Digital Maestros: Dissecting the Seven Crucial Dimensions of Digital Literacy Competencies for Vocational Teachers' Digital Creativity

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Abstract
Digital transformation in vocational education requires a reconceptualization of teacher competencies, but a comprehensive understanding of digital creativity literacy competencies is still limited. This study aims to analyze the conceptualization of digital creativity literacy competencies in the context of vocational education, identify the main dimensions that shape them, and explore effective development models to improve these competencies in vocational teachers. A systematic literature review (SLR) was conducted on 12 recent publications (2023-2025) from the Scopus database using the PRISMA approach with strict inclusion and exclusion criteria. The results of the analysis reveal the evolution of the concept from a technocentric understanding to a multidimensional construct that integrates technical, creative, and pedagogical aspects. Seven competency dimensions were identified, including technical/operational (92%), creative/production (100%), pedagogical (100%), critical/evaluative (83%), social/collaborative (75%), ethical/responsibility (67%), and cultural/contextual (58%), which vary significantly between vocational fields (engineering, business, health). Four competency development models were identified (Spiral, Ecosystem, Modular, Project-based), with practice-based and contextual approaches proving to be the most effective. The study contributes by providing a comprehensive framework to inform education policy, the development of vocational teacher education curricula, and differential professional improvement programs according to the specific context of the vocational field.

1. Introduction

The tectonic shift resulting from Industrial Revolution 4.0 and the acceleration of digital transformation has fundamentally changed not only industrial practices but also the essence of vocational education, placing teachers' digital competencies in a strategically important position. Digitalization, automation, and the integration of new technologies are transforming not only production processes and services but also the skills required by the future workforce. In this context, vocational education faces significant challenges in adapting its curricula and preparing learners with skills relevant to the demands of an ever-evolving industry (Harteis, 2018). Vocational teachers stand at the forefront of this transformation, and their digital competencies have become a crucial factor in facilitating learners' transition into the digital world of work (Tacconi & Perini, 2026).

As digital technology has evolved, so too has the understanding of what constitutes digital competence. The conventional notion of digital literacy centered on the ability to operate digital devices and applications is now considered inadequate to meet the needs of contemporary vocational education (Pettersson, 2021). A more comprehensive concept, "digital creativity literacy competencies," has emerged as a more holistic framework that integrates technical skills with creative, pedagogical, and contextual abilities (Brauer et al., 2022). This concept emphasizes the importance not only of using digital technologies, but of creatively adapting and integrating them into pedagogical practice in ways that remain relevant to industry needs.

Research on teachers' digital competencies has evolved considerably over the past decade. Early studies, such as that of Krumsvik (2014), focused on general frameworks of educators' digital competence, identifying domains such as professional, pedagogical, and information-technology competencies. The Digital Competence Framework for Educators (DigCompEdu), developed by the European Commission (Carretero et al., 2017),

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represents an important foundation that identifies six areas of educator digital competence; however, it remains generic across educator types and offers no specification for vocational contexts. Subsequent developments were marked by studies exploring the integration of technology and pedagogy more directly. The TPACK (Technological Pedagogical Content Knowledge) model, as adapted for vocational education (Harris et al., 2009), began to account for the interaction between technological knowledge, pedagogy, and content within specific vocational contexts. This model, however, still lacks flexibility for creativity and for the dynamic realities of industry.

More recent research points to a shift toward more comprehensive conceptualizations of digital competence. Some studies have begun to introduce creativity as an explicit dimension of digital competency models, while others highlight the importance of digital adaptability and innovation within vocational education (Wu, 2025). Related work has proposed a "Digital Creative Pedagogy" framework that integrates digital literacy, creativity, and pedagogy (Ju-zaveroni & Lee, 2023); however, this framework remains largely limited to general education and does not explore the specific needs of vocational education in depth.

While these developments offer valuable conceptual grounding, the literature still contains several significant gaps. First, the conceptualization of digital creativity literacy competencies specifically for vocational teachers has not yet been formulated clearly or comprehensively (Instefjord & Munthe, 2017); existing frameworks tend to be oriented toward general education and give insufficient attention to the distinctiveness of vocational contexts, particularly their proximity to industry and practical skill demands. Second, understanding of how the various dimensions of this competence interact and manifest in actual vocational teaching practice remains limited (Cattaneo et al., 2025). Third, no effective model for developing vocational teachers' digital creativity literacy has yet been systematically investigated (Fernández-Batanero et al., 2020).

A further gap concerns the lack of research accounting for contextual variation across vocational fields. Roll et al. (2021) note that the digital competencies required of mechanical engineering vocational teachers differ from those required of business or health vocational teachers, yet the existing literature tends to treat vocational teachers as a homogeneous group. Guo (2024) further identifies a lack of competency assessment frameworks sufficiently sensitive to capture the creative dimension of digital technology use among vocational teachers. Digital creativity literacy competencies are becoming increasingly important in vocational education for several reasons. First, industry increasingly demands a workforce with not only technical skills but also the ability to think creatively and innovatively using digital technology (WEF, 2023). Second, the development of authentic and relevant vocational learning increasingly depends on the creative integration of digital technologies that reflect current industry practice (Yang, 2024). Third, the evolving role of vocational teachers from transmitters of knowledge to facilitators of learning requires the creative use of digital technology to build dynamic, student-centered learning environments (DeWitt & Alias, 2023).

Preliminary studies suggest that digital creativity literacy competencies comprise several interrelated dimensions, although no consensus yet exists on which dimensions are most relevant to vocational contexts, nor on how these dimensions interact in practice or vary across different vocational fields such as engineering, business, or health care. Likewise, while several approaches to competency development have begun to appear in the literature, their relative effectiveness and applicability across different vocational contexts still require further investigation, and any such approach needs to align with the competency dimensions identified and account for contextual variation across vocational fields.

This study offers an innovative approach by integrating three aspects that have thus far been studied separately digital literacy, creativity, and vocational pedagogy into a single, comprehensive analytical framework. Through a systematic literature review of recent research indexed in the Scopus database, this study aims not only to identify the constitutive dimensions of digital creativity literacy competencies, but also to map the dynamic interconnections among these dimensions within specific vocational education contexts. The novelty of this study lies in its interdisciplinary synthesis, which moves beyond the conventional dichotomy between technical and pedagogical skills while linking academic discourse on digital competencies to the practical realities of various vocational fields.

