HANDWRITTEN NOTES VS DIGITAL NOTES, WHICH IMPROVES LEARNING?

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Abstract. *This article presents a comparative analysis of the impact of handwritten note-taking and digital note-taking on learning effectiveness based on scientific literature. The study demonstrates that the process of handwriting transforms learners from passive information copiers into active creators of meaning, which significantly improves conceptual thinking, deep comprehension, and long-term memory retention. Contemporary research in neuroimaging and cognitive psychology confirms that handwriting activates brain regions associated with learning and memory more intensively than digital note-taking.*

Keywords: *handwritten notes, digital note-taking, learning effectiveness, cognitive processing, long-term memory, elaborative encoding, educational technology, neuroimaging, dual coding*

Introduction. Today, educational technologies are developing rapidly, and students are faced with an important choice: traditional handwritten note-taking with paper and pen, or electronic note-taking through laptops, tablets, and other digital devices. Although this question may seem simple at first glance, it involves complex cognitive processes, memory mechanisms, and the psychology of learning. Many students prefer digital devices because of their convenience, speed, and ability to store information efficiently. At first sight, this appears logical: typing on a laptop allows users to record more information, organize files easily, and search for needed materials within seconds. However, scientific research fundamentally challenges this assumption.

This article presents a comparative analysis of the effects of handwritten and digital note-taking on learning based on scientific literature. The aim is not to support technology alone or remain loyal only to traditional methods, but rather to draw

evidence-based conclusions and provide practical recommendations for educational practice.

Literature review. The cognitive advantages of handwriting**.** One of the most frequently cited studies in the psychology of learning was conducted by Pam A. Mueller and Daniel M. Oppenheimer (2014), which found that students who took handwritten notes performed significantly better on conceptual questions than those using digital devices. The researchers explained the main reason as follows: because handwriting is a slower process, students are less likely to copy information word-for-word. Instead, they mentally process the information, identify the most important ideas, and restate them in their own words. This process is known as "elaborative encoding," meaning deeper cognitive processing of information. Kelsey Morehead, John Dunlosky, and Katherine A. Rawson (2019) expanded upon the study of Mueller and Oppenheimer and reached a similar conclusion: students who took handwritten notes consistently achieved higher scores on conceptual and application-based questions compared to those using digital devices. The underlying principle behind this result is that writing at a limited speed is, in fact, a powerful learning strategy.

A neurovisualization study conducted by Audrey van der Meer, Frederik Ose Askvik, and Anne Mangen (2020) provided even more interesting findings. Using high-density EEG technology, the researchers observed that students writing by hand showed significantly higher activity in brain regions associated with learning and memory than those using keyboards. Specifically, increased theta and alpha wave activity during handwriting indicated deeper cognitive integration processes. This finding suggests that forming letters by hand is not merely a motor activity, but also a process that actively stimulates the brain for learning.

Advantages of digital note-taking**.** For the sake of fairness, it should be acknowledged that digital note-taking also has important advantages. In a study conducted by Luo Luo, Kenneth A. Kiewra, Abigail E. Flanigan, and Mark S. Peteranetz (2018), students using laptops recorded considerably more information during lectures. The increase in the amount of recorded information slightly improved performance on factual questions; however, students taking handwritten notes still outperformed them on conceptual questions. Therefore, the advantage of digital note-taking appears mainly quantitative, while the advantage of handwritten note-taking is primarily qualitative. Furthermore, the organizational conveniences of digital note-taking such as folders, search functions, multimedia integration, and cloud storag may play an important role in long-term learning processes. Especially when reviewing large volumes of material, these features can save considerable time compared to handwritten notes.

Reading and comprehension**.** This issue can also be examined not only from the perspective of writing, but also from the perspective of reading. In an article published by Anne Mangen, Bente R. Walgermo, and Kolbjørn Brønnick (2013), students who read texts on paper demonstrated better comprehension than those reading on computer screens. The researchers emphasized that this may be related to the haptic characteristics of physical pages: moving between pages and physically pointing to specific sections help reinforce information in spatial memory. Tina J. Smoker, Christine E. Murphy, and A. Kim Rockwell (2009) conducted an experiment on remembering handwritten versus typed words. The results showed that handwriting was significantly more effective for memory retention because the process of physically forming each word strengthens the memory trace associated with that word.

