
Digital Media for Teachers in Vocational Schools: Digital Competence of 21st Century Educators

Setuju^{1*}, Asri Widowati², Dianna Ratnawati³, Astuti Wijayanti¹

¹Universitas Sarjanawiyata Tamansiswa

²Universitas Negeri Yogyakarta

³Universitas Negeri Malang

Email: setuju@ustjogja.ac.id*

*Corresponding author

ABSTRACT

Digital competency is a challenge and necessity for educators in the 21st century, especially in vocational schools. This study aims to bridge the gap by comprehensive review of digital media as a component of digital competency for teachers in Vocational Education and Training (VET). Data were collected from the Scopus, Research Gate, and Scholar databases based on inclusion and exclusion criteria. This study employs content analysis on 11 articles published in international journals indexed by Scopus between 2018 and 2024. The stages carried out include formulating material based on research questions, selecting relevant journal articles, analyzing main topics, interpreting data, identifying categories to develop digital skills, reporting findings, drawing conclusions, and suggesting further research. The findings indicated that digital media influenced teacher competence.several technologies to develop educators' digital competence, such as blogs, websites, mobile smartphones, video conferencing, digital content and new digital devices. Project-based learning as an alternative instructional model for developing digital competencies using digital media. Digital media influences digital competence and its domain. Future studies could carry out empirical investigations based on this finding to further enhance digital competence among VET teachers.

Keywords: digital competence, teachers, vocational, 21st century, media

Article history

Received:

29 June 2025

Revised:

17 July 2025

Accepted:

26 August 2025

Published:

02 October 2025

Citation (APA Style): Setuju, S., Widowati, A., Ratnawati, D., & Wijayanti, A. (2025). Digital Media for Teachers in Vocational Schools: Digital Competence of 21st Century Educators. *Jurnal Pendidikan Teknologi Dan Kejuruan*, 31(2). <https://doi.org/10.21831/jptk.v31i2.84470>

INTRODUCTION

Learning in the 21st century is impacted by digital media. It is imperative to find ways to embrace media into the learning process. It also requires the application of media creation technology solutions to ensure meaningful communication (Trilling & Fadel, 2009). The application of Information and Communication Technology (ICT) can increase the skills of undergraduate candidates designated in the curriculum (Ghavifekr, Afshari, & Salleh, 2012; Pheeraphan, 2013). ICT for learning introduces a new set of variables and adds complexity as technology develops (Hamilton et al., 2016).

Technological changes affect the classroom climate, methods, and techniques used in teaching and place responsibilities on teachers and students. Teachers must balance technical and

personal elements by considering digital pedagogy in achieving learning targets. It is the case that teachers and prospective teachers face when teaching students. Teachers are required to increase skills and knowledge, and integrate with technology in learning frameworks or models (McKenney et al., 2015). Besides that, teachers must use the right technology in appropriate pedagogy for specific content. These competencies are contained in Technological Pedagogical and Content Knowledge (TPACK). The continuous and rapid advancement of technology demands that teachers adapt to these changes in order to stay effective in the learning process (Koehler et al., 2013).

Teachers as professional educators must have competence (Irwantoro & Suryana, 2016). Three aspects of teacher competence are knowledge, processes, and attitudes as educators (Thomson & Gregory, 2013, Veal & Allan, 2014). Complex skills for 21st century education require professional teachers to make them happen. A teacher professional with competence in his field can create quality education (Bayar, 2014). Educators need to possess digital competence to deliver innovative and relevant content in 21st-century learning environments.

Educators play a leading role in designing appropriate learning environments and carefully selecting effective learning media to obtain technology that can facilitate students to learn well. The learning environment is influenced by the speed of development of learning technology (Kapici et al., 2020). Innovation in teaching by teachers can shape students' creativity (Ahmadi & Besançon, 2017). Learning-based technology and questions in learning also characterize teacher competence in implementing innovation of teaching (Thomson & Gregory, 2013). Technology skills are necessary for teachers to construct a better learning environment (Altinay-Gazi & Altinay-Aksal, 2017), and deliver material in adequate ways in the classroom (Grossman et al., 2009).

Digital competence starts from accessing, managing, developing, and evaluating devices and their applications (Janssen et al., 2013; Falloon, 2020). The aspects of digital competence, as defined by the European Digital Competence Framework (DigComp), include digital content creation, information and data literacy, communication and collaboration, and digital security (Redecker, 2017). Blyznyuk defines digital competency as communication, information, problem-solving, security, educational content creation (Blyznyuk, 2019). Digital competence enables individuals to explore new possibilities and opportunities through the use of digital technologies and emerging challenges and participate meaningfully in new knowledge. Based on these reasons, the application of digital media has the potential to develop teachers' digital competence in 21st century learning.

Digital media has been applied at all levels of education, such as pre-schools (Lee, 2015), primary (Loizou, 2022), secondary (Habiddin et al., 2022), and higher education (Jahn & Kenner, 2017). Based on previous research, the application of digital media can significantly improve

digital literacy (Dewi et al., 2022; Kaeophanuek, Na-Songkhla, & Nilsook, 2019), communication (Reyna et al., 2018), higher thinking skills (Pentury & Anggraeni, 2021), and other 21st century abilities. Although previous studies have analyzed the use of digital media, there remains a shortage of literature specifically focused on how digital media is applied to enhance teachers' digital competence in Vocational Education and Training (VET).

