

# How does the shift from handwriting to digital writing technologies impact writing for learning in school?

Lisbet Rønningsbakk<sup>1</sup>

<sup>1</sup>UiT the Arctic University of Norway, Box 6050, Langnes N-9037 Tromsø, Norway  
Lisbet.ronningsbakk@uit.no

## Abstract.

The shift from handwriting to using writing technologies are widespread in today's schools. And where handwriting still is the most used method, it is supported with digital writing technologies. My aim in this article is to show and discuss some aspects on how digital writing technologies impacts learning in school. Writing is a frequent activity in all education and the shift from handwriting til keyboarding brings significant changes. The linear form of text production that characterizes handwriting is replaced by a flexible and non-linear form. Keyboarding enables the writer to start any place in the document and edit constantly without having to start over. For students in school, it is also a benefit that they can write long texts even before their handwriting skills are developed. This seems to stimulate motivation for writing and producing texts in school. The study showed that digital writing technology improved writing skills but not text skills. Therefore, using digital writing technology prerequisite emphasis on supervising the writing process to develop good text strategies.

**Keywords:** Digital writing technology, digital writing in school, technology supported learning, teaching with technology.

## 1. Introduction

Writing is a main activity in all learning work in school. The ability to write fluent and legible is essential for students' learning. Thus, the aim for this article is to present and discuss the changes that occur when shifting from handwriting to keyboarding in school based on results from a phd-study that investigate how technology impact different aspects of learning in school [1].

Using digital writing technology changes the writing process from a linear process to a process where all parts of the text can be produced and changed along the way. It allows texts to be saved and shared in ways that have not been possible before. This leads to questions about if and how the teachers should change their ways of teaching to adapt these changes. The research question in the study targets these challenge, asking "how does the use of digital writing technologies impact learning work in school"? This paper will try to give some answers, based on what my research revealed about writing.

## 2. Key concepts and theoretical framework

Writing is defined as a basic skill for learning in the Norwegian curriculum LK-20 [2]. Writing for learning can be viewed as an ongoing dialogue, mostly between student and teacher but also with peers and others, supporting the dynamic movement between feedback and feed forward that drives all learning processes [3, 4]. Feed forward is the expectations of future learning and feedback is the conception of the previous learnt. From the learning point, the expected future knowledge change, due to changes in prior knowledge. What you learn changes the way you see what you already know. In this way, adding something new to the prior knowledge, changes both feed forward and feedback. Hence, the dynamics between feed forward and feedback is a driving force in all learning, and writing is an essential activity mediating this movement [3, 4].

However, the student needs basic writing skills to be part of this written learning dialogue. Hertzberg [5] see writing as dependent of two different types of strategies; writing strategies and text strategies. Writing strategies are the connected with the technical part of writing, such as forming letters, writing fluently, spelling and grammar, while text strategies are connected with the ability to compose a text for a certain purpose. Berninger et al. [6] describes four components in basic writing: text generation, transcription, working memory and executive functions. Both theories can contribute to understanding of writing as a phenomenon for learning, pointin both at basic skills and functions that are related to a more contextual perspective on learning. To study how technology affects writing as learning work, the gaze must therefore be directed both at the writing tool itself and the students' writing strategies, and towards the purpose of the text and the students' text strategies.

Vygotsky also describes the writing process as an abstract and complicated skill that implicates an interaction of various cognitive processes [7]. He explains the challenges of writing by comparing between what can be called oral and written speech. Written speech is a separate linguistic function that differs from the spoken language both structurally and functionally [7]. Children struggle to express themselves in writing, even if they have well developed vocabulary and master the grammar of speech because they are two different processes. While oral speech is quoted in a social context where the situation itself supports what is said and creates meaning for those who participate, the written speech is detached from its context or situation [7]. A written text must therefore include all the information necessary for the reader to interpret the meaning of the text as intended by the writer.

Ricoeur refers to language as an exterior of inner experiences, a way to make them available to others [4]. Salomon et al. also point that writing forms and refines thoughts and ideas that enable us to see things in new ways [8]. The activity to write is thus far more than just using a tool, it must consider its future purpose which is to convey something to others.