Analysis and discussion. Based on the body of scientific literature, handwritten note-taking appears to be superior to digital methods, particularly in terms of comprehension, analytical thinking, and long-term memory retention. The main mechanism behind this advantage is that writing by hand transforms the student from a passive recorder of information into an active constructor of meaning.

However, approaching this issue from only one perspective would also be misleading. Depending on the learning context, the optimal strategy may vary. Situations Where Handwriting Is More Effective Handwritten note-taking demonstrates a clear advantage during lectures or lessons that involve understanding concepts, ideas, and the relationships between them. Especially when a new topic is being introduced for the first time, handwriting is recommended because it encourages deeper cognitive processing. In subjects requiring structured thinking such as mathematics, logic, and linguistics drawing diagrams and схемas by hand can further strengthen learning.

Situations where digital note-taking is more effective. When recording large amounts of factual information such as tables, statistics, or lists digital methods help students capture a greater volume of material. In addition, for multi-stage projects, seminar papers, or collaborative assignments, digital devices are often preferable because they provide easier opportunities for cooperation, editing, and information management.

Combining both approaches**.** In modern educational practice, the most effective approach may be to combine both methods according to purpose. Taking notes by hand during lectures to capture key concepts and relationships, and later transferring those notes into digital form for expansion and organization, aligns with the theory of “dual coding.” This theory suggests that processing information through two channels can significantly strengthen learning outcomes.

Another important factor to consider is individual differences. For some learners, handwriting may be physically difficult due to motor limitations, while others may struggle to concentrate on digital devices because of technological distractions. Therefore, there is no universal answer to the question, "Which method is better?" Instead, the more appropriate question is: "Which method is more effective under specific conditions, for specific goals, and for specific learners?"

Conclusion. Existing scientific research comparing handwritten and digital note-taking generally reaches one conclusion: for deep understanding, long-term memory retention, and conceptual thinking, handwriting still remains superior to digital methods. This advantage is based on the full activation of the brain, the process of reformulating information "in one's own words," and the involvement of haptic-motor memory.

However, this does not mean that traditional methods should be considered absolute. Educational technologies have become firmly integrated into modern life, and rejecting them entirely would not be practical. The main recommendation is that students and educators should use digital devices consciously and purposefully rather than blindly relying on them. During lessons, whenever possible, handwritten note-taking should be adopted as the primary method.

For education professionals, these findings may serve as an important foundation for both policy and practical decision-making. When introducing digital tools in schools and universities, it is essential to consider students' cognitive development and evaluate every technological innovation from the perspective of pedagogical effectiveness.

References

1. Luo Luo, Kenneth A. Kiewra, Abigail E. Flanigan, & Mark S. Peteranetz (2018). Laptop versus longhand note taking: Effects on lecture notes and achievement. Instructional Science, 46(6), 947–971. https://doi.org/10.1007/s11251-018-9458-0
2. Anne Mangen, Bente R. Walgermo, & Kolbjørn Brønnick (2013). Reading linear texts on paper versus computer screen: Effects on reading comprehension. International Journal of Educational Research, 58, 61–68. https://doi.org/10.1016/j.ijer.2012.12.001
3. Kelsey Morehead, John Dunlosky, & Katherine A. Rawson (2019). How much mightier is the pen than the keyboard for note-taking? A replication and extension of Mueller and Oppenheimer (2014). Educational Psychology Review, 31(3), 753–780. https://doi.org/10.1007/s10648-019-09468-2

4. Pam A. Mueller & Daniel M. Oppenheimer (2014). The pen is mightier than the keyboard: Advantages of longhand over laptop note taking. Psychological Science, 25(6), 1159–1168. https://doi.org/10.1177/0956797614524581
5. Frederik Ose Askvik, Frode R. van der Weel, & Audrey L. H. van der Meer (2020). The importance of cursive handwriting over typewriting for learning in the classroom: A high-density EEG study of 12-year-old children and young adults. Frontiers in Psychology, 11, Article 1810. https://doi.org/10.3389/fpsyg.2020.01810
6. Tina J. Smoker, Christine E. Murphy, & A. Kim Rockwell (2009). Comparing memory for handwriting versus typing. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 53(22), 1744–1747. https://doi.org/10.1177/154193120905302218