Several studies have investigated the possibilities of digital media to increase the skills of 21st-century teachers, which has primarily been applied in vocational education. Flipped classrooms as a technology-enabled learning tool (Villalba et al., 2018; Loizou, 2022), project-based learning to nurture digital skills with authentic and collaborative activities (Rahman et al. 2022; Basilotta Gómez-Pablos et al., 2017) and online learning and digital platforms to enhance digital literacy and pedagogical skills are among the studies that have been discussed (Wannapiroon et al., 2022). Most of the existing research has concentrated on assessing teachers' levels of digital proficiency, or the effectiveness of targeted digital media or technologies under vocational learning scenarios (Rahmawati, Abdullah, Widiaty, & Islami, 2022; Barboutidis & Stiakakis, 2023).

However, there are not many systematic studies mapping the relationships between vocational teachers' digital competency domains, learning strategies, and types of digital media in an integrated analytical model. Most of previous research has only examined the conceptual and methodological aspects of the subject of digital competency, focusing on operational skills or fundamental digital literacy and not on the comprehensive competency domains (Janssen et al., 2013; Falloon, 2020; Redecker, 2017). This approach uses largely perception-based surveys or small case studies as a starting point. To fill this gap, this study conducts a content analysis of the articles in Scopus-indexed journals published from 2018-2024 that systematically investigates educational technologies, learning approaches, and digital competency domains in vocational education. This approach makes a unique contribution by creating an integrated conceptual map. The framework provides direction for future empirical studies and policy initiatives that promote vocational teachers' digital competence.

While the number of empirical investigations pertaining to teachers' digital competence in VET has grown significantly, existing reviews are still disjointed. Existing literature either addresses the determination of levels of digital competence or single technology interventions, rather than integrating educational technology types, pedagogical models, and competence domains within a cohesive, analytical framework. To date, no review has systematically synthesized these three dimensions into an integrated conceptual structure specifically tailored to VET contexts. As such, this study does not just offer an overview of related findings, but builds an analytical map

connecting digital media, instructional strategies, and digital competence areas into a consistent model.

This study aims to address that gap by conducting a comprehensive review of studies from 2018 to 2024 to gain insights into the development of teacher digital competence in the 21st century. Conceptually, this review is informed by an integrated framework that conceptualizes digital media as instructional enablers, pedagogical approaches as mediating mechanisms, and domains of digital competence (defined by DigCompEdu) as outcome dimensions. This tripartite framework allows for a structured synthesis of prior studies and provides a basis for future empirical validation in VET teacher education contexts.

The research questions used are:

1. What educational technology is used to develop digital competence of 21st century educators?
2. What learning approach or model is used to develop digital competence?
3. How does digital media influence digital competence of VET teachers?
4. What domains of digital competency do VET teachers need to have?

METHOD

Content analysis was used as a method to draw valid and replicable conclusions from texts (or other meaningful materials) based on the context in which they are used (Krippendorff, 2004). The method has the advantage of flexibility in handling various data, using theory to generate new theories, and providing in-depth insights for researchers (Stemler, 2015). The stages of content analysis included the following steps: First, formulating the material to be analyzed in accordance with the research questions. Second, choose journal articles according to the topic being studied regarding digital media for VET teachers as a digital competency according to the specified inclusion criteria. Third, analyze the main topics determined and interpret the data with descriptive, frequency and percentage analysis and find the categories that are most frequently used to develop digital skills. Fourth, report the findings systematically. Fifth, draw conclusions and provide suggestions for future research.

The scientific articles reviewed were obtained from the Scopus, Research Gate and Google Scholar. Table 1 presents the inclusion and exclusion criteria for the review article.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Published in Scopus international indexed journals	Published in proceedings
Published between 2018 to 2024	Published less than 2018
Limited in vocational education	Outside vocational education
Reporting research results on digital media for teachers as a digital competency	Not reporting research result on digital media for teachers as a digital competency
Empirical studies	Not empirical research

The search strategy followed a structured review protocol. Most of the databases used were Scopus-indexed journals. While we did resort to ResearchGate and Google Scholar for cross-checking if an article existed, only peer-reviewed articles indexed in Scopus were kept for analysis. Scopus was employed; this search string consisted of combinations of the following keywords with the use of Boolean operators: (“digital competence” OR “digital literacy”) AND (“vocational education” OR “TVET” OR “VET”) AND (“digital media” OR “educational technology”). The selection process involved identification, screening, eligibility checking, and final inclusion stages. After removing duplicates and records that were not pertinent to our topic, 11 articles met all our inclusion criteria.

The included articles were used from Scopus-indexed academic journals published between 2018 and 2024. Articles were selected through a screening process based on predefined inclusion criteria. Eleven papers made the cut, each backed by solid research standards and focused on how tech skills shape the work of vocational educators. Instead of aiming for large volumes of data, the review leaned toward rich interpretation - this helped keep results grounded and trustworthy. Based on three predefined categories, articles were coded via content analysis on the categories (1) types of digital media, (2) pedagogical approaches or instructional models, and (3) digital competence domains. The coding framework was deductively derived from DigCompEdu and inductively updated in our analysis process. To maximise analytical integrity, coding analyses were cross verified with each other throughout repeated rounds and any discrepancies were corrected through discussion. This process was used to improve the reliability and minimize individual perception.

RESULTS AND DISCUSSION

Results

The articles reviewed are articles resulting from qualitative, quantitative, mixed methods, and research and development in several countries, namely Indonesia (Said, Kurniawan, & Anton, 2018, Rahmawati, Abdullah, Widiaty, & Islami, 2022), Malaysia (Abdullah et al., 2021; Rahman et al., 2022; Razali et al., 2023), Finland (Vilppola et al., 2022), Greece (Barboutidis & Stiakakis, 2023), Vietnam (Phan et al., 2020), Thailand (Wannapiroon et al., 2022), Ukraine (Romanova et al., 2022), Spain and Hungary (Villalba et al., 2018). The international scope highlights the wide range of perspectives that contribute to the development of digital competencies, emphasizing both the breadth and depth of the issue.

