Implementation of Digital Portfolio for Vocational Teachers' Digital Skills: A Systematic Literature Review

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ABSTRACT

Implementing digital portfolios in vocational education has become a critical strategy to improve teaching quality, facilitate evidence-based evaluation, and accelerate continuous professional development. The research objectives are to (1) examine the development of vocational teachers' digital skills, (2) evaluate the effectiveness of practice-based training models, and (3) analyze the integration of technology in vocational learning to meet the demands of Industry 4.0. The method used is Systematic Literature Review (SLR) with the PRISMA approach by thematically analyzing 9 Scopus-indexed articles from ScienceDirect, SpringerLink, and Google Scholar from 2019 - 2024. The results of this study reveal three main findings, including (1) the successful implementation of digital portfolios depends on the adequacy of digital infrastructure, (2) practice-based training models, such as the Structured Academic Portfolio (SAP) are effective in improving teacher competence, and (3) technology integration must be aligned with industry needs. Reflection through digital portfolios is proven to strengthen teachers' understanding of technology pedagogy and encourage the development of metacognitive skills. However, gaps such as inequitable access to technology, lack of specific training, and challenges in reflective task design were found. The findings provide a conceptual framework for vocational education providers in designing a sustainable digital-based development system.

The conclusion emphasizes that digital portfolios can be a transformational tool to develop vocational teachers' digital competencies with support from adequate infrastructure, structured training, and safe integration of technology with the curriculum. Recommendations for future research include exploring the long-term impact of digital portfolios as well as the adaptation of models, such as SAP and Technical Application for Portfolio (TAP), in various vocational education contexts. Institutional policies need to ensure equitable access to and support for technology to maximize the potential of digital portfolios in vocational education.

Keywords: Digital Portfolio, Vocational Teacher, Vocational Education, Digital Skills, E-Portfolio

INTRODUCTION

Recently, the world has entered the era of Industrial Revolution 4.0, a concept first introduced by Klaus Schwab, founder and executive chairman of the World Economic Forum, in 2015 (Hossain, 2023; Schwab, 2015; Xu et al., 2018). This revolution marks an accelerated transformation in various sectors, such as the economy, ecology, finance, agriculture, industry, education, as well as social and political dynamics (Abiltarova, 2022; Hossain, 2023). These changes focus on automation, technological advancement, and continuous innovation (Magagula & Awodiji, 2024). In this context, rapid technological advances and globalization in various fields have presented new challenges to the quality of education, especially in preparing a professional workforce that is relevant to the needs of the times (Abiltarova, 2022), especially in the field of education.

The new education 4.0 paradigm, which focuses on the lifelong learning conception while developing education and skills, has made future learning more customized, hyper, intelligent, portable, worldwide, and virtual (Shahroom & Hussin, 2018). Based on observations from the results of the Upskilling and Reskilling Vocational Teacher Training conducted at one of the Technical Implementation Units (UPT) of the Ministry of Primary and Secondary Education of Indonesia, namely the Center for Development and Quality Assurance of

Vocational Education (BBPPMPV) Business and Tourism, it shows that when taking the competency certification test as a measuring tool for the final assessment of the training, teachers find it a little difficult to collect technical experience and expertise competencies in their respective fields through portfolio documents. The portfolio documents are in the form of training certificates, competency certification test certificates, videos and photos, or other works that have been made when carrying out practical activities both at school and outside school, and industrial internship experiences, so that the collection of evidence is carried out manually by examiners/assessors.

This is reinforced by data from the Center of Data and Information, Ministry of Primary and Secondary Education of Indonesia (2023) showing that only 7% of teachers are proficient in specific tools, and fewer than 10% of vocational teachers have a certificate of competency. Therefore, a digital container is needed that can collect all documentary evidence, in the form of photos, videos, and certificates, which would make it easier for teachers to take the portfolio-based competency certification test and improve vocational teachers' digital skills. Thus, mastering digital competencies is essential for teachers to effectively apply technology-based pedagogical approaches. Furthermore, teachers at all levels of education must continuously develop their digital skills (Ortega-Gras, 2023; Rahmawati et al., 2022).

A digital portfolio is a collection of evidence that represents a person's learning journey over time (Barret, 2010). Digital portfolios, or e-portfolios, are the digital transformation of traditional written portfolios, which have long been used to assess personal and professional activities. Digital portfolios are used as educational technologies for professional development at all levels of education, including bachelor's, master's, and postgraduate studies; advanced training; and the assessment of professional competency levels. They employ various forms and methods of assessment, such as formative, diagnostic, current, and intermediate assessments (e.g., text and exam) and state final certification, in a modern and secure digital educational process (Nechaeva, 2021). Modern digital portfolios benefit from an appealing visual design. Material can be presented as a combination of text, pictures, photos, videos, figures, etc., to demonstrate an individual's multifaceted competence. Digital portfolios are an ideal platform for demonstrating vocational teachers' competence in the teaching profession, as discussed in the following chapter.

Digital portfolios can be used by vocational teachers to showcase their technical expertise, pedagogical innovation, and industry-relevant digital applications (Ottenbreit-Leftwich et al., 2018). Despite their great potential, the implementation of digital portfolios in vocational teacher training remains under-explored, particularly in assessing their impact on long-term skills retention and classroom application (Cairns et al., 2017). Conversely, digital skills play a significant role in bridging the gap between classroom theory and industrial practice, particularly during students' industrial internships (Antonietti et al., 2022). This highlights the importance of considering the characteristics of vocational education and training systems, in which the use of technology is essential to connect school-based and work-based education pathways (Cattaneo et al., 2022).

