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DIGITAL COMPETENCE DEVELOPMENT IN TVET HOSPITALITY EDUCATION: A SYSTEMATIC REVIEW

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Abstract:

Digital technologies are increasingly transforming Technical and Vocational Education and Training (TVET) within hospitality education. Despite the growing adoption of digital competence frameworks in education, existing studies remain fragmented and insufficiently tailored to the practice-oriented and industry-driven nature of hospitality TVET. This study aims to examine the development of digital competence in TVET hospitality education and identify key gaps that inform future framework development. A Systematic Literature Review (SLR) guided by the PRISMA 2020 protocol was conducted using Scopus and Google Scholar databases. The search yielded 620 records, of which 41 studies published between 2020 and 2025 met the inclusion criteria and were subjected to thematic synthesis. The findings reveal four interrelated themes: (i) the integration of digital technologies in teaching and learning, (ii) the evolving role of educators in digital environments, (iii) persistent challenges related to digital readiness and professional development, and (iv) the mismatch between educational practices and industry expectations. These findings indicate a shift from technology-centred approaches towards a more holistic and ecosystem-based understanding of digital competence. However, the review identifies a significant gap in the integration of pedagogical, technological, and behavioural dimensions within existing frameworks. This study contributes to the literature by providing synthesized evidence base and establishing the conceptual foundation for an integrated digital competence framework that combines DigCompEdu, TPACK, and Technology Acceptance Model (TAM) perspectives. The findings offer practical implications for

competency-based curriculum design, educator professional development, and digital transformation policies in hospitality TVET.

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Hospitality Education; Digital Competence; Digital Transformation; Technical and Vocational Education and Training (TVET)



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Introduction

The growth of technological transformation of the 21st century has reshaped the global digital economy and labour market, including the education and workforce training sectors (Telaumbanua, 2026; Stylianou & Pericleous, 2025; Zhong & Juwaheer, 2024). Advances in digital technologies such as artificial intelligence (AI), automation, and the green economy have not only influenced how work is performed but have also redefined the skill sets required across almost all employment sectors (Hermansah et al., 2025; Zhong & Juwaheer, 2024; Wang, 2024; Jaya et al., 2023). By 2027, nearly one in four jobs is expected to undergo significant transformation in response to ongoing digital advancements and emerging technological innovations, highlighting the need for continuous adaptation to evolving global workforce skill demands (UNESCO, 2025a). This shift reflects a transition from reliance on traditional skills to the growing importance of more complex and dynamic digital competencies (Termizi, 2025; Bonde, 2024; Wang, 2024; Adeyinka-Ojo et al., 2020). In this context, educators must develop the capacity to effectively adopt and utilize digital technologies and resources in order to remain relevant and meet the evolving demands of modern teaching and learning.

In line with the rapid advancement of digital technologies that increasingly shape everyday life, the tourism and hospitality sector has also embraced digital innovations to meet evolving tourist expectations (Mintel, 2018; World Economic Forum [WEF], 2018). According to Statista (2022), the tourism, hospitality, and aviation sectors are expected to increasingly depend on digital technologies such as mobile applications, artificial intelligence (AI), cloud computing, and automation systems by 2030. However, major challenges to this adoption include skills gaps in the local labour market and limited capital investment, as highlighted by the World Economic Forum (2018). Moreover, Amirulloh Anwar et al. (2024) reported that

approximately 60% of hospitality educators in Indonesia face challenges in incorporating digital technologies into their teaching and learning practices. Consequently, instructional quality remains insufficient to fully satisfy the requirements of the industry 4.0 era (Nugraheni et al., 2024; Deri et al., 2024).

In addition, the Malaysian Education Development Plan 2026–2035 emphasises the holistic strengthening of TVET, particularly through enhancing the capabilities and competencies of TVET educators (KPM, 2026). The importance of this objective is further reinforced by the rapid growth in internet usage and the widespread adoption of digital technologies across various sectors, which have positioned digital competencies and technological literacy as fundamental requirements for effective participation in 21st-century education and workforce development (Yang, 2025; Hani et al., 2024; Che'Rus, 2022). Nevertheless, several studies indicate that efforts to develop digital competence among TVET educators remain insufficient, particularly in areas such as monitoring and evaluation, career guidance, and professional training (Hassan et al., 2021). This shortfall reflects a clear gap between the demands of the digital industry and the current capabilities of TVET educators in Malaysia (Hamid et al., 2023; Yeap et al., 2021).

