Technology Use in Schools – A Study of Teachers' Digital Didactical Design

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Abstract

McLoughlin and Lee [13] describe that in a society increasingly using a variety of high-speed technologies, teachers have access to more ideas, resources, and communities to support the development of their didactic design in a technology-rich learning environment. A teacher's didactic design includes both planning and the teacher's actions in learning processes, encompassing both a planned part and an operational component [7]. Teachers must understand how technology can support communication, creativity, and innovation. Additionally, they should be aware of the opportunities, limitations, effects, and risks associated with the use of technology [3] The selection of learning resources is based on teachers' understanding of technology as part of students' learning environments, along with understanding of how digital technology can add value to students' learning. Teachers should have knowledge of how technology changes and expands the content of the subject, pedagogical methods, and have an overview of how technology can add value in students' learning environments [9]. This qualitative interview study is placed within the social constructivist tradition, where knowledge, and thus all meaningful reality, is based on interactions between people in a context [1] The purpose of the study was to investigate the didactic designs of nineteen *experienced teachers in a technology-rich learning environment. Qualitative data was collected from focus group interviews and written reflection notes. The results are focused on developing knowledge in two areas: (1) Knowledge about teachers' narrow didactic design. Specifically, we expect the study to construct knowledge about teachers' conscious choices and practices concerning mastering technology. (2) Knowledge about teachers' broad didactic designs, which involve the selection and use of digital resources to create added value in a flexible, personalized, and inclusive learning environment. A broad understanding also encompasses digital judgment and formation for the future society. Knowledge from this study can contribute to developing awareness among teachers about working with their own narrow and broad didactic designs in context.*

Keywords: Broad didactic design – technology-rich learning environments – technology's added value

1. Introduction

In the ever-evolving digital landscape, where tools and learning resources rapidly become outdated, it is crucial to focus on the underlying principles and strategies for using technology effectively. In this study, the term "technology" specifically refers to digital technology. Integrating technology into creative and inclusive learning environments has consistently presented challenges. Common excuses for limited use of technology in teaching often include a lack of computers in schools, and insufficient skills and fear of technology among teachers. While these factors can influence teachers' use of technology, success also significantly depends on their ability to explore the relationship between pedagogy and technology [15]."Effective technology integration in learning should be considered alongside issues related to teaching and learning, such as developing learning objectives, choosing teaching methods, and devising feedback, assessment, and evaluation strategies, including follow-up activities.

This study focuses on teachers' digital didactic design when employing technology in teaching. Descriptions from nineteen experienced teachers form the empirical basis of this study. The purpose is to deepen knowledge about teachers' digital didactic design. This encompassing both the broad aspect, which involves the selection and use of digital resources, and the narrow aspect, which involves conscious choices and practices related to mastering technology. The research question guiding this study is: How do teachers design their teaching in a technology-rich classroom?

In this study, the term "didactic design" refers to the teacher's planning and actions in students' learning processes [7]. Integrating technology into teaching challenges the teacher's instructional design, and success in integration depends on this design [8]. Didactic design focuses on

promoting student learning by ensuring that goals, learning activities, and assessments interact effectively [8]. In a digital didactic design, social relationships, interaction, and communication are central, both among students and between teacher and student [6]. A narrow design focuses merely on developing digital skills, while a broad design aims for technology to add value to learning.

Okojie et al. [15] argue that a narrow understanding of technology integration can hinder teachers' understanding of its use in teaching. Technology should be an integrated part of teaching, not merely a tool for developing digital skills. Kolb [10] emphasizes that technology, in itself, does not guarantee motivation and engagement in learning. A limited understanding of "technology integration" will most likely result in poor use of technology for learning purposes. Many teachers do not link technology use with pedagogical principles [15]. Additionally, the diversity of students' digital competencies requires recognizing this diversity and prioritizing training in digital competence [3].

Munthe et al. [14] highlight that digital skills are not only about mastering technology but also about digital judgment and formation. Using technology in learning encompasses more than training in hardware and software; it includes a conscious relationship with theories and research to support teaching and learning. This requires strategies for selecting and using technology that align with pedagogical needs.