LITERATURE REVIEW

TVET (Technical and Vocational Education and Training) Concept in Digital Portfolio

The term TVET (Technical and Vocational Education and Training) originated from the international community and became widely known since it was introduced by various organizations in the world, such as UNESCO and the ILO (International Labour Organization) in the 20th century. TVET is a coaching program designed to instill three main aspects of competence, namely cognitive, psychomotor, and affective, to meet the demands of a job or job cluster. In its implementation, TVET integrates various forms of planned and unplanned learning to guide individuals towards the professional world (UNESCO, 2015). The implementation of TVET requires a systemic view that encompasses education, economic development, and industry needs to bridge education with labor market needs (King, 2019; World Bank, 2019).

Stephen Billet (2011) emphasizes that work experience is the main source of the development of vocational competencies. TVET should prepare a workforce that is not only skilled but also environmentally and socially aware (McGrath, 2012). Vocational education and training has four main objectives, including (1) preparing learners to enter the world of work, including helping them to choose an appropriate career; (2) providing the

basic skills needed for a particular profession; (3) improving competencies on an ongoing basis as industry needs change; and (4) facilitating job transitions either by personal desire or due to changing working conditions (Billet, 2011a). TVET also aims to help individuals find a suitable profession, master basic skills, and continue to hone and develop their skills to remain relevant to the needs of today's workforce.

In this context, digital portfolios play a strategic role as a documentation and reflection tool on vocational teachers' competencies and learning experiences. For TVET teachers, digital portfolios not only reflect mastery of digital skills but also serve as a medium to demonstrate innovative learning practices, industry collaboration, and continuous professional development. The implementation of digital portfolios allows teachers to map cognitive, psychomotor, and affective achievements in a more structured and transparent manner, while encouraging reflective learning and improving teaching quality in line with Industry 4.0 needs.

The Use of Digital Portfolios in Technical and Vocational Education and Training (TVET)

An electronic portfolio (e-portfolio) or web folio, this tool began to be used to assess students' performance in the late 1980s, mainly in North American universities (Barrett, 2007). The term "portfolio" originally referred to a container for storing unstructured collections of documents, which later evolved from paper-based formats to electronic/digital forms, and from local networks to the global web (Farrell, 2020). An e-portfolio is an electronic document that allows individuals to present information about their educational background as well as their personal and professional experiences (Ciesielkiewicz, 2019). Meyer et al. (Meyer et al., 2010) define an electronic portfolio as a digital archive containing visual and audio materials, including text, images, videos, and sound. Balaban et al. (2013) further explain that an e-portfolio is a personal digital record reflecting formal, informal, and non-traditional learning, containing evidence of achievements in the form of artifacts, reflections, and personal and professional experiences. Digital portfolios are also known by various terms, such as e-folio, digital portfolio, web-based portfolio, and online portfolio (Scully et al., 2018), whether stored on web-based platforms or mobile devices. Web interfaces allow users to add and modify portfolio content, making it instantly accessible to other parties.

Portfolios, particularly in electronic form, are increasingly being used in education, especially in teacher education (Totter & Wyss, 2019). For teachers or educators, e-portfolios enable them to apply 21st-century learning skills in practice as they utilize these digital tools (E. H. Y. Tan et al., 2018). They are also highly relevant in dual VET (Vocational Education and Training) systems, which combine school-based and workplace learning, where cross-location learning presents unique challenges for students (Sappa & Aprea, 2018; Taylor & Freeman, 2011). The use of technology becomes crucial in bridging learning locations in VET, ensuring alignment between school-based and work-based learning (A. P. , A. Cattaneo et al., 2021; Kilbrink et al., 2020).

One platform that TVET educators can use to create digital curriculum vitae is LinkedIn. LinkedIn is the largest network for individuals interested in managing their professional careers (LinkedIn, 2019) expanding career-related concepts and knowledge from literature to explore the use of professional social media. Therefore, e-portfolios hold promising potential as tools for job searching, professional development across various fields (Ciesielkiewicz, 2019) and as assessment tools focused on teaching and learning processes (Marinho et al., 2021).

Developing Digital Skills Through Digital Portfolios

The development of a knowledge-based global society and the rapid integration of ICT have made mastering digital skills essential for employment and participation in society. In addition, as the job market changes, 21st-century skills are considered essential (van Laar et al., 2017). In general, 21st-century skills include collaboration, communication, digital literacy, citizenship, problem solving, critical thinking, creativity, and productivity (Voogt & Roblin, 2012). Teacher digital skills refer to the technical, pedagogical, and reflective abilities that vocational teachers need to select, use, and evaluate digital technologies effectively in the context of competency-based learning and link them to industry needs (Cattaneo et al., 2022b).

Digital skills in vocational education include vocational teachers' digital skills, including technical skills

related to the use of specific digital tools, pedagogical integration related to technology-based learning design for practical skills and industry alignment related to understanding digital tools used in the world of work and teaching the use of job-relevant technologies (job specific tools) and then modeling digital practices in industrial environments (Redecker & Punie, 2017; Schmid et al., 2021). Individuals interact with digital technologies in a variety of ways that require a variety of digital skills, knowledge, and attitudes, which in combination form digital competencies (Vuorikari et al., 2025).

