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Digital Didactical Design: A Promising Pedagogic Competence in Digital Era

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Abstract

Teachers must carry out innovation and learning reform to face digital transformation. Teachers must be able to find the right formula for preparing effective learning plans that suit the needs of students to meet the challenges of the 21st century. This research explores how primary teachers' understanding of the design and subsequent use of digital tools in their scientific instruction develops as they participate in digital didactic design (DDD). How elementary teachers might increase their expertise of teaching using digital technology is the topic of the study. The method of this article is the systematic literature review, using literature reviews from various sources, both journals, books, and other supporting sources. The findings show that DDD has the potential to foster profound learning experiences by providing a framework that invites educators and researchers to research, investigate, and evaluate the actual designs that are being used in classrooms, where teachers are actively involved in the design process. A new way of thinking about planning, carrying out, and commenting on teaching and learning is provided by DDD. Our empirical research's findings support the use of educational technology in learning expeditions as an effort to shift away from conventional course-based learning.

Keywords: Digital didactical design, pedagogic competence, teacher, primary school.

Introduction

The development of information technology is increasing (Donohue & Schomburg, 2017). People cannot contain the flow of incoming information anymore. Digital transformation is important for integrating digital solutions into everyday life (Bilyalova et al., 2019). All existing education systems have shifted to digitalization (Amelia et al., 2021). Even the data collection system in schools today has also changed to digital. All information on schools, teachers, and students is easily accessible. In addition, technological developments also have an impact on learning.

Technology makes it possible to communicate and transmit information extremely quickly from one place to another at any time (Rintayati et al., 2022). The study and ethical use of using appropriate technological procedures and resources to support learning and improve performance is described as educational technology by the Association for Educational Communications and Technology (AECT) (Häll et al., 2015; Xie et al., 2021). Students may readily learn from many online and social media sources. However, the pupil may not always learn as a result of this simple access. This is due to the fact that learning cannot occur without reflection from the instructor or other adults who are present with the students (Wardana et al., 2023).

According to a constructivist perspective, learning is the development of new knowledge, which is "an active process of creating rather than gaining information," and is described as co-creation of new knowledge (Sh, 2022). The role of the student in active learning is one in which they are not simply information consumers but also active actors, creators, and producers in the joint development of new knowledge (prosumers) (Ally, 2019). Teaching encourages students to engage in critical-constructive, creative activities as well as superficial learning such as recalling information from textbooks. The learners' thinking is expanded beyond typical knowledge reproduction and consumptive behavior with the aid of teaching that encourages both surface and deeper learning (Jahnke & Kumar, 2014).

Our statistics show that the conventional textbook-based learning methodology is sometimes reproduced using

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educational technologies. However, an ongoing, ubiquitous online presence is possible in the digital era and social media. It offers information access anywhere. It implies that looking for information and looking for answers to problems is common for the Homo Interneticus (Jahnke & Kumar, 2014). Learning informally, or outside of official educational institutions, is more similar to learning done thus. Let's alter our viewpoint to effect change. Teachers should pay more attention to the pedagogical practices and the designs of those activities rather than the technology or conventional course-based learning (Bergström & Mårell-Olsson, 2017; Gnaur, 2017). Educators need designs for teaching and designs for learning opportunities to permit and nurture a learning process in the Internet-driven networked environment since it is too late to reinvent current, conventional learning models (Ronzhina et al., 2021). In order to assist students advance in their learning throughout their learning processes, teachers particularly require designs for student learning that allow students to go from a consumer to a pro-sumer position (producer and consumer) (Jahnke, Norqvist, et al., 2014).

On many levels, educational institutions are experiencing a change as a result of innovation and the use of new technologies. The usage of technologies has an impact on many aspects of education, including how people behave in the classroom, including instructors and students, the curriculum, extracurricular activities, and local and federal decision-making (Amelia et al., 2021; Vallance, 2021). The science of didactics, which investigates educational issues and discloses the patterns of knowledge and skill absorption and opinion development, serves as the foundation for a teacher's pedagogical understanding. For many years, the cornerstone for a teacher's expertise was didactics (van Rooyen, 2021). The emergence of new channels for information transmission changed the established system of knowledge transfer from instructor to student. Humanity gained new educational tools with the development of computers at the turn of the 20th century (Mirela, 2014).

