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Digital Skills in Technical and Vocational Education: A Data-Driven Analysis of TVET Competency Trends

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ABSTRACT

In the age of digital transformation, digital competence has become crucial for vocational educators to effectively align learning practices with the changing demands of the industry. This study aims to analyze the global development and thematic trends surrounding digital competence in Technical and Vocational Education and Training (TVET) through a combined approach of bibliometric analysis and a systematic literature review, referred to as Systematic Literature Network Analysis (SLNA). Utilizing Scopus as the primary database, the research retrieved 216 articles and employed bibliometric visualization tools (Bibliometrix, Biblioshiny, VOSviewer) alongside eligibility criteria-based screening for the systematic review. The results reveal three key insights: (1) significant connections between digital competence and the advancement of AI in vocational education, (2) the emerging importance of interaction and social competence in enhancing digital literacy, and (3) the limited yet essential integration of AI literacy within current digital competence frameworks. Two selected articles from the systematic literature review suggest that the combination of digital and social competencies is vital for preparing vocational teachers and students for the demands of a technology-driven workforce. This study underscores the necessity for a forward-looking digital competence framework that addresses the interplay between digital skills, social skills, and AI readiness within vocational education contexts.

Introduction

The rapid development of digital technology has significantly impacted various aspects of life, including the world of education. In the midst of global digital transformation, education can no longer be separated from technology; the learning process, evaluation, class management, and

professional collaboration now rely heavily on the use of digital technology (Knezek & Christensen, 2016; Najdabbasi & Pedaste, 2014; Valverde-Berrocoso et al., 2021). In this context, developing digital competencies for teachers is very crucial, especially for teachers in vocational education. Vocational education has different characteristics from general education because it aims to prepare graduates who are ready to work and have skills that are relevant to the needs of the business world and industry (DUDI). Therefore, vocational teachers are required not only to master the content of their field of expertise but also to be able to integrate digital technology into learning that reflects work practices (Han et al., 2023; Jatmoko et al., 2023; Rahmawati, 2022). Within the framework of the link and match policy between vocational schools and industry, teachers' digital competencies are an important foundation for bridging the gap between learning in schools and technological needs in the workplace. Without adequate mastery of digital competencies, teachers will have difficulty translating developments in industrial technology into the context of learning, which will ultimately have an impact on students' low readiness to face the increasingly digitalized world of work (Cavanagh et al., 2015; Mn et al., 2020).

Numerous previous studies have demonstrated that digital competence is a vital factor in enhancing the effectiveness of learning in the digital era. In a general context, Ertl et al. (2020) and FU & Pow (2011) emphasized that teachers' digital competence directly influences the quality of technology integration in educational settings and the success of digital-based learning. Additionally, Prestridge & Tondeur (2015) identified that teachers' digital competence encompasses not only technical skills but also deeper pedagogical and reflective dimensions. In Indonesia, research conducted by Astuti et al. (2021), Nursaimatussaddiya (2023), and Rahmah (2015) reveals that many teachers face challenges in understanding and applying technology pedagogically, despite their ability to use basic software. This issue becomes even more complex in the realm of vocational education. Research by Anori et al. (2022) and Wahjusaputri & Nastiti (2022) indicates that vocational teachers often struggle to keep pace with the rapid advancements in industrial technology, particularly in integrating digital tools and applications pertinent to specific fields such as automotive, hospitality, or computer engineering. Furthermore, it has been noted that the low digital competence of vocational teachers adversely affects students' abilities to engage with learning experiences that align with industry demands (Md Yusoff et al., 2012; Rodzalan et al., 2022). This highlights that, while awareness of the significance of digital competencies is growing, there remains a disparity between policy expectations and teacher preparedness, particularly in vocational education settings that must adapt to the evolving demands of the digital workforce. To

identify this research gap, the study will employ a literature review focusing on the current challenges and advancements in digital competence within vocational education to conduct a further empirical research.