Educational Technology used by 21st century Educators to Develop Digital Competence

In the 21st century, educators use various technologies to develop digital competencies. The educational technology enhances cognitive and skills characteristics (Stošić, 2015). In general, educational technology is classified into two, namely technology in education and technology of education (Dey, 2017). The technology of education is an approach identified as a software approach related to learning aids and includes constructive technology (Silverman, 1968). Meanwhile, technology in education refers to a hardware-oriented approach that involves teaching aids and encompasses various related technologies used to enhance the learning process (Silverman, 1968).

Table 2. Educational technology to develop digital competence

Author (Year)	Aim or RQ	Subject Research	Educational Technology	Instrument, Research Method, Result
Barboutidis & Stiakakis (2023)	To investigate the factors that influence the digital competency levels of students in different areas at the Vocational Training Institute.	100 individuals were selected to complete 8-9 laboratory tasks designed to assess internet skills based on the digital skills framework.	PC, internet, smartphone	Instruments: survey, computer-based performance test, self-assessment questionnaire Methods: quantitative Results: Educational institutions need to update their curricula to ensure graduates achieve sufficient digital competency, while also implementing teaching practices that consider the effects of factors like age and technology usage.
Razali et al. (2023)	To explore the elements of multimedia in learning for TVET according to the arts content.	Five experts specializing in art and multimedia.	Multimedia element (graphics, text, audio, animation, and video)	Instruments: interview Method: qualitative (Fuzzy Delphi Method) Results: eight vital elements to implement mobile learning based on CBE are teachers, students, content, learning activity, learning design, learning environment, assessment and technology.
Rahmawati et al. (2022)	(a) analyze the advanced digital competence (ADC) levels of Vocational High School (VHS) teachers in technical versus non-technical schools, (b) compare the ADC levels of VHS teachers according to the island where the school is located, and (c) assess the effect of school quality on teachers' ADC performance.	392 respondents were classified and divided into several fields according to the vocational school, island and accreditation	Internet, online communication tools, multimedia, digital content, new digital device	Instruments: survey using Likert scale Method: quantitative (the statistics method) Results: VHS engineering teachers scored higher in ADC levels, but there are several components that need improvement for vocational teachers in both fields. Island location and school accreditation had little impact, with results contradicting expectations.
Rahman et al. (2022)	To enhance and validate the elements of Competency-Based Education (CBE) and Project-Oriented Problem-Based Learning (PoPBL) in TVET	500 Vocational Colleges teachers	Video learning	Instruments: questionnaire/survey Method: quantitative Results: A significant relationship exists, influenced by the video design and quality, learning content elements, and teaching delivery.

Author (Year)	Aim or RQ	Subject Research	Educational Technology	Instrument, Research Method, Result
Vilppola et al. (2022)	instructional videos model. To explore the ICT competency aspects among vocational teacher trainees in work-based training and identify the supporting factors and challenges.	44 vocational teacher trainees	Online webinars with digital presentations, social media, and video-conferencing tools	Instruments: questionnaire Method: qualitative (content analysis) Results: Work-based VET teacher training has the potential to enhance ICT competencies by providing opportunities to apply and experiment with new ICT concepts and tools.
Wannapiroon et al. (2022)	To develop, assess, and determine the readiness of vocational instructors in managing online learning through synchronous online platforms.	2,233 vocational instructors of the Office of the Vocational Education Commission, Ministry of Education, across five regions in Thailand.	Zoom, Cisco webex or Skype, Google Meet, Microsoft Teams,	Instruments: pre-test and post test with 20 test items of digital competence Method: quantitative (the statistical method) Results: Vocational core instructors express high levels of satisfaction with online learning management training.
Romanova et al. (2022)	To reveal the readiness of VET teacher in utilizing digital technology in learning and highlight efforts to improve their digital competencies.	165 VET teachers during 2020-2021 who took part in training at the University of Education Management	Cyber hunt, Google Classroom, blogger, Google Sites, Google Spreadsheet, Google Form, Google Calender	Instrument: online questionnaire; informal conversation Methods: qualitative and quantitative (the method of pedagogical experiment, the statistical method) Results: Many participants expressed a desire for further understanding and expertise in utilizing digital technology for their professional growth.
Abdullah et al. (2021)	To investigate the components of mobile learning within the framework of CBE in TVET.	Six respondents, three of whom are Associate Professors, two are Senior Lecturers and one is Head of Department.	Mobile devices, wireless network technology, m-learning and e-learning	Instruments: interview Method: qualitative Results: An implementation framework that utilizes mobile devices as a supporting element in teacher teaching is able to increase student competence.
Phan et al. (2020)	To identify IT competency frameworks and suggest necessary requirements, procedures, tools, and resources derived from IT competencies for effective communication, organization, storage, management, and assessment in online teaching.	42 expert opinions, 342 teachers and undergraduates	Computer system, IT application, internet resources, digital computers, online courses	Instruments: interview, ICT competence survey Method: qualitative and quantitative Results: The information technology competency framework in online teaching has been extensively used in training processes to enhance student learning capabilities.
Said et al. (2018)	To develop media-based learning using Android mobile learning	Media experts, teachers and learners of SMK Maitreyawira	Mobile smartphone	Instruments: interview, questionnaire Method: research and development Results: Android mobile learning based learning media can increase student interest, is suitable for use as a learning media, is cheap and easy to carry everywhere.
Villalba et al. (2018)	To explore what factors impact the implementation of	634 teachers from Hungary, Spain, and the Czech Republic	Computer with internet connection	Instruments: open-ended questions and questionnaire using Likert-scale Methods: qualitative and quantitative

Author (Year)	Aim or RQ	Subject Research	Educational Technology	Instrument, Research Method, Result
	flipped classrooms in VET education			Results: Factors that effect technology in the classroom using flipped classes in vocational education include teacher training, teacher practice, level of pedagogical resources, teacher attitudes, positive attitudes towards innovation and teacher ICT competence.

