OPTIMIZING ELEMENTARY SCHOOL TEACHERS' KNOWLEDGE THROUGH DIGITAL TEACHING MATERIAL ASSISTANCE: AN IMPLEMENTATIVE STUDY

Mardhatillah[1], Shirly Rizki Kusumaningrum[2], Ade Eka Anggraini[3], Sri Rahayuningsih[4], Siti Faizah[5]

Universitas Negeri Malang
Corresponding author: [1]mardhatillah.atjeh@gmail.com

Abstract

This study aimed to optimize the pedagogical knowledge and digital skills of elementary school teachers through a Digital Teaching Material (DTM) mentoring program. Using a descriptive qualitative approach, this implementation study was conducted in three stages: needs identification, training and mentoring, and evaluation of results. The research subjects were elementary school teachers selected based on their active program involvement. Results showed significant improvements in technological mastery (26% to 87%), creativity in preparing DTMs (21% to 92%), and student participation (53% to 89%). Mentoring served as effective scaffolding to enhance teachers' confidence in using technology. Constraints included limited infrastructure and the need for advanced training. This study recommends a sustainable mentoring model to systematically accelerate technology integration in basic education.

Keywords: Mentoring, Primary School Teachers, Digital Teaching Materials, Learning Transformation, Digital Literacy, Educational Technology.

A. Introduction

Amid rapid advances in information and communication technology, education faces significant challenges and opportunities to integrate technology into learning. At the basic education level, teachers play a key role in shaping 21st-century competencies like critical, creative, collaborative, and communicative thinking (Braun & Huwer, 2023). However, many Indonesian primary school teachers lack understanding and mastery of digital technology, hindering efforts to transform digital education (Ramdani et al., 2023).

Mardhatillah, Shirly Rizki Kusumaningrum, Ade Eka Anggraini, Sri Rahayuningsih, Siti Faizah

Research confirms that digital technology in basic education improves learning effectiveness, student engagement, and material relevance (Schrum, 2021) (Nipyrakis et al., 2023) (Luo & Forbes, 2019) (Drumm, 2019). Unfortunately, a gap persists between technology's potential and teachers' readiness, especially in non-urban areas where conventional methods dominate. Insufficient training, limited infrastructure, and inadequate technical support undermine teachers' confidence in using digital tools. (Carpenter et al., 2024) (Althubyani, 2024).

This text highlights that the use of digital technology in primary education can improve learning effectiveness and student engagement. However, there is a big gap between the potential of technology and teachers' readiness, especially in non-urban areas, where traditional teaching methods are still common. Many teachers lack confidence in using digital tools due to insufficient training, limited infrastructure, and inadequate technical support.(Kasperski et al., 2023) (Wang et al., 2023) (Hung & Wati, 2020).

To address these challenges, comprehensive teacher training programs focusing on digital literacy and pedagogical integration of technology are essential. Schools and education authorities should also invest in improving technological infrastructure, including reliable internet connectivity and access to appropriate devices. Additionally, establishing ongoing technical support systems and creating opportunities for teachers to collaborate and share best practices can help build their confidence and skills in leveraging digital tools effectively in the classroom.(Mardiana, 2024) (Soekamto et al., 2022) (Quadrado et al., 2021)

Furthermore, policymakers should consider implementing mentorship programs in which tech-savvy educators can guide their less confident colleagues. Teachers' incentives to successfully integrate technology into their curricula could encourage wider adoption and innovation. Lastly, partnering with local tech companies or universities to provide resources and expertise can help bridge the digital divide in education, ensuring that all students benefit from modern learning approaches regardless of their geographic location.(Greene et al., 2019) (Hunter, 2017)

This challenge aligns with Indonesia's *Merdeka* Curriculum, which emphasizes flexibility, differentiated learning, and student-centered approaches. The curriculum requires teachers to be adaptive learning designers, but without digital capacity, its goals remain unattainable (Mardiana, 2024) (Gul et al., 2023). Mentoring addresses this by offering contextualized reflective learning beyond technical training (Segal, 2023) (Saiz-Linares & Susinos-Rada, 2020).

Digital teaching material (DTM) mentoring provides scaffolding within teachers' zone of proximal development (Dominguez & Svihla, 2023) (Magnusson et al., 2023). Studies confirm its positive impact on teacher confidence, material creativity, and

student engagement (Naimi-Akbar et al., 2023) ("Effectiveness of Digital Technology Tools in Teaching Pronunciation to Saudi EFL Learners," 2022). Therefore, this intervention should be the focus of elementary school teachers' professional development strategies.