This study aims to comprehensively and deeply analyze the global development of digital competence in vocational education. By conducting a combined method of bibliometric analysis and systematic literature review, which is globally known as Systematic Literature Network Analysis (SLNA), we seek to offer insights into the implementation of digital competence in vocational education on a global scale. These are the research questions for this study:

1. What are the current trends and future research directions in digital competence for vocational education? *(bibliometrics analysis)* and;
2. how important are digital and social competence relations? *(systematic literature review)*

A bibliometric analysis and a generated keyword answered the first research question. Moreover, the following research question would be answered by a different research question to answer a specific research question purposefully.

Literature Review

This chapter presents an integrative theoretical framework that merges three key constructs influencing digital transformation in vocational education: digital competence, readiness for artificial intelligence, and social interaction. These interrelated components collectively enhance the capacity of vocational teachers to effectively adopt and integrate digital technologies into their teaching practices.

Digital Competence

Digital competence is described as a combination of knowledge, skills, attitudes, and understandings needs for the effective, critical, and responsible use of digital technologies across different contexts, including education. Digital competence was first introduced by Gilster in 1997 under the term "digital literacy," which emphasizes the ability to comprehend and utilize information presented in various digital formats (Gilster & Glister, 1997). Over time, this concept has evolved into a more structured understanding, commonly known as "digital competence." This notion has increasingly concentrated on specific domains, particularly within the field of Education. A prominent example is the Digital Competence Framework for Educators (DigCompEdu), developed by the European Commission in 2017, which outlines six core competencies (Redecker, 2017). Digital competence is increasingly vital in vocational education, as teachers must not only incorporate technology into their teaching methods but also cultivate digital skills that align with

industry demands. Vocational education aims to prepare graduates who are not only job-ready but also adaptable to the latest technological advancements in the workplace. Therefore, it is essential for vocational teachers to possess digital competence that goes beyond pedagogical skills and encompasses knowledge relevant to the evolution of industrial technology.

Numerous studies have demonstrated that digital competence is a crucial factor in the success of 21st-century education, encompassing both general and vocational settings. Research indicates that various factors, including age, teaching experience, educational background, and participation in ICT training, significantly influence teachers' digital competence (Antonietti et al., 2022; Saripudin et al., 2021). In vocational education, teachers encounter a dual challenge: they must not only master technology for effective learning but also grasp the technological aspects relevant to their students' specific industries. This highlights the urgent need for vocational teachers to enhance their digital competence; without these skills, they may struggle to provide contextual and applicable learning experiences. Consequently, investing in the digital competence of vocational teachers is a strategic initiative aimed at ensuring that graduates are work-ready and competitive in the digital age (Gunadi et al., 2020).

AI in Education

Artificial intelligence literacy (AI literacy) pertains to an individual's capability to comprehend, assess, and ethically utilize artificial intelligence technologies in both professional and everyday settings. In the educational context, AI literacy encompasses not only a technical understanding of the functioning of algorithms or intelligent systems but also an awareness of the social, ethical, and pedagogical implications associated with their use (Alam, 2021). The advancement of artificial intelligence technologies, such as chatbots and intelligent tutoring systems, is increasingly being integrated into various educational contexts (Akgun & Greenhow, 2022). In vocational education, the significance of AI literacy is on the rise as the industrial sector increasingly incorporates AI technology into its operations. Vocational educators must not only be well-versed in this technology but also adept at integrating it into the learning process. This integration ensures that students become familiar with and prepared to thrive in an automated, data-driven work environment.

Previous studies have indicated that the integration of AI in education enhances learning efficiency, offers a more personalized learning experience, and facilitates data-driven assessment. A study by Luckin in 2016 highlighted the significance of pedagogical understanding in the implementation of AI in the classroom, stressing that its use should not solely prioritize efficiency but also foster meaningful learning processes (Holmes & Luckin, 2016). Various studies have

highlighted that teachers encounter difficulties in comprehending both the potential and the limitations of AI technology, particularly in relation to student data privacy and algorithmic bias. Enhancing AI literacy among vocational educators is crucial, as they serve as a vital link between the educational landscape and the professional world. Teachers equipped with a solid understanding of AI can empower students to develop a critical awareness of technology and prepare them to thrive in a workplace that is continuously evolving due to technological advancements.