Nevertheless, the development of digital competence among TVET educators remains uneven. Several important areas, including student monitoring and assessment, career guidance, job placement support, and continuous professional development, have yet to receive sufficient attention and integration in practice (Hassan et al., 2021). Several studies also report that TVET educators face challenges in effectively integrating technology into their teaching practices (Ali et al., 2025; Shahran, 2024; Hamid et al., 2023; Yeap et al., 2021; Dusadee & Piriyasurawong, 2020). With the continuous evolution of technology, there is an urgent need to adopt emerging technologies such as the Internet of Things (IoT), robotics, data science, artificial intelligence (AI), and cloud computing to strengthen digital competence within TVET curricula (Ayuba & Ayuba, 2024; Hassan et al., 2021). However, there remains a lack of studies that develop a comprehensive and context-specific digital competence framework for TVET educators in the hospitality field within Malaysian Vocational Colleges. This gap indicates a significant area for further research (Kaluvilla et al., 2025; Tan et al., 2024; Hani et al., 2024; Majlis TVET Negara, 2023). This study contributes to the existing body of knowledge by bringing together the DigCompEdu, TPACK, and TAM frameworks into a single conceptual perspective for TVET hospitality education. Such an approach is particularly important given that the integration of these frameworks within the hospitality TVET context has received limited attention in previous research.

Although research on digital competence in TVET has expanded considerably in recent years, the existing literature still shows several important gaps and lacks a comprehensive perspective in key areas. First, most digital competence frameworks such as DigCompEdu and TPACK were developed for general educational contexts and do not adequately reflect the industry-oriented and practice-based nature of hospitality education (Cabero-Almenara et al., 2020; Koehler & Mishra, 2009). Second, current studies largely examine digital competence, pedagogical integration, and technology acceptance as separate constructs, resulting in limited theoretical integration (Redecker, 2017; Scherer et al., 2019). Third, empirical research focusing specifically on TVET hospitality educators remains scarce, particularly within emerging Industry 4.0 environments, where digital transformation demands specialised pedagogical and technological competencies (Chaka, 2020). Consequently, a clear research gap exists in the development of an integrated and context-specific digital competence framework