Table 2 shows the various technologies used by VET teachers in delivering material to students as learning facilities. The teachers have used digital media such as social media, blogs, websites, mobile smartphones, computer systems, Google Classroom, and multimedia. Most teachers have also carried out online learning by using video conferencing tools such as Webex, Zoom, Google Meet, Skype, Microsoft Team, and Cisco. This technology can be applied by connecting to the internet. Some teachers develop learning media through learning videos, digital presentations, digital content, and even the development of new digital devices. The development of 21st century technology has had a major effect in VET education, where it can be used as a learning media for teachers.

The results showed that online platforms were frequently used in vocational schools (Wannapiroon et al., 2022; Rahmawati et al., 2022). The reviewed studies indicated that teacher training programs primarily focused on basic operational digital skills (Janssen et al., 2013; Falloon, 2020) have added further support. Other research has often investigated single technologies or discrete skill sets (e.g., Villalba et al., 2018). By contrast, the current review illustrated interlinkages between digital tools, pedagogical modalities, and vocational-specific competencies. Digital media enabled VET teachers to connect with fellow professionals. Collaboration on curricula and exchanges of best practices among VET teachers became possible. Because of these links, it becomes clearer that building strong digital proficiency isn't about isolated efforts - it demands long-term, coordinated efforts instead, as earlier analyses by Redecker (2017) and McGarr & McDonagh (2019) had already hinted.

Learning Approach or Model used to Develop Digital Competence

Teachers apply several approaches to develop digital competence, including strategies, methods, and learning models). The synthesis results of the 11 articles that have been reviewed show that the majority of teachers use learning media in digital learning (Barboutidis & Stiakakis, 2023; Razali et al., 2023; Vilppola et al., 2022). Some of them have also implemented learning models such as flipped classrooms (Villalba et al., 2018), synchronous online learning (Wannapiroon et al., 2022), competency-based education (Abdullah et al., 2021; Rahman et al.,

2022), distance learning (Rahmawati et al., 2022), media-based learning (Said et al., 2018), and project activities (Rahman et al., 2022; Romanova et al., 2022). Based on the findings, it shows the diversity of approaches implemented by teachers in facilitating digital learning, which can produce diverse and student-centered learning experiences.

Still, results show hands-on projects link strongest to better digital skills (Basilotta Gómez-Pablos et al., 2017.; Rahman et al., 2022). What stands out is how learning happens outside real-world tasks - building competence when students work together, tackle challenges, using tech for actual purposes (Owens & Hite, 2020; Trisdiono et al., 2019).

The Influence of Digital Media on VET Teacher Digital Competence

In the rapidly evolving VET landscape, the integration of digital media is becoming increasingly widespread, changing the roles and responsibilities of teachers. As digital technologies continue to revolutionize teaching and learning environments, teachers are tasked with adapting their practices to effectively utilize these tools (Brown et al., 2015). The essence of this adaptation lies in the digital competence of VET teachers regarding their ability to navigate, utilize, and innovate with digital media in educational contexts.

Table 2 shows the various methods used to explore VET teacher competencies by utilizing educational technology. The findings indicated that digital media influenced teacher competence that digital media influences teacher competence. Several studies reveal that training is useful for improving the professional development process of VET teachers in terms of readiness to use digital technology (Phan et al., 2020; Romanova et al., 2022). The factors that influence the use of technology include teacher training, practice, positive attitude towards innovation, level of pedagogical resources, and ICT competence (Villalba et al., 2018, Gutiérrez, Sánchez, Castañeda, & Prendes, 2017). The technology can increase students' interest, ability to operate or entertain, and ease of access (Phan et al., 2020; Said et al., 2018). One way to produce teacher graduates who have digital competence is by updating the curriculum to suit the needs (Barboutidis & Stiakakis, 2023). Digital media offers access to a variety of educational resources and online learning tools, allowing teachers to gain a thorough understanding of technologies tailored to specific industries and workforce demands.

Project-based learning and project-oriented approaches were featured more in reports of improvements in digital competence domains according to the projects that were investigated in the included studies (Basilotta Gómez-Pablos et al., 2017.; Rahman et al., 2022). However, most of the primary studies were based on self-reported rather than performance-based measures that reduced the robustness of the causal inference. What stands out is how learning happens outside real-world tasks - building competence when students work together, tackle challenges, using tech for actual purposes (Owens & Hite, 2020; Trisdiono et al., 2019).

Domains of Digital Competency for VET Teachers

According to the European Framework for the Digital Competence of Educators, DigCompEdu identifies six key areas for professional activities of educators: digital resources, empowering learners, teaching and learning, professional engagement, facilitating learners' digital competence and assessment (Redecker, 2017, McGarr & McDonagh, 2019). The explanation of each of these areas includes:

Area 1: Professional engagement involves using digital technology for collaboration, communication, and continuous professional development.

Area 2: Digital resources cover the selection, creation, modification, management, protection, and sharing of digital materials.

Area 3: Teaching and learning encompass teaching methods, promoting collaborative learning, and fostering independent learning.

Area 4: Assessment includes strategies for evaluation, analysing evidence, providing feedback, and planning.

Area 5: Empowering learners focuses on accessibility, inclusion, and actively engaging students in the learning process.

Area 6: Facilitating student's digital competence involves media and information literacy, digital collaboration and communication, responsible digital use, digital content creation, and digital problem-solving.