Recent literature indicates that AI literacy is a crucial component in equipping educators and students in vocational education to navigate the increasingly complex challenges posed by digital technology. A previous study emphasized that AI literacy—comprising knowledge, skills, and attitudes toward AI—indirectly influences risk awareness regarding the use of generative AI (GAI) through the mediation of AI self-efficacy (Barbas et al., 2025). This finding highlights the importance of individual confidence in using Generative AI (GAI) technology to manage risks like algorithmic bias and technology dependency in vocational education. Additionally, research shows that while ChatGPT can enhance students' critical thinking and reflection skills, its use requires guidance and reinforcement of academic integrity (Wu et al., 2025). A recent study highlights that the success of AI integration in vocational education relies significantly on teachers' readiness to adopt AI, including their understanding of its potential and limitations. Mastery of AI literacy and digital competence involves not only technical skills but also cognitive, affective, and social dimensions. For vocational education teachers, the responsible application of AI is essential for creating adaptive, innovative, and ethical learning experiences (Rosyadi et al., 2023). Engagement of educators in online communities and intergenerational collaboration with emerging teachers can enhance self-efficacy and promote technology adoption. Thus, fostering AI literacy and awareness of technological risks is essential through a sustainable framework rooted in authentic experiences in vocational education.

Social Competence

Social competence refers to an individual's ability to interact effectively and harmoniously in a social environment, including communication skills, collaboration, empathy, and intercultural awareness (Mulder, 2017). In the technological development era, especially in the field of education, social competence is becoming increasingly important because teachers and students are not only required to master technology, but also to build relationships and communication that support collaborative learning processes. In a vocational education environment, where interaction with the industrial world is an integral part of the educational process, social competence is very important

to bridge academic and professional needs (Monnier et al., 2016). Vocational teachers are required to not only deliver technical material, but also instill the values of cooperation, professional ethics, and communication skills in a multicultural and cross-generational work environment.

Several studies showed that the integration of digital and social competencies is crucial for vocational teachers in dealing with the complexity of increasingly diverse learners' needs. A study by Hernández-Serrano et al. (2025) developed and tested a flexible framework that combines digital and social competencies in the context of vocational education in five European countries (Hernández-Serrano et al., 2025). Their findings confirm that vocational teachers need training that develops cross-contextual skills, including social skills, to reach learners from vulnerable backgrounds and build inclusive learning environments. This framework reflects the importance of developing teachers who are not only technically competent but also able to facilitate learning with a humanistic approach (Sokolova & Sergeeva, 2021). Therefore, in facing global challenges such as digitalization, social inclusion, and sustainability, the social competence of vocational teachers is an important foundation in transforming learning towards something more adaptive and meaningful.

A humanistic approach of social competence for teachers is related to how the teachers learn and implement technology wisely using thei digital and AI competence. The connection of these three components can be visualized in figure 1.

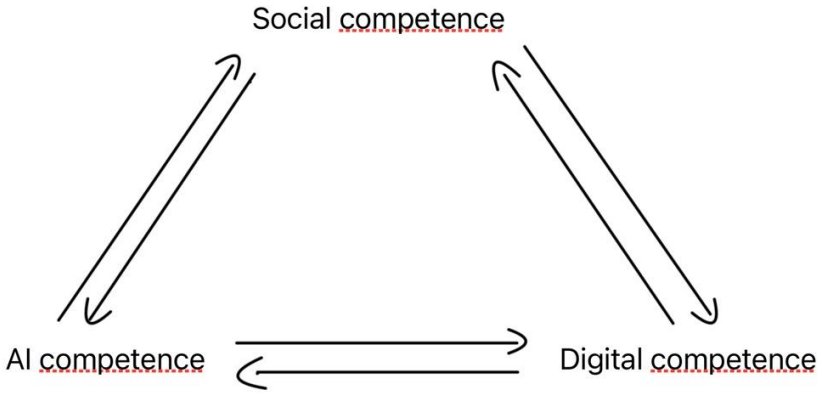

Fig 1: PRISMA Flow

The doubts about how to effectively teach business to undergraduate students persist, as the skills and competencies needed in the business world are difficult to achieve through traditional classroom instruction, which often involves passive student participation. In Indonesia, despite the growing demand for entrepreneurship education, studies indicate that its implementation in higher education institutions has not been fully effective (Ghina, 2014; Larso et al., 2012). Inefficiencies