All these theories have been useful to understand both the technical part of writing: the writing strategies [5] or the text genention and the transcription [6] and the higher functions that is neede: text strategies [5] and working memory and executive funtions [6], which are all important to understand writing as learning work in schoo when changing writing technology, or writing mode, from handwriting to keyboarding.

### 3. Method

The paper is based on a multi case study of 25 students from two classes and two schools: 15 students from 4<sup>th</sup> grade (9-10 years old) from Southam school and 10 students in 10<sup>th</sup> grade (15-16 years old) from Norwich school. The study took part during one academic year, using participating observations as main access to the field. In addition, the study had access to students' text productions during the year of observation [1].

The choice of multi case study as research strategy gave access to collect a wide range of data about the empiric field of study [9, 10]. I could select cases within my network of teachers and schools which were innovative using technology, and the observations cover a period of one academic year, represented by five weeks of participation in the two schools. I observed teaching with and without technology support and aimed to identify all kinds of changes that occurred in the students' learning work. Data were generated through writing, coding with NVivo<sup>1</sup>, rewriting and refining reflections from the observations, before presenting them in narratives. As I studied a field I knew well as former teacher, I needed a hermeneutic approach to the observations to avoid biased perceptions [11]. Therefore, all data were approved by all participants (parents, teachers, school leaders) as a reliability check [1]. I also had access to students' texts on Learning Management System (LMS) which were analysed to support the impressions of every student's written performance. The results will be presented with use of narratives to illustrate findings.

### 4. Results

In general, the study showed that writing was a frequent method in all the theoretical subjects, and that students used both handwriting and keyboarding as writing modes. Writing was often linked to activities that followed an introduction or a social learning dialogue in class, with the purpose of processing knowledge, practicing subject-specific skills, or getting general writing training. There was also some writing related to the students' homework. All texts could be understood within the frame of functioning as a dialogue between (mostly) teachers and students, but with more emphasis on social learning when the text production used digital technology.<sup>2</sup>

The study showed that students both in 4<sup>th</sup> and 10<sup>th</sup> grade were motivated for writing using keyboarding. It also showed that the students wrote long texts and that they wrote more efficient. It also eased the writing for students who were reluctant writers. The positive effect of keyboarding seemed to be mostly connected to writing strategies or the technical parts of the writing. However, it seemed that keyboarding did not have the same positive impact on students' text strategies.

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<sup>1</sup> NVivo is a well-known tool for qualitative data analysis: [Qualitative Data Analysis Software | NVivo \(qsrinternational.com\)](https://www.qsrinternational.com/)

<sup>2</sup> This article will not include multi media texts, which also were frequent in the observations. But social learning processes increased when students worked with multi media, a finding which is supported by other studies [6, 12].

### **Motivation for writing increased with digital technology**

The study showed that the fourth graders seemed very motivated to write. They had functional and fast typing strategies on the keyboard, and they wrote long texts. They had used Trageton's method<sup>3</sup> of learning to read by digital writing tools [13] and were familiar with the digital writing technologies. Research suggests that the use Trageton's method develop better writing skills with better content quality, grammar, and orthography [14]. Reports also states that students write faster and more correctly and are more motivated to write when using writing technology in early literacy training [15]. Feng et.al. also showed in their meta-analytic review that students' wrote faster and longer texts using keyboarding [6].the same tendency seems to be supported by Williams & Beams' research review which states that motivation seems to increase and that that reluctant writers benefit from keyboarding [12].

The tenth graders started using digital technology when I first met them. Most of the writing in all subjects were keyboarding and all work was organised in the LMS<sup>4</sup> so they had to change a nine-year old handwriting practice. But they rapidly embraced the new technologies and changed the way they worked. In relatively short time their motivation to write increased and they wrote efficiently and produced long texts.

The increased motivation can be explained by the fact that the writing itself was changed. Since writing is complex and demanding [7], writing for learning can bring negative experience. Since negative motivation is often connected to the situation where the reluctance arose [16] negative experiences with writing can be crucial for learning. Negative emotions tend to replenish the functions of consciousness so that there is no room for the reflection required to learn [17].

