

NARRATIVE REVIEW: DIGITAL TECHNOLOGY COMPETENCE AND TRAINING NEEDS AMONG SECONDARY SCHOOL TVET TEACHERS

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Abstract: *This study is a comprehensive narrative review of research and literature about the Digital Competence of Secondary School Technical and Vocational Education and Training (TVET) Teachers; identifies and synthesizes the literature concerning the Digital Competence and Training Needs of Secondary School TVET Teachers, identifies key areas, challenges and methods of influencing teachers' ability to use digital tools effectively within the context of vocational education. As education has become rapidly digitalized and there is an increasing need for students to develop technology-driven skills, digital competence has emerged as a key professional competency for TVET teachers. Nevertheless, many secondary TVET teachers face significant challenges in acquiring and applying sufficient digital competence because they are provided with limited opportunities for professional development, inadequate institutional support, and inequitable distribution of digital resources. The COVID-19 pandemic has highlighted the need to equip teachers with robust digital competences in order to maintain effective educational experiences and learning outcomes in increasingly virtual learning environments. A systematic literature search was performed using Scopus, Web of Science, ERIC and Google Scholar databases. In addition to these databases, studies were also identified from reference lists of studies included in this review, as well as relevant policy documents. Studies published in English between 2010 and 2025 were included in this review based on their focus on digital competence frameworks, training needs, barriers to acquiring digital competences, and professional development initiatives for secondary level TVET teachers. Six major themes were identified as part of this review: definitions of digital competence, the importance of digital competence in TVET, digital competence training and professional development gaps, barriers to developing digital competence, new developments in building capacity, and unresolved issues. The findings of this review indicate that while most training programs provide secondary TVET teachers with the necessary ICT knowledge and skills to utilize digital technologies, few provide teachers with the necessary knowledge and skills to incorporate digital technologies into the curriculum in a manner that reflects effective pedagogy. Therefore, the digital competence levels of TVET teachers remain highly variable. Additionally, several barriers to developing digital competence were found to exist including*

limited access to resources, limited institutional support for professional development, and the absence of standard digital competence assessment frameworks. Finally, some new ways of building capacity for TVET teachers including blended learning, mentoring and micro-credentials have potential to become good models for TVET teacher capacity building; however, these would need to be tailored to the local contexts of each region. The findings of this study further underscore a persistent gap in the rate of technological progress versus the preparedness of TVET teachers to meet that progress. They also highlight the necessity for sustained and contextualized professional development for TVET teachers, as well as institutional commitment to supporting digital transformation throughout all layers of the vocational education system. The synthesis of existing evidence contained in this review provides the basis for the development of specific strategies and policy frameworks to support the development of digital competence among TVET teachers, as well as to enhance the alignment of vocational training with the requirements of future workforces.

Keywords: *Digital competence, TVET teachers, training needs, professional development, technology integration, secondary education*

Introduction

The speed of dissemination of digital technologies within education has revolutionised the roles of teachers and learners worldwide (Caaena & Redecker, 2019), and thus being digitally competent is an area which educators across all subject areas should be skilful in. In the case of TVET, the skill of a teacher in using digital technologies is particularly significant as underpins the preparation of learners who can cope in industry and work environments of the future (Mbatha, 2024). But even in the face of many policy interventions to prepare educators with appropriate digital literacy skills, the adoption and sustainability of sufficient competence are challenges faced by most secondary TVET teachers when trying to access, introduce and sustain adequate digital technology competency (Subrahmanyam, 2022). Recent research reveals differences in the access to training, differences in self-efficacy and variations in institutional support for TVET teachers (Ogodo et al., 2021), suggesting there is still a divide between technological developments and teacher preparedness for their implementation.

Furthermore, the digital transformation of education has been highly accelerated by the COVID-19 pandemic, revealing flaws in teacher training structures and highlighting the urgency on specific capacity building interventions to be undertaken in the short term (Tarricone et al., 2021). In the light of this, the intent of this narrative review is to reflect and explore the literature on digital technology competence in relation to TVET secondary school teachers and their training, focussing upon the main themes, gaps and best practice (Abdullah & Masek, 2024). The review focus on theoretical approach to digital competence, readiness of TVET teachers and curriculum policy (Rakisheva & Witt, 2023). The review assembles multiple sources and views in an attempt to take a holistic look at how the TVET sector can raise the level of digital capability required (Rokeman et al., 2024).