Viewing technology integration from a broader perspective provides teachers with a solid foundation to implement it successfully in the classroom. The selection and use of technology should be decided early in the teacher's planning, where learning goals, methods, and the role of technology are set in relation to the expected results. "The Triple E Framework attempts to define effective technology integration by supporting learning goals through engagement, enhancement, and extension" [10, p.30].

Koehler and Mishra [9] emphasize the importance of the TPACK model, which considers the interaction between content, pedagogy, and technology. Utilizing this model allows teachers to plan more meaningful and creative activities that goes beyond basic didactic design. Understanding how technology affects learning and how it can be adapted to students' prior knowledge and learning styles enables teachers to create engaging and tailored learning experiences.

No teaching situation is identical, and no universal technology solution fits all teaching plans. Technology integration is complex and involves interconnected activities [15]. Teachers need an in-depth understanding and flexibility to navigate these interactions. Developing tailored solutions that reflect each unique teaching context requires robust digital competence [2]. Teachers must recognize and address the complexity, viewing technology as a supplement and an integral part of inclusive learning [16]. This approach includes a deep insight into how individual technological components can be integrated to promote student learning and engagement [2], enabling teachers to design innovative learning experiences.

2. Method

The purpose of this qualitative study is to examine digital didactic designs among experienced primary school teachers. Our aim is to explore how teachers design instruction to develop students' digital skills and how they use digital resources to add value in a flexible, personalized, and inclusive learning environment. The study adheres to research ethical guidelines and has been approved by SIKT (Norwegian Agency for Shared Services in Education and Research).

This study is inspired by phenomenological approaches, where we, as researchers, focus on obtaining rich and detailed empirical data [17]. Through interviews and reflection notes, nineteen teachers provided retrospective descriptions of their experiences and opinions [4]. Eight teachers were interviewed, while eleven supplemented the interviews with reflection notes.

The interviews are situated within a social constructionist tradition, where knowledge is co-created between individuals, and experiences are verbalized in interaction with others [12]. Conducted in an informal style but with thematic question prompts, the interviews encouraged teachers to contribute their own insights [11]. The research question and its limitations framed the study. The interviews focused on understanding and developing knowledge of the meaningful reality formed in dialogue between the researchers and the teachers. As Crotty [1] emphasizes, all meaningful reality is socially constructed.

The reflection notes included text fields where teachers had unlimited opportunities to formulate their answers. The questions were thematically and deductively formulated. Unlike closed questions typically formatted with checkboxes, the open-ended questions allowed teachers to provide rich descriptions in their responses. The analysis of these reflection texts revealed nuanced

differences between the teachers' responses. Through a hermeneutic approach to analysis, involving circular movements between the texts and theory, new understandings and meaningful main categories appeared from the texts as a whole (transcribed interviews and reflection texts).

3. Findings

The teachers describe classroom practices that emphasize strengthening students' digital skills and integrating technology to enhance their learning experiences and outcomes. They discuss how digital learning resources transform teaching by promoting active student engagement and catering to individual needs through technological tools. Additionally, the teachers highlight their role in selecting and incorporating technology to engage students, stimulate creativity, foster collaboration, and communication, and develop essential digital skills.

However, the teachers also report challenges in technology-rich classrooms. These include distractions, technical and economic limitations, and varying levels of digital competence. The teachers note that such circumstances require extra attention to ensure technology use supports a positive and inclusive learning environment. They discuss issues related to access and administrative rights for both teachers and students, which can hinder the effectiveness of digital tools in the learning process. When it comes to training students in using technology, teachers specifically point out the challenges in transitioning from iPads in primary school to PCs in secondary school. The significant differences in storage methods, file systems, and the use of keyboard versus mouse require teachers to spend considerable time bridging the gap.