Several narratives from the study seem to be about motivation. Fourth class wrote scary stories and Yunus and Vera had failed to save their text. When the class continued writing they had to start over from the beginning. While the other students could continue working on their drafts, Vera and Yunus have no visible results of their first attempts. One might have expected that Vera and Yunus would have reacted with frustration and protests. But they started writing new drafts, rather untouched and without being tracked down. Self-regulated learning theory shows that students can opt out of learning, when they do not believe that they will succeed because investing also implies the risk of failure [18]. The loss of work that has already been done could lead to experiencing failure. Motivation can be further weakened if the students perceive themselves without guilt for the loss of work. It could easily have happened with these two, at least with Yunus, who did not work as independently and efficiently as Vera. When they both started over without a problem it was clear that the motivation for writing seemed to be present and resilient.

The theory of self-regulated learning was also important for another situation. Stanley was keen to compare himself to Vivien while they were working on a science assignment. Boekaerts points out that students' motivation can be fundamentally mastery-

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<sup>3</sup> Trageton's method is developed by Norwegian Arne Trageton and involves using digital writing technology to learn to read.

<sup>4</sup> They used Moodle as Learning Management System (LMS).

or performance-oriented. Performance-orientation can lead students to being more concerned with comparing themselves to others than focusing on their own learning [18]. This was typical for Stanley. His focus changed from the task itself to the length of the text when he found the word count function on the computer. He was obviously stressed by the fact that Vivien, who he often compared with, could have written more words than he. It is difficult to say for sure how this affected Stanley's motivation for the task at hand, but it may be suggested that the focus on performance and comparison with Vivien would go beyond his academic work there and then. At the same time, an external level of performance may also trigger the desire to succeed because the competition with the others become important. Boekaerts say that performance-oriented students can try to avoid resistance or struggle in their learning work because they dare not take the chance of failure [18]. However, there is no basis for considering performance motivation as a critical factor in the current observation of Stanley. Stanley seemed positive and content in every way in the situation, and his competitive motive may have been a more stable attribute of his personality. As Boekaerts notes, performance orientation increases in students with age [18], so this is also a natural part of the students' development. However, teaching can inhibit or promote performance orientation through the way the teacher handles feedback to individual students in classroom publicity. Teachers who emphasize mastery instead of achievements, which focus on approaches and not the right answer, and that legitimize making mistakes, can counteract performance orientation in the learning environment [19, 20].

Although Stanley was derailed by Vivien, it was clear that writing was less available for comparison when students were using digital writing technology. Stanley could compare himself to Vivien because she was sitting beside him. However, he did not have immediate access to the other students and could not keep up with how their work. The location in front of each computer could mitigate the tendency for comparison between students, compared to sitting in groups in the classroom with possibilities to overlook each other's workbooks. This is also something that teachers have experienced from other situations using computers in classrooms [15]. Digital writing technology can thus be positive for students who are easily derailed by comparing themselves to others.

Using digital writing technology seems to work positive in various ways for students' motivation to write. Even when students are performance oriented, the use of technology levels out differences in performances in ways that eases the impact they have on each other because the differences become less visible.

### **Digital technologies change writing strategies**

Using digital writing technologies change the course of writing. Students get tools that able them to write perfect even before they have developed a functional handwriting. Traditional text has a linear form from the beginning to the end. When using digital writing technology, the linear form is no longer necessary [8]. The writing can start wherever wanting and jump forth and back in the text. This is more in line with the way students' think when learning [7].

The changes in the writing course were obvious when tenth grade changed from handwriting to digital writing tools. They stopped drafting before writing when they experienced the differences. They were able to adjust, rewrite and reorganize the texts during the writing process and could plan the text along the process, not before starting [8]. The writing process gets more flexible and open for the students' choices and adaptations along the work. Thus, the digital writing technology has impact on both the writing strategies and the text strategies [5]. The writing went easy, and the text were looking good when not written by hand. This freed capacity to work with the content, or for working memory and executive functions [6]. When writing is freed from the linear form which handwritten texts are bounded to, the students got more freedom to adapt writing to their own writing- and text strategies. This requires that they have developed an automatised use of the keyboard [7], which seemed to be the situation for most of the students in 4th and 10th grade, probably because they used keyboarding in a large scale outside of school, using SoMe and phone messaging.