Unlike previous studies, which tend to adopt a purely generic or technological perspective, this study presents a differentiated framework that accommodates the contextual particularities of various vocational fields engineering, business, and health and identifies field-specific patterns in how these competencies manifest. This contextual approach enables the development of more precise and relevant recommendations for capacity-building among vocational teachers in the digital age. Specifically, this study aims to: (1) analyze the conceptualization of digital creativity literacy competencies within the context of vocational education; (2) identify the key dimensions constituting these competencies and how they vary across vocational contexts; and (3) explore effective strategies and models for developing vocational teachers' digital creativity literacy competencies.

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The findings of this study are expected to make a theoretical contribution by clarifying the conceptualization and dimensions of digital creativity literacy competency, as well as offering practical implications for the design of vocational teacher competency-development programs. In the context of Indonesia, which is seeking to strengthen the relevance of vocational education to industry needs, the findings of this research may inform education policy and curriculum development that is more responsive to digital transformation.

2. Method

The research method used is Systematic Literature Review (SLR) with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) method, a structured approach to systematically compile and evaluate relevant literature (Moher et al., 2015). The stages, which consist of identification, screening, eligibility, and included, are the foundation for the implementation of this method. Identification aims to identify studies that are relevant to the research topic, while screening is used to evaluate those studies initially. The eligibility stage is used to determine whether the studies meet the inclusion criteria or not, while the included stage is the final step in which studies that meet the inclusion criteria will be included in further analysis.

2.1. Identification

The data collection process begins with choosing the right keywords. The keywords used ("digital creativity" OR "digital creativity literacy" OR "digital creativity competence" OR "digital media literacy" OR "digital literacy" AND "creative") AND ("vocational education" OR "vocational teacher" OR "vocational training" OR "technical and vocational education" OR "TVET" OR "career and technical education") AND ("teacher" OR "educator" OR "instructor" OR "trainer"). The main data search was carried out through the Scopus database which is a database with credible reference sources and good quality (Baas et al., 2020). The article search was conducted in February 2026 specifically for "journals" and "proceedings", only "title words", and the year of publication "2023-2025". The year of publication is limited to the last 3 years with the intention that researchers can ensure that the information contained in the literature remains relevant to current conditions and developments. Search results show 267 related articles relevant to the keywords used in Scopus. The data is collected and downloaded into the form of a CSV file that includes title, author, institution, abstract, keyword, and bibliography information.

2.2. Screening

From the initial search, a total of 267 records were identified from the Scopus database. Before proceeding to title, keyword, and abstract screening, all records were checked for duplication using the reference management tool. This process identified 232 duplicate records, which were subsequently removed, leaving 35 unique records to be screened further. After the duplicate articles were removed, the next step was to re-filter the remaining 35 records by title, keywords, and abstract to match the topic of discussion namely, analyzing the conceptualization of digital creativity literacy competencies in the context of vocational education, identifying the main dimensions that shape them, and exploring effective development models to improve these competencies among vocational teachers. This process aimed to ensure that the selected articles were strictly relevant to the established research topic. During this screening process, each title, keyword, and abstract was carefully analyzed to confirm that the article clearly and appropriately addressed the digital creativity literacy competency area. Articles that did not meet these criteria were eliminated at this stage. Following this careful screening process, 22 full-text articles were assessed for eligibility. This number reflects the level of rigor applied during selection and indicates that the available literature on the conceptualization of digital creativity literacy competencies in the context of vocational education is substantial enough to warrant further full-text review.

2.3. Eligibility

At the eligibility stage, after the screening articles were selected, the next step was to download and filter the full texts. This process allowed the researcher to examine the content of each article in detail, both to check its consistency with the inclusion criteria and to assess its overall quality.

The exclusion criteria applied at this stage were established for the following reasons. Articles published before 2023 were excluded to ensure that the review reflects the most current developments in digital creativity literacy competencies, given the rapidly evolving nature of digital technology in vocational education. Articles not available in full text were excluded because content-level analysis and quality appraisal require access to the complete methodology and findings, not abstracts alone. Non-peer-reviewed journal articles and conference papers were excluded to maintain a baseline standard of methodological rigor and academic credibility. Non-English articles were excluded due to the language proficiency of the research team and to avoid inaccuracies arising from translation. Articles discussing general digital literacy without addressing creativity or competence were excluded because they fall outside the specific conceptual focus of this review. Studies conducted outside educational contexts were excluded as they do not address the pedagogical dimension central to this study. Studies that do not address competencies, or that focus solely on students without implications for teaching

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practice, were excluded because the review's focus is specifically on teacher/educator competencies. Finally, opinion articles unsupported by data were excluded because they do not provide the empirical or conceptual evidence needed for systematic synthesis.

Alongside these criteria, each full-text article was also appraised for overall quality, focusing on four aspects: (1) clarity of the study's aim and its relevance to digital creativity literacy competencies in vocational education; (2) appropriateness of the research design (empirical study, literature review, case study, or competency framework development) for the stated aim; (3) transparency of data sources and analytical procedures; and (4) credibility of reported findings, including whether claims were supported by empirical or documented evidence rather than opinion alone. Articles were retained only if they satisfied both the inclusion criteria in Table 1 and these quality considerations.

After this combined process of eligibility screening and quality assessment, the results showed that of the 22 articles assessed for eligibility, 12 articles met the inclusion criteria and quality standards, and were considered relevant for further analysis. This number reflects the level of rigor applied in the selection process to ensure that only the most relevant and high-quality literature was used in this study.