Digital didactics design (DDD) is the new term and fresh material for the philosophy of education in contemporary circumstances. As a result, it is a science that focuses on the art of successful learning using a broad range of digital and multimedia tools (Jahnke & Kumar, 2014). DDD is a process of education linked to the growth of the Internet, the realization of the activity approach, the adoption of open education, and other technical advancements focused on the school of the future. DDD to research teaching techniques seems promising since it encourages a shifting viewpoint. The name Didactics emphasizes the contrasts between teaching activities and learning activities and focuses on the design for social connections, such as student with student contact and teacher with student engagement (Lund & Eiliv Hauge, 2011). The DDD addresses the questions of "what" to learn (materials and curricula), "why," and "when/where" (in what contexts and places), as well as how it may be achieved (resources, organizational and academic development). The following is a research question in this study, namely:

- RQ1: How is the three layers of DDD?
- RQ2: How is the the elements of DDD?
- RQ3: How is the position of DDD in developing teacher pedagogic competencies?

Method

Research design

The research design used in this study is descriptive. This research was conducted using the Systematic Literature Review (SLR) method by taking data through the PRISMA method on studies that discuss digital didactical design (DDD). Research using SLRs was conducted to obtain information from existing studies and sourced from databases such as ScienceDirect, Springer, and IEEE (Creswell & Poth, 2017). The goal is to get an idea of what problems occur in teacher pedagogical competence and how the influence of DDD develops teacher pedagogical competence in the digital era.

Population and Sample

The population in this study is a study (journal) that discusses DDD sourced from the ScienceDirect, Springer, and IEEE databases. Meanwhile, the sample in this study is a problem in teachers' pedagogical competence after the Covid-19 pandemic.

Data Search Strategy (Literature)

Questions are designed so that the research review is focused and structured. Research questions are designed by determining Population, Intervention, Comparison,

Table 1: PICOC Analysis Table

Population	*Digital Didactical Design (DDD)*
Intervention	Pedagogical competence, problems of teacher pedagogical competence in the digital era, strategies in improving teacher pedagogical competence.
Comparison	Proceedings articles, data that do not explain the problems and pedagogical competence of the teacher in depth.
Outcomes	Knowing the common problems contained in the teacher's pedagogical competence and knowing effective solutions to overcome these problems.
Context	Research data is taken from international journals such as ScienceDirect, Springer, and IEEE.

Outcomes, and Context (PICOC) (Turner et al., 2010). The following is a table that presents the problem analysis (PICOC) in this study:

Data Collection

Data collection using the PRISMA method Over the past decade, advances in systematic review methodology and terminology require updating guidelines (Beller et al., 2013). Page et all. in their research designed an update in the PRISMA 2020 method to replace the PRISMA method in 2009. New reporting guidelines reflect advances in identifying, selecting, assessing, and synthesizing studies. The purpose of the study was to make modifications to the structure and presentation of data items to facilitate the implementation of the PRISMA method (Page et al., 2021).

Searching for data begins with determining a digital library or data source. Researchers should select the correct data source to increase the likelihood of finding relevant articles. Popular databases have a broad perspective and scope of literature and have good credibility. For this reason, in this study, Researchers used digital databases to find data sources: ScienceDirect, Springer, and IEEE. The next stage is to determine the keywords. The keywords used for data collection vary. The main keywords are Digital Didactical Design (DDD) and pedagogic competence. After that, preliminary data collection from search results was carried out in as many as 2.116 studies from 3 databases. Then Researchers made a selection based on the title and abstract, and 108 studies were selected.

SLR Research Procedure

This study used a systematic literature review approach to find out, compare, and identify research on digital didactical design and pedagogic competence. Here's a picture of the SLR research flowchart.