DTM also fosters teacher collaboration and prepares students for the digital era. In addition, the program has the potential to improve students' critical thinking and problem-solving skills through appropriate use of technology. The widespread implementation of DTM at the primary school level could be a strategic step in preparing the younger generation to face the challenges of the digital era..(Schrum, 2021) (Bagnallanan an& Heath, 2018.) Gamez-Monterooet al .

To support the successful implementation of DTM, adequate policy and infrastructure support is needed from the government and schools. Continuous training and technical assistance for teachers are key factors for optimising the benefits of DTM in the classroom. Furthermore, periodic evaluations of the impact of DTM on student learning outcomes should be conducted to refine this approach according to the needs of education in the digital era. (Collier-Harris and Mamvuto, 2018) (Mannathoko and Goldman, 2016).

Collaboration between schools, parents, and communities is also important to ensure alignment between learning at school and at home. The development of quality digital content in line with the national curriculum should be prioritised in the implementation of DTM. In addition, it is important to pay attention to the safety and ethical aspects of using digital technology in the learning process to protect students from potential negative impacts.(Nipyrakis et al., 2023) (Liang et al., 2023)

Collaboration with the private sector and research institutions can enrich DTM content and features in line with the latest technological developments. The development of an accessible and user-friendly DTM platform is also important to ensure wider adoption in different regions. In addition, involving parents and communities in the DTM implementation process can increase support and sustainability of the program beyond the school environment.(Callahan et al., 2022) (Williams et al., 2020)

Based on this background, several fundamental research questions arise and must be answered systematically. First, what is the effectiveness of the digital teaching material mentoring program in improving pedagogical knowledge and digital skills of elementary school teachers? Second, how do teachers respond to the training and mentoring provided? Third, what obstacles are faced during the implementation of the program and how are problem-solving strategies? These questions form the core of problem formulation to be studied in depth and contextually.

The main objective of this research is to develop and implement a digital teaching material mentoring program that can improve the pedagogical knowledge and digital

skills of elementary schoolteachers. Specifically, this research aims to (1) identify teachers' needs related to the development of digital teaching materials; (2) train teachers in designing and using curriculum-based DTM; (3) evaluate the impact of the program on student activity and changes in teachers' attitudes towards technology; and (4) formulate a mentoring model that can be replicated in various basic education contexts.

The limitations of this study include the scope of the object, time, and location of the research. The research object is limited to elementary school teachers who are actively teaching and have basic access to technological devices such as laptops or smartphones. The program implementation time was limited to four weeks, with three main stages: needs identification, training, and implementation. The research was conducted in a model school under the auspices of the State University of Malang with varying characteristics of early digital readiness. Given this limitation, the research focused on avoiding overgeneralisation and maintaining the validity of the findings.

Furthermore, the results of this study are expected to make a scientific contribution to the development of a sustainable and contextualised teacher training model. This model is designed to not only transfer technical skills but also to form an innovative mindset that is adaptive to changing times. With systematic documentation and in-depth reflection of the mentoring process, this research can be used as a reference for developing digital technology-based education policies that are inclusive and based on real needs in the field.

B. Method

This research uses a descriptive qualitative approach with a type of implementative study that aims to deeply understand the process of mentoring elementary school teachers in developing and implementing Digital Teaching Materials (DTM) to optimise their pedagogical knowledge and mastery of teaching materials. Through this approach, researchers can explore how mentoring plays a role in improving the quality of planning and implementing digital-based learning that is appropriate to the elementary school context.

The participants in this study were elementary school teachers actively teaching in one of the selected areas with basic technological readiness, such as ownership of digital devices (laptops or smartphones) and minimal access to the Internet. The teachers were purposively selected based on their willingness and active involvement in participating in mentoring activities. The research location was chosen based on the need to strengthen teachers' capacity for digital learning transformation as well as the potential impact of the program implementation.

The study was conducted in three stages. The first stage is preparation, which includes identifying teachers' needs for digital learning, preparing training materials, and developing evaluation and observation instruments. The second stage is the implementation of mentoring, in which researchers facilitate training on the creation and use of DTM based on the elementary school curriculum, followed by intensive mentoring in the process of implementing it in the classroom. The third stage is evaluation, which includes collecting data on the effectiveness of DTM use through classroom observations, interviews with teachers, and an analysis of student learning outcomes.