In the last 20 years, skills assessment and measurement have been the focus of a large body of academic literature as well as numerous books and institutional reports, e.g., OECD (2001), UN (2006), (Ala-Mutka, 2011). Two main characteristics of digital skills measurement emerge from reviews that focus on measuring procedural knowledge, such as digital operations skills and measuring knowledge of digital tools and their use (Litt, 2013; Siddiq et al., 2016). Digital technologies include digital resources and devices, software, hardware, and digital data/ content (Carvalhais & Azevedo, 2024; Vuorikari et al., 2025). One of the benchmarks in measuring vocational teachers' digital skills is through digital portfolios. Digital portfolios as teacher professional development. The process of developing a digital portfolio can encourage and document evidence of competence and guide long-term professional development. Digital portfolios are recognized as a reflective and practical means of achieving a comprehensive picture of one's learning path or competencies (Jans & Awouters, 2008; Voogt & Roblin, 2012) as illustrated in the flow below:

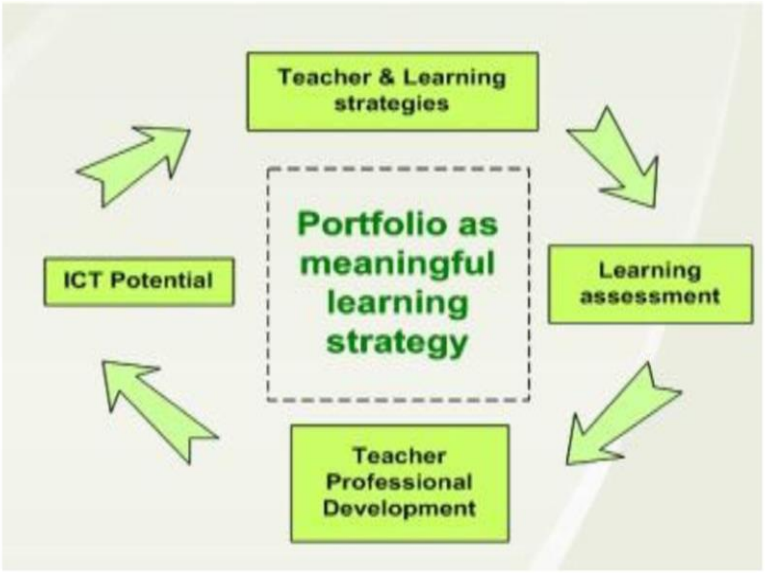

Fig 1. Elements of a portfolio as a meaningful learning strategy

Objectives of the Study

This literature review aims to (1) examine the development of vocational teachers' digital skills in the availability of devices, connectivity and digital platforms relevant to learning needs, (2) evaluate the effectiveness of practice-based training models in improving teacher competencies with a focus on hands on approaches, learning by doing and the use of digital portfolios as a reflection and assessment tool, (3) analyze the integration of technology in vocational learning can prepare students in facing the demands of the world of work.

Research questions

(Q1) What is needed in the implementation of digital portfolios for vocational teachers' digital skills?

(Q2) What is the role of reflection through digital portfolios in strengthening teachers' understanding of technology pedagogy?

(Q3) What are the gaps between the digital skills taught in teacher training and the demands of Industry 4.0?

MATERIAL AND METHODS

This study used a Systematic Literature Review (SLR) by following PRISMA (Preferred Reporting Items for Systematic Literature Reviews and Meta-Analyses) guidelines to ensure transparency, reproducibility, and rigor in literature selection. Literature searches were conducted on four academic databases, namely (1) Scopus, (2) ScienceDirect, (3) SpringerLink, and (4) Google Scholar, using Publish or Perish software to collect relevant studies. A systematic approach to document retrieval was designed and implemented in four sequential phases, covering the processes of identification, screening, manuscript eligibility, and inclusion (Caharian & Cabanlit, 2024; Fatimah et al., 2024), in the figure below:

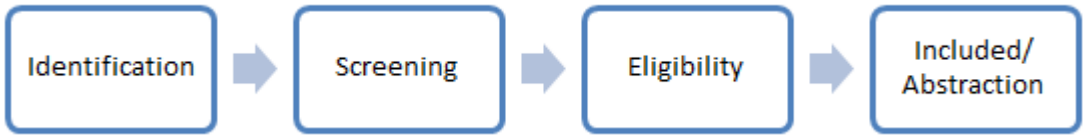

Figure. 2. PRISMA Flow of Steps

Phase 1. Identification, initial searches in the database yielded a large number of records.

The search was conducted using Publish or Perish software with similar combinations of keywords and word equivalents, such as “digital portfolio” or “e-portfolio”, “digital portfolio and vocational teacher”, and “benefits of digital portfolio for vocational teachers”. The initial results gathered a literature of 469 studies (419 from Scopus and 50 from non-scopus sources. A total of 50 from non-Scopus sources), then as many as 50 studies were excluded because they used Indonesian, so that 419 studies entered the screening stage. The following can be seen in the table below:

Table 1. Study/ Article Search Details

No.	Database	Keywords
1.	Scopus	“digital portfolio” OR “e-portfolio”, “vocational education” OR “TVET” “digital skills development”AND “vocational teacher”, “implementation digitial portfolio for digital skill teacher”
2.	Non Scopus	“benefits of vocational teachers' digital portfolios”

(Source: Author, 2025)

Phase 2. Screening, titles, and abstracts were screened for relevance.

The collected literature was then screened for relevance to digital portfolios and the impact of digital portfolio implementation on teacher skills. A total of 419 sources were from Scopus, and 50 were from non-Scopus literature. This selection process excluded duplicate literature (e.g., similar authors or titles), publications in English and languages other than English, and publications only between 2019 and 2024.