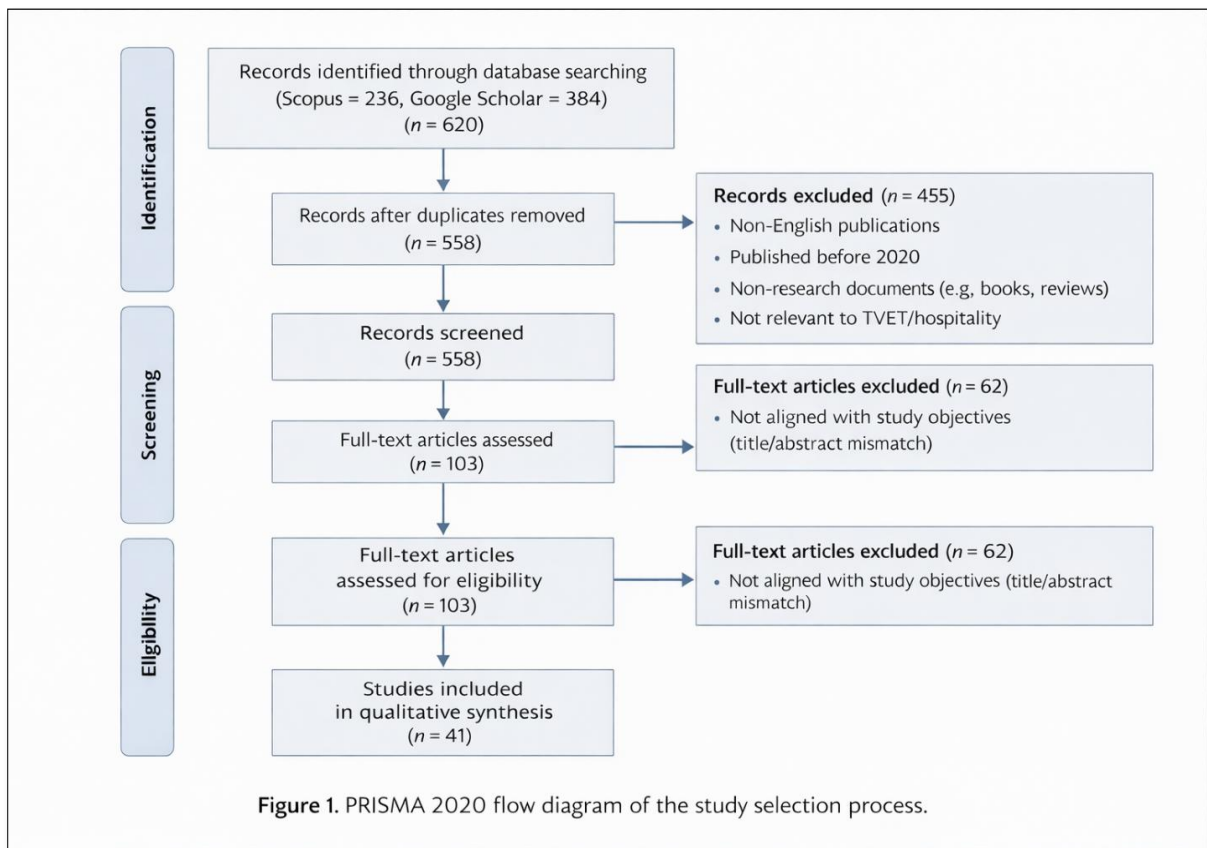
that combines pedagogical, technological, and behavioural dimensions for TVET hospitality education (Davis, 1989; Koehler & Mishra, 2009; Redecker, 2017).

Methodology

This review adopted the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework as the guiding review protocol to ensure methodological transparency, replicability, and comprehensive reporting (Page et al., 2021). The review process consisted of four stages: identification, screening, eligibility assessment, and inclusion, consistent with the PRISMA 2020 guidelines for systematic evidence synthesis (Page et al., 2021). PRISMA was adopted in this study because it offers a clear and systematic process for reporting how studies are identified, screened, and selected, thereby improving transparency and reducing the risk of selection bias in the review process (Liberati et al., 2009; Page et al., 2021).

A systematic review was undertaken to conceptualise digital competence, drawing on prior work that examines its definition within higher education contexts (Spante et al., 2018). To ensure a structured and comprehensive investigation, four research questions were formulated to guide the analysis, with the objective of providing a balanced synthesis and interpretation of existing findings (Gough et al., 2004). The review procedure adhered to established methodological guidelines for systematic literature reviews, particularly those proposed by Kitchenham and Charters (2007) and García-Peñalvo (2017) and was aligned with recent review frameworks applied in educational technology research (Crompton & Burke, 2018).

The review process began with the formulation of clear research questions to define the focus and boundaries of the study. Following the screening process, the studies that met the eligibility requirements were retained for further analysis. Consistent with the approach proposed by Gough et al. (2017), the review was conducted through three interconnected phases which is identification, selection, and synthesis. This process helped ensure that the review was carried out in a systematic, rigorous, and transparent manner.



Search String

This review utilised Scopus and Google Scholar as the main search databases due to their broad coverage of scholarly literature and their relevance to educational research. Scopus was selected for its strong indexing of peer-reviewed and high-impact journals, while Google Scholar was included to capture additional studies, conference proceedings, and other scholarly sources that may not be indexed in Scopus.

The search process involved searching for relevant keywords to article titles, abstracts to maximise the retrieval of studies aligned with the research objectives. Search strings were progressively refined to ensure consistency with the scope of the review, particularly in relation to digital competence, TVET, and hospitality education.