Table 3. Digital competence of VET teachers

Author	Domains of Digital Competence
Barboutidis & Stiakakis (2023)	Information and data literacy, problem-solving, security, communication and collaboration, and digital content creation.
Razali et al. (2023)	Digital Content
Rahman et al. (2022)	Digital literacy (information, media and ICT Literacy)
Vilppola et al. (2022)	Planning and utilization of digital learning environments, creation and use of digital learning materials, general ICT competencies, synchronous digitally enhanced teaching, assessment and digital interaction.
Wannapiroon et al. (2022)	Analysis of course content, managing online classes, organizing active learning activities, implementing video conferencing systems, managing online learning resources and learning activities, developing learning media, tests, instructional videos, and online evaluation and teaching assessments.
Romanova et al. (2022)	The importance of social platforms, distance learning, and the overall enhancement of digital competence.
Rahmawati et al. (2022)	Information, safety, content creation, communication, and problem solving
Abdullah et al. (2021)	ICT pedagogy, TVET content and curriculum
Phan et al. (2020)	Knowledge, skills and attitudes at each level 1-3 (basic, quite proficiencie and proficiency level of digital competence)
Said et al. (2018)	Competence in operating electronic control systems: understanding the operating principles, designing the circuit, constructing the circuit, operating the system, interpreting the data, and ensuring the security system.
Villalba et al. (2018)	Basic IT skills, photo editing, multimedia, animations, blogs, concepts maps, digital timelines, hypertext, presentations, social network

In addition to digital competence, teachers are required to have digital literacy (Jongsermtrakoon & Nasongkhla, 2015). Digital literacy includes information, media and ICT literacy (Gruszczynska et al., 2013). Digital literacy tends to be dominant compared to indirect influence through the career plans of VET students (Soeprijanto et al., 2022). The digital competencies highlighted align with the digital competency and teacher literacy domains, which emphasize the diverse skills and knowledge required for effective digital teaching and learning (see Table 3).

Discussion

Analysis of the review on the digital media to develop VET teachers' digital competence in the 21st century shows several important findings. Digital media provides learning tools and resources (see Table 2) that can increase student interactivity and engagement. It supports previous findings that stated simulations (Cahnoto & Murphy, 2016), learning videos (Vellappan et al., 2023), and online learning platform enable more effective learning experiences.

Despite a general positive association between digital media use and digital competence development revealed in the literature reviewed, there are some limitations. For one, many studies use perception-based survey methods which might overestimate actual competence. Second, contextual issues such as uneven infrastructure, readiness (or lack thereof) of institutions and the constraints on the teachers' workload are largely unexplored. In development settings especially, digital transformation in VET is likely to be constrained by structural and policy-level constraints which may undermine the positive effect of digital media assimilation.

The use of digital learning media allows VET teachers to increase skills in using various types of technology and digital tools. They become more skilled at operating software, applications, and online platforms relevant to teaching and learning. VET teachers who actively use digital learning media tend to have higher digital literacy (Eila et al., 2020). Level of digital technology maturity in teachers and students sequentially starting from caring, capability, literacy, critical and creativity using digital technology (Astuti et al., 2021). Through digital media, VET teachers can connect with fellow professionals and collaborate on curriculum development, exchange of best practices, and discussions on innovation in education and technology (Preston, Younie, & Hramiak, 2021, Pérez-Mateo, Romero, & Romeu-Fontanillas, 2014). Additionally, integrating digital skills development into formal VET teacher education programs can ensure that aspiring educators are ready to utilize digital media in their teaching practice. Frequent use of various digital technologies is an essential indicator of digital competence if procedural knowledge is transferred and supported by targeted use of digital tools (Kovalchuk & Soroka, 2020).

Implementing VET teachers' digital competencies needs to be a planned and structured approach. Several learning strategies, methods, and models that can be applied include online, distance learning, competency-based education, flipped classrooms, and project-based learning. Each learning model has its aims and objectives according to learning characteristics. Project-based Learning (PjBL) has the potential as a learning model for implementing digital learning (Meng et al., 2023; Rini & Cholifah, 2020). PjBL enables the use of digital media as a tool for designing, implementing, and presenting projects (Basilotta Gómez-Pablos et al., 2017). In PjBL, students are actively involved in planning, implementing, and evaluating their projects. It builds overall student engagement in learning, which also applies to VET teachers who are participants in their digital competencies. Students can also develop cross-disciplinary skills namely creativity, collaboration, communication, and problem-solving (Jewpanich & Piriyasurawong, 2015; Loizzo et al., 2018; Owens & Hite, 2020; Trisdiono et al., 2019).

Although digital media offers many benefits, some challenges need to be overcome. It includes the need to ensure fair access and equality in the use of technology, as well as developing sufficient digital competence for VET teachers to effectively use these digital tools in their teaching (Eila et al., 2020; Stošić, 2015, Adamu, Kanbul, Gambo, & Zanna, 2020). Through effective digital media, VET teachers can improve their digital competencies and contribute to the digital society of the 21st century.

CONCLUSION

Conceptually, this review contributes by suggesting a holistic analytic mapping linking digital media types, pedagogic modes and digital competence domains in the VET. Instead of conceptualizing digital competence as a monolithic construct, the present study shows that its emergence is mediated by instructional design decisions and contextual factors of practice. The work suggests that VET teacher education programs should adopt structured digital competence frameworks like DigCompEdu. They should also look to embed project-based pedagogies and conduct systematic professional development programs that align with competency domains directly linked to them. Future work, however, should expand beyond perception-based paradigms, and utilize longitudinal or performance-based data to verify the relationships found in this study.