stem from a limited understanding of appropriate methods to teach and foster new entrepreneurs (Rumijati, 2017; Priyanto, 2012). Most courses still rely heavily on teacher-centered approaches, with minimal active involvement from students.

Entrepreneurship, however, is a dynamic learning process that demands motivation, creativity, and the ability to develop and implement new business ideas. It requires various skills, such as risk calculation, team formation, resource management, business planning, and opportunity recognition (Kolb, 2014). Given this complexity, educators have a crucial role in developing students' skills in discovery, planning, and managing business ideas under conditions of uncertainty (Neck and Greene, 2011).

To address these challenges, more modern approaches such as Experiential Learning (EL) have emerged. EL emphasizes learning by doing, encouraging students to try, experiment, and learn from their experiences. According to Othman et al. (2012), cultivating an entrepreneurial spirit in students is essential for effective entrepreneurship education. Several scholars support the use of EL in this context, highlighting its role in building entrepreneurial skills and attitudes (Nabi et al., 2017; Neck & Greene, 2011; Politis, 2005). Kolb's (2014) Experiential Learning Theory explains that knowledge is created through a cycle of experience, reflection, thinking, and action. Research by Cervantes-Guzmán (2021) also shows that EL significantly influences students' entrepreneurial intentions, while Mason and Arshed (2013) demonstrate that EL exposes students directly to real-world entrepreneurial challenges.

Further studies strengthen this argument, showing that EL contributes to business start-up development, career planning, and entrepreneurial decision-making through risk management, strategic action, and ethical business practices (Karia et al., 2015; Ferreira, 2020; Mansoori, 2017; Awaysheh & Bonfiglo, 2017; Morris & König, 2021). Thus, integrating EL into entrepreneurship education is highly relevant, particularly for Indonesia's goal of producing entrepreneurial graduates who are ready to develop businesses and create job opportunities.

By applying EL, students directly engage with real-world business challenges, such as planning strategies, marketing, and management, thereby deepening their entrepreneurial competencies (Kolb, 1984; Manimala & Thomas, 2017). Moreover, EL encourages students to solve problems within their environment, further strengthening their entrepreneurial mindset (Fromm et al., 2021).

Nevertheless, research on the application of EL in Indonesian universities remains limited. Addressing this gap, the present study conducts a systematic literature review to examine the use and impact of EL in entrepreneurship education within Indonesia. The study aims to organize

existing knowledge, connect practices and outcomes, and offer insights that can be adapted across higher education institutions.

Method

This study arises from technology development, especially in vocational education, and focuses on artificial intelligence (AI) (Alam, 2021; Schiff, 2022). Therefore, it aims to provide insight and an overview of digital competence trends toward technological advancement in vocational education. The method of this study employed systematic literature network analysis (SLNA), which combines bibliometrics and Systematic Literature Review (SLR) techniques. Bibliometric analysis is a review method that uses quantitative methodologies and bibliometric data to advance scientific research (Donthu et al., 2021). Meanwhile, a systematic literature review uses qualitative approaches, such as literature surveys, to identify, retrieve, and present data through a review process (Barbara Kitchenham & Charters, 2007). In this research, we used Scopus as the database to download the dataset and as one of the biggest databases in a research field (Diz-Otero et al., 2022; Lemay et al., 2021; Martín-Martín et al., 2018; Muktiarni et al., 2021; Sánchez-Cruzado et al., 2021; Singh et al., 2021). The database is limited to the utilization of the Scopus database because of its broad range of coverage for literature review studies. It has reputable and high-impact peer-reviewed journals in the database. We retrieved the dataset from Scopus for bibliometrics analysis by searching the publication using this structured keyword:

(TITLE-ABS-KEY ("digital literac*" OR "digital competenc*" OR "digital abilit*" OR "digital skill*") AND TITLE-ABS-KEY ("vocational education" OR tvet OR vet OR vet OR cte OR "Technical and Vocational Education and Training" OR "Career and Technical Education" OR polytechnic))

Our search yielded a total of 216 articles, which were carefully evaluated to determine their relevance to the study's focus on digital competence in vocational education. We chose not to impose strict specifications for the bibliometric study, as the researcher aimed to explore the topic from multiple perspectives. The bibliometric analysis for this study was conducted using the RStudio application "Bibliometrix," along with the graphical web version of "Biblioshiny" and VOSViewer. In contrast, the Systematic Literature Review (SLR) adopted a more rigorous approach, with researchers imposing specific limitations to ensure quality during the review process. These limitations were defined through eligibility criteria and selection choices within the Scopus database. The eligibility criteria of the SLR are described in Table 1.

Table 1. Eligibility Criteria

Inclusion Criteria	*Exclusion Criteria*
The articles are focused on digital competence in vocational education	The articles are not focused on digital competence in vocational education
The articles are published from 2020 to 2025	The articles are not published from 2020 to 2025
The articles are written in English	The articles are not written in English
The articles are not a pre-proof or preprints type of paper	The articles are a pre-proof or preprints type of paper
The articles are published in a journal	The articles are not published in a journal

In the systematic literature review process, articles deemed irrelevant or lacking substantial content were excluded from our dataset during the review. Ultimately, the final articles included in the SLR were only two. The starting point of this SLR review is 2020 because the development of research in digital competence, especially in vocational education, significantly increased during the COVID-19 pandemic (Diz-Otero et al., 2022; Duarte Alonso et al., 2020; Lemay et al., 2021; Sánchez-Cruzado et al., 2021; Saripudin et al., 2020). However, the results showed that the start of digital competence and social competence connection is in 2025. Two articles are the final selected criteria included in this SLR and answered the research questions. The PRISMA flow in Figure 2 describes the process of SLR.

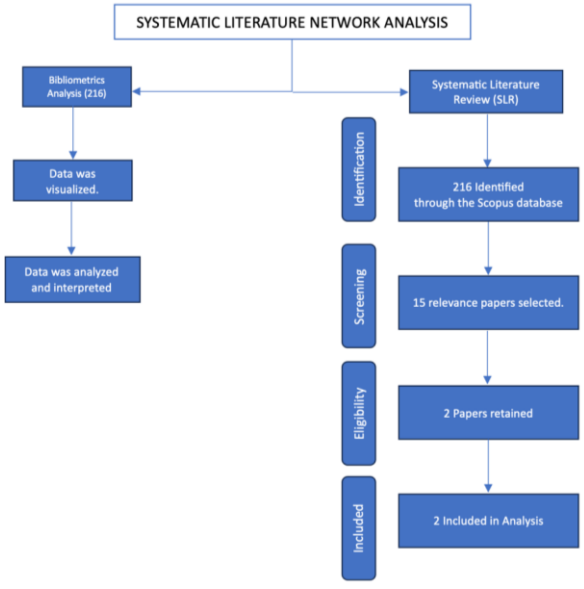

Fig 2: PRISMA Flow

Results and Discussion

This study examined three research topics to determine the development of digital competence, significant areas of digital competence in vocational education, and current trends in vocational education. The results and discussions are arranged based on the study question.

1. What are the current trends and future research directions in digital competence for vocational education? and;
2. How important are digital and social competence relations?