The teachers also emphasize the need for greater opportunities for teachers and ICT advisors to explore and evaluate digital learning resources to promote a unified approach to technology use in the classroom. They describe both economic and practical limitations that may hinder effective student participation and learning outcomes.

Despite these challenges, the teachers emphasize the positive effects of technology on the learning environment, such as increased student participation and differentiated learning. They describe a shift towards more personalized and engaged teaching, preparing students for a digital future, while also underscoring the teachers' crucial role in this process. The analysis revealed three main categories that structure the presentation of the findings

3.1 The Teacher's Emphasis on an Inclusive Learning Environment and Student Involvement

Through conscious choices of digital tools and resources, pedagogical integration, and varied teaching methods, teachers aim to create a dynamic and inclusive learning environment. They emphasize that their planning and actions are based on a reflective pedagogical use of technology. By doing so, they believe they can meet all students' needs, foster collaboration and interaction, and strengthen the learning environment. The findings suggest that the use of digital learning resources positively affects both learning and social processes in the classroom.

The teachers express that if technology is used strategically, it can create an inclusive and supportive learning environment where the goal is to promote collaboration, creativity, and engagement. Using tools that support peer assessment and project-based learning contributes to a deeper understanding of the subject matter, enhances social skills, and develops critical thinking. The teachers provide examples of how digital tools like Showbie and iPads promote collaboration and adaptation to individual needs, increase student engagement through interactive learning resources like Minecraft Education, and enhance digital skills. These practices contribute to a more dynamic, inclusive, and engaging learning environment.

Technology supports individual learning preferences, making the learning environment more personal and engaging. The teachers describe this flexibility as being enabled through digital platforms and resources. They emphasize the importance of recognizing and supporting students' varied digital competency levels through customized learning resources to ensure active and effective participation in the learning process. They believe that addressing each student's unique learning preferences through technology in teaching is crucial. Digital resources, such as visual, auditory, and kinesthetic learning tools, offer a varied and interactive learning experience, helping all students actively and effectively take part in their own learning process.

The findings also suggest that technology can improve text production and collaboration among students, especially for those with reading and writing difficulties. The teachers emphasize the importance of technology in fostering inclusive education, ensuring that every student has the

opportunity to express themselves and collaborate effectively, regardless of their individual challenges. Central to student involvement is the importance of evaluation and feedback, ensuring that students' perspectives and experiences are acknowledged. The teachers describe that evaluations from students offer valuable insights into the effectiveness of teaching methods while also strengthening students' sense of ownership of the learning process.

3.2 Teacher Strategies for Promoting Personalized Learning

Teachers describe a practice where they support the teaching of digital skills, linking their choice of digital resources closely to specific learning goals, individual student needs, and competencies. Their main focus is on strategic and reflective pedagogical practices that use technology to enhance learning outcomes. Through digital platforms and tools, teachers can offer personalized instruction that meets the individual needs of each student. However, teachers emphasize the importance of balancing the use of technology with traditional teaching methods, supporting personal contact and student involvement to strengthen a reflective approach to integrating digital tools in teaching.

Teachers say that emphasizing choice in learning methods and styles contributes to Student Ownership of Learning (SOL). Digital platforms like Showbie for feedback and follow-up of work allow parents to engage in the learning process. Teachers believe that such digital platforms improve home-school collaboration.

By integrating technology into teaching, teachers can promote more differentiated and student-centered learning. They highlight synchronous and asynchronous learning formats as providing increased accessibility and flexibility. The descriptions show variation among teachers in their approaches and strategies. Although the goals largely align, with the development of digital skills and active student learning highlighted as central, there is some resistance to technology integration. This is mainly due to teachers experiencing, a lack of technical support and inadequate training in the use of digital technology.

3.3 Student-Driven Learning

Teachers describe classroom practices where they integrate technology to promote student-driven learning, enhancing engagement and exploration. They advocate for classroom practices where students are producers of knowledge rather than passive recipients, using technology to create, share, and present knowledge. Teachers describe practices where students, through projects involving digital presentations, self-made videos, and other creative forms of expression, apply and deepen their understanding of the subject matter in innovative ways.

Teachers note that varied learning formats, pedagogical adaptation, and feedback systems promote critical thinking and creativity. They highlight their active role in choosing technology that meets educational goals and supports student-driven learning. Examples of learning resources mentioned include digital tools like Book Creator, iMovie, various math and language apps, and the use of iPads. However, teachers express some skepticism about the variety of technological resources available to students, as these can lead to distraction. In this context, they emphasize the need for thorough guidance and training in digital competency for students.

Teachers underscore the importance of reflection and critical thinking in the learning process, where students assess their own progress and find areas for improvement. They particularly emphasize the importance of proper use of digital resources, digital literacy, and ethical considerations. This can enhance learning outcomes by making students more aware of their own knowledge development and how to approach new learning challenges. The teacher’s role in guiding and supporting students’ creative processes is highlighted as more important than the traditional role as a knowledge transmitter.

4. Discussion

The purpose of this study has been to generate knowledge about teachers' didactic design when technology is used in teaching. We will discuss key findings across the categories of analysis to highlight the study's two main focuses: the narrow and the broad design. The first focuses on teachers' descriptions of practices where technology is used to develop digital skills, referred to as a narrow

design by Okojie et al [15]. We then turn our attention to the second main focus, the broad design, where technology is used to provide added value in learning [13]. In teachers' descriptions of their practice, it is clear that communication and human interaction play a significant role in both the narrow and the broad design. The social element is thus included in both designs, something that Jahnke [6] emphasizes as important in didactic digital design.

The narrow design

This design revolves around the integration of digital resources in the classroom that contribute to the development of students' digital skills. When teachers describe their classroom practice, this includes both their planning and their actions with students. One of the challenges teachers experiences is the significant differences in students' digital skills. This requires them to prioritize systematic training in digital competence [5]. Recognizing and supporting the diversity in students' digital skill levels is highlighted. The teachers also emphasize adapting learning resources and developing individual digital skills to ensure active, equal, and effective participation in the learning process. They particularly emphasize the careful selection of digital resources tailored to students' learning needs, competencies, and skills, describing a classroom practice where strengthening students' digital skills is crucial so that they can master the use of digital tools and later use technology appropriately in their own learning [15].

Integrating technology into teaching challenges traditional instruction. The narrow design influences the content of instruction and the success of technology integration [8]. This is challenging because the teacher must adapt the teaching of digital skills while also supporting academic content. Teachers in secondary school especially point out the challenges they experience in transitioning between iPad use in primary school and PC use in secondary school. These conditions present challenges for teachers, and the teacher's own digital competence is considered central to developing students' digital skills [2]. In this context, teachers express experiencing a lack of technical support and inadequate training in the use of technology, which can lead to skepticism and resistance to changing their pedagogical designs. Specifically, limitations in user access and administrative rights to learning resources are mentioned, which can hinder effective use and training with digital tools.

Teachers believe that pupils should take part in their learning, which will strengthen the integration of digital tools in teaching. However, they express some skepticism about the variety of technological resources available to students, as these can lead to distractions in students' learning. The need for thorough guidance and training in digital competence for students is highlighted here. Reflection and critical thinking in the learning process, where students assess progress and find areas for improvement, are especially mentioned. This can be linked to digital literacy and formation, significant for an expanded understanding of digital skills [14].

Technology integration encompasses more than just the teacher using technological artifacts in teaching. It also involves a conscious relationship with research-based knowledge to support teaching in digital skills. It requires strategic choices of technology adapted to pedagogical frameworks [15]. If technology is limited to an understanding of technology as a value in itself, teachers will not see it as an integrated part of teaching and learning [15]. However, the findings from our study suggest that teachers promote the targeted development of digital skills by ensuring that technology use is pedagogically justified and integrated as a natural part of the learning process. This connection between pedagogy and technology is necessary to succeed in a technology-enhanced learning environment [15], leading our discussion to the broad digital didactic design.

The broad design

Okojie et al. [15] point out that technology integration is about more than just using technology. The research-based grounding of technology-rich teaching is a necessary foundation for teachers' choices and use of technology in the classroom. The second main focus is therefore described as the broad didactic design, where technology is more strongly linked to learning goals and pedagogical methods intended to add value to students' learning. The findings suggest that most teachers have a strategic and reflective approach to integrating technology into learning processes, going beyond simply teaching digital skills. They argue that technology can enhance, expand, and transform learning experiences for students [10]. Teachers also describe a classroom practice where technology is seen as a means to achieve a variety of pedagogical goals, rather than an end in itself. The didactic design thus involves more than focusing on digital skills; it promotes student learning holistically. When teachers view teaching as a whole, where technology, pedagogy, and content are seen in context [8], teaching can also be experienced as an integrated whole where goals, learning activities, and assessment interact [8]. By recognizing and addressing the complexity of technology integration from

a broader perspective, teachers can create meaningful learning experiences that promote student learning and engagement [2]. Through a broad approach, teachers can use technology to design learning experiences that are social, innovative, creative, and tailored, preparing students to navigate an increasingly technology-driven world. The study shows that teachers believe students should be producers of knowledge rather than passive recipients in their learning processes.

Teachers must understand how technology can be used to tailor teaching to individual students [8], as emphasized by the teachers in the study. Findings suggest that teachers believe using technology simplifies the planning and implementation of teaching and makes it easier for them to provide tailored feedback, while students can also provide feedback to the teacher. Their broad digital didactic design thus includes the dynamic social direction highlighted by Jahnke [6].

Teachers' descriptions of practice suggest that the strategic use of digital learning resources improves and enriches student learning in several ways. They specifically emphasize the importance of differentiation and tailored teaching, where the use of technology is adapted to students' individual needs. By using the TPACK model's dynamic approach, teachers can plan how to adapt the content of teaching with technology in combination with pedagogical techniques [9], making learning more personal and tailored to each individual. When technology is used effectively in a comprehensive design, the teacher can create more personal and engaging learning experiences that may be difficult to achieve with traditional teaching materials. A central added value highlighted lies in the engaging and interactive learning experiences that digital tools, such as iPads, offer. These resources allow teachers to visually design teaching and learning experiences while promoting active participation through innovative, creative, and tailored tasks [2].

Summary

The purpose of the study has been to develop knowledge about teachers' digital didactic design. Nineteen teachers have contributed descriptions of their practice, framed within the narrow and broad designs [13], focusing on students' learning of digital skills as well as using technology to learn subject matter. The findings suggest that the added value of using technology supports varied and customized learning methods, promotes independence, social interaction, and active student participation, while also strengthening students' digital competence. By supporting diverse teaching methods, the findings show that learning is enhanced for students. Therefore, strategic and research-based choices and use of technology in teaching and learning should be established early on. In this way, pedagogical methods, including the role of technology, will be defined in relation to expected outcomes for learning [10]. By engaging students in learning and involving them in expanding their learning goals [10], motivation among students can be increased, which the teachers in the study describe as crucial for a successful learning process.

Technology integration is complex and consists of interconnected activities [15]. When technology is used strategically, it can contribute to building an inclusive and supportive learning environment. Reflective use of technology can provide space for learning with creativity and exploration, but it requires that the teacher views technology as a supplement and as an integrated part of inclusive learning [16]. By balancing technology use with traditional teaching methods, teachers believe they can maintain personal contact, support, and student participation, while also fostering a reflective approach to integrating digital tools into teaching. When teachers guide in this way, students' engagement and learning in the use of technology are also promoted [2]. Jahnke and Kumar [7] highlight the importance of both the teacher's planning and actions in students' learning processes. Navigating these complex interactions between the components requires competence, depth of understanding, and flexibility [9]. In digital didactic design, it is about combining the narrow and broad perspectives and engaging them in dialogue. There is no doubt that students must have digital skills to effectively use technology in their learning process. The teacher's practice will be influenced by both perspectives.

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