Beyond creating a visual link between edtech and vocational teaching skills online, the work shows how closely content review ties to spotting shifts in training research. By sorting through varied sources with clear rules, team members pull key ideas from scattered projects, turning raw data into a starting point before jumping into live experiments. This way fits well as a first step when aiming to map complex knowledge landscapes over time. It turns out a clear

method using published studies helps build key ideas for teaching tech skills to vocational educators in today's learning environment.

REFERENCES

- Abdullah, S. A., Saud, M. S., & Mohd Hisham, M. H. (2021). Establishing mobile learning elements using competency-based education framework. *Journal of Technical Education and Training*, 13(1), 102–111. <https://doi.org/10.30880/jtet.2021.13.01.011>
- Adamu, I., Kanbul, S., Gambo, A., & Zanna, T. (2020). Technical and vocational education teachers computer competencies using artificial intelligence. *Journal of Advanced Research in Social Sciences and Humanities*, 5(6), 256–269. <https://doi.org/10.26500/jarssh-05-2020-0604>
- Ahmadi, N., & Besançon, M. (2017). Creativity as a stepping stone towards developing other competencies in classrooms. *Education Research International*, 2017, 1–9. <https://doi.org/10.1155/2017/1357456>
- Altinay-Gazi, Z., & Altinay-Aksal, F. (2017). Technology as mediation tool for improving teaching profession in higher education practices. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(3), 803–813. <https://doi.org/10.12973/eurasia.2017.00644a>
- Astuti, M., Arifin, Z., Mutohhari, F., & Nurtanto, M. (2021). Competency of digital technology: The maturity levels of teachers and students in vocational education in Indonesia. *Journal of Education Technology*, 5(2). <https://doi.org/10.23887/jet.v5i3.35108>
- Barboutidis, G., & Stiakakis, E. (2023). Identifying the factors to enhance digital competence of students at vocational training institutes. In *Technology, Knowledge and Learning* (Vol. 28, Issue 2). Springer Netherlands. <https://doi.org/10.1007/s10758-023-09641-1>
- Basilotta Gómez-Pablos, V., Martín del Pozo, M., & García-Valcárcel Muñoz-Repiso, A. (2017). Project-based learning (PBL) through the incorporation of digital technologies: An evaluation based on the experience of serving teachers. *Computers in Human Behavior*, 68, 501. <https://doi.org/10.1016/j.chb.2016.11.056>
- Basilotta Gómez-Pablos, V., Martín del Pozo, M., & García-Valcárcel Muñoz-Repiso, A. (2017). Project-based learning (PBL) through the incorporation of digital technologies: An evaluation based on the experience of serving teachers. *Computers in Human Behavior*, 68, 501–512. <https://doi.org/10.1016/j.chb.2016.11.056>
- Barboutidis, G., & Stiakakis, E. (2023). Identifying the factors to enhance digital competence of students at vocational training institutes. *Technology, Knowledge and Learning*, 28(2), 877–900. <https://doi.org/10.1007/s10758-023-09641-1>
- Bayar, A. (2014). The components of effective professional development activities in terms of teachers' perspective. *International Online Journal of Educational Sciences*, 6(2), 319–327.

<https://doi.org/10.15345/iojes.2014.02.006>

- Blyznyuk, T. (2019). Formation of teachers' digital competence: Domestic challenges and foreign experience. *Journal of Vasyl Stefanyk Precarpathian National University*, 5(1), 40–46. <https://doi.org/10.15330/jpnu.5.1.40-46>
- Brown, M., Dehoney, J., & Millichap, N. (2015). The next generation digital learning environment. A report on research. *ELI Paper*, 5(1), 1–13.
- Cahnoto, A. ., & Murphy, J. (2016). Learning from simulation design to develop better experiential learning initiatives – An integrative approach. *Journal of Marketing Education*, 38(2), 1–33.
- Dewi, C. A., Awaliyah, N., Fitriana, N., Darmayani, S., Nasrullah, Setiawan, J., & Irwanto, I. (2022). Using android-based e-module to improve students' digital literacy on chemical bonding. *International Journal of Interactive Mobile Technologies*, 16(22), 191–208. <https://doi.org/10.3991/ijim.v16i22.34151>
- Dey, N. (2017). Concept and scope of educational technology. In *Introduction to Educational Technology* (pp. 5–32). Indira Gandhi National Open University (IGNOU). <http://egyankosh.ac.in/bitstream/123456789/8409/1/Unit-1.pdf>
- Eila, B., Essi, S., Nataša, P. B., & Stevan. (2020). Supporting the development of digitally competent VET teachers in Serbia and Russia. *The Education and Science Journal*, 22(9), 174–203. <https://doi.org/10.17853/1994-5639-2020-9-174-203>
- Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Educational Technology Research and Development*, 68(5), 2449–2472. <https://doi.org/10.1007/s11423-020-09767-4>
- Ghavifekr, S., Afshari, M., & Salleh, A. (2012). Management strategies for e-learning system as the core component of systemic change: A qualitative analysis. *Life Science Journal*, 9(3), 2191–2196.
- Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and Teaching: Theory and Practice*, 15(2), 273–289. <https://doi.org/10.1080/13540600902875340>
- Gruszczynska, A., Merchant, G., & Pountney, R. (2013). “Digital futures in teacher education”: Exploring open approaches towards digital literacy. *Electronic Journal of E-Learning*, 11(3), 193–206.
- Gutiérrez, I., Sánchez, M. M., Castañeda, L., & Prendes, P. (2017). Learning e-Learning skills for vocational training using e-learning: The experience piloting the (e)VET2EDU project course. *International Journal of Information and Education Technology*, 7(4), 301–308. <https://doi.org/10.18178/ijiet.2017.7.4.885>
- Habiddin, H., Ashar, M., Hamdan, A., & Nasir, K. R. (2022). Digital comic media for teaching