Table 1. Inclusion and Exclusion Criteria

Category	Inclusion Criteria	Exclusion Criteria
Year of Publication	Articles published between 2023-2025	Articles published before 2023
Access	Full-text articles that can be accessed through institutional or open access subscriptions	Articles are not available in full-text
Publication Type	Peer-reviewed journal articles and conference papers	Journal articles are not peer-reviewed results and conference papers
Language	Only articles that use English	Non-English articles
Content Relevance	Focusing on digital creativity literacy competencies, creative digital competency frameworks, or digital creativity skill development	Articles that only discuss general digital literacy without any aspect of creativity or competence
Educational Context	Studies conducted in the context of formal or non-formal education	Studies conducted outside the educational context
Subject/Focus	A study that discusses the competence of teachers (especially vocational teachers) in digital creativity literacy	Studies that do not address competencies or focus only on students with no implications for teaching practice
Methodology	Empirical studies, literature reviews, case studies, or competency framework development studies	Opinion articles that aren't supported by data

2.4. Included

The right selection of articles is an important foundation in a solid research. In the included process, researchers must be careful in determining the relevance of each literature to the research questions asked. Through the selection of full text, the researcher can ensure that the selected article is truly in accordance with the research focus and has a significant contribution to the understanding of the topic being discussed. Based on the results of the previous screening, 12 articles were selected from the available literature (see Figure 1). Based on the selected articles, it is hoped that researchers can get a more focused and in-depth picture of the issues being researched. The next step is to conduct a thorough analysis of the articles, exploring the findings, arguments, and methodologies used to strengthen the conceptual framework of the research. Careful and meticulous analysis will assist the researcher in formulating strong conclusions and making valuable contributions in his field of research.

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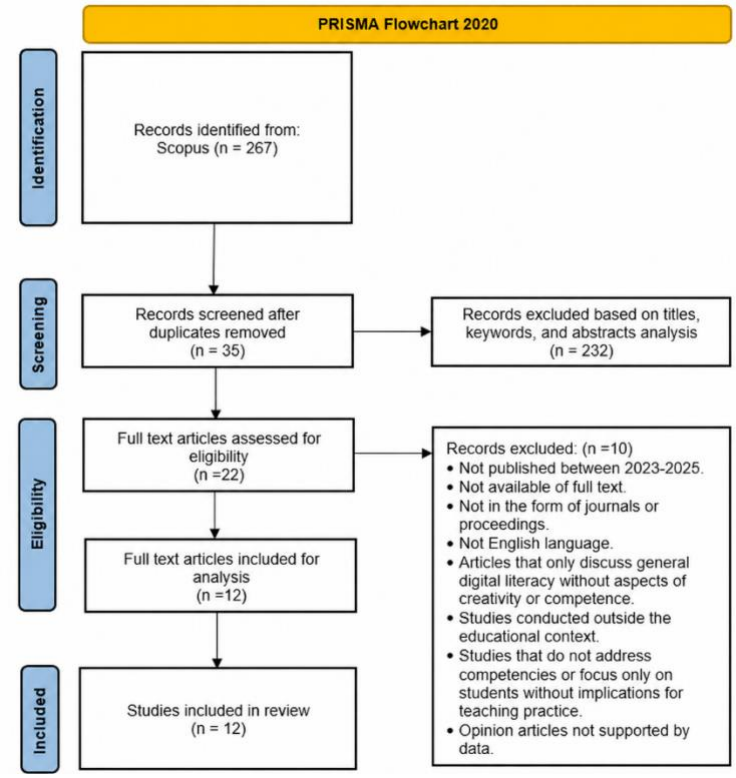


Figure 1. Prisma Flowchart

3. Results and Discussion

3.1. Results

A Systematic Literature Review conducted on 12 selected articles on digital creativity literacy competencies in the context of vocational education produced key findings presented below.

3.1.1. Conceptualization of Digital Creativity Literacy Competencies in the Context of Vocational Education

3.1.1.1. Definition and Conceptual Framework

The analysis of the 12 selected articles shows variations in defining digital creativity literacy competencies for vocational teachers, which is summarized in Table 2.

Table 2. Definition of Digital Creativity Literacy Competency from Selected Literature

No.	Author (Year)	Definition	Key Focus
1	(Jia & Huang, 2023)	Ability to critically access, analyze, and creatively create digital content in the context of vocational learning.	Creation, evaluation, and practical application
2	(Lahn & Berntsen, 2023)	Ability to design, develop, and implement digital-based creative solutions to address learning challenges in the context of vocational education	Problem-solving and pedagogical innovation
3	(Deschênes & Dionne, 2024)	Capacity to design, implement, and evaluate digital learning experiences that foster creativity and vocational practical skills	Pedagogical integration and evaluation
4	(Diachuk, 2024)	A set of technical, cognitive, and creative competencies that enable vocational educators to develop and integrate digital creativity in teaching practice	Pedagogical integration and creativity
5	(Zervas & Stiakakis, 2024)	Ability to adapt and use digital technologies ethically and creatively to facilitate learning relevant to business and entrepreneurial needs	Digital ethics and business relevance
6	(Tischendorf et al., 2024)	The ability to integrate digital technologies in vocational learning in a way that encourages creativity, innovation, and practical skills relevant to the industry	Industry relevance and vocational context
7	(Li, Tan, Yang, & Meng, 2025)	Integration of digital literacy skills with creative thinking skills to overcome learning challenges in the context of health vocational education.	Health ethics, safety, and applications

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No.	Author (Year)	Definition	Key Focus
8	(Ramdani, Nurtanto, & Supriyatna, 2025)	Skills in using digital technology creatively and critically to develop innovative and industry-relevant vocational learning content	Creative production and industry relevance
9	(Cahyono et al., 2025)	A combination of technical and pedagogical competencies that enable vocational teachers to creatively integrate technology in engineering and manufacturing learning	Teaching techniques and digital simulation
10	(Primartadi et al., 2025)	A skill set that enables vocational teachers to create a digital learning environment that supports students' creativity and innovation	Digital collaboration and community of practice
11	(Cui & Li, 2025)	Multidimensional skills that include technical literacy, creativity, ethical awareness, and pedagogical application in using digital technology for vocational learning	Technical and ethical dimensions
12	(Wu, 2025)	Integration of digital competencies, vocational pedagogy, and creativity to prepare students for the demands of the future of work	21st century skills and job readiness

Based on the definition that has been put forward by the researchers, there is a consensus that digital creativity literacy competencies are a multidimensional construct that combines technical skills, creativity, and pedagogical abilities in the context of vocational education. Jia and Huang (2023) emphasizes the creation and evaluation components in the context of practical vocational learning, while Diachuk (2024) focuses more on the pedagogical integration aspect of digital creativity. Cui and Li (2025) developed a multidimensional framework with special attention to ethical dimensions, while Tischendorf et al. (2024) examined the relevance of the industry. Lahn and Berntsen (2023) highlights the application of creative solutions to address vocational learning challenges.