Method

The Methods Section provides detailed information about how the overview was completed regarding:

Literature in this narrative review was searched via numerous trustful electronic databases including: Scopus, Web of Science, ERIC (Education Resources Information Center) and

Google Scholar. These databases were selected because they provide extensive coverage of education, technology and vocational education literature. Additional search across reference lists of the identified studies and relevant policy documents related to the topic were also conducted in order to include additional sources that might be not found in the first search into these major databases. Therefore, this procedure guaranteed that not only early but also recent studies in relation to DC as well as training needs for the TVET educators were included.

The search strategy used included identifying and combining the key concepts with the aid of Boolean operators. Search keywords were “digital competence”, “digital literacy”, “technology integration”, “training needs”, “professional development” and TVET teachers”. These keywords were also used combined in several searches using AND and OR to broaden or narrow the search (e.g., “digital competence AND TVET teachers” or “digital literacy OR technology integration AND secondary education”). In order to concentrate on current digital education practices and technologies, we limited search results to articles published in the English language between 2010-2025.

A work would be considered if focused on digital competence frameworks, training needs or technology integration of the secondary school TVET teachers was empirically based or conceptual paper or policy review had provided knowledge about challenges, strategies and/or best practices in teacher professional development for TVET. The reports that were not eligible for inclusion were: (i) studies on non-TVET education; (ii) studies that targeted higher education or pre-service teacher training, and (iii) studies lacking conceptual/ methodological robustness. Broad and inclusive method of study selection enabled us to reject studies with very broad or narrow scopes, leading to a balanced representation of the literature on digital technology competence in TVET secondary levels.

Result and Discussion

Synthesis Analysis

Definitional Framework for Digital Technology Competence in TVET Education

Digital technology skill competence are the knowledge, skills and attitudes teachers should have to facilitate their effective use of digital tools in teaching process (Demissie et al., 2022). In the TVET (Technical and Vocational Education and Training) space, this competency entails more than computer literacy in everyday use but skills typical of using custom-built software, manipulating digital appliances and creating technology-driven learning environments (Orji & Perumal, 2024). Researchers including Redecker (2017) and Ferrari (2013), for example, have discussed digital competence as a multi-faceted skill set that includes information literacy, communication, content creation, safety and problem solving. However, for TVET, the definition changes according to disciplinary context technology teachers might think of simulation tools and engineering design software, or business education teachers mobile and digital communication platforms. This variation highlights the importance of creating a context responsive DC framework that reflects the practical, and technical based nature of TVET.

Need for Digital Competence among TVET Educators

Inclusion of digital technologies in vocational education for preparing learners to work with technology (Fitrihana & Nurdiyanto, 2024). According to UNESCO (2020), and Sang et al.

(2018) also stress the role of digitally competent teachers to support student engagement, better employability skills and innovative experience in technical learning. The COVID-19 pandemic also shed light on the inalienable nature of digital literacy to maintain educational continuity when schools are closed. Educators who had good command over learning management systems, virtual simulations and digital assessment tools showed high level of adaptability and better quality teaching in online classes (Ahmed & Sidiq, 2023). On the other hand, those without these digital skills faced challenges in lesson delivery, communication and assessment. As a result, being digitally competent is not just an optional skill but a professional requirement in contemporary TVET teaching (Diao et al., 2023).

Professional Development Needs and Gaps in Training

Despite being recognized as a significant factor in the learning process of students, there is extensive empirical evidence suggesting that many secondary TVET teachers lack the digital competences they need and also have limited access to the types of training needed to be effective with technology in their classrooms. Studies conducted across Europe, Asia, and Africa (Tondeur et al., 2023), (Rahmatiah et al., 2022) illustrate that most teacher training programs provide only basic computer skills and do not develop pedagogically meaningful use of technology by teachers.