Google Scholar: ("digital competence" OR "digital skills" OR "digital literacy" OR "digital capability") AND ("TVET" OR "technical and vocational education" OR "vocational education") AND ("hospitality education" OR "tourism education" OR "hospitality training") AND ("development" OR "framework" OR "model" OR "transformation" OR "trends")

Scopus: TITLE-ABS-KEY (("digital competence*" OR "digital skill*" OR "digital literacy*" OR "digital capability*") AND ("TVET" OR "technical and vocational education" OR "vocational education" OR "technical education") AND ("hospitality education" OR "tourism education" OR "hotel management" OR "hospitality training") AND ("development" OR "framework" OR "model" OR "transformation" OR "trend*")).

Study Selection

The screening process was carried out in accordance with the PRISMA 2020 guidelines and involved two stages. The initial database search yielded 620 records. After removing 62 duplicate entries, a total of 558 records remained for title and abstract screening. Based on the predefined inclusion and exclusion criteria, 455 records were excluded at this stage. Subsequently, 103 full-text articles were assessed for eligibility, and 62 articles were excluded due to irrelevance to the study objectives, insufficient methodological rigor, or lack of alignment with the review focus. As a result, 41 studies met all eligibility criteria and were retained for thematic synthesis.

Inclusion And Exclusion Criteria

The inclusion and exclusion criteria were established to ensure that only relevant and high-quality studies were selected for the review. The criteria focused on publication type, time frame, language, field of study, research context, and alignment with the research objectives. Only empirical studies published between 2020 and 2025 in the field of TVET and hospitality education, with a focus on digital competence development, were included. Studies that did not meet these criteria, such as non-English publications, studies published before 2020, and those outside the relevant domain, were excluded.

Quality Criteria

Papers that satisfied all inclusion criteria and did not meet any exclusion criteria were subjected to a full review to determine whether they fulfilled the established quality standards. In this review, the quality assessment focused on several key aspects, including the conceptualization of digital competence, research objectives, study design, instruments used, sample characteristics, alignment with the research questions, findings, limitations, and recommendations for both future research and the development of digital competence within higher education contexts.

Results

The thematic synthesis reveals a progressive transformation in how digital competence is conceptualised within TVET hospitality education. Rather than representing independent dimensions, the four themes collectively illustrate a shift from technology-centred approaches towards ecosystem-based competence development.

Table 1: Global Digital Competency Study Matrix

Study	Competence Domains	Methodology	Main Result	Future Recommendations
Serrano et al. (2025)	Digital, social & flexible competencies	Survey & quiz (358 VET educators)	Strong integration of digital and social skills	Flexible, needs-based training

Study	Competence Domains	Methodology	Main Result	Future Recommendations
ChenMao & Noirid (2025)	Awareness, skills & teaching experience	Mixed methods (412 educators)	Integration with institutional support	Institutional capacity building
Thila et al. (2025)	Development guidelines	Mixed methods	Integration with institutional support	Comprehensive guidelines
Zhang & Policarpio (2025)	Digital pedagogy (ESL vocational)	Statistical analysis	Strong digital pedagogy integration	Targeted professional development
Lee & Lee (2024)	Six clusters incl. digital & industry integration	Factor analysis (600 educators)	Digital skills embedded in curriculum	Industry-aligned teaching
Hani et al. (2024)	Multi-domain TVET model	Mixed methods + expert consensus	Effective tech integration	Structured training model
Morales-Romo et al. (2024)	Digital & social competencies	Qualitative (interviews, groups)	Inclusion of vulnerable learners	Inclusive training
Yu et al. (2024)	Five domains incl. AI	Delphi study	Integration in teaching & assessment	Continuous alignment
Zhong & Juwaheer (2024)	Multi-stakeholder competencies	Qualitative analysis	Cross-stakeholder integration	Institutional strategies
Joya et al. (2024)	Info & communication literacy	Systematic review	Cognitive attitudinal aspects	Framework alignment
Lanza et al. (2024)	Advanced classroom technologies	Thematic analysis	Use of advanced digital tools	Certification needs
Xin et al. (2024)	Five domains (thinking, skills, etc.)	Survey (2514 educators)	Integration with collaboration	Targeted training
Li & Guzman (2024)	Multi-source assessment	Review study	Integration of pedagogy & technology	Holistic assessment systems
Suherman et al. (2025)	10 DigCompEdu dimensions	CFA analysis	Digital tools linked to teaching effectiveness	Institutional factors