In this study, researchers did not include data or studies sourced from proceedings articles because there was a lack of deepening of the discussion, so they did not answer the research questions. For example Jorgensen & Shepperd, in his literature study research did not include data sourced from proceedings articles because he thought it would take longer in his review (Jørgensen, 2007). Meanwhile, Catal and Diri used studies sourced from proceedings articles due to the lack of literary sources on the topics discussed (Catal & Diri, 2009). To aid in the understanding of synthesis results and check the validity of the presented conclusions, researchers might apply quality evaluations of literature studies. Data synthesis seeks to gather proof or information from certain studies to address research problems. Both quantitative and qualitative data were gathered for this review. Researchers use the method of narrative synthesis. The following is a research question in this study, namely:

- RQ1: How is the three layers of DDD?
- RQ2: How is the the elements of DDD?
- RQ3: How is the position of DDD in developing teacher pedagogic competencies?

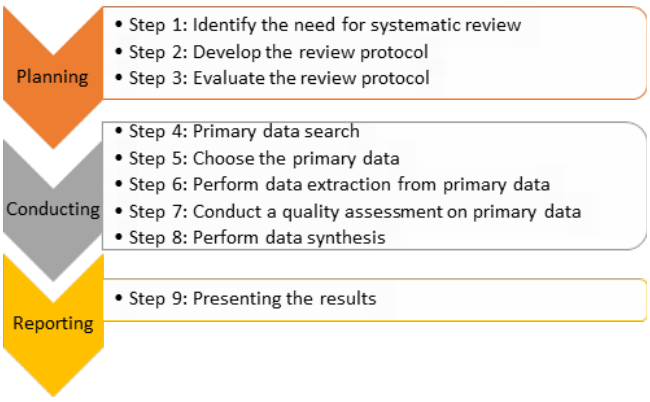

Fig. 1: SLR Research Procedures

Findings

2.116 items of literature were found during the first phases of the search procedure but they did not yet meet the criteria for inclusion. Additionally, the researcher gathered the literature after putting it through a number of filtering stages to find the material that was pertinent to the study's issue. The final product consists of 26 articles of relevant literature that were found on ScienceDirect, Springer, and IEEE.

The four predetermined criteria were: (1) literature presented in English; (2) minimum publication limit of the last ten years (2013-2022); (3) literature that discusses Digital

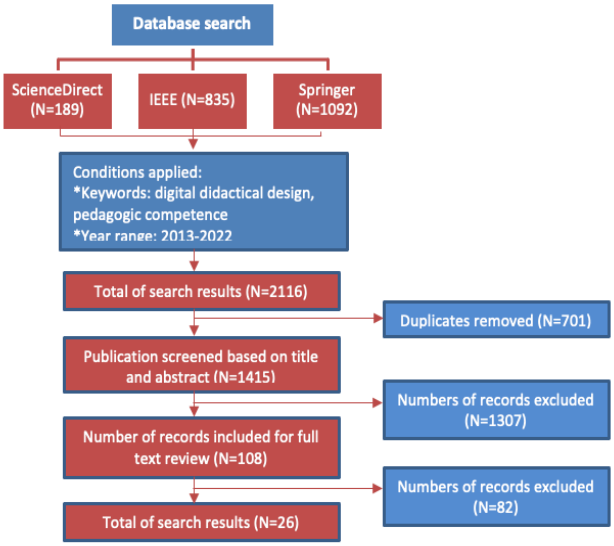

Fig. 2: Flow of information through the different phases of a systematic literature review

Didactical Design (DDD) and pedagogic competence; and (4) literature in the form of journals and conferences with whole text nature. These 26 categories of literature were chosen based on these four criteria. The outcomes of the quality evaluation shown in Table 1.