Phase 3. Eligible full manuscripts were assessed based on the inclusion criteria.

Researchers used certain criteria in selecting articles. These criteria were used to ensure that the research objectives could be achieved. The inclusion criteria used were as follows: (1) articles focusing on Digital Portfolios and Vocational Teachers, (2) articles published after 2019 were excluded from the study, and (3) only articles written in English and Scopus-indexed were used.

The researcher pointed out that there are a large number of articles discussing Digital Portfolios, but only a few are specifically related to education, teacher development. Digital portfolios are often associated with business innovation and the digital transformation of corporate organizations. In the initial stage, 419 articles were identified for selection, screening, and eligibility assessment before being included in the literature review.

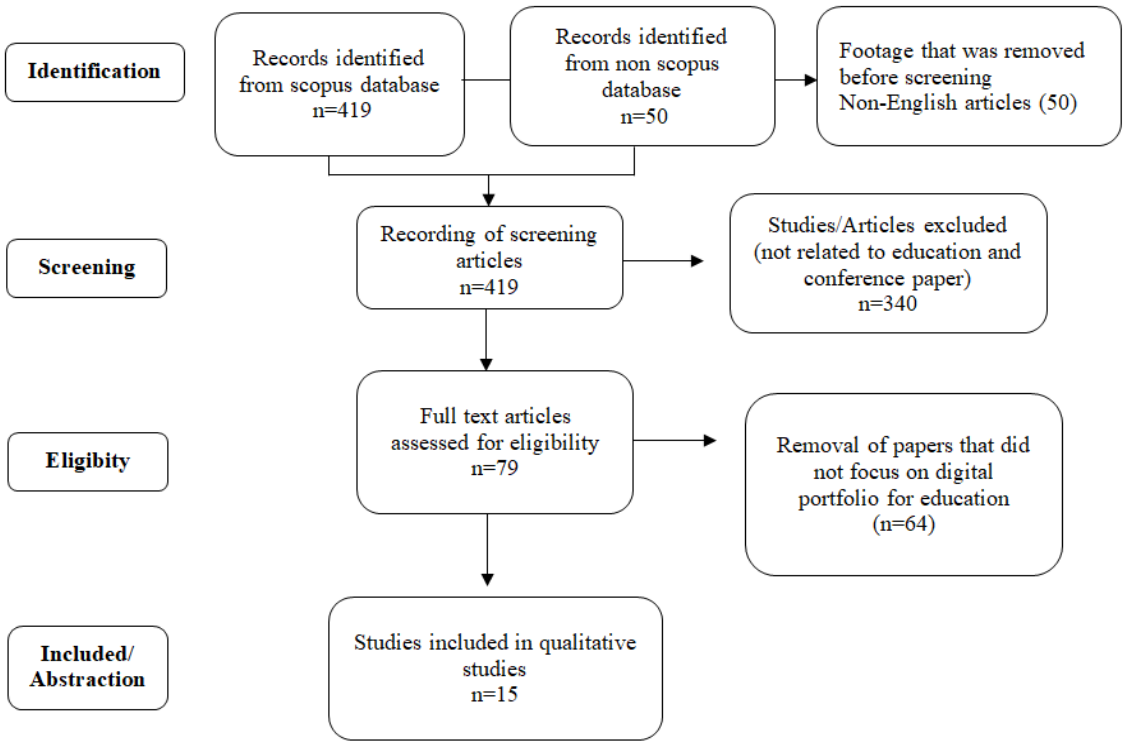

Figure 3. Literature Review Identification via Databases

Phase.4. Inklusi, studi terpilih akhir disintesis.

From a total of 469 studies identified through database searches, including 419 from Scopus databases and 50 from Non-Scous databases, 50 studies were excluded before screening due to being in languages other than English. The remaining 419 studies underwent screening based on title, abstract, and research focus**,** resulting in 79 studies assessed for eligibility via full-text review. Following critical appraisal, 15 studies met the inclusion criteria and were synthesized for thematic analysis**.** The selected studies focus on digital portfolios, teacher development, and the factors influencing the implementation of digital portfolios.

Table 2. Screening list of 15 eligible articles that were reviewed detail

No.	Author	Title	Journal	Research Subject
1.	(Hegarty & Thompson, 2019)	A teacher's influence on student engagement: Using smartphones for creating vocational assessmente Portfolios	Journal of Information Technology Education: Research	Investigate how the facilitation of a vocational lecturer (teacher) influenced the engagement of fifteen carpentry students during learning.
2.	(Smolyaninova & Bezyzvestnykh , 2019)	A teacher's influence on student engagement: Using smartphones for creating vocational assessment ePortfolios	Journal of Siberian Federal University	Digital competency which is the basic competency of Teacher 4.0, which allows teachers to systematically implement professional activities in a digital society, integrate knowledge and interdisciplinary skills.
3.	(Ciesielkiewicz , 2019)	Education for employability: the ePortfolio from school principals' perspective	Emerald Insight	Explore the question of whether the school principals would use an educational e-Portfolio for recruiting purposes.
4.	(Hj. Ebil et al., 2020)	The use of E-portfolio for self-reflection to promote learning: a case of TVET students	Education and Information Technologies	Investigated the use of structured reflection through digital learning portfolios (e-portfolio).