- secondary school science. *International Journal of Interactive Mobile Technologies*, 16(3), 159–166. <https://doi.org/10.3991/IJIM.V16I03.28967>
- Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. (2016). The substitution augmentation modification redefinition (SAMR) model: a Critical review and suggestions for its use. *TechTrends*, 60(5), 433–441. <https://doi.org/10.1007/s11528-016-0091-y>
- Irwantoro, N., & Suryana, Y. (2016). *Kompetensi Pedagogik*. Genta Group Production.
- Jahn, D., & Kenner, A. (2017). Critical thinking in higher education: How to foster it using digital media. In *The Digital Turn in Higher Education: International Perspectives on Learning and Teaching in a Changing World* (pp. 82–109). https://doi.org/10.1007/978-3-658-19925-8_7
- Janssen, J., Stoyanov, S., Ferrari, A., Punie, Y., Pannekeet, K., & Sloep, P. (2013). Experts' views on digital competence: Commonalities and differences. *Computers and Education*, 68, 473–481. <https://doi.org/10.1016/j.compedu.2013.06.008>
- Jewpanich, C., & Piriyasurawong, P. (2015). Project-based learning using discussion and lesson-learned methods via social media model for enhancing problem solving skills. *International Education Studies*, 8(6), 24–31. <https://doi.org/10.5539/ies.v8n6p24>
- Jongsermtrakoon, S., & Nasongkhla, J. (2015). A group investigation learning system for open educational resources to enhance student teachers' digital literacy and awareness in information Ethics. *International Journal of Information and Education Technology*, 5(10), 783–788. <https://doi.org/10.7763/ijiet.2015.v5.611>
- Kaeophanuek, S., Na-Songkhla, J., & Nilsook, P. (2019). A learning process model to enhance digital literacy using critical inquiry through digital storytelling (CIDST). *International Journal of Emerging Technologies in Learning*, 14(3), 22–37. <https://doi.org/10.3991/ijet.v14i03.8326>
- Kapici, H. O., Akcay, H., & de Jong, T. (2020). How do different laboratory environments influence students' attitudes toward science courses and laboratories? *Journal of Research on Technology in Education*, 52(4), 534–549. <https://doi.org/10.1080/15391523.2020.1750075>
- Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education*, 193(3), 13–19.
- Kovalchuk, V., & Soroka, V. (2020). Developing digital competency in future masters of vocational training. *Professional Pedagogics*, 1(20), 96–103. <https://doi.org/10.32835/2707-3092.2020.20.96-103>
- Krippendorff, K. (2004). *Content analysis: An introduction to its methodology* (Vol. 31, Issue 6). SAGE Publications. <https://doi.org/10.1103/PhysRevB.31.3460>
- Loizou, M. (2022). Digital tools and the flipped classroom approach in primary education.

- Frontiers in Education*, 7, Article 793450. <https://doi.org/10.3389/feduc.2022.793450>
- Lee, L. (2015). Digital media and young children's learning: A case study of using iPads in American preschools. *International Journal of Information and Education Technology*, 5(12), 947–950. <https://doi.org/10.7763/ijiet.2015.v5.643>
- Loizou, M. (2022). Digital tools and the flipped classroom approach in primary education. *Frontiers in Education*, 7(February), 1–8. <https://doi.org/10.3389/feduc.2022.793450>
- Loizzo, J., Conner, N. W., & Cannon, K. J. (2018). Project-based learning for developing digital literacy in undergraduate science communication. *NACTA Journal*, 62(2), 142–150.
- McGarr, O., & McDonagh, A. (2019). Digital competence in teacher education curricula. *Output 1 of the Erasmus+ Funded Developing Student Teachers' Digital Competence (DICTE) Project*, 1–49. <https://doi.org/10.7577/njcie.4228>
- McKenney, S., Kali, Y., Markauskaite, L., & Voogt, J. (2015). Teacher design knowledge for technology enhanced learning: an ecological framework for investigating assets and needs. *Instructional Science*, 43(2), 181–202. <https://doi.org/10.1007/s11251-014-9337-2>
- Meng, N., Dong, Y., Roehrs, D., & Luan, L. (2023). Tackle implementation challenges in project-based learning: a survey study of PBL e-learning platforms. *Educational Technology Research and Development*, 71(3), 1179–1207. <https://doi.org/10.1007/s11423-023-10202-7>
- Owens, A. D., & Hite, R. L. (2020). Enhancing student communication competencies in STEM using virtual global collaboration project based learning. *Research in Science and Technological Education*, 00(00), 1–27. <https://doi.org/10.1080/02635143.2020.1778663>
- Pentury, H. J., & Anggraeni, A. D. (2021). Using digital newspaper as creative learning media to boost students' higher thinking skills. *Deiksis*, 13(2), 170. <https://doi.org/10.30998/deiksis.v13i2.6902>
- Pérez-Mateo, M., Romero, M., & Romeu-Fontanillas, T. (2014). Collaborative construction of a project as a methodology for acquiring digital competences. *Comunicar*, 21(42), 15–23. <https://doi.org/10.3916/C42-2014-01>
- Phan, T. C., Ngo, T. T., & Phan, T. M. (2020). Assessment of information technology use competence for teachers: Identifying and applying the information technology competence framework in online teaching. *Journal of Technical Education and Training*, 12(1 Special Issue), 149–162. <https://doi.org/10.30880/jtet.2020.12.01.016>
- Pheeraphan, N. (2013). Enhancement of the 21st century skills for Thai higher education by integration of ICT in classroom. *Procedia - Social and Behavioral Sciences*, 103, 365–373. <https://doi.org/10.1016/j.sbspro.2013.10.346>
- Preston, C., Younie, S., & Hramiak, A. (2021). Learning Alone or Learning Together? How Can Teachers Use Online Technologies to Innovate Pedagogy? In *Handbook for Online*

Learning Contexts: Digital, Mobile and Open: Policy and Practice (pp. 257--273). Springer International Publishing.