Table 1: List of Reviewed Articles

			Quality Assessment				
No.	*Article's Title*	*Year*	*QA1*	*QA2*	*QA3*	*QA4*	*The Results*
1	Digital Didactical Designs: Teachers' Integration of iPads for Learning-Centered Processes	2017	Yes	Yes	Yes	Yes	Accepted
2	Digital didactical designs of learning expeditions	2014	Yes	Yes	Yes	Yes	Accepted
3	Digital Didactical Designs for tablets: experiences from Finland	2015	Yes	Yes	Yes	Yes	Accepted
4	Digital Literacy and Digital Didactics as the Basis for New Learning Models Development	2020	Yes	Yes	Yes	Yes	Accepted
5	Pedagogical Digital Competence--Between Values, Knowledge, and Skills.	2017	Yes	Yes	Yes	Yes	Accepted
6	Analysis of Teachers' Pedagogical Digital Competence: Identification of Factors Predicting Their Acquisition	2020	Yes	Yes	Yes	Yes	Accepted
7	Digital competence of pedagogical students: definition, structure, and didactical conditions of formation	2020	Yes	Yes	Yes	Yes	Accepted
8	Digital Didactical Designs – Reimagining Designs for Teaching and Learning	2014	Yes	Yes	Yes	Yes	Accepted
9	General Didactic Principles of Pedagogical Technologies	2022	Yes	Yes	Yes	Yes	Accepted
10	Digital didactical designs: Re-imagining designs for teaching and learning using media tablets	2014	Yes	Yes	Yes	Yes	Accepted
11	A collaborative exploration of language teachers' digital didactical designs for tablet classrooms	2021	Yes	Yes	Yes	Yes	Accepted
12	Teachers' Digital Didactical Design: Towards Maker Movement Pedagogies In Tablet Mediated Learning	2015	Yes	Yes	Yes	Yes	Accepted
13	Digital didactical designs in multimodal, hybrid learning environments	2017	Yes	Yes	Yes	Yes	Accepted
14	Pandemic Pedagogy in The Era of Digital Transformation	2021	Yes	Yes	Yes	Yes	Accepted
15	Work-in-progress: Didactical Design for Virtual Reality Education	2021	Yes	Yes	Yes	Yes	Accepted
16	The relationship between trainers' media-didactical competence and media-didactical self-efficacy, attitudes, and use of digital media in training	2020	Yes	Yes	Yes	Yes	Accepted
17	Teacher education and Covid-19: responses and opportunities for new pedagogical initiatives	2020	Yes	Yes	Yes	Yes	Accepted
18	Swedish teachers' didactical design from students' perspective: perspectives on digital competences	2017	Yes	Yes	Yes	Yes	Accepted
19	Samarakoon, Uthpala, and Hakim Usoof. "Work-in-Progress: Development of a Framework for Incorporating Usability Aspects with Digital Didactical Design for Mobile/Tablet Based Learning in Pre-primary Education	2019	Yes	Yes	Yes	Yes	Accepted
20	Teacher's digital competence among final year Pedagogy students in Chile and Uruguay	2019	Yes	Yes	Yes	Yes	Accepted
21	Pedagogy in the era of Industrial Revolution 4.0	2019	Yes	Yes	Yes	Yes	Accepted
22	Digital pedagogy: analysis, requirements, and experience of implementation	2020	Yes	Yes	Yes	Yes	Accepted
23	Smart pedagogy for smart learning	2019	Yes	Yes	Yes	Yes	Accepted
24	Empowering professional and ethical competence in reflective teaching practice in the digital era	2018	Yes	Yes	Yes	Yes	Accepted
25	Digital didactical designs–reimagining designs for teaching and learning	2014	Yes	Yes	Yes	Yes	Accepted
26	Developing teachers' digital identity: towards the pedagogic design principles of digital environments to enhance students' learning in the 21st century	2021	Yes	Yes	Yes	Yes	Accepted

Discussion

Three Layers of Digital Didactical Design

One of the most important tasks in contemporary education is the development of an effective learning environment, which calls for the collaboration of educators, scientists, administrators of educational institutions, and the government. Numerous issues become significant as a result of the transfer of traditional didactics into digital ones, the resolution of which is crucial today. A comprehensive system of communication between all subjects involved in the educational process, the strategy for improving the educational environment (conceptual and procedural aspects), the design of electronic learning environments, the creation of a web-portal for teachers devoted to the advancement of digital didactics, and all of these activities are, in our opinion, related to near-term prospects (Bergström et al., 2015; Jahnke, Norqvist, et al., 2014).