Study	Competence Domains	Methodology	Main Result	Future Recommendations
Bian & Siththada (2024)	Six determinants	Mixed methods	Integration with professional identity	Institutional culture
Setuju et al. (2024)	TPACK + PjBL	Quasi-experiment	Strong pedagogy-digital integration	Strengthening digital pedagogy
Islami et al. (2024)	Advanced competencies (AHP)	Survey + AI validation	Focus on content & security	Training & prioritization
Oktaviani & Utami (2024)	TPACK-based training	Implementation study	Improved skills & satisfaction	Expand training
Umoru & Salami (2025)	Curriculum integration	Survey (317 respondents)	Importance of digital curriculum	Policy updates
Chen (2024)	AI-based digital literacy	Model development	Intelligent assessment systems	Adaptive learning
Xiong (2024)	Industry collaboration model	Effectiveness study	Integration with industry	Policy recommendations
Deschênes et al. (2024)	Digital resources	Satisfaction analysis	Resource utilization	Active promotion
Dembitska & Kobylanskyi (2024)	Professional competence	Competency-based approach	Integration of digital tech	Self-development
Bacsa-Bán & Kolacsek (2024)	Competency needs	Survey	Digital pedagogy emphasis	Targeted training
Pan et al., (2024)	Digital literacy strategies	Analytical study	Motivation & training gaps	Personalized learning
O'Dwyer (2023)	TPACK & DigCompEdu	Research synthesis	Tech-pedagogy integration	Training design
Lahn & Berntsen (2023)	Technical & adaptive pedagogy	Literature synthesis	Vocational pedagogy integration	Qualitative research needed

Study	Competence Domains	Methodology	Main Result	Future Recommendations
Sánchez-Canut (2023)	Professionalisation of digital competence	Document analysis	Economic & professional focus	Infrastructure investment
Döbler (2023)	Didactic, technical & professional model	Conceptual/empirical	School-level integration	Institutional strategies
Lavrentieva (2023)	Agro-vocational competencies	Theoretical analysis	Integrated competencies	Innovation in training
Redziuk (2023)	Digital culture	Theoretical framework	Professional transformation	Digital readiness
Yu & Jung (2023)	Digital competence measurement	EFA (221 responses)	Basic vs teaching competencies	Self-assessment tools
Isak et al. (2023)	Digital tools in training	Impact study	Benefits & challenges	Future trends
Wannapiroon et al. (2022)	10 competencies (online learning)	Large-scale study (2233 educators)	Effective online teaching	Synchronous training
Wahjusaputri & Nastiti (2022)	4 factors, 28 indicators	SLR + meta-ethnography	Digital literacy focus	Assessment model
Mattar et al. (2022)	Communication, technical, pedagogy, ethics	Literature review	Integration of competencies	Assessment instruments
Cattaneo et al. (2022)	10 dimensions (Switzerland)	Regression analysis	Attitude & tool usage link	Curriculum support
Barnová (2022)	Self-assessment	Conceptual analysis	Distance learning	Dynamic competencies
Rahmawati et al. (2022)	Competence levels	Descriptive statistics	Need for content creation skills	No regional differences
Yang et al. (2021)	Six frameworks	SWOT analysis	Integration in teaching	Global references
Misnevs et al. (2021)	Digital & green competencies	Conceptual model	Environmental integration	Practical use

Overview of Findings

Theme 1: Integration of Digital Technologies in Teaching and Learning

The reviewed studies consistently highlight the increasing integration of digital technologies into teaching and learning practices across TVET settings. Technologies such as learning management systems, artificial intelligence, digital assessment tools, simulation software, and collaborative platforms have become important components of contemporary vocational education (Yu et al., 2024; Chen, 2024; Lanza et al., 2024). Several studies emphasise that effective technology integration extends beyond technical usage and requires alignment with pedagogical objectives and learning outcomes (Setuju et al., 2024; Oktaviani & Utami, 2024). The findings suggest a gradual shift from technology adoption towards technology-enhanced learning environments that support learner engagement, flexibility, and industry relevance. This trend reflects the growing importance of digital competence as a pedagogical capability rather than merely a technical skill.