5.	(Davis et al., 2020)	Networking via LinkedIn: An examination of usage and career benefits	Journal of Vocational Behavior	Benefit of using such social networking platforms especially LinkedIn which was designed for professional purposes.
6.	(Marinho et al., 2021)	The digital portfolio as an assessment strategy for learning in higher education	Distance Education	Identify and characterize the meanings and effects that students and teachers attribute to the use of digital portfolio as an assessment and learning strategy.
7.	(A. Cattaneo et al., 2022)	How digitalised are vocational teachers? Assessing digital competence in vocational education and looking at its underlying factors	Computer & Education	Provide a snapshot of the status quo of digital competence, examine possible differences in digital competence and to investigate whether personal context in VET.
8.	(Zhang et al., 2022)	Educational e-Portfolio Overview: Aspiring for the Future by Building on the Past	IAFOR Journal of Education: Studies in Education	Investigated e-portfolios' use in teaching, learning, or assessment. It has risen to prominence, becoming commonplace.
9.	(López-Crespo et al., 2022)	The educational e-portfolio: preliminary evidence of its relationship with student's self-efficacy and engagement	Education and Information Technologies	Explore whether achievement, student's personal on academic performance and evaluate the use of the e-portfolio.
10.	(Fazlina et al., 2022a)	E-Portfolio As An Assessment Tool in Teaching and Learning: A Survey of Teacher's Perceptions Journal of Contemporary Social Science and Education Studies	Journal of Contemporary Social Science and Education Studies	Identify teacher's knowledge, perceptions and software recommendations for using e-portfolio as a digital assessment tool at the school level.
11.	(Leibur et al., 2023)	Towards a conceptualized model of supporting teachers' application process for acquiring professional qualifications	International Journal of Educational Research Open	The concept of professionalism, which includes the expected qualification of a teacher and their lifelong professional development
12.	(Kanematsu et al., 2024)	Digital Innovation in Faculty Development: Crafting Academic Portfolios for the Next Era	Procedia Computer Science	Integrating digital innovation in faculty development by creating academic portfolios.
13.	(X. Tan et al., 2024)	Development and validation of a secondary vocational school students' digital learning competence scale	Smart Learning Environments	Evaluating students' digital learning competence in secondary vocational schools.
14.	(Khademi-Vidra & Bakos, 2024)	An Overview of the Digital Competencies of Teachers in the Hungarian Secondary Agricultural Vocational Training System	Technology, Knowledge and Learning	Report on the available professional development opportunities, but less attention is given to the educators' personal attitudes. In our viewpoint, the success of the digital competence development process greatly hinges on realistic and effective teacher self-reflection.
15.	(Modise & Vaughan, 2024)	ePortfolios: A 360-Degree Approach to Assessment in Teacher Education	Canadian Journal of Learning and Technology	How ePortfolios are being used to support assessment practices in a South African and a Canadian teacher education program

RESULT AND FINDING

The selected articles according to Table 2 are explained in detail the criteria for the evaluation scoring result to determine the quality of the study and review the overall assessment. Studies of academic publication related to digital portfolio, such as the concept of digital portfolio or e-portfolio, digital portfolio in education and TVET, digital portfolio or e-portfolios' use in teaching, learning, or assessment, use of structured reflection and for recruiting purposes. Through Table 3, the result of the selected articles that have been evaluated shown.

Table 3. Identify of selected articles for implementation digital portfolio review

No.	Source	Aspects of digital portfolio implementation Research Question 1#	The role of reflection Research Question 2#	The gap that emerges Research Question 3 #
1.	(Hegarty & Thompson, 2019)	Integration of social media Mobile tools Real-time feedback Creative content	Adjusting learning strategies and design Improving critical and collaborative thinking	Technology and access gaps Application familiarity gap Limited reflective design
2.	(Smolyaninova & Bezyzvestnykh, 2019)	Modular structure (basic module, practical module and professional-personal module) Competency based assessment ICT criteria (operational cognitive, communicative, motivational, reflective-evaluative and creative)	As a professional development through refelction on projects ICT self evaluation Encourage self-directed learning by taking initiative in improving digital skills	Gap in traning, the use of digital tools Infrasctructure gap Competency gap as it is still difficult to reach the constructive stage without systematic assistance Integration into teacher education policy
3.	(Ciesielkiewicz, 2019)	Multifunctional: learning, showcase and assessment portfolios Multimedia CV for employability	Enhance self-awareness, promotes lifelong learning and support the development of transferrable skills Document achiements and learning journey	Time-constraints based school principals Lack of technical training Institutional support Variation in usage, eportfolios implementation remains inconsistent
4.	(Hj. Ebil et al., 2020)	Teacher's input Student motivation Software of portfolio chosen Connectivity setting (tech access)	Structured reflective strategies using simple and accessible digital tools can be integrated in the TVET context and effectively develop competencies required by the world of work Strengthens high-order and metacognitive skills	Challenges adapting to industrial technology Digital skill development in vocational context
5.	(Davis et al., 2020)	LinkedIn Social profiles for career alignment Networking	Self evaluation Strategy refinement for professional goals	The gap between active and passive users Personality gap (introverts vs extroverts) Digital literacy gap
6.	(Marinho et al., 2021)	Assessment integration Peer collaboration Authentic tasks Blended learning	Support self-regulated learning Feedback loops High-order thinking	Student engangement variability Teacher workload Platform and assessment inconsistencies