The persistent gap between the aspirational goals of policy for transforming teaching and learning through the use of technology and the preparation of teachers to teach using technology is a recurring theme (Butler et al., 2024). Some authors suggest that short, episodic training experiences are not capable of producing lasting or sustainable digital competences in teachers; other authors argue that the reason TVET institutions have not developed continuing professional development (CPD) models to help teachers develop and maintain their digital competences is due to a variety of factors, including resource constraints (Majola, 2024). Furthermore, developing countries experience an additional layer of difficulty, largely because of differences in the infrastructure available, institutional support, and motivation for implementing technology into their schools (Omweri, 2024).

Barriers and Challenges for the Development of a Digital Competence

There are a number of structural and personal reasons impeding digital competence development in TVET teacher ((Xin et al, 2024). Barriers previously described include limited availability of digital resources, scarce technical support, time poor to acquire training and lack of confidence in using technology (Koehler & Mishra., 2009; Ng, 2019). Unstable connectivity and outdated devices in resource-sensitive environments may further impede teachers' use of digital technologies. At the organizational level, lack of coherence among policies and leadership commitment weakens systemic capacity-building initiatives (Bahreini et al., 2021). Psychological causes such as technophobia and fear of change remain to be a problem, especially for older or longer serving teachers (Ottakath, 2025). On the other hand, some researchers emphasize that inefficient training design and a lack of mentoring systems will hinder the use of infrastructure even at existing installations (Pressey & Kendall, 2007). These results indicate that digital competency is influenced by a combination of personal, organizational and contextual factors beyond technical proficiency.

Emerging Trends and Innovative Approaches

Recent literature identifies that a change has been taking place in digital competence development towards more holistic and sustainable approaches. Blended learning workshops, peer-mentoring programs and collaborative professional development communities are

becoming success models (Lund et al., 2022). The combination of theories and models, such as TPACK (Technological Pedagogical Content Knowledge) and DigCompEdu can provide more systematic support for the alignment between pedagogy and technology utilization (Tomczyk & Fedeli, 2021). In addition, micro-credentialing and online certification are being utilized more frequently as a means of acknowledging and encouraging the adoption of digitally mediated professional learning among educators. Nevertheless, the success of such pioneering efforts is contingent upon adaptation to local contexts and institutional commitment. Critics warn that generic models threaten to underplay the diversity of TVET subject areas as well as technological contexts on-the-ground (Mancotywa, 2023).

Gaps, Controversies, and Implications for Practice

The literature shows that there are ongoing discussions about the definition and evaluation of digital competence (Sánchez-Canut et al., 2023). Some authors argue in favor of a standardized set of teaching competencies, while others favor context-sensitive approaches to account for a wide verity of learning settings (Xu et al., 2025). There is little longitudinal research examining whether training in digital competence impacts teaching practice over time or student outcomes (Hirsch & Rubach, 2024). Also, characteristics related to gender, generation and equity are underexplored (Farina et al., 2023). These gaps show the importance of conducting focused research on scalable teacher professional development models, and integration of digital competence in teacher education policy.

Indeed, from a technological standpoint, learning institutions should infuse digital training within their pre-service and in-service programs with appropriate mentorship, investment of infrastructure, and ongoing assessment (Gisbert-Cervera et al., 2022). The digital competency frameworks need to be linked with national education and labourmarket priorities to maintain the continued ability of TVET teachers teaching a digitally competent workforce (Grech, 2023).

Summary of Synthesis

On the whole, evident from the literature that there exists agreement on the significance of digital competence for quality TVET delivery with sustained weaknesses in training, resources and institutional support. Single Sentence Summary A new paradigm for professional development is being developed, but application has been uneven. Further efforts are required to narrow the technological-teacher readiness chasm via long-term context-based and policy-driven interventions.