The data collection techniques included participatory observation, semi-structured interviews, documentation, and open and closed questionnaires. Observations were conducted to directly observe mentoring activities and teaching practices using the DTM, while in-depth interviews were used to explore teachers' experiences and perceptions more personally. Documentation in the form of developed modules, photos of activities, and learning recordings was also collected as complementary data.

The obtained data were analysed using Miles and Huberman's interactive model, which includes three stages: data reduction, data presentation, and conclusion drawing. Data reduction was performed by sorting and selecting the relevant information from the field results. The data presentation took the form of narratives, tables, and visual documentation to illustrate the dynamics of mentoring. Finally, conclusions are drawn through a process of interpretation and verification of the findings to obtain a complete and valid understanding.

To maintain data validity, source and method triangulation techniques were used to compare the results from observations, interviews, and documentation. In addition, the researcher also conducted member checking by providing the results of the interpretation to the research subject to obtain confirmation and clarification of the data collected. With this methodology, it is expected that this research can provide a real and comprehensive picture of the impact of DTM mentoring on improving elementary school teachers' knowledge in the context of 21st century learning.

This study also used a reflective approach to analyse the mentoring process and changes that occurred in teachers during the program. Reflective analysis allows researchers to identify the key factors that influence the success of DTM mentoring in improving primary school teachers' competencies. In addition, this approach also helps uncover the challenges and obstacles faced during the mentoring process to provide recommendations for future program improvements.

Through this reflective analysis, researchers can identify the best practices for DTM mentoring that can be replicated or adapted for other professional teacher development programs. The results of this study can also provide valuable insights for

education policymakers in designing and implementing more effective and sustainable teacher competency improvement programs. Furthermore, the findings from this study can be the basis for developing a more comprehensive mentoring model that is adaptive to the specific needs of primary school teachers facing the challenges of 21st century learning.

Reflective analysis can also help to identify aspects of DTM mentoring that need to be improved or modified to increase its effectiveness. By understanding the dynamics and complexities of the mentoring process, researchers can develop targeted strategies to support primary school teachers' professional growth. In addition, the results of this analysis can make a significant contribution to the academic literature on professional teacher development and the effectiveness of mentoring programs in the context of basic education in Indonesia.

C. Finding and Discussion

1. Finding

You The results of this study show that mentoring elementary school teachers in designing and implementing Digital Teaching Materials (DTM) can significantly improve their pedagogical understanding and digital skills in managing the learning process. Based on the findings from observations, interviews, documentation, and pre-test and post-test questionnaires, the improvement can be seen from several main indicators: mastery of technology, creativity in the preparation of teaching materials, student activity during learning, and changes in teacher attitudes towards digital learning.

a. Improved Mastery of Technology

At the beginning of the program, only 26% of the teachers stated that they were able to use digital learning design applications independently, such as Canva, interactive PowerPoint, and Wordwall. After the four-week mentoring process, this figure increased dramatically to 87% based on post-test results and practice observation sheets. Teachers also showed improvement in terms of understanding the structure of digital teaching materials aligned with the Merdeka Curriculum.
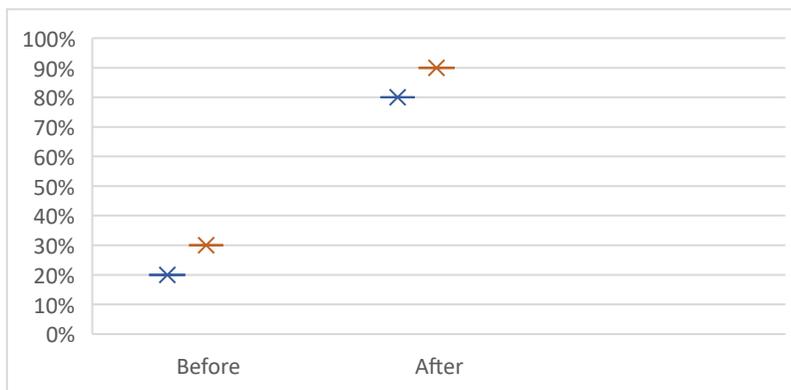
Mastery of Digital Technology

Figure 1: Technology Mastery Summary

b. Changes in Planning and Creativity of Teaching Materials

Before mentoring, most teachers (around 71%) claimed to still use conventional media, such as textbooks and blackboards, to deliver the material. After participating in the program, as many as 92% of the teachers managed to compile at least two forms of Digital Teaching Materials developed based on student needs analysis, with multimedia support such as simple animations, audio narratives, and interactive elements such as digital quizzes. One teacher even said that, "I became more enthusiastic about making my own learning media, and students became more interested in participating in the lessons."