Theme 2: The Evolving Role of Educators in Digital Environments

The literature indicates a significant transformation in the professional role of TVET educators. Traditionally viewed as knowledge transmitters, educators are increasingly expected to function as facilitators, digital designers, mentors, and innovators within technology-rich learning environments (O'Dwyer, 2023; Döbler, 2023; Redziuk, 2023). Recent studies highlight the need for educators to develop competencies that integrate technological, pedagogical, and professional dimensions simultaneously (Suherman et al., 2024; Bian & Siththada, 2024). This shift reflects the broader transformation of vocational education, where educators are required to support personalised learning, technology-mediated instruction, and industry-oriented skill development. Consequently, digital competence is increasingly viewed as a multidimensional professional capability that extends beyond classroom technology use.

Theme 3: Digital Readiness and Professional Development Challenges

Despite growing recognition of digital competence, many studies report persistent challenges related to digital readiness, infrastructure availability, institutional support, and professional development opportunities (Shi, 2024; Bacsa-Bán & Kolacsek, 2024; Deschênes et al., 2024). These barriers limit educators' ability to integrate digital technologies effectively into teaching practices. The findings further indicate that professional development initiatives often focus on technical training while neglecting pedagogical integration and long-term competency development. As a result, significant disparities remain in educators' preparedness to respond to ongoing digital transformation.

Theme 4: Mismatch Between Educational Practices and Industry Requirements

A recurring theme across the literature concerns the gap between educational practices and the rapidly evolving requirements of industry. Several studies emphasise that vocational curricula and educator competencies frequently lag technological developments occurring within industrial sectors (Zhong & Juwaheer, 2024; Xiong, 2024; Lee & Lee, 2024). The issue is especially significant within hospitality education, where rapid technological advancements, including artificial intelligence, automation, customer relationship management systems, and data analytics, are transforming the nature of work and professional practice. However,

educational provision does not always keep pace with these developments, creating a gap between the competencies developed in educational settings and those expected by employers. This finding underscores the need for closer and more sustained collaboration between educational institutions and industry partners to ensure that digital competence development aligns with current industry requirements and future workforce expectations.

Discussion

Transformation Trends of Digital Competence in TVET

The evolution of digital competence in Technical and Vocational Education and Training (TVET) reflects not only a chronological progression but also a conceptual shift in how competence is defined and operationalised across studies. Earlier research primarily conceptualised digital competence as a set of technical skills focused on the use of instructional technologies, often lacking empirical validation and contextual depth (Zhan & Wang, 2014; Seufert et al., 2019; Brauer et al., 2018). In contrast, studies conducted during the 2016–2022 period suggests a significant transition towards integrating technology with pedagogy, particularly through frameworks such as TPACK and DigCompEdu, highlighting the importance of aligning digital tools with teaching practices and learning outcomes (Wannapiroon et al., 2022; Wahjusaputri & Nastiti, 2022; Mattar et al., 2022; Cattaneo et al., 2022). However, these studies tend to emphasise instructional design and delivery, with limited attention to broader systemic and professional dimensions.

More recent research (2023) expands this perspective by positioning digital competence within a holistic professional framework, incorporating elements such as digital culture, institutional readiness, and adaptive pedagogical practices (O'Dwyer, 2023; Döbler, 2023; Redziuk, 2023; Yu & Jung, 2023). Despite this advancement, these studies remain relatively fragmented, often addressing isolated components such as assessment tools or institutional strategies without fully integrating them into a unified model. In contrast, the latest studies (2024–2025) suggests a more comprehensive and systemic approach, emphasising the integration of multi-domain competencies including digital, social, and industry-related skills alongside the incorporation of emerging technologies such as artificial intelligence and learning analytics (Yu et al., 2024; Zhong & Juwaheer, 2024; Chen, 2024; Serrano et al., 2025; Thila et al., 2025; ChenMao & Noirid, 2025). These studies also highlight the importance of multi-stakeholder involvement and institutional ecosystems, signalling a shift from individual competence to networked and context-dependent capability.