7.	(Cattaneo et al., 2022)	Digital tools (e-mail, social network, learning content management system platform, software for video conference, virtual reality) Digital resources selection (multimedia presentation, mind maps, quizziz, video)	The digital competency scala can be used as a useful self-asessment tool to help teachers realize their personal strengths and weaknesses.	Attitudes toward technology and frequency of digital tool usage Teacher workload Weak curriculum support
8.	(Zhang et al., 2022)	Dossier (collection of evidence) Showcase or presentation tools Asessment, as a tool for both formative and summative assessment by providing evidence Learning tracking, help track the continuous development and learning process.	Promote reflective learning and develop metacognitive. Self-development and the enhancement of learning quality through continuous reflective practice. Provide structured guidance and specific exercises in reflective writing	Reflection skills gap Digital ethics Platform usability issues
9.	(López-Crespo et al., 2022)	Collection of digital artifacts Application of concepts to real-life situations and critical evaluation of topics Alligment with learning objectives, must align with curriculum goals and competencies	Enhances metacognition Boosting self-efficacy Identity formation	Limited empirical evidence, Educator resistance, Research design limitations Low student engangement, Training needs Infrastructure
10.	(Fazlina et al., 2022b)	Structured documentation Multimedia evidence Asessment and evaluation with specific performance criteria, making assessment more authentic and competency based. Presentation of achievement, through multimedia integration Goal setting	Supporting formative assessment to provide continuous feedback to improve learning. Enhancing metacognition to analyze learning strategies. Self-directed learning	Knowledge and platform gaps Infrastructure limits Rubric standardization needed to ensure objectivity and consistency.
11.	(Leibur et al., 2023)	Secure platform TAP-based structure Organized evidence	Identifying professional strengths and weaknesses Developing self-awareness of teaching practices Goal setting	Gap in writing and reflection skills Gap in access to and support for technology Lack of meaningful feedback
12.	(Kanematsu et al., 2024)	SAP model (Structured Academic Portfolio) with a six-stage structure: (1) foundation setting, (2) start-up setting, (3) collaborative reflection, (4) drafting, (5) integration, and (6) finalization.	Reflection as the core of development Career goal mapping	Technology dependence Data security (protection of sensitive information in the portfolio Pedagogical gap

		Dynamics Paperless system Teacher's motivation		
13.	(X. Tan et al., 2024)	Use of digital technology Activity management Motivation, self-efficacy, learning belief system	Helps to recognize strengths and weaknesses in the learning process Self regulation Encourages continuous improvement in portfolio content quality	Low self-motivation Technological skill variation
14.	(Khademi-Vidra & Bakos, 2024)	ICT integration in vocational learning Technology integration in industry-based learning Self-evaluation/ assessment tools	Reflecting on teaching practices in designing based instructional design	Device access Lack of specific training Lack of specific digital teaching materials
15.	(Modise & Vaughan, 2024)	Multifunctional use as tools for storage, reflection, documentation, collaboration, showcasing and assessment. Technology integration, e.g digital rubrics, blogs, google docs, video tools, embedded multimedia.	Encourages lifelong learning Metacognition to analyzing progress and setting improvement goals.	Educator knowledfe gaps Student unpreparedness Assessment disconnect or misalignment.

Aspects of Digital Portfolio Implementation (Research Question #1#)

In the column addressing aspects of digital portfolio implementation (RQ1), digital portfolios have evolved into multifaceted tools that serve various educational and profesional functions. Across the reviewed literature, several core aspects emerge as critical to their implementation. At the foundational level, digital portfolios are seen as structured systems for collecting, organizing and presenting artifacts, including credentials, assessment, multimedia content and reflective narratives. These artifacts are used to track personal and prefesional development but also for employability purposes (Ciesielkiewicz, 2019; Zhang et al., 2022).

In many cases, portfolios are implemented with integrated digitals tools and platforms, such as Learning Management System (LMS), blogs, video tools and interactive apps (Hegarty & Thompson, 2019; Modise & Vaughan, 2024). Portfolios often include structured assessment components, both formative and summative as well as features that encourage collaboration and self-regulated learning (Marinho et al., 2021). Portfolios in vocational education and teacher training further reflect the importance of aligning content with authentic tasks, industry standards and 21-st century competencies (Kanematsu et al., 2024; Smolyaninova & Bezyzvestnykh, 2019). The Structured Academic Portfolio (SAP) and the Technical Application for Portfolio (TAP) models emerge as two promising frameworks for adaptation in vocational teacher contexts. The models are clearly defined and easily understood, particularly by vocational educators.

This one of practical examples of implementing SAP and TAP especially in vocational schools, designed to align with both academic and technical competencies.

SAP (Structured Academic Portfolio)

Focus: Pedagogical/ academic development and reflection

Purpose: Used during teacher evaluations, certification programs or performance reviews

Tabel 4. Example in a Vocational School (Hospitality/ Tourism Program)

SAP Component	Example
Cover & Identity	Name, ID, subject, taught, teaching experience, photo
Teaching Philosophy	Written reflection: "My Philosophy in delivering vocational learning in hospitality"
Lesson Plans	RPP (lesson plans) for modules, such as "Front Office Procedures" or "Food & Beverage Service"
Classroom Implementation	Photos/ videos of teaching activities, student projects, and hotel role-play simulations
Student Assessment	Examples of rubrics, formative assessment result, peer and self-assessment
Professional Training	Certificates from industry-based training (e.g., hotel internship program)
Reflection Log	Weekly or monthly reflections on teaching challenges and student feedback reviews
Future Goals	Short and long-term goals for instructional improvement and career progression

TAP (Technical Application for Portfolio)

Focus: Technical skill development and industry-standard evidence

Purpose: Used as a graduation requirement, for certification portfolio or job seeking

Tabel 5. Example in a Vocational School (Mechanical Engineering Program)