- Rahman, K. A. A., Rozali, M. Z., Samah, N. A., Bakar, M. A., Ahmad, N. A., Gerijih, D. D., & Zakariah, S. H. (2022). Conceptual model of video learning based on project-oriented problem-based learning and competency-based education for technical and vocational education. *Journal of Technical Education and Training*, 14(1), 38–53. <https://doi.org/10.30880/jtet.2022.14.01.004>
- Rahmawati, S., Abdullah, A. G., Widiaty, I., & Islami, A. R. (2022). The distributions of vocational high school teachers' advanced digital competence (ADC). *Journal of Technical Education and Training*, 14(2 SPECIAL ISSUE), 190–201. <https://doi.org/10.30880/jtet.2022.14.02.017>
- Razali, S. S., Ismail, A., Yazid, F. M., Ahmad, M. F., Hashim, S., Rohanai, R., & Mohamed Shafieek, M. S. (2023). TVET in The 21st century: Exploring multimedia elements in digital teaching and learning based on art content. *Journal of Technical Education and Training*, 15(1), 9–19. <https://doi.org/10.30880/jtet.2023.15.01.002>
- Redecker, C. (2017). European framework for the digital competence of educators: DigCompEdu. In *Joint Research Centre (JRC) Science for Policy report*. <https://doi.org/10.2760/159770>
- Reyna, J., Hanham, J., & Meier, P. (2018). The Internet explosion, digital media principles and implications to communicate effectively in the digital space. *E-Learning and Digital Media*, 15(1), 36–52. <https://doi.org/10.1177/2042753018754361>
- Rini, T., & Cholifah, P. (2020). Electronic module with project based learning (PjBL): innovation of digital learning product on 4.0 era. *Edcomtech Jurnal Kajian Teknologi Pendidikan*, 5(2), 155–161. <https://doi.org/10.17977/um039v5i22020p155>
- Romanova, G., Petrenko, L., Romanov, L., Kupriyevych, V., & Antoniuk, L. (2022). Digital technologies as a driver of professional development of teachers of vocational education establishments. *Youth Voice Journal*, 4(SpecialIssue), 67–80.
- Said, K., Kurniawan, A., & Anton, O. (2018). Development of media-based learning using android mobile learning. *Journal of Theoretical and Applied Information Technology*, 96(3), 668–676.
- Silverman, R. E. (1968). *Two kinds of technology*. Educational Technology Publications.
- Soeprijanto, Diamah, A., & Rusmono. (2022). The effect of digital literacy, self-awareness, and career planning on engineering and vocational teacher education students' learning achievement. *Journal of Technology and Science Education*, 12(1), 172–190. <https://doi.org/https://doi.org/10.3926/jotse.1434>
- Stemler, S. (2015). Content analysis. In R. Scott & S. Kosslyn (Eds.), *Emerging Trends in the Social and Behavioral Sciences*. John Wiley & Sons, Inc.

- Stošić, L. (2015). The importance of educational technology in teaching. *International Journal of Cognitive Research in Science, Engineering and Education*, 3(1), 111–114. <https://doi.org/10.23947/2334-8496-2015-3-1-111-114>
- Thomson, M. M., & Gregory, B. (2013). Elementary teachers' classroom practices and beliefs in relation to US science education reform: reflections from within. *International Journal of Science Education*, 35(11), 1800–1823. <https://doi.org/10.1080/09500693.2013.791956>
- Trilling, B., & Fadel, C. (2009). 21st century skills, enhanced edition: Learning for life in our times. In *John Wiley & Sons, Inc.* (First Edit). John Wiley & Sons Inc.
- Trisdiono, H., Siswandari, S., Suryani, N., & Joyoatmojo, S. (2019). Multidisciplinary integrated project-based learning to improve critical thinking skills and collaboration. *International Journal of Learning, Teaching and Educational Research*, 18(1), 16–30. <https://doi.org/10.26803/ijlter.18.1.2>
- Veal, W. R., & Allan, E. (2014). Understanding the 2012 NSTA science standards for teacher preparation. *Journal of Science Teacher Education*, 25(5), 567–580. <https://doi.org/10.1007/s10972-013-9366-8>
- Vellappan, U., Liyen, L., & Lim, S. Y. (2023). Engaging learning experience: enhancing productivity Software lessons with screencast videos. *Journal of Informatics and Web Engineering*, 2(2), 189–200. <https://doi.org/10.33093/jiwe.2023.2.2.14>
- Villalba, M. T., Castilla, G., & Redondo-Duarte, S. (2018). Factors with influence on the adoption of the flipped classroom model in technical and vocational education. *Journal of Information Technology Education: Research*, 17, 441–469. <https://doi.org/10.28945/4121>
- Vilppola, J., Lämsä, J., Vähäsantanen, K., & Hämäläinen, R. (2022). Teacher trainees' experiences of the components of ICT competencies and key factors in ICT competence development in work-based vocational teacher Training in Finland. *International Journal for Research in Vocational Education and Training*, 9(2), 146–166. <https://doi.org/10.13152/IJRVET.9.2.1>
- Wannapiroon, P., Nilsook, P., Jitsupa, J., & Chaiyarak, S. (2022). Digital competences of vocational instructors with synchronous online learning in next normal education. *International Journal of Instruction*, 15(1), 293–310. <https://doi.org/10.29333/iji.2022.15117a>