Limitations

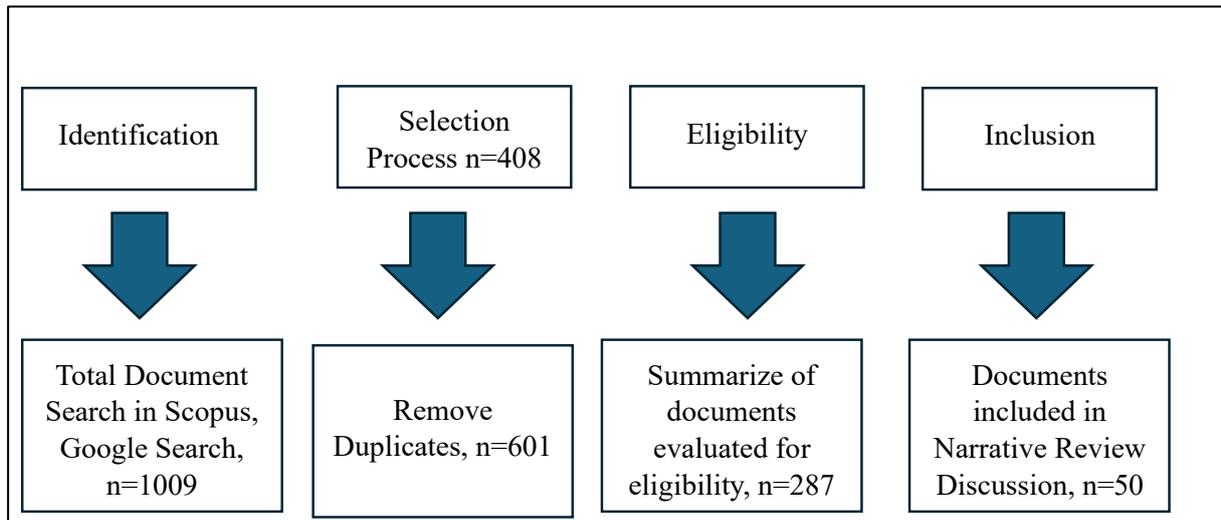


Figure 1. PRISMA-based Flow Diagram of Document Selection Process for Narrative Review

In total, 21 individual searches were carried out to systematically explore digital competency frameworks, training requirements, barriers and context relevant issues in secondary TVET education.

This narrative review is not without certain methodological and interpretive limitations, which need to be recognized. First, the non-systematic nature of narrative reviews means that studies are included based on relevance and thematic contribution rather than more systematically determined criteria. It is worth noting that research in nonindexed journals or in languages other than English may have been inadvertently precluded from these searches, perhaps limiting the search for a potential language and publication bias.

Furthermore, the diversity of studies made difficult to integrate these findings. Studies on TVE-TVET teachers' digital competences and training needs at secondary education level vary in terms of their contexts, approaches, methodologies, and constructs. Accordingly, comparing of results and extrapolation of findings is restricted. Most studies were based on self-report, and social desirability and overestimation of digital competence may bias results.

Additionally, the dominance of cross-sectional studies limits the ability to draw causal conclusions regarding training interventions and skill development. Third, the absence of standardized measures that evaluate digital competence beyond TVET disciplines will challenge synthesis and possibly result in discrepancies among interpretations. The use of existing literature by the review also suggests that emerging, or unpublished evidence may have been missed.

Other limitations should be targeted in future studies using systematic review methodologies, longitudinal study design and mixed methods research design in addition to the use of context-based EDC measures. Future reviews could be more comprehensive and representative by

broadening the breadth of research beyond English language sources and incorporating gray literature.

Conclusion

This narrative review has analysed the literature on digital technology competences and needs in-service training of component-form (secondary level) TVET teachers to conclude that there is, indeed, a broad consensus concerning the importance of digital competence for quality or forward-looking vocational education. While there is growing recognition and support in State policies, wide variations remain across the country in teacher's access to training, infrastructure and institutional provision. The synthesis identified that although models such as TPACK and DigCompEdu provide order to the guiding factors, they encounter varied implementation due to contextual and resource constraints. Evidence suggests that the majority of professional development focusses on basic technological proficiency to the detriment of pedagogically integrated digital competence and, thus, results in mere surface thought regarding technology adoption. Obstacles such as lack of self-confidence, poor mentorship and a faltering wisdom are also barriers to advancement. Relieving these shortcomings suggests that future efforts need to project a sustainable, contextually sensitive model of professional development that connects technological knowledge with pedagogical innovation. Policymakers and TVET leadership should also focus on systemic digital capacity building: ensuring equitable access to resources and training in both tools and methods among all TVET institutions. Longitudinal and mixed-method studies are recommended to determine the sustained impact of digital training on teaching quality and learner outcomes. Through enhancing these dimensions that greater theorising and practice around digital competence can be achieved, and that TVET teachers will become more prepared to respond to the needs of an increasingly digitalised workforce.

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