The new situation has an impact on various aspects of DDD, including the teacher-content-student relationship, which we 1refer to as the "didactical interaction model," the didactical design (teaching goals, learning activities, and assessments), and the didactical conditions, which include curriculum development (curriculum-driven learning, including exam styles), institutional development, and academic staff development (Jahnke, Olsson, et al., 2014).

In our Internet-driven, networked society, where the amount and caliber of mobile technology integration fluctuate, teaching techniques are constantly technology-based to varying degrees, enabling various types of learning (Moiseienko et al., 2020). This is why we use the term "digital" to emphasize this point. One example of low technology integration is the exchange of documents over the school intranet. Making clear the connection between design, education, and technology integration in keeping with the concept of "informed choices" is the aim of the DDD method (Olofsson & Lindberg, 2012).

Elements of Digital Didactical Design

In the current era of the development of the informational educational environment, Monakhov and his adherents distinguish As a contemporary philosophy of education that is continuing to operate and grow alongside digital technology, DDD is a strategically relevant innovational approach (Monakhov, 2016). To do this, all newly developed electrical, technical, and technological achievements in the field of computers and digital technologies are interpreted and used. According to Balalaeva, multimedia electronic didactics is a philosophy of education that makes use of a variety of information-transmission methods in a highly communicative setting (Balalaeva, n.d.). The scientist outlines key distinctions between pedagogy based on new principles of operating in an informational and communicative environment and pedagogy that employs multimedia (Bergström & Mårell-Olsson, 2017; Häll et al., 2015; Jahnke & Kumar, 2014; van Rooyen, 2021). This kind of pedagogy should be founded on collaborative relationships between teachers and students, using their own drive, and fusing pedagogy, knowledge, and system-changing technology.

The two separate designs that make up the digital didactical design paradigm (Fig. 4) are design for teaching and design for learning, as shown in Figure 5. The plan for instruction includes process-based evaluation that is determined by the instructor, as well as learning objectives and instructional activities. The learning design looks at learning from the viewpoint of the learner. In a perfect, fantasy world, the two designs could be similar to one another, but in reality, instructors' and students' expectations might be different. The possibility that learning occurs and pupils are able to learn is better when all five of these factors (see Fig. 4) are constructively aligned.

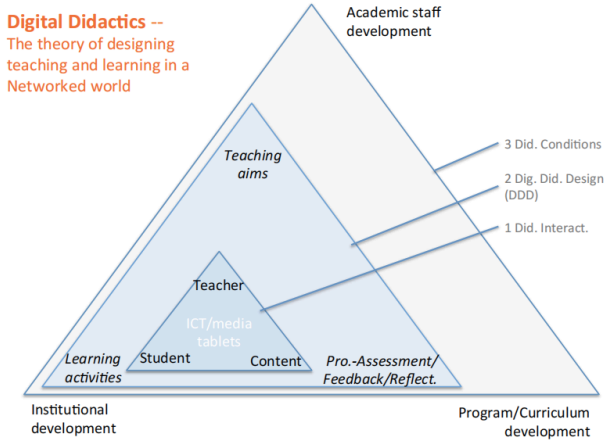

Figure 3: Layers of Digital Didactical Design

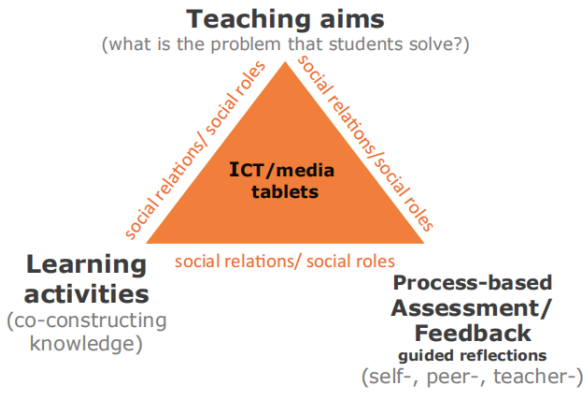

Fig. 4: Elements of Digital Didactical Design

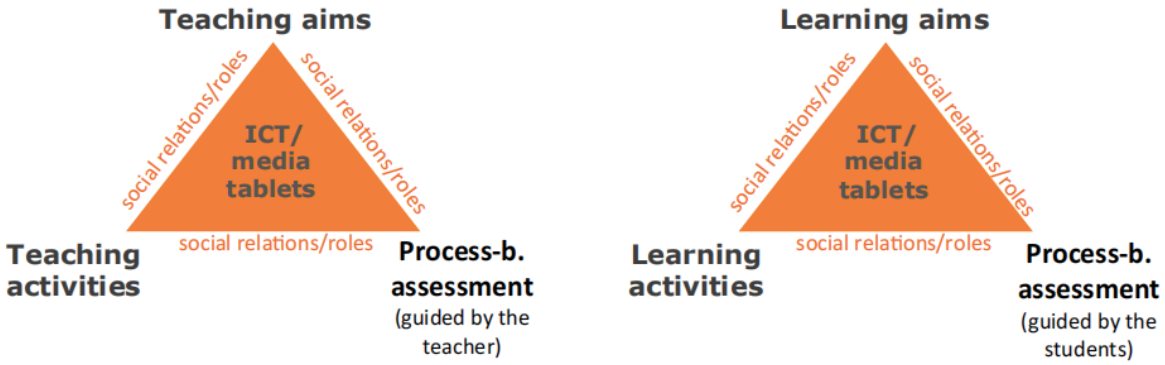

Fig. 5: Digital Didactical Design Model

The five components' constructive alignment is like a home constructed on building blocks or the parts of a larger jigsaw that fit together harmoniously in a dream world. The dream world, however, is distinct from reality. Between teaching ideas and practices, there is a gap (Vallance, 2021). The design idea is a way to highlight certain acts and portions of instructional practices; it concentrates on some aspects without taking the complete picture into account. A design creates a form and forms a focus and essential points (Gestalt). A design is both a process and a result at once, having both a planned element and an operational doing.

Studies on technologies-enhanced learning and teaching are seen in a new way with the help of DDD. Teaching is not the only means of achieving the cognitive component, and learning is not only a cognitive endeavor (Ab Jalil et al., 2022). Instead of being a process of information consumption, learning is a continuous activity of knowledge creation and production. Hauge & Dolonen provide a detailed example of "activity designs for learning," demonstrating the requirement for a "multimodal viewpoint" in creating teaching and learning (Lund & Eiliv Hauge, 2011). It seems that instructors have a more difficult time integrating technology into didactical designs than is really the case.

Studies demonstrate how difficult it is to integrate pedagogical, technical, and subject knowledge (TPCK). Additionally, using schools as an example, ICT use in education demonstrates how "improvisation" is needed to support the co-evolutionary development of subject knowledge and didactics. A framework for "learning how to use ICT" and "learning via ICT" is provided by (Kirschner & Davis, 2003). Their research provides guidelines on how ICT should be utilized in teacher training programs and how it is already used in education. The standards include three areas: (1) didactic ICT usage, (2) ICT as a teaching instrument, and (3) social ICT use in education.

DDD is a breakthrough as a learning innovation, especially towards guidelines in compiling complete learning; essential things related to the learning process are contained in lesson design (From, 2017). DDD in the development of teaching materials goes through three stages: (a) Analysis of the didactic situation carried out by the teacher before learning, in the form of teacher thoughts about predictions and anticipation of student responses that will arise at the time of learning. (b) Didactic metapeda analysis was carried out during the learning process in the form of the teacher's ability related to learning events to view the components of a modified didactic triangle (Liu et al., 2020). Then, the teacher develops pedagogical and didactic strategies to meet the needs of the students, observes and evaluates the students' reactions to these strategies, and then implements more sophisticated pedagogical and didactic strategies based on the findings of the analysis of the students' reactions in order to help the students achieve their learning objectives. (c) Retrospective analysis, which is an analysis that relates the results of the analysis of the hypothetical didactic situation with the results of metapedadictic analysis in the form of post-learning reflections. DDD is one way to develop teachers' pedagogical competence in elementary schools (Jahnke, Norqvist, et al., 2014).