3.1.1.2. Evolution of Competency Concepts

Chronological analysis of 12 articles shows the evolution of the concept of digital creativity literacy competencies during the 2023-2025 period. The following is the evolution scheme of the concept of digital creativity literacy competencies (see Figure 2).

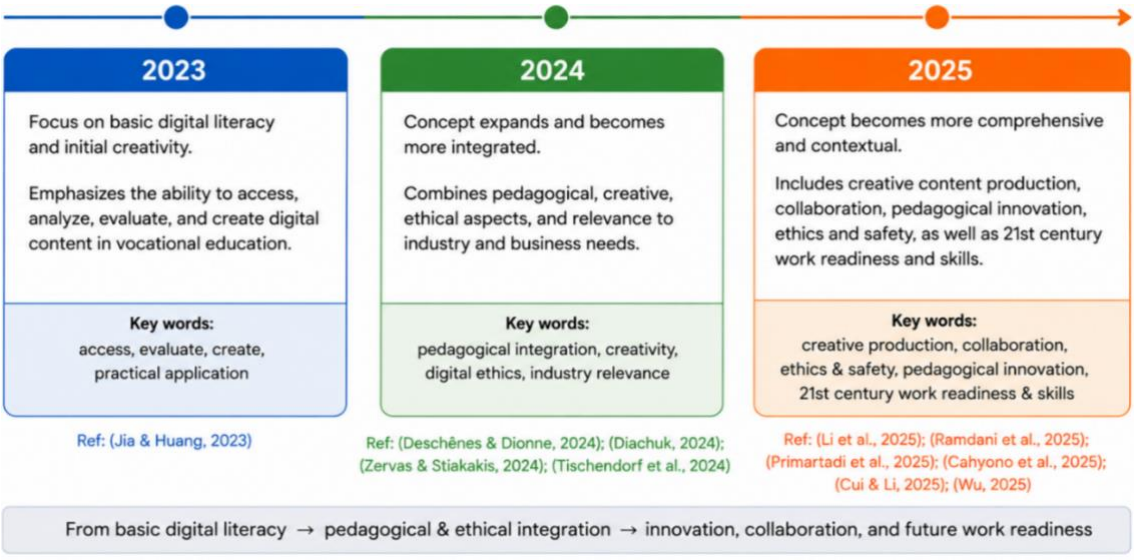


Figure 2. The Evolution of the Concept of Digital Creativity Literacy Competency

In 2023, the two identified articles, namely Jia and Huang (2023), and Lahn and Berntsen (2023), still view this competence relatively technically and pragmatically. Jia and Huang define it as the ability to critically and creatively access, analyze, and create digital content in vocational learning, with an emphasis on the creation, evaluation, and practical application aspects. Meanwhile, Lahn and Berntsen directed attention to the problem-solving dimension, namely the capacity to design and implement digital-based solutions to overcome learning challenges, so that the concept of competence at this stage is closer to pedagogical innovation than creativity itself.

Entering 2024, the conceptualization of competencies began to shift towards a more integrated direction, as seen in the four articles published that year (Deschênes & Dionne, 2024; Diachuk, 2024; Tischendorf et al., 2024; Zervas & Stiakakis, 2024). Deschênes and Dionne expanded the scope of competencies to include the capacity to design, implement, and evaluate digital learning experiences, making the aspect of evaluation a new

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element that had not been touched much before. Diachuk deepens this integration by emphasizing the blend of technical, cognitive, and creative competencies in vocational teaching practice, while Zervas and Stiakakis bring an ethical dimension to the discussion, namely the ability to use digital technologies ethically and creatively for business and entrepreneurial needs. Tischendorf et al. complement this shift by explicitly linking digital competencies to industry relevance, emphasizing that digital creativity needs to be contextualized according to the needs of the vocational workforce.

By 2025, there will be six articles (Cahyono et al., 2025; Cui & Li, 2025; Primartadi et al., 2025; Ramdani et al., 2025; Wu, 2025) presents the most comprehensive conceptualization in the time span studied. Li et al. expanded the scope of competencies to the health vocational realm, combining digital literacy with creative thinking while highlighting ethical and safety aspects. Ramdani et al. focus on the production of innovative and industry-relevant learning content, while Cahyono et al. associate this competence with the teaching of digital engineering and simulation in manufacturing. Primartadi et al. highlighted the collaborative dimension, namely the ability of vocational teachers to create a digital environment that supports students' creativity and innovation. The most thorough conceptualization is seen in the model proposed by Cui and Li, which brings together four dimensions as well as technical literacy, creativity, ethical awareness, and pedagogical application in one multidimensional framework. To conclude this series of evolutions, Wu integrates 21st-century skills perspectives with digital competencies and vocational pedagogy, explicitly linking digital creativity literacy competencies with students' readiness to face the demands of future jobs.

3.1.1.3. Dominant Theoretical Framework

The analysis of the theoretical framework used in the 12 articles identified four main frameworks that dominate the literature on digital creativity literacy competencies. Four main frameworks of digital literacy are presented in Figure 3

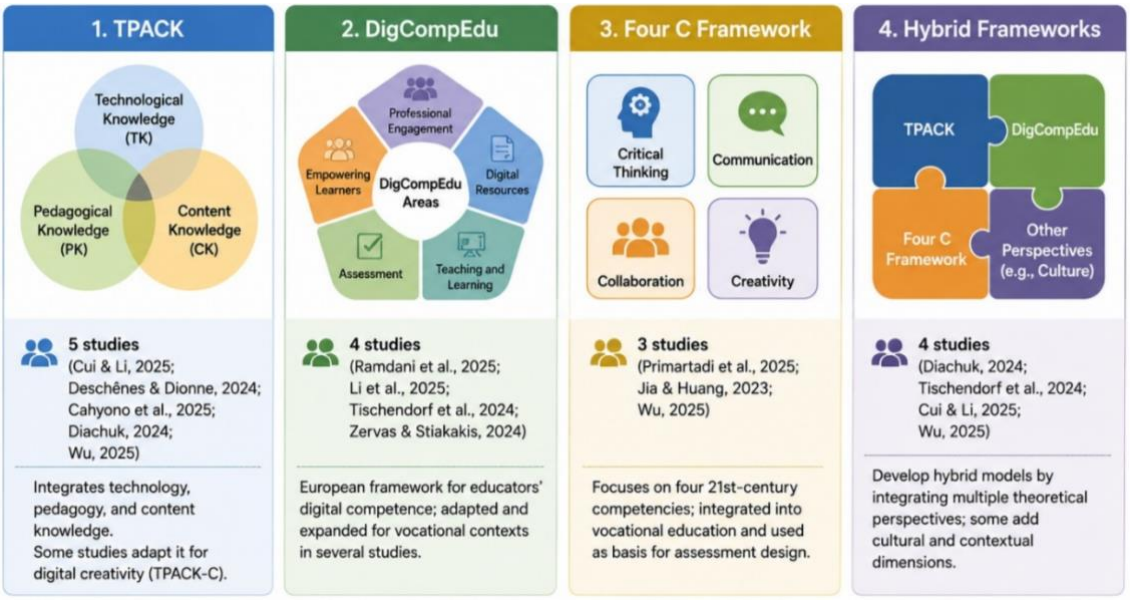


Figure 3. Four Main Theoretical Framework in Digital Creativity Literacy Competency Research

The TPACK (Technological Pedagogical Content Knowledge) framework used by five studies (Cahyono et al., 2025; Cui & Li, 2025; Deschênes & Dionne, 2024; Diachuk, 2024; Wu, 2025) adapted TPACK specifically for the context of vocational digital creativity, while Deschênes and Dionne (2024) developed a variant of "TPACK-C" (Creative TPACK) that puts creativity as an additional dimension within the framework.

DigCompEdu (European Framework for Digital Competence of Educators) was used as a reference in four studies (Ramdani et al., 2025; Li et al., 2025; Tischendorf et al., 2024; Zervas & Stiakakis, 2024). Ramdani et al., (2025) applied DigCompEdu as a tool to measure the competence of vocational teachers, while Li et al. (2025) adapted this framework by adding a dimension specific to vocational health. (Tischendorf et al., 2024) expands the framework by adding a more explicit dimension of creativity. The Four C Framework (Critical thinking, Communication, Collaboration, Creativity) became the basis for three studies (Jia & Huang, 2023; Lahn & Berntsen, 2023; Primartadi et al., 2025; Wu, 2025) integrate this framework with specific vocational contexts, while Jia and Huang (2023) and Wu (2025) use it as a basis for designing competency assessment instruments. In addition to using existing frameworks, four studies (Cui & Li, 2025; Diachuk, 2024; Tischendorf et al., 2024; Wu, 2025) developed a hybrid framework that integrates various theoretical perspectives. Diachuk (2024)

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created a comprehensive TPACK-DigCompEdu synthesis, while Tischendorf et al. (2024) added a cultural dimension to the framework they developed.

3.1.2. Identification and Characterization of Competency Dimensions

An in-depth thematic analysis of 12 articles identified seven key dimensions that make up digital creativity literacy competencies for vocational teachers. The schema of the characteristics of the competency dimension is presented in Table 3.

Table 3. Identification and Characterization of the Competency Dimension of Digital Creativity Literacy

No.	Competency Dimension	Number of Articles (n = 12)
1	Technical / Operational	11 articles (92%)
2	Creative / Production	12 articles (100%)
3	Pedagogical	12 articles (100%)
4	Critical / Evaluative	10 articles (83%)
5	Social / Collaborative	9 articles (75%)
6	Ethical / Responsible	8 articles (67%)
7	Cultural / Contextual	7 articles (58%)

The Technical/Operational dimension was discussed in 11 of the 12 articles (92%), including the ability to use digital devices, software, and platforms relevant to vocational education. Cui and Li (2025) developed a comprehensive taxonomy for the technical skills required by vocational teachers, emphasizing the importance of rapid technological adaptability in line with industry changes. Cahyono et al. (2025) examined the specific technical needs for the fields of engineering and manufacturing, identifying that mastery of CAD software, 3D modeling, and digital simulation are core competencies for engineering vocational learning.

The Creative/Production dimension appears in all 12 articles (100%), making it the most consistent dimension discussed. This dimension includes the ability to create innovative digital content and design creative learning experiences. Ramdani et al. (2025) focuses deeply on this aspect, stating that digital creativity is not just about using digital tools, but transforming pedagogy through the production of industry-relevant content. Jia and Huang (2023) identifies four levels of digital creativity in vocational contexts: replication, adaptation, modification, and innovation, with competent teachers able to operate at all levels. Diachuk (2024) developed a rubric for assessing digital creativity, identifying fluency, flexibility, originality, and elaboration as key indicators.

The Pedagogical Dimension also appears in all 12 articles (100%), covering the ability to effectively integrate digital technologies in the vocational learning process. Deschênes and Dionne (2024) developed a comprehensive pedagogical integration model, stating that pedagogical competence enables the transformation from superficial use of technology to transformative learning in vocational contexts. Diachuk (2024) identifies five innovative pedagogical practices that leverage technology: digital project-based learning, vocational simulation, digital portfolio-based assessment, online collaborative learning, and virtual workplace simulation.

The Critical/Evaluative Dimension was discussed in 10 articles (83%), including the ability to critically evaluate information, technology, and digital practices. Jia and Huang (2023) emphasizes the importance of critical information literacy in the age of technical disinformation, identifying that vocational teachers need to develop students' abilities to evaluate the validity of technical information online. Cui and Li (2025) developed a comprehensive evaluation framework for learning technologies, emphasizing suitability, reliability, and industry relevance as key criteria in the selection of technologies for vocational learning. The Social/Collaborative Dimension is discussed in 9 articles (75%), including the ability to participate in professional digital communities and collaborate online. Primartadi et al. (2025) examined in depth the dynamics of digital practice communities for vocational teachers, finding that active participation in online professional networks is positively correlated with teaching innovation. Tischendorf et al. (2024) explore a model of teacher-industry collaboration through digital platforms, concluding that collaborative relationships with industry professionals facilitate the development of authentic and up-to-date learning content.

The Ethical/Responsibility dimension appeared in 8 articles (67%), focusing on digital ethical awareness, privacy, security, and intellectual property rights. Cui and Li (2025) developed a comprehensive digital ethical framework for vocational education, emphasizing that ethical awareness is becoming increasingly important due to the growing integration between vocational learning and real industry data. Li et al. (2025) examined specifically the implications of data privacy and security in health vocational education, identifying that the protection of patient data and simulated clinical cases requires strict ethical protocols.

The Cultural/Contextual dimension, although discussed in 7 articles (58%) is the least discussed dimension, but it is still significant. This dimension is related to the ability to adapt digital practices according to cultural, social, and institutional contexts. Tischendorf et al. (2024) examined how vocational teachers adapt

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digital content to different cultural contexts, finding significant variations in how technical content is received and interpreted in different cultural contexts. Primartadi et al. (2025) examined the influence of institutional context on technology adoption, concluding that institutional policies and school culture play an important role in facilitating or inhibiting digital innovation.

3.1.2.1. Interaction Between Competency Dimensions

Analysis of the interaction between competency dimensions reveals several important patterns discussed in the literature. Hierarchical relationships were identified in seven articles (58%), where technical competence was seen as the foundation for the development of other dimensions. Cui and Li (2025) presents a hierarchical model in which technical competence becomes the foundation that allows the development of other dimensions. Ramdani et al. (2025) and Cahyono et al. (2025) support this perspective, with empirical evidence that teachers with limited technical skills experience barriers in exploring creative aspects in the use of digital technology. Patterns of reciprocal reinforcement between different dimensions of competence were identified in nine articles (75%). Diachuk (2024) identifies a cycle of positive reinforcement between creativity and pedagogy, in which pedagogical innovation encourages creative exploration, and vice versa. Deschênes and Dionne (2024) observed that teachers who implement innovative pedagogical practices tend to be more motivated to explore new technologies and their creative use in vocational teaching.

Integrative complex models were proposed in five articles (42%). Tischendorf et al. (2024) developed an integrative model in which all dimensions operate simultaneously, forming a complex ecosystem of competencies. Cui and Li (2025) assert that the competency dimension cannot be separated in real practice, but rather serves as an analytical framework to understand the actual competencies of vocational teachers that are holistic and integrated. The concept of context as a moderator was identified in four articles (33%). Tischendorf et al. (2024) found that contextual factors significantly moderate how other dimensions of competence are manifested in practice. Primartadi et al. (2025)identified variations in the priority of competency dimensions based on institutional and social contexts, suggesting that the institutional environment and policies influence which competency dimensions are more emphasized in teaching practice.

3.1.2.2. Contextual Differences in Vocational Education

Analysis of contextual variations in the application of digital creativity literacy competencies reveals important differences based on specific vocational fields. In the context of engineering and manufacturing vocational discussed in three articles (Cahyono et al., 2025; Cui & Li, 2025; Wu, 2025), there is a greater emphasis on the technical and creative dimensions, with a special focus on 3D visualization, CAD modeling, CNC programming, and AR/VR technology for technical skill demonstrations. Cahyono et al. (2025) found that high technical competence is a prerequisite for effective technology integration in workshop practical learning.

In the context of business and entrepreneurship vocational studies studied in two articles (Ramdani et al., 2025; Zervas & Stiakakis, 2024), social and critical dimensions take precedence, with an emphasis on data analysis, digital communication, and virtual collaboration. Zervas and Stiakakis (2024) noted that business vocational teachers place more emphasis on competencies related to digital marketing, analytics, and virtual collaboration than in-depth technical aspects. The health and care vocational context examined in two articles (Cui & Li, 2025; Jia & Huang, 2023) shows priority on the ethical and pedagogical dimensions. Li et al. (2025) identified that patient privacy, data security, and ethical use of clinical simulation technologies are of primary concern for health vocational teachers. Jia and Huang (2023) found that virtual reality-based assessments and digital documentation are the main focus of competencies in health education.

Five articles adopted a multidisciplinary approach (Deschênes & Dionne, 2024; Diachuk, 2024; Primartadi et al., 2025; Tischendorf et al., 2024), identify core competency principles that can be applied in a variety of vocational contexts with specific adaptations. Tischendorf et al. (2024) emphasizes the importance of a flexible approach that can be tailored to the specific needs of various vocational fields, while still maintaining the core principles of digital creativity literacy competency development.

3.1.3. Development of Digital Creativity Literacy Competency for Vocational Teachers

An analysis of 12 articles reveals competency development strategies, barriers, facilitators, and sustainable development models. Practice-based approaches (75% of articles), collaborative learning (58% of articles), critical reflection (50% of articles), and integration of specific vocational contexts (67% of articles) were identified as effective strategies. Primartadi et al. (2025) reported a significant improvement in competence after hands-on workshops, while Wu (2025) demonstrated the effectiveness of digital practice communities. Development barriers include structural/institutional factors (67% of articles) such as infrastructure and policy limitations, individual barriers (58% of articles) such as resistance and lack of confidence, and pedagogical barriers (50% of articles) including difficulties integrating technology with

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vocational curricula. Key facilitators include institutional support (67% of articles), intrinsic motivation (67% of articles), and pedagogical alignment (58% of articles).

Four models of sustainable development are identified: Spiral Models (25% of articles) with gradual and cyclical development (Li et al., 2025), Ecosystem Models (33% of articles) that integrate various stakeholders (Cui & Li, 2025), Modular Models (25% of articles) with flexible discrete components (Diachuk, 2024), and Project-Based Models (17% of articles) that focus on solving authentic problems (Lahn & Berntsen, 2023). These models offer a structural framework for sustainable professional development programs for vocational teachers.

3.2. Discussion

The results of the analysis of 12 articles (2023-2025) on digital creativity literacy competencies for vocational teachers reveal a significant transformation in the conceptualization, dimension identification, and approach to developing this competency.

3.2.1. Conceptualization of Digital Creativity Literacy Competencies

The conceptualization of digital creativity literacy competencies has undergone a paradigm shift from a simple understanding of technical digital skills to a multidimensional construct that integrates technical skills, creative abilities, and pedagogical applications. Ramdani et al. (2025) emphasizes that digital creativity is not just about the use of digital tools, but pedagogical transformation through the production of content relevant to the industry. Cui and Li (2025) reinforces this view with a multidimensional model that connects technical, creative, ethical, and pedagogical aspects in one integrated framework.

The approach that is still applied in the vocational education system in Indonesia tends to treat digital competence as a technical skill separate from creativity and pedagogy. This conceptual gap has the potential to create a misalignment between teacher competencies and the demands of the industry that increasingly requires digital creativity. Tischendorf et al. (2024) emphasized that without a creativity and contextual dimension, digital literacy becomes a mechanical skill with limited relevance to the dynamic world of work. The view that technical mastery should take precedence over creative aspects needs to be reviewed based on the findings of Cui and Li (2025). Their longitudinal study showed that teachers who developed technical and creative competencies simultaneously showed more significant improvements in pedagogical application than those who focused on technical competence first. Li et al. (2025) added that fragmented approaches tend to make it difficult to integrate skills later in life.

This conceptual evolution is relevant to the context of Indonesia, which is undergoing digital transformation. The Making Indonesia 4.0 roadmap places improving the quality of human resources as one of the ten national priorities, with an emphasis on overhauling the STEAM-based vocational education curriculum (Science, Technology, Engineering, the Arts, Mathematics) to prepare competitive graduates in the digital industry era (Ministry of Industry, 2018). However, the curriculum and competency standards of vocational teachers have not fully reflected this evolution. Regarding the theoretical framework, the analysis shows that there is no single comprehensive framework. TPACK is used in 42% of studies, with Cui and Li (2025) adapting it to "TPIACK" by adding the "Industry Knowledge" dimension. DigCompEdu (33% of the study) offers a detailed taxonomy but requires contextualization for vocational education. The Four C Framework (25% of the study) effectively captures the creativity aspect but is less elaborative in the technical dimension of the vocational.

The development of hybrid frameworks in 33% of recent studies shows a promising trend. Diachuk (2024) validated the TPACK-DigCompEdu hybrid approach, finding ecological validity to be higher than using a single framework. This approach is relevant for Indonesia, which requires a comprehensive but adaptive framework for the diversity of vocational contexts. Compared to the latest hybrid framework, the competency framework used in Indonesia still tends to be generic and fragmentative. Wu (2025) found that development programs based on fragmented frameworks tend to result in teaching practices that are also fragmented.

Based on these findings, the development of a hybrid framework that integrates the TPACK structure is expanded, the DigCompEdu taxonomy, the emphasis on creativity of the Four C Framework, and the contextual dimension of Indonesia are promising approaches. Tischendorf et al. (2024) provides evidence that initial investments in comprehensive frameworks result in long-term efficiencies and increase the relevance of professional development programs. This conceptual reformulation has fundamental implications for the development, assessment, and integration of digital creativity literacy competencies in vocational education. This paradigm shift needs to be reflected in education policies, vocational teacher education curricula, and professional development programs in Indonesia.

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3.2.2. Key Dimensions of Digital Creativity Literacy Competencies for Vocational Teachers

An analysis of the 12 latest articles identifies seven main dimensions that make up digital creativity literacy competencies for vocational teachers. These findings expand conventional understandings of digital competencies that often focus solely on technical aspects. The Technical/Operational Dimension, which appears in 92% of articles, includes the ability to use digital devices and learning platforms relevant to vocational education. Cui and Li (2025) developed a comprehensive taxonomy for technical skills, emphasizing the importance of rapid adaptation to new technologies in accordance with industry changes. Cahyono et al. (2025) identify specific needs in engineering vocational contexts, where mastery of CAD software, 3D modeling, and digital simulation are core competencies.

The Creative/Production Dimension and the Pedagogical Dimension appear in all the articles analyzed (100%), confirming their significance. Ramdani et al. (2025) underline that digital creativity involves pedagogical transformation through the production of industry-relevant content, not just the use of technology. Jia and Huang (2023) and Ahmad et al. (2023) identified four levels of digital creativity: replication, adaptation, modification, and innovation. Meanwhile, Deschênes and Dionne (2024) explains how pedagogical competence enables the transformation from the use of superficial technology to transformative learning in vocational contexts. The Critical/Evaluative (83% of articles) and Social/Collaborative (75% of articles) dimensions complement the fundamental dimensions above. Jia and Huang (2023) highlighted the importance of critical information literacy in the age of disinformation, while Primartadi et al. (2025) found that participation in digital professional networks was positively correlated with teaching innovation. The Ethical/Responsibility (67% of articles) and Cultural/Contextual (58% of articles) dimensions complement the competency framework, with Li et al. (2025) and Tischendorf et al. (2024) respectively underlining the importance of digital ethics in health education and contextual adaptation in multicultural settings.

The interaction between dimensions forms a complex pattern. Cui and Li (2025) and Ramdani et al. (2025) identify hierarchical relationships in which technical competence becomes the foundation for other dimensions. However, Diachuk (2024) found that there is a cycle of mutual reinforcement between the creative and pedagogical dimensions. Tischendorf et al. (2024) offers an integrative model in which all dimensions operate simultaneously, with cultural/contextual dimensions acting as moderators that influence the manifestations of other dimensions. The implementation of these dimensions varies based on the specific vocational context. The engineering and manufacturing fields emphasize the technical and creative dimensions, with a focus on 3D visualization and simulation. The business and entrepreneurship fields prioritize the social and critical dimensions, with an emphasis on data analysis and digital communication. The health profession emphasizes ethical and pedagogical dimensions, especially related to patient privacy and clinical simulation.

In contrast, the vocational education system in Indonesia tends to treat digital competencies in a monolithic manner, without differentiation based on vocational context. Digital competency development programs for vocational teachers often use a generic approach that does not consider the specific needs of various vocational fields. The application of the seven-dimensional framework identified in this study can help address this gap by offering a more differentiated and contextual understanding of digital creativity literacy competencies. These findings have implications for how the competencies of vocational teachers are developed and evaluated. Cui and Li (2025) recommends a portfolio-based valuation approach that covers all dimensions, not just the technical aspects. Wu (2025) emphasizes the importance of competency standards that are differentiated based on vocational fields, while maintaining a coherent general framework. Recognition of the multidimensional and contextual nature of digital creativity literacy competencies is an important step towards the professional development of vocational teachers who are more effective and relevant to the demands of the contemporary world of work.