TAP Component	Example
Profile Page	Student/ teacher profile with specialization (e.g., CNC Milling, CAD design)
Competency Standards	List of national competencies (e.g., KKNI level II for machining)
Skill Artifacts	Upload of CAD drawing projects, machining videos or 3D printed component images
Industry Internship	Internship report, signed logbook, supervisor testimonial and project work
Certification Evidence	Photos and PDFs of LSP certificates (e.g., CNC operator), OSHA, or AutoCAD certifications
Project Documentation	Technical report in capstone project: "Design and Manufacturing of a Motorcycle Part"
Maintenance Log/ SOP	Examples of machine maintenance checklist or standard operating procedures (SOPs)
Reflection Journal	Reflection on what was learned during technical taks or projects
Technical Assessment	Rubrics and grades for technical tests (lathe machine, weding, etc)

The Role of Reflection in Digital Portfolio Implementation (Research Question 2#)

The reflection role column (RQ2), stands as a central pillar in the effective implementation of digital portfolios. Rather than serving as a mere repository of artifacts, e-portfolios or digital portfolios are increasingly recognized as reflective spaces that support metacognitive development, critical thinking, and the formation of professional identity (Fazlina et al., 2022a; López-Crespo et al., 2022). Through reflective writing self-evaluation and goal setting, learners are encouraged to make sense of their educational experiences, identify strengths and areas for improvement, and articulate learning trajectories in meaningful ways. Structured reflection is not merely a self-evaluation process, but rather an essential component of lifelong learning and professional growth.

In teacher education and vocational contexts, reflective strategies help connect theoretical knowledge to practical applications, bridging learning across different settings (Hj. Ebil et al., 2020; Marinho et al., 2021). It bridges theory and practice, especially within the context of Technical and Vocational Education and Training (TVET), enabling teachers to critically assess and improve their instructional practices. Structured reflection

not only enhances academic performance but also promotes lifelong learning and self-directed improvement (Smolyaninova & Bezyzvestnykh, 2019). Reflection in e-portfolios also supports digital competency development, particularly when combined with tools that guide metacognitive processes and prompt deeper insight (X. Tan et al., 2024; Zhang et al., 2022).

Emerging Gaps in Digital Portfolio Implementation (Research Question 3 #)

The column on emerging gaps (RQ3) outlines the major challenges in adopting digital portfolios for vocational teachers. Despite the potential of digital portfolios, the literature reveals persistent challenges and gaps in implementation. A significant barrier lies in the digital divide, unequal access to infrastructure, devices, and internet connectivity remains a concern in many educational settings (Fazlina et al., 2022a; Leibur et al., 2023). Additionally both students and teachers often lack sufficient technical training, which hampers optimal use e-portfolio or digital portfolio platforms and tools (Ciesielkiewicz, 2019; Khademi-Vidra & Bakos, 2024).

Pedagogical gaps also emerge, particularly in the integration of reflective and metacognitive components. Many educators struggle to scaffold reflection effectively, and some learners find it difficult to articulate deep insight without structured guidance (López-Crespo et al., 2022; Zhang et al., 2022). Other common issues include inconsistent assessment practices, student motivation disparities, lack of standardized rubrics, and educator resistance to adopting new technologies (Marinho et al., 2021; Modise & Vaughan, 2024). These gaps indicate the need for strategic frameworks, targeted training, and stronger institutional support to ensure equitable, meaningful, and sustainable implementation of digital portfolios.

DISCUSSION

Strengthening Digital Skills Through Digital Portfolios

The implementation of digital portfolios in Technical and Vocational Education and Training (TVET) emerges not only as a pedagogical innovation but also as a strategic imperative to align teacher competencies with the demands of Industry 4.0 (A. Cattaneo et al., 2022; Rahmawati et al., 2022). As shown across various studies, portfolios act as dynamic tools for documenting teacher development, structuring learning, and enhancing evidence-based assessment (Hegarty & Thompson, 2019; Smolyaninova & Bezyzvestnykh, 2019). Unlike traditional record-keeping, digital portfolios provide real-time, multimedia-enriched environments that support both summative and formative evaluations (Marinho et al., 2021).

Moreover, the integration of structured portfolio models, such as SAP (Structured Academic Portfolio) and TAP (Technical Application for Portfolio) offers a scalable solution to improve teacher readiness and digital capacity(Kanematsu et al., 2024; Leibur et al., 2023). These frameworks facilitate a hands-on, practice-based approach that is particularly suitable for vocational teachers who often balance both pedagogical and industrial demands (Billet, 2011b; Ciesielkiewicz, 2019). However, evidence suggests that for these tools to be effective, institutional support, digital infrastructure, and training must be in place (Khademi-Vidra & Bakos, 2024).

Application of e-portfolio or digital portfolio in TVET, case studies of Germany and Singapore. According to the German Federal Ministry of Education and Research (BMBF, 2020) Germany's dual vocational training system has adopted e-portfolios to bridge theory and practice. The dual VET system requires students to compile work reports and competency portfolios during internships, which are prerequisites for graduation and serve as key documents for employers to assess job readiness. Many vocational schools in Germany use ELFE (Electronic Learning and Training Environment) to track apprentices' progress. Meanwhile, Singapore has integrated e-portfolio or digital portfolios into its Technical and Vocational Education and Training (TVET) system through the SkillFuture initiative, which emphasizes lifelong learning and skill development. Singapore's Institute of Technical Education (ITE, 2021; MOE, 2019) uses e-portfolios integrated with industry recruitment systems, where students document projects, certifications, and internship experiences. Students upload project work, industry attachments, and employer feedback, enhancing employability. Companies like Singapore Airlines, ST Engineering, Siemens, and Bosch use e-portfolios to assess trainees' hands-on skills.