The data are presented as follows:

Table 1. Changes in Planning and Creativity of Teaching Materials

Aspect	Teacher's Percentage
Still using conventional media	71%
Have compiled post-program interactive DTM	92%

The significant increase in the use of Digital Teaching Materials (DTM) demonstrates the success of the mentoring program in encouraging teaching innovation. Teachers not only adopt new technologies but also develop materials that better suit the needs of their students. These changes have the potential to increase student engagement and learning effectiveness, as reflected by one teacher's positive comments on increased student interest.

The increase in the percentage of teachers who developed interactive DTMs from 29% to 92% showed the positive impact of the mentoring program. This transformation is not only limited to the use of technology but also includes a change in teachers' mindset in designing more interactive and relevant learning materials. This success can serve as a model for teacher professional development programs in other areas that focus on the use of digital technology to improve teaching quality.

This initiative also has the potential to encourage collaboration among teachers in sharing best practices and experiences using digital technology. In addition, improving teachers' digital skills can help bridge the technology gap between educators and students, who are often more adept at using digital devices. This, in turn, can create a more dynamic learning environment that is relevant to the needs of today's digital generation.

c. Student Response to Digital Learning

The implementation of DTM also had a positive impact on student participation in the classroom. From the observation results during the three post-assistance teaching sessions, 80% of the students showed an increase in the activity of asking and answering questions, compared to an average of 53% in the previous conventional learning session. In addition, the teacher's reflection results indicated that students became more enthusiastic, easier to understand material that was visual or concrete, and more interested when the teacher showed a short video or used a game-based digital quiz.

This increase in student participation and enthusiasm shows that the DTM succeeds in creating a more interesting and interactive learning experience. The use of visual elements and games in digital learning seems to play an important role in increasing students' understanding of and interest in the material being taught. These positive results can serve as a foundation for further development of digital learning strategies to optimise the teaching and learning process in the digital era.

However, it is important to remember that the successful implementation of DTM also depends on teachers' readiness and skills for integrating technology into learning. Therefore, continuous training and technical support for teachers is important to ensure the effectiveness of DTM implementation. In addition, periodic evaluation of the impact of DTM on student learning outcomes is needed to continuously improve the digital learning strategies implemented.

d. Changes in Teachers' Attitudes towards Digital Innovation

Teachers' attitudes towards the use of technology in learning have also changed significantly. In the initial questionnaire, only 32% of the teachers felt confident in trying new digital learning methods. However, after mentoring, 89% of the teachers stated that they were ready and motivated to continue developing digital learning media. This is reflected in the initiatives of some teachers who began to develop long-term plans for DTM development for the next semester, even without the need for direct guidance.

The increase in teachers' confidence and motivation to adopt digital technology demonstrates the success of the mentoring programme. This change in attitudes has the potential to have a long-term positive impact on the quality of learning in schools. With more teachers proactively developing digital learning media, it is expected that students will obtain a more interactive learning experience that is relevant to the digital era.

e.   Challenges and Suggestions for Development

Although the results were successful, some challenges were noted in the implementation of the program. One of them is the limited digital devices owned by teachers or schools, especially in areas with unstable Internet access. As many as 38% of teachers stated that Internet connection was an obstacle to accessing certain digital platforms or downloading large materials. Therefore, it is recommended that digital materials be prepared offline or in lightweight formats so that they can be used more flexibly. In addition, there is a need for further training, particularly in the use of simple video editing platforms and integration of DTM with learning assessment applications.

Such training can help teachers develop their digital skills and improve the quality of their learning materials. Government and educational institutions need to collaborate to provide adequate technology infrastructure across the region, especially in remote areas. In addition, developing learning content that can be accessed offline could be a short-term solution to overcome Internet connectivity issues.

2.   Discussion

Overall, this study proves that the DTM mentoring program is effective in optimising primary school teachers' knowledge and skills in designing and implementing digital learning that is engaging, adaptive, and relevant to students' needs. With continued support and improved digital infrastructure, this kind of activity has the potential to accelerate the transformation of basic education to become more inclusive and innovative.

The increase in teachers' ability to master digital technology was significant, from 26% before mentoring to 87% after mentoring. This shows that the mentoring program had a positive impact on strengthening the digital literacy of primary school teachers. This finding is in line with Vygotsky's (1978) Zone of Proximal Development (ZPD) theory, which emphasises the importance of the role of mentors or facilitators in helping individuals achieve their learning potential. Mentoring functions as a form of scaffolding that allows teachers to develop digital learning tools more quickly (Thomas et al., 2021) (Lantolf & Xi, 2023) (O'Keeffe, 2020).

Furthermore, teachers' creativity in developing digital-based teaching materials also experienced a striking jump, from only 21% before the assistance to 92% afterwards. This shows that the training provided is not only technical in nature but also able to stimulate teachers' ability to design interactive and interesting teaching materials. According to Guilford (1967), creativity is a divergent thinking ability that can be improved by training and experience. Support in the form of digital training materials gives teachers the opportunity to develop more innovative teaching approaches relevant to the needs of today's students (Aguirre et al., 2022) (. C. Richardson et al., 2022) (O'Connor et al., 2023) .

Mardhatillah, Shirly Rizki Kusumaningrum, Ade Eka Anggraini, Sri Rahayuningsih, Siti Faizah

Student activity in the learning process also increased from 53% to 89%, indicating that the use of Digital Teaching Materials (DTM) has a direct impact on students' active participation in the classroom. Based on the theory of constructivism developed by Piaget and Bruner, students will more easily understand subject matter when they are actively involved in the learning process. Interactive DTM gives students the space to participate, explore, and build their own understanding, thus increasing their motivation and engagement in learning. Multimedia learning also supports this, as simultaneous visual and verbal presentations of materials have been shown to improve students' retention and understanding (Maran et al., 2011).

The change in teachers' attitudes towards using technology is also an important finding, as teachers' confidence in using DTM increased from 32% to 82%. This is in line with Rogers' (2003) theory of the diffusion of innovations, which explains that acceptance of innovations is highly dependent on individual perceptions of the benefits and ease of use of the technology. With mentoring, teachers gained direct experience and saw the effectiveness of DTM in practice, thus encouraging them to be more open and confident in adopting learning technology(Edouard, 2022) (Sun et al., 2024) (Ateş et al., 2023).

Increased teacher confidence in using DTM can positively impact the quality of learning in the classroom. Confident teachers tend to be more creative and innovative in integrating technology into their teaching and learning processes. This can ultimately increase student engagement and create a more interactive and meaningful learning experience (Maisyaroh et al., 2024) (Mutch-Jones et al., 2021)

In addition, teachers who are confident in using DTM can serve as role models for their peers, encouraging wider adoption of technology in the school environment. Increased teacher confidence can also help overcome the resistance to change and innovation in education. Thus, mentoring and increasing teachers' confidence in using DTMs can be a catalyst for broader and more sustainable educational transformations.

However, challenges remain in the implementation of the DTM. About 44% of teachers complained about the limited Internet network, while another 38% stated that they still needed further training in editing and utilising advanced features of the DTM. This finding confirms that digital transformation in education is not enough to improve teacher competence but must also be supported by adequate technological infrastructure and continuous training programs. UNESCO (2020) also emphasizes the importance of a supportive education ecosystem, including technical support and policies that favor the development of educational technology (Awdziej et al., 2023) (Zheng et al., 2023)

Improving technological infrastructure, especially a stable and adequate Internet network, is an important priority to overcome barriers to DTM implementation. Continuous training programs need to be designed to meet the needs of teachers to

master the advanced features of DTM, especially in terms of editing and optimal utilisation.

In addition, collaboration between education stakeholders is needed to create a supportive ecosystem, including policies that favour the development of educational technology and the provision of adequate technical support. (Gogus, 2021) (Van Thiel, 2018) (Taghizadeh & Basirat, 2022)

Overall, the results of this study show that digital teaching assistance is very effective in improving the quality of learning at the primary school level. Increased teacher competence, creativity in developing teaching materials, and active student participation are important indicators that technological integration into basic education can run optimally when supported by systematic and sustainable training. This approach can be an important strategy for realising education that is adaptive and relevant to the demands of the digital era.

D. Conclusion

This study shows that a Digital Teaching Material (DTM) mentoring program is effective in improving the pedagogical competence and digital skills of elementary school teachers. Through an implementative qualitative approach involving needs identification, training, and evaluation, teachers experienced significant improvements in technological mastery (26% → 87%), creativity in preparing digital teaching materials (21% → 92%), and student activity and participation in learning (53% → 89%). Mentoring acts as scaffolding that can increase teachers' confidence in integrating technology into learning. Despite challenges, such as limited infrastructure and the need for further training, the results of this study show that sustainable mentoring can accelerate the transformation of basic education systematically and adaptively to the demands of the digital era. Therefore, this mentoring model should be used as a national strategy for teacher professional development in the era of the digital transformation of education.

The implementation of this approach also has the potential to improve the overall quality of education, not only at the primary level, but also at higher education levels. By improving teachers' abilities to integrate technology, learning can become more interactive, effective, and relevant to students' needs in the digital era. In addition, this mentoring model can be a catalyst for continuous educational innovation, encouraging collaboration between teachers and creating a vibrant learning community.

Bibliography

Braun, D., & Huwer, J. (2023). Computational literacy is an important element of digitised science teacher education: A Systematic Review of Curriculum Patterns in Physics Teacher Education Degrees in Germany. Education Sciences, 13(10), 1063. https://doi.org/10.3390/educsci13101063

Ramdani, J. M., Baker, S., & Gao, X. (Andy). (2023). Exploratory practice as a professional development strategy for English language teachers in Indonesia. RELC Journal, 54(2), 340–355. https://doi.org/10.1177/00336882231152944

Schrum, K. (2021). Developing student capacity to produce digital scholarships in the humanities. Arts and Humanities in Higher Education, 21(2), 158–175. https://doi.org/10.1177/14740222211045246

Nipyrakis, A., Stavrou, D., Avraamidou, L. (2023). Designing technology-enhanced science experiments in elementary teacher preparation: The role of learning communities. Research in Science & Technological Education, ahead-of-print(ahead-of-print), 889–911. https://doi.org/10.1080/02635143.2023.2202386

Luo, J., & Forbes, K. (2019). 'It's a plus rather than a must': perspectives of mainstream teachers in China on the influence of advertised educational ethos in supplementary English education. Compare: A Journal of Comparative and International Education, 51(6), 824–842. https://doi.org/10.1080/03057925.2019.1681937

Drumm, L. (2019). Folk pedagogies and pseudo-theories: how lecturers rationalise their digital teaching. Research in Learning Technology, 27(0). https://doi.org/10.25304/rlt.v27.2094

Carpenter, J. P., Rosenberg, J. M., Kessler, A., Romero-Hall, E., & Fischer, C. (2024). The importance of context in teacher educators' professional digital competence. Teachers and Teaching, 30(4), 400–416. https://doi.org/10.1080/13540602.2024.2320155

Althubyani, A. R. (2024). Digital Competence of Teachers and the Factors Affecting Their Competence Level: A Nationwide Mixed-Methods Study. Sustainability, 16(7), 2796. https://doi.org/10.3390/su16072796

Kasperski, R., Porat, E., & Blau, I. (2023). Analysis of emergency remote teaching in formal education: crosschecking three contemporary techno-pedagogical frameworks. Research in Learning Technology, 31. https://doi.org/10.25304/rlt.v31.2982

Wang, X., Iqbal, M. Z., Young, G. W., & Guckin, C. M. (2023). The potential of extended reality in Rural Education's future – perspectives from rural educators. Education and Information Technologies, 29(7), 8987–9011. https://doi.org/10.1007/s10639-023-12169-7

Hung, R., & Wati, U. (2020). 'Digital Home Schooling' During the Pandemic: Possibilities and Challenges. Knowledge Cultures, 8(2), 36. https://doi.org/10.22381/kc8220206

Mardiana, H. (2024). Perceived Impact of Lecturers' Digital Literacy Skills in Higher Education Institutions. Sage Open, 14(3). https://doi.org/10.1177/21582440241256937

Soekamto, H., Nikolaeva, I., Lazareva, N., Kostyrin, E., Kosov, M., Yumashev, A., Kvitkovskaja, A., Abbood, A. A. A., Nikitina, N., & Grachev, D. (2022). Professional Development of Rural Teachers Based on Digital Literacy. Emerging Science Journal, 6(6), 1525–1540. https://doi.org/10.28991/esj-2022-06-06-019

Quadrado, J. C., Pokholkov, Y. P., & Zaitseva, K. K. (2021). ATHENA: Contributing to Development of Higher Education Institutions for the Digital Age. Vysshee Obrazovanie v Rossii = Higher Education in Russia, 30(1), 125–131. https://doi.org/10.31992/0869-3617-2021-30-11-125-131

Greene, J. L. R., Koerner, B., & Wilson, J. (2019). From the inside out: Exemplary music education association mentoring programs. Arts Education Policy Review, 121(2), 74–88. https://doi.org/10.1080/10632913.2019.1596852

Hunter, J. (2017). High Possibility Classrooms as a pedagogical framework for technology integration in classrooms: an inquiry in two Australian secondary schools. Technology, Pedagogy and Education, 26(5), 559–571. https://doi.org/10.1080/1475939x.2017.1359663

Gul, R., Tahir, T., & Ishfaq, U. (2023). Perspectives of the Teachers on Challenges and Possibilities to Online System of Education amid COVID-19 Outbreak in Balochistan, Pakistan. Sage Open, 13(1), 215824402311550. https://doi.org/10.1177/21582440231155063

Segal, A. (2023). Rethinking Collective Reflection in Teacher Professional Development. Journal of Teacher Education, 75(2), 155–167. https://doi.org/10.1177/00224871231188702

Saiz-Linares, Á., & Susinos-Rada, T. (2020). Revisiting reflection in pre-service teacher training: let's rethink through a practicum in Spain. Reflective Practice, 21(5), 629–645. https://doi.org/10.1080/14623943.2020.1785414

Dominguez, S., & Svihla, V. (2023). A review of teacher implemented scaffolding in K-12. Social Sciences & Humanities Open, 8(1), 100613. https://doi.org/10.1016/j.ssaho.2023.100613

Magnusson, C. G., Luoto, J. M., & Blikstad-Balas, M. (2023). Developing teachers' literacy scaffolding practices—successes and challenges in a video-based longitudinal professional development intervention. Teaching and Teacher Education, 133, 104274. https://doi.org/10.1016/j.tate.2023.104274

Mardhatillah, Shirly Rizki Kusumaningrum, Ade Eka Anggraini, Sri Rahayuningsih, Siti Faizah

Naimi-Akbar, I., Weurlander, M., & Barman, L. (2023). Teaching-learning in virtual learning environments: a matter of forced compromises away from student-centredness? Teaching in Higher Education, 29(8), 2095–2111. https://doi.org/10.1080/13562517.2023.2201674

Effectiveness of Digital Technology Tools in Teaching Pronunciation to Saudi EFL Learners. (2022). FWU Journal of Social Sciences, 68–82. https://doi.org/10.51709/19951272/fall2022/5

Bagnall, R. S., & Heath, S. (2018). Roman Studies and Digital Resources. Journal of Roman Studies, 108(108), 171–189. https://doi.org/10.1017/s0075435818000874

Gamez-Montero, P. J., Peña, M., & Olmedo-Torre, N. (2020). Flipped learning and threshold concepts in the Turbomachinery section of Fluid Engineering course. Computer Applications in Engineering Education, 29(4), 795–809. https://doi.org/10.1002/cae.22280

Mannathoko, M. C., & Mamvuto, A. (2018). Teaching the Arts in the Primary School Curriculum: What Strategies Imbue the Integrative Arts Subjects? Studies in Art Education, 59(2), 145–158. https://doi.org/10.1080/00393541.2018.1440149

Collier-Harris, C. A., & Goldman, J. D. G. (2016). Puberty and sexuality education using a learning and teaching theoretical framework. Educational Review, 69(4), 393–410. https://doi.org/10.1080/00131911.2016.1225672

Liang, Y., Wei, C., Shi, Y., & Ren, L. (2023). The Influence of Internet-Specific Epistemic Beliefs on Academic Achievement in an Online Collaborative Learning Context for College Students. Sustainability, 15(11), 8938. https://doi.org/10.3390/su15118938

Callahan, K. P., Provost, J. J., Peterson, C. N., Huisinga, K. L., Bell, E., Koletar, C., Bell, J. K., Martinez-Vaz, B. M., Galport, N., & Eddy, R. M. (2022). External Collaboration Results in Student Learning Gains and Positive STEM Attitudes in CUREs. CBE—Life Sciences Education, 21(4), ar74. https://doi.org/10.1187/cbe.21-06-0167

Williams, L. J., Jaya, I. K. D., Hall, A., Cosijn, M., Rosmilawati, R., Sudirman, S., Suadnya, W., & Sudika, I. W. (2020). Unmasking partnerships for agricultural innovation: the realities of a research–private sector partnership in Lombok, Indonesia. Innovation and Development, 12(3), 417–436. https://doi.org/10.1080/2157930x.2020.1857949