To provide valuable insights into vocational education and digital competence. The research question can be answered by several fields of analysis, such as co-occurrence, three-field plot, and systematic literature review.

a. Three-field plot analysis

The three-field plot analysis, a significant tool in this research, explains the correlations among the references, authors, and keywords. This analysis helps the researcher identify the research development of digital competence in vocational education. Figure 3 shows that the most cited reference is from Belaya and Ferrari, who discussed two different things. Belaya analyzed the use of e-learning in vocational education and training (VET), employing a systematic literature review to describe the research development. Ferrari was developing a framework for digital competence, and it has become a famous framework for assessing digital competence or literacy. The most used and influential keyword in this plot graph is "digital skill". On the other side, Kholifah, Rauseo, and Nurtanto are the top three contributing authors with more than three documents. Three fields of the plot identified that the topic of digital competence in vocational education is strongly connected with digital transformation in vocational education. Digital transformation is crucial in vocational education. However, digital change in vocational education faces numerous challenges. Their objectives encompass enhancing students' learning capacity and initiative, further embedding information technology in pedagogy, updating and elevating the quality and level of digital teaching proficiency, augmenting data-driven management and service competencies, upgrading digital support infrastructure, and refining digital systems and mechanisms (Han et al., 2023).

The second most cited reference comes from Stephen Billett's book titled "Vocational Education: Purpose, Traditions, and Prospects, published in 2011" (Billett, 2011). This work offers a profound exploration of the purpose of vocational education, which serves as a cornerstone for its development. As illustrated in Figure 3, Indonesia stands out as the most productive country regarding authors and institutions. However, Table 2 reveals that Switzerland leads the way with

the highest number of citations, totaling 239. Nonetheless, Indonesia remains among the top three countries with the highest citations regarding digital competence in vocational education. The data suggests that the high citations do not necessarily ensure that they will lead to significant findings or possess a high impact factor in the context of academic discourse.

The discourse surrounding digital competence in vocational education persists, and technological advancements are accelerating yearly. Despite this progress, several prior research studies indicate that teachers are not adequately prepared to navigate the technological changes impacting their daily teaching practices (Cattaneo et al., 2022; Falloon, 2020; Martínez-Rico et al., 2022; Saripudin et al., 2021). The research explained that the biggest challenges for teachers in developing their digital competence are facilities, workloads, teaching experience, age, and curriculum support. Moreover, in this AI era, teachers face a significant challenge in elevating and adapting to new skills.

Table 2. Countries Citation Total

Country	***Total Citation***	***Average Article Citations***
Switzerland	239	47.80
Netherland	235	78.30
Indonesia	173	6.20
Spain	124	13.80
USA	81	81.00

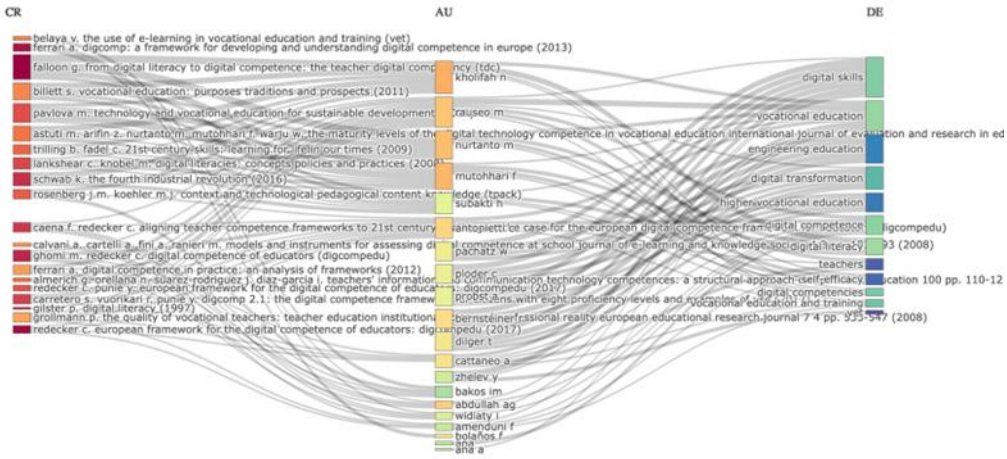

Fig 3: Three-Field-Plot analysis (AU= Authors, CR= References, DE= Author Keywords)

b. Co-occurrence analysis

To determine the most prominent keyword in this study, the author employed VOSViewer, which uses co-occurrence analysis to provide an overview of keyword development. The author also

used overlay visualization to find recent keywords related to digital competence in vocