriting produced better results for word writing and reading. Mayer et al. (2020), meanwhile, studied 4- to 6-year-old kindergarteners using a pencil, keyboard, and tablet stylus while learning to read and write. The children were assessed before, immediately after, and about a month after the learning activities. The pencil group performed significantly better than the typing group in letter recognition and visuospatial skills. The stylus group performed somewhere in between. At the same time, typing training resulted in significantly better results for word writing and reading than the stylus

group. The pencil group, this time, performed somewhere in between. The results suggest that writing by hand on paper helps improve letter knowledge and visuospatial skills, which corroborates the findings of Kiefer et al. (2015), while a stylus is the least effective instruction method.

In a final study worthy of note, Spilling et al.'s (2022) findings corroborated those of Frangou et al. (2018, 2019) but differed slightly from the findings of Mayer et al. (2020). Norwegian 6-year-old first graders were taught using both pencil and paper and digital tablet keyboards for the first three months of their writing lessons and then assessed. The findings indicated moderate to strong evidence of a lack of difference between methods, and typing and writing in their other lessons were noted to result in similar text quality. It was concluded that writing performance was not connected to method at this age.

Conclusion and implications

Learning is largely understood to occur in the mind, with action and perception as mere influencing factors (Wilson & Golonka, 2013). Embodied cognition theories, however, view cognition as the result of the simulated motoric action of neural circuits that occurs during learning activities when the learner's body interacts with the physical learning environment. Writing is an activity that entails all of the 4E theory's dimensions: first, learning to write or learning through writing is a cognitive and bodily movement entailing a process; second, it is enactive, with sensory-motor and visuospatial features and interactivity linking embodiment and cognition; third, it is extended as it always needs a medium; lastly, it is embedded, as it occurs in the physical environment and the sociocultural environment of each individual, which influences the writing moment. Writing is achieved through movements controlled by a writer using a particular medium. How such movements influence learning, recalling, and understanding must be investigated so that instructional methods can be improved to achieve the best possible learning results.

Based on the research findings, we recommend that to support writing instruction, teachers should, from early on, balance their teaching of handwriting and typing. To optimally prepare learners for tomorrow's society, it is important to maximise the potential of the various technologies for writing and to teach the use of a variety of keyboards, such as those of desktop and laptop computers and the virtual keyboards of smartphones and tablet computers. Within the 4E theoretical framework, the use of multiple mediums extends the embodied learning experience. This strengthens the different stimulative embodied cognitive processes that learners must adopt to effectively use different writing methods. At the same time, it is equally important to continue teaching pupils and students to write by hand so they can develop various motoric and visuospatial skills, establish sensory-motor representations, and succeed in their literacy learning. To enhance the embodied experience of writing, we recommend the integration of interactivity into writing exercises in order to make embodied learning enactive. Here are some

practical examples of how to promote interaction and foster cognitive socialisation in writing instruction:

- Offer a group assignment in which each person starts a story, another continues, and another finishes it. Then, the stories can be shared.
- Offer pair assignments in which each pair decides on ten words (adjectives, animals, etc.) that need to be in the story.
- Offer a pair or small group a topic that they first need to familiarise themselves with and then make a mind map and collaboratively write about it, possibly even visualising it through drawings.

Furthermore, changing the writing environment and embedding different physical and sociocultural elements in it will not only connect the embodied learning moment in the context but also inspire and motivate the learning writer. Here are some practical examples for creating and providing an embodied writing environment:

- Start with a moment of calming and relaxing silence, eyes closed, to activate the senses.
- Make use of all senses.
 - Aural environments can be created with different kinds of music, nature sounds, busy street sounds, factory sounds, and so on.
 - The visual experience of nature, animals, and art can inspire the writing process. Also, giving the learners a picture (even drawings) of a place with many features, such as a busy street with cars and people, can help the writers' imaginations. Learners can even swap pictures and, after writing, share their own story of the picture and listen to the other learners' imaginative stories.
 - Smelling perfumes, spices, flowers, and so on.
 - Tasting fruits and vegetables, and, if possible, baking something (and then tasting) together.
 - Touching different textures, such as vegetables, leaves, stones, and so on.
- Visit a museum, art gallery, park, supermarket, forest, farm, police car, ambulance, fire engine, garden, market place and so on, where the learners can observe their surroundings with all their senses and then write about their thoughts and experiences.
- Use ready-made book templates with pictures that guide the story.

Many of these practical examples can be modified to fit the needs of diverse pupils, students, and contexts. Learners must be supported early to develop typing skills so that they can play an active role in our digital world, from their studies to their later working lives, as well as in their free time from childhood through adulthood. Contemporary society needs members who can produce, acquire, and evaluate information in any shape or form. Much remains to be

done to provide teachers with the necessary support and resources to teach today's pupils and students different writing methods so that they develop balanced skills.

Acknowledgements

This study was funded by Eudaimonia Institute, University of Oulu.

References

- Alonso, M. A. P. (2015). Metacognition and sensorimotor components underlying the process of handwriting and keyboarding and their impact on learning: An analysis from the perspective of embodied psychology. *Procedia, Social and Behavioral Sciences*, 176, 263–9. <https://doi.org/10.1016/j.sbspro.2015.01.470>
- Bouriga, S., & Olive, T. (2021). Is typewriting more resources-demanding than handwriting in undergraduate students? *Reading and Writing*, 34, 2227–55. <https://doi.org/10.1007/s11145-021-10137-6>
- Bui, D. C., Myerson, J., & Hale, S. (2013). Note-taking with computers: Exploring alternative strategies for improved recall. *Journal of Educational Psychology*, 105(2), 299–309. <https://doi.org/10.1037/a0030367>
- Chettaoui, N., Atia, A., & Bouhlel, M. S. (2022). Examining the effects of embodied interaction modalities on students' retention skills in a real classroom context. *Journal of Computers in Education*. <https://doi.org/10.1007/s40692-021-00213-9>
- Frangou, S.-M. (2020). Write to recall: An embodied knowledge construction model of affects in writing. [Doctoral dissertation, University of Lapland]. *Acta Electronica Universitatis Lapponiensis*, 272. <http://urn.fi/URN:ISBN:978-952-337-188-0>
- Frangou, S.-M., Ruokamo, H., Parviainen, T., & Wikgren, J. (2018). Can you put your finger on it? The effects of writing modality on Finnish students' recollection. *Journal of Writing Systems Research*, 10(2), 82–94. <https://doi.org/10.1080/17586801.2018.1536015>
- Frangou, S.-M., Wikgren, J., Sintonen, S., Kairaluoma, L., & Vasari, P. (2019). The effect of writing modality on recollection in children and adolescents. *Research in Learning Technology*, 27, 2239. <https://doi.org/10.25304/rlt.v27.223>
- Georgiou, Y., & Ioannou, A. (2021). Developing, enacting and evaluating a learning experience design for technology-enhanced embodied learning in math classrooms. *TechTrends*, 65, 38–50. <https://doi.org/10.1007/s11528-020-00543-y>
- Gillespie Rouse, A., Graham, S., & Compton, D. (2017). Writing to learn in science: Effects on grade 4 students' understanding of balance. *The Journal of Educational Research*, 110(4), 366–79. <https://doi.org/10.1080/00220671.2015.1103688>
- Graham, S. (2018). A revised writer(s)-within-community model of writing. *Educational Psychologist*, 53(4), 258–79. <https://doi.org/10.1080/00461520.2018.1481406>
- Graham, S., Kihara, S. A., & MacKay, M. (2020). The effects of writing on learning in science, social studies, and mathematics: A meta-analysis. *Review of Educational Research*, 90(2), 179–226. <https://doi.org/10.3102/0034654320914744>
- Haas, C. (1996). *Writing technology studies on the materiality of literacy*. Lawrence Erlbaum Associates. <https://doi.org/10.1109/tpc.1997.649562>
- Kiefer, M., Schuler, S., Mayer, C., Trumpp, N. M., Hille, K., & Sachse, S. (2015). Handwriting or typewriting? The influence of pen- or keyboard-based writing training on reading and writing performance in preschool children. *Advances in Cognitive Psychology*, 11(4), 136–46. <https://doi.org/10.5709/acp-0178-7>

- Kosmas, P., & Zaphiris, P. (2020). Words in action: Investigating students' language acquisition and emotional performance through embodied learning. *Innovation in Language Learning and Teaching*, 14(4), 317–32. <https://doi.org/10.1080/17501229.2019.1607355>
- Lee, B. J. (2021). Writing medium's impact on memory: A comparison of paper vs. tablet. *Technology in Language Teaching & Learning*, 3(2), 51–66. <https://doi.org/10.29140/ttl.v3n2.575>
- Lund, K., Niccolai, G. P., Lavoué, E., Hmelo-Silver, C., Gweon, G., & Baker, M. (Eds.). (2019). A wide lens: Combining embodied, inactive, extended, and embedded learning in collaborative settings. In *13th international conference on computer supported collaborative learning. Conference proceedings*, Volume 1.
- Mangen, A. (2018). Modes of writing in a digital age: The good, the bad and the unknown. *First Monday*, 23(10). <https://doi.org/10.5210/fm.v23i10.9419>
- Mangen, A., Andal, L. G., Oxborough, G. H., & Brännick, K. (2015). Handwriting versus keyboard writing: Effect on word recall. *Journal of Writing Research*, 7(2), 227–47. <https://doi.org/10.17239/jowr-2015.07.02.1>
- Martin, A., Tarnanen, M., & Tynjälä, P. (2021). Narratives of professional development in a teachers' creative writing group. *New Writing*, 18(4). <https://doi.org/10.1080/14790726.2021.1900274>
- Mayer, C., Wallner, S., Budde-Spengler, N., Braunert, S., Arndt, P. A., & Kiefer, M. (2020). Literacy training of kindergarten children with pencil, keyboard or tablet stylus: The influence of the writing tool on reading and writing performance at the letter and word level. *Frontiers in Psychology*, 10, 3054. <https://doi.org/10.3389/fpsyg.2019.03054>
- McClelland, E., Pitt, A., & Stein, J. (2015). Enhanced academic performance using a novel classroom physical activity intervention to increase awareness, attention and self-control: Putting embodied cognition into practice. *Improving Schools*, 18(1), 83–100. <https://doi.org/10.1177/1365480214562125>
- Nicolau, H., & Joaquim, J. (2012). Touch typing using thumbs: Understanding the effect of mobility and hand posture. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2683–6). ACM. <https://doi.org/10.1145/2207676.2208661>
- Opetushallitus. (2014). *Perusopetuksen opetussuunnitelman perusteet 2014* [National Core Curriculum for Basic Education 2014]. Finnish National Board of Education.
- Spilling, E. F., Rønneberg, V., Rogne, W. M., Roeser, J., & Torrance, M. (2022). Handwriting versus keyboarding: Does writing modality affect quality of narratives written by beginning writers? *Reading and Writing*, 35, 129–53. <https://doi.org/10.1007/s11145-021-10169-y>
- Van Galen, G. P. (1991). Handwriting: Issues for a psychomotor theory. *Human Movement Science*, 10(2–3), 165–91. [https://doi.org/10.1016/0167-9457\(91\)90003-g](https://doi.org/10.1016/0167-9457(91)90003-g)
- Van Wijk, C. (1999). Conceptual processes in argumentation: A developmental perspective. In G. Rijlaarsdam, E. Espéret (Series Eds.), M. Torrance, & D. Galbraith (Vol. Eds.), *Studies in writing: Vol. 4. Knowing what to write: Conceptual processes in text production* (pp. 31–50). Amsterdam University Press.
- Wilson, A. D., & Golonka, S. (2013). Embodied cognition is not what you think it is. *Frontiers in Psychology*, 4, 58. <https://doi.org/10.3389/fpsyg.2013.00058>
- Yeganeh Doost, M., Orban de Xivry, J. J., Bihin, B., & Vandermeeren, Y. (2017). Two processes in early bimanual motor skill learning. *Frontiers in Human Neuroscience*, 11, 618. <https://doi.org/10.3389/fnhum.2017.00618>