Thomas, G. L., Bailey, J., & Engeness, I. (2021). Scaffolding athlete learning in preparation for competition: what matters. Sports Coaching Review, 12(3), 281–301. https://doi.org/10.1080/21640629.2021.1991713

Lantolf, J. P., & Xi, J. (2023). Digital Language Learning: A Sociocultural Theory Perspective. TESOL Quarterly, 57(2), 702–715. https://doi.org/10.1002/tesq.3218

O'Keeffe, P. (2020). The case for engaging online tutors for supporting learners in higher education in refugee contexts. Research in Learning Technology, 28(0). https://doi.org/10.25304/rlt.v28.2428

Aguirre, T., Cortabarría, L., Verche, E., Borges, Á., & Aperribai, L. (2022). Challenges for Teachers' and Students' Digital Abilities: A Mixed Methods Design Study. Sustainability, 14(8), 4729. https://doi.org/10.3390/su14084729

Richardson, C. (2020). Supporting collaborative creativity in education with The i5 Framework. Educational Action Research, 30(2), 297–312. https://doi.org/10.1080/09650792.2020.1810731

O'Connor, J., Ludgate, S., Le, Q.-V., Le, H. T., & Huynh, P. D. P. (2023). Lessons from the pandemic: Teacher educators' use of digital technologies and pedagogies in Vietnam before, during and after the Covid-19 lockdown. International Journal of Educational Development, 103, 102942. https://doi.org/10.1016/j.ijedudev.2023.102942

Maran, C. M., C, S., & Ravikumar, B. (2011). Effectiveness of Multimedia Learning in Higher Education. International Journal of Multimedia Technology, 1(2), 88–92. https://doi.org/10.5963/ijmt0102005

Edouard, G. (2022). Why and How Colleges and Universities Should Leverage Technology Mentoring to Maximize Faculty's Technology Integration Efforts. TechTrends, 67(1), 124–132. https://doi.org/10.1007/s11528-022-00769-y

Sun, F., Yang, Y., Sun, D., Tian, P., & Fan, Y. (2024). Pre-service teachers' inclination to integrate AI into STEM education: Analysis of influencing factors. British Journal of Educational Technology, 55(6), 2574–2596. https://doi.org/10.1111/bjet.13469

Ateş, H., Garzón, J., & Lampropoulos, G. (2023). Evaluating science teachers' flipped learning readiness: a GETAMEL approach test. Interactive Learning Environments, 32(10), 6283–6300. https://doi.org/10.1080/10494820.2023.2255232

Maisyaroh, M., Juharyanto, J., Wiyono, B. B., Nawi, A. M., Adha, M. A., & Lesmana, I. (2024). Unveiling the nexus of leadership, culture, learning independence, passion trend-based learning, and teacher creativity in shaping digital student skills. Social Sciences & Humanities Open, 9, 100884. https://doi.org/10.1016/j.ssaho.2024.100884

Mutch-Jones, K., Wiebe, E., Boulden, D. C., Reichsman, F., Gasca, S., & Lord, T. (2021). Co-teaching with an immersive digital game: supporting teacher-game instructional partnerships. Educational Technology Research and Development, 69(3), 1453–1475. https://doi.org/10.1007/s11423-021-10000-z

Awdziej, M., Wolny, R., Jaciow, M., Tkaczyk, J., & Lipowski, M. (2023). Students Digital Maturity and Its Implications for Sustainable Behavior. Sustainability, 15(9), 7269. https://doi.org/10.3390/su15097269

Zheng, W., Nie, Y., Wen, S., & Lian, B. (2023). Research on a Sustainable Teaching Model Based on the OBE Concept and the TSEM Framework. Sustainability, 15(7), 5656. https://doi.org/10.3390/su15075656

Gogus, A. (2021). Shifting to digital: adoption and diffusion. Educational Technology Research and Development, 69(1), 11–16. https://doi.org/10.1007/s11423-020-09862-6

Van Thiel, L. (2018). Professional learning design framework: supporting technology integration in Alberta. Research in Learning Technology, 26(0). https://doi.org/10.25304/rlt.v26.1989

Taghizadeh, M., & Basirat, M. (2022). Investigating pre-service EFL teachers' attitudes and challenges of online teaching. Computer Assisted Language Learning, 37(7), 1937–1974. https://doi.org/10.1080/09588221.2022.2136201