The Central Role of Reflection in Digital Portfolios

A recurring theme across the selected literature is the centrality of reflection in the effective implementation of digital portfolios. Portfolios are increasingly viewed not merely as containers for articles but as cognitive and affective spaces where professional identity, pedagogical insight, and lifelong learning intersect (Fazlina et al., 2022a; López-Crespo et al., 2022). Reflection facilitates self-regulation, allowing teachers to evaluate their teaching practices, set future goals, and align instructional strategies with both learner needs and industry requirements (Korhonen et al., 2020; Zhang et al., 2022).

Notably, reflection plays a mediating role in bridging the gap between theory and practice, particularly in vocational settings where experiential learning is foundational (Hj. Ebil et al., 2020; Smolyaninova & Bezyzvestnykh, 2019). The findings affirm constructivist learning theories and the Zone of Proximal Teacher Development (ZPTD), where reflective scaffolding encourages incremental mastery of digital teaching practices (Fani & Ghaemi, 2011). However, the depth and quality of reflection depend largely on the provision of structured prompts, feedback mechanisms, and institutional cultures that value introspection as a professional standard.

Gaps in Practice: Infrastructure, Pedagogy and Readiness

Despite the transformative potential of digital portfolios, several implementation gaps persist. Foremost among these is the digital divide, which manifests through unequal access to devices, connectivity, and platform reliability (Fazlina et al., 2022a; Leibur et al., 2023). These disparities hinder equitable portfolio usage, particularly in under-resourced vocational institutions. Moreover, the lack of targeted training in digital tools and reflective practice has been widely reported (Ciesielkiewicz, 2019; Khademi-Vidra & Bakos, 2024).

A less explored but equally critical challenge is the pedagogical disconnect between the use of portfolios and meaningful curriculum integration. Without strong theoretical alignment, digital portfolios risk becoming superficial checklists rather than tools for transformative learning (Modise & Vaughan, 2024). Additionally, low student motivation, teacher resistance to digital change, and the absence of standardized assessment rubrics further limit the efficacy of portfolio-based strategies (Davis et al., 2020; Marinho et al., 2021).

Lastly, studies reveal limited empirical research on the long-term impact of digital portfolio adoption, especially regarding its effect on sustained professional growth and student outcomes (López-Crespo et al., 2022; Zhang et al., 2022). Addressing these gaps will require a systemic approach that includes policy-level support, cross-sectoral collaboration, and the promotion of digital literacy as a core element in vocational teacher training.

Synthesis and Implications

The reviewed literature converges on the view that digital portfolios offer substantial benefits in terms of skill development, assessment, and reflection for vocational educators. However, these advantages can only be realized through coherent implementation strategies that include structured models**,** ongoing professional development**,** and equitable infrastructure investment. Comparative insights from Germany and Singapore further reinforce the value of embedding portfolio systems into industry-aligned curricula **and** national certification frameworks.

CONCLUSION

This study aimed to explore the implementation of digital portfolios in vocational education through a systematic literature review, focusing on three core areas: (1) aspects required for effective implementation (RQ1), (2) the role of reflection in supporting professional development (RQ2), and (3) emerging gaps between training and real-world digital demands (RQ3). Drawing upon fifteen Scopus-indexed studies published between 2019 and 2024, the analysis reveals several important insights.

First, the successful implementation of digital portfolios depends on key structural elements including access to digital platforms, integration with learning management systems, and alignment with assessment and employability goals. Structured frameworks such as the Structured Academic Portfolio (SAP) and Technical Application for Portfolios (TAP) were highlighted as adaptable models that can scaffold vocational teachers in systematically documenting competencies, engaging in self-assessment, and aligning with industry needs (Kanematsu et al., 2024; Leibur et al., 2023).

Second, reflection emerges as a central component in portfolio-based professional development. Rather than serving as passive repositories of documents, digital portfolios act as reflective spaces that support metacognitive development, goal setting, and identity formation. Reflection helps vocational teachers bridge theory and practice, develop digital pedagogical strategies, and foster lifelong learning habits (Hj. Ebil et al., 2020; Zhang et al., 2022). However, the literature emphasizes the need for structured prompts and feedback mechanisms to support high-quality reflection (López-Crespo et al., 2022).

Third, the review identifies significant implementation gaps that must be addressed to realize the full potential of digital portfolios. These include the digital divide in infrastructure and access, the lack of technical training among educators, pedagogical misalignment, and variability in assessment design (Fazlina et al., 2022a; Modise & Vaughan, 2024). The absence of standardized rubrics and institutional policies further exacerbates inequity in adoption and limits sustainability. Without addressing these issues, digital portfolios risk becoming underutilized or superficial.

In conclusion, digital portfolios represent a transformative strategy in vocational education for enhancing teacher digital competencies and aligning instruction with Industry 4.0. To maximize their effectiveness, institutions must ensure equitable access to infrastructure, provide targeted professional development, and embed portfolio use into curriculum design and teacher evaluation systems. Future research should investigate the longitudinal impact of digital portfolios on teacher performance and student outcomes, as well as examine the scalability of portfolio models across diverse educational and cultural contexts. Emphasizing teacher agency, reflection, and curriculum alignment will be critical to fostering resilient, digitally literate vocational educators in the years ahead.

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