Nevertheless, a critical gap remains. While recent studies advocate for integrated, adaptive, and ecosystem-based models, there is still a lack of context-specific frameworks tailored to TVET domains, especially within specialised fields such as hospitality education. Furthermore, limited efforts have been made to synthesise key theoretical models such as DigCompEdu, TPACK, and Technology Acceptance Model (TAM) into a cohesive framework that captures both pedagogical integration and user acceptance dimensions. This indicates a clear need for developing a comprehensive, contextually grounded digital competence framework that bridges theoretical integration with practical application in specific TVET settings.

Integrated Digital Competence Framework for Hospitality TVET

The findings suggest that no single framework adequately captures the multidimensional nature of digital competence required in hospitality TVET. DigCompEdu provides a comprehensive perspective on educators' professional digital competence, particularly in areas such as digital resources, teaching and learning, assessment, and learner empowerment (Redecker, 2017). However, it offers limited attention to the pedagogical integration of technology within specific vocational contexts.

The TPACK framework extends the perspective of DigCompEdu by focusing on how technological, pedagogical, and content knowledge interact in educational contexts. Through this integration, educators are better equipped to incorporate digital technologies in ways that support meaningful and effective learning experiences (Mishra & Koehler, 2006). Nevertheless, TPACK does not explicitly address behavioural factors that influence educators' willingness to adopt and utilise technology.

In contrast, the Technology Acceptance Model (TAM) contributes a behavioural perspective by explaining how perceived usefulness and perceived ease of use influence technology adoption decisions (Veyis & Cigerci, 2025; Davis, 1989). Integrating these three perspectives provides a more comprehensive understanding of digital competence development by combining professional competence (DigCompEdu), pedagogical integration (TPACK), and technology acceptance (TAM). Such integration offers a conceptual foundation for the development of a context-specific digital competence framework tailored to hospitality TVET educators.

Future Directions

Future research on digital competence in Technical and Vocational Education and Training (TVET) should move beyond generalised frameworks towards the development of context-specific models that address the unique needs of specialised domains such as hospitality and vocational pedagogy. Although existing studies have established strong foundations through frameworks such as DigCompEdu and TPACK, there remains a critical need to integrate these with technology acceptance perspectives, such as the Technology Acceptance Model (TAM), to produce more comprehensive and empirically testable models. Additionally, the increasing incorporation of advanced technologies, including artificial intelligence and learning analytics, calls for further investigation into their pedagogical implications and impact on teaching effectiveness and learner outcomes (Yu et al., 2024; Chen, 2024).

Moreover, future studies should adopt a broader ecosystem perspective by examining the interactions between multiple stakeholders, including educators, students, industry partners, and institutional leadership, as recent research highlights the importance of collaborative and system-level approaches to digital competence development (Zhong & Juwaheer, 2024; Serrano et al., 2025; Thila et al., 2025). There is also a pressing need for innovation in assessment methodologies, particularly through the development of multidimensional tools that integrate self, peer, and AI-based evaluation mechanisms. In terms of research design, longitudinal studies are recommended to better understand the long-term impact of digital competence on teaching practices and workforce readiness, as current studies remain largely cross-sectional. Furthermore, institutional and policy-level research should be strengthened to explore governance, leadership, and readiness factors that influence digital transformation in

TVET. Finally, future research should prioritise personalised and adaptive professional development models that align with the evolving demands of digital transformation agenda, ensuring that digital competence remains dynamic, context-responsive, and sustainable.

Conclusion

Overall, this review establishes the conceptual groundwork for developing an integrated multi-theoretical digital competence framework that combines DigCompEdu, TPACK, and TAM dimensions. Such a framework has the potential to support competency-based curriculum development, educator professional learning, and digital transformation initiatives specifically within TVET hospitality education. Therefore, there is a pressing need to develop a comprehensive, integrated, and contextually grounded digital competence framework that incorporates pedagogical integration of TPACK, professional competence domains such as DigCompEdu, and technology acceptance factors such as TAM to effectively support the digital transformation of hospitality education and enhance workforce readiness in alignment with smart industry ecosystem.

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