3.2.3. Development of Digital Creativity Literacy Competency for Vocational Teachers

The analysis of the 12 latest articles reveals various strategies, obstacles, facilitators, and models for developing digital creativity literacy competencies for vocational teachers. These findings are important to inform effective professional development programs in the context of vocational education. Practice-based approaches emerged as the dominant strategy, discussed in 75% of the articles analyzed. Primartadi et al. (2025) reported a significant increase in teacher confidence and competence after hands-on workshops with digital technology. Diachuk (2024) found that teachers who created digital artifacts relevant to their teaching showed better transfer of skills to the classroom context. Cui and Li (2025) assert that the experience of overcoming authentic challenges results in higher skill retention than theoretical learning approaches.

Collaborative learning (58% of articles) and critical reflection (50% of articles) complement the practice-based approach. Wu (2025) reports that digital communities of practice accelerate the development of creative competencies through the exchange of ideas and feedback from peers. Li et al. (2025) observed that teachers

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engaged in structured reflection showed a higher level of technology adaptation. Integration with specific vocational contexts (67% of articles) is also a crucial aspect, with Zervas and Stiakakis (2024) showing increased motivation when digital competencies are directly linked to industry practices. Competency development faces three main categories of obstacles. Structural/institutional barriers (67% of articles) include infrastructure limitations and unsupportive policies, as reported by Cui and Li (2025). Individual barriers (58% of articles) include resistance to change and lack of confidence, which according to Ahmad et al. (2023) significantly hinder experimentation with new technologies. Pedagogical barriers (50% of articles) include difficulties integrating technology with vocational curricula, as identified by Diachuk (2024).

Competency development facilitators include institutional support (67% of articles), including leadership that prioritizes digital innovation and investment in infrastructure. Intrinsic motivation (67% of articles) was a strong individual driving factor, with Jia and Huang (2023) and Ahmad et al. (2023) reporting that teachers with internal motivation for innovation showed faster competency development. Pedagogical alignment (58% of articles) is also important, where Deschênes and Dionne (2024) found that technologies that clearly support vocational learning goals are more likely to be adopted by teachers.

Four models of sustainable development are identified in the literature. The Spiral model (25% of articles) emphasizes cyclical development with repeated stages, as developed by Li et al. (2025). Ecosystem Models (33% of articles) involve various stakeholders in interconnected networks, with Cui and Li (2025) emphasizing the importance of synergy between educational institutions, industry, and policymakers. The Modular model (25% of articles) divides competencies into discrete components that can be developed as needed, as proposed by Diachuk (2024). The Project-Based Model (17% of articles) emphasizes development through the completion of authentic industry-related projects, with Lahn and Berntsen (2023) reporting its effectiveness in integrating various dimensions of competencies.

In contrast to the above findings, digital competency development approaches for vocational teachers in Indonesia are often sporadic and less systematic. Training programs tend to focus on technical aspects and rarely integrate the creativity dimension or contextualization of vocations. Training is also often conducted in a short seminar format with no ongoing support or community of practice, contrary to the recommendations of Wu (2025) on the importance of sustainable development. The findings of this literature analysis have implications for the need to reformulate the approach to developing the competency of vocational teachers in Indonesia. An ecosystem-based development model that integrates practice, collaboration, and reflection approaches, with strong institutional support and integration of specific vocational contexts, promises more sustainable outcomes. Development programs also need to explicitly address identified barriers and leverage potential facilitators in local contexts.

3.3. Implications

The findings provide important implications for theory, practice, and policy. Theoretically, the seven dimensions of digital creativity literacy competency identified in this review broaden the concept of digital literacy into a more comprehensive framework for vocational teacher competency. Practically, the four development models (Spiral, Ecosystem, Modular, and Project-Based) offer flexible approaches for designing teacher training that can be adapted to different vocational fields and contexts. From a policy perspective, the results highlight the need to shift from fragmented, technology-oriented training toward sustainable, ecosystem-based professional development supported by institutional commitment, collaboration, and continuous learning.

3.4. Limitations

This study has several limitations. First, the review was limited to Scopus-indexed publications identified through title-based searches, which may have excluded relevant studies from other databases or search strategies. Second, the review covered only studies published between 2023 and 2025, potentially overlooking earlier foundational work. Third, the final sample of 12 articles is relatively small and may not fully represent the diversity of vocational education contexts. Finally, as a qualitative literature review, the proposed competency dimensions and development models are based on thematic synthesis and require further empirical validation in broader educational settings.

4. Conclusion

This Systematic Literature Review (SLR) examines 12 recent publications (2023-2025) on digital creativity literacy competencies for vocational teachers through a systematic PRISMA approach. The SLR methodology allows for the comprehensive identification, analysis, and synthesis of relevant literature from the Scopus database, with the application of strict inclusion and exclusion criteria. The results of the analysis reveal a significant evolution in the conceptualization of digital creativity literacy competencies, which have shifted from technocentric understanding to integrated multidimensional constructs. The seven main dimensions that make up this competence were successfully identified: technical/operational (92% of articles), creative/production (100%), pedagogical (100%), critical/evaluative (83%), social/collaborative (75%),

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ethical/responsible (67%), and cultural/contextual (58%). These dimensions interact in complex patterns and vary based on specific vocational contexts, with significant differences in emphasis between the fields of engineering/manufacturing, business/entrepreneurship, and health. Effective competency development approaches include four main models Spiral, Ecosystem, Modular, and Project-Based with practice-based, collaborative, reflective, and contextualized strategies proving to be most effective. These findings have important implications for the professional development of vocational teachers, encouraging the reconceptualization of training programs from a purely technical focus to a holistic and differential approach according to the vocational context. This study has limitations in the focus of the database and the time range of publication, so future research is recommended to: conduct empirical validation of the identified dimensions of competence, explore the interactions between dimensions in real practice, evaluate the effectiveness of competency development models, and develop valid assessment instruments. As a dynamic and contextual multidimensional construct, digital creativity literacy competencies require comprehensive understanding and continuous development to ensure vocational education remains relevant in the face of digital transformation and contemporary industrial needs.

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Ethics and Consent Declarations

This study is a Systematic Literature Review (SLR) that analyzes previously published, publicly available secondary data (journal and proceeding articles) and does not involve direct data collection from human or animal subjects. Accordingly, ethical approval and informed consent were not required for this study. All primary sources analyzed are appropriately cited and referenced in accordance with academic and copyright standards.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

AI-based tools may have been used solely for auxiliary purposes such as language/grammar checking. The authors take full responsibility for the content, accuracy, and originality of the manuscript.

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