The Position Digital Didactical Design to Develop Pedagogic Competence

Technology integration in learning can be based on the philosophy of DDD (Gnaur, 2017). DDD is interpreted as involvement and reflective practice in teaching and learning activities through digital technology (Moiseienko et al., 2020). DDD stands apart because it (a) unites theory and practice, producing and thinking; (b) fosters creativity, play, and problem-solving; (c) promotes public involvement, cooperation, and engagement; and (d) aspires to deepen critical knowledge of the digital world. DDD is a methodology that focuses on how instructors may use technology to foster the development of students' emotional and cognitive skills while also enhancing their own teaching abilities. Students examine current realities before creating their own via the use of student-centered learning and technology in a

stimulating learning environment. This will foster an attitude of skepticism, curiosity, empathy, and the desire to find answers to problems, developing not just knowledge but also social intelligence (Jahnke, Olsson, et al., 2014).

The DDD incorporates several axiomatic modifications to conventional teaching and resembles the constructivist method more, which encourages students to develop their knowledge in a social setting (Jahnke, Mrell-Olsson, et al., 2014). The DDD also includes instruction on the use of digital technologies for learning. DDD places a strong focus on collaborative knowledge creation (Bonnes et al., 2020). Planning for learning that is less content-heavy than problem-based learning is included in the DDD. This strategy could portray knowledge as a hindrance rather than as a benefit. It may help pupils develop higher-order thinking abilities and shift their focus from just memorizing something to really comprehending it (Sh, 2022).

By taking on the role of a digital technology designer during an in-service training, primary teachers may use digital didactic design as an activity to advance their technological literacy (Jahnke, Norqvist, et al., 2014). Teachers become more educated and motivated to utilize and integrate these tools into their teaching practice if they actively participate in the creation of digital technologies based on their own teaching and students' learning requirements (Bonnes et al., 2020). To build and deploy high-quality digital technologies that promote instructors' competency and students' learning, teachers may participate in participatory design. Additionally, via often online production, editing, and publication, it enables students to acquire critical analysis, metacognition, and reflection (Vallance, 2021).

In addition, Web 2.0 technologies for social networks including blogs, wikis, iPhones, and iPads for learning may be included in digital pedagogy. DDD fosters global interconnectedness in this manner (van Rooyen, 2021). Teachers must possess the abilities to create and assess technology for its intended use and must have opportunity to do so in a learning setting (Erviana & Ghufron, 2021; Rintayati et al., 2022). A number of research have looked at how digital pedagogy is used in the classroom. For instance, Bergström and Mrell-Olsson (2017) used a language experience approach to digital storytelling using power points with voice recordings and the use of electronic storybooks to increase reading motivation and discovered that the method was effective in inspiring students and teaching literacy-related concepts.

Conclusion

The shift in perspectives and ways of life in the digital age has also shifted the importance of learning through education and how to approach it effectively. Integrating technology into education is an urgent matter that needs to be implemented properly. That needs to be done to answer the need for education by the ongoing technological disruption. Digitalization in various sectors places today's young generation as digital learners who need different learning approaches to meet their expectations and needs in seizing opportunities and facing challenges in the future.

Teachers must carry out innovation and reform of learning. In facing the challenges of the 21st century, teachers must find the right formula to apply to students; this formula has to do with how students acquire knowledge in the learning process. The findings show that DDD has the potential to foster profound learning experiences by providing a framework that invites educators and researchers to research, investigate, and evaluate the actual designs that are being used in classrooms, where teachers are actively involved in the design process. A new way of thinking about planning, carrying out, and commenting on teaching and learning is provided by DDD. Our empirical research's findings support the use of educational technology in learning expeditions as an effort to shift away from conventional course-based learning.

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