The word processor can also provide direct feedback on spelling and grammar, which will be of great help to students who are struggling with this part of writing. Spelling and grammar might occupy the students' feed forward feedback processes. When technology provides automatic corrections, students do not have to reflect on whether they write correctly as they type. Just as if the students had internalized the spelling so that it becomes a habit, technology has taken over this task. The spelling is not habituated in the traditional way, but the result is the same: the functions of consciousness are released for tasks other than spelling. When students receive direct feedback on spelling from the computer, and can correct errors themselves, they will not need the teacher's review of the orthography. They can concentrate on developing other aspects of the text, such as storytelling (text strategies). Having access to strategies that enable them to help themselves makes students more independent and self-driven in their learning work.

One observation of a writing exercise is from an assignment where the 4th grade students wrote scary stories. The assignment was designed as process-oriented writing and the students had individual supervisions with the teacher along the work. Content, grammar, and orthography were discussed, based on what they had decided to focus on. Since I served as a teacher in the class I also participated actively in this work. I want to highlight the dialogue I had with Linda and with Carl.

Linda appeared academically clever, independent, and generally self-driven in her learning work. She was also a little modest and did not show herself much in the class publicity. Linda wrote quickly and her text was long. The class had not had much focus on spelling in previous years because the teachers were concerned with developing the joy of writing. But in 4th grade there was an increasing focus on spelling in the students' writing assignments. Linda was one of those who wanted to have correct orthography. At the same time, I saw that she had some challenges with grammar which I also brought up in the supervision. Linda's feed forward was linked to developing a correct writing and she wanted feedback on grammar so that she got a flawless product. In this situation, there was a correlation between the student's own experience of potential for improvement and what the teachers were concerned about. Her feed forward feedback loop [3, 4] ensured that the learning work drove the learning object [20] in the right

direction. Thus, it seemed that the teaching was well adapted to her proximal zone of development.

Carl had previously told me about challenges that made him find the learning work demanding. In supervising Carl, it was therefore important to focus on promoting positive experiences from the learning work [17, 18]. For students who find the school particularly demanding, my experience is that the joy of learning quickly becomes damaged. The dialogue between Carl and me was characterized by closeness and mutual recognition. It gave Carl the opportunity to show his mastery and get feedback on his work based on what he wanted with his text (feed forward). He showed great commitment to his work, and I saw the dialogue as a support for strengthening Carl's feed forward feedback processes related to striving which is an important requisite for learning [3, 4].

Such learning dialogues can be conducted without the writing taking place in digital devices. In other words, they are not dependent on the use of technology. But there was more space between the students in the computer room and easier to supervise without the other students hearing. In addition, the threshold for making changes was low, because of the digital writing tool. It seems that students' learning in the form of feed forward feedback processes could be stimulated and directed towards developing writing and text strategies when using digital tools.

### **Digital writing technologies demands new text strategies**

Students in tenth grade needed new text strategies when they switched to digital writing tools. This was evident in a situation where Ann, Camilla and Diana were collaborating on process-oriented writing. In process-oriented writing, the students will work with the text in different phases, supported by responses from other students (and teachers). The collaboration between the students gives them both valuable input to their own texts and training in identifying good ideas that could be further developed. In addition, they can suggest ways in which this can be done, while also exercising their critical ability to assess both their own and others' texts [19]. The teachers were used to using this way of working, but I quickly realized that Ann, Diana and Camilla were not. They showed each other what they had written, but the comments confined themselves to positive affirmations, as "nice." They also compared the length of their texts, concluding who had come the furthest in the writing process based on the number of words. They did not have the prerequisites to ask critical questions about each other's texts and give constructive feedback on the choice of topic, disposition, language, and dissemination. The learning activity did not become the feed forward feedback [3, 4] process they needed to reflect on how they could improve their own texts. They did not seem to see the purpose (feed forward) of doing the activity, because they lacked concepts that could form the basis for such an activity (feedback). Neither Ann, Camilla nor Diana made changes to their texts while the activity was going on, nor did they give each other concrete input that might be captured and taken to the completion of the texts that they were going to do at home. Their text strategies [5] seemed not to be developed for this purpose.

Process-oriented writing is often associated with digital writing technology because it is so much easier to make changes along the way in the text when it is produced digitally. The teaching in tenth grade must therefore be changed in terms of how the students were prepared for the new ways of working, by teaching them strategies that make the learning work feel meaningful.

### **Writing long texts is not the same as writing well**

In tenth grade, students were expected to have correct orthography and grammar and to have developed understanding of writing as dissemination. Access to the student work in their LMS provided an opportunity to look at the quality of the texts they wrote. Among other things, the students wrote film reviews. This assignment worked well for assessing and comparing students' texts. The film review was a to part task, where the first part was to give a summary of the film. Conveying a written summary of a film requires that the text not only refers what is going on, but also provides sufficient information about the situation and context. In film, it is often the dialogue that drives the action, at least if the film does not have a clear narrative role. When the students are to convey the film's content in what Vygotsky calls written speech, it is required that the students be able to distinguish it from the oral speech that the dialogue conveys. The written speech differs from both what Vygotsky calls inner speech and oral speech and requires a higher level of abstraction [7]. Written speech must fully explain the situation to be understandable [7]. Therefore, some textual steps are necessary that can help to explain the situation fully to be understandable [7]. This requires text strategies [5].

The texts gave the impression of how and to what extent the different students had made the content of the film available to the reader. The students' texts varied considerably in length: Betty had written 2532 words, Diana had written 1558 words, Ann had written 1359 words, Arnold's text was 872 words, Elsie had 647 words, Chris had written 506 words, while Daniel ended up with 149 words. Betty, who had written the longest text, conveyed the content of the film as a summary of what she saw on the screen, but provided minimal information about context that could make it possible to imagine the situation in which the film took place. She was thus unable to make the dissemination an exterior of her inner experiences, or context independent [4, 7]. Diana, who had 1,000 fewer words, on the other hand, succeeded quite well with the dissemination. She had made sure to describe the situation as early as the first sentence, where she explained who the film is about. Ann and Elsie delivered texts like Bettys', characterized by a lack of context description, while Chris and Daniel accounted for the circumstances of the action in the film, like Diana. Arnold's text was relatively long and excellent when it came to solving the assignment. The texts showed the variation among the students. Some of them lacked good text strategies even though they wrote long texts, and some wrote only short but good texts.

As the observation above shows, there was a mismatch between the qualities of the texts and their length. While some texts appeared to be good written expressions, some also looked more like oral speech. In this study, it is not possible to say anything certain about this. It seems that the easily accessible digital writing tools able students to write



ling texts. Thus, there is nothing here that points to students' texts getting better when using technology.

## 5. Conclusion

Using keyboards change the way students write in several ways. The course of the writing is changing from a linear form to a flexible form which is able to adapt to students' various preferences. Students can start where they want, change what they want under ways, and they do not have to plan the text before starting. They do not have to start over when the work goes astray. This seems to ease motivation for writing. It also seems that digital writing makes it easier for students not to compare with each other because the texts look more alike when they write, and thus preventing performance motivation in class.

Using digital writing technologies help students to better writing strategies. They can write texts without having developed a functional handwriting. Thus, they can produce more texts, helping the dynamic movement of feedback and feed forward between teacher and student to learning.

Better motivation and eased writing strategies free cognitive capacity for other learning tasks, like developing text strategies. It seems that use of digital writing technology does not have impact on students' text strategies, ability to tell a story, to disseminate in a proper way according to the genre.

With the use of digital writing technologies, methods like process-oriented writing, work well in class. The flexibility that comes with digital writing, are efficient tools for making changes in the texts without having to start over. This requires learning necessary strategies for process-oriented writing, like drafting, presenting ideas, questioning drafts and ideas, critical reviewing and so on. Thus, motivation for writing can be maintained, providing more possibilities for learning when students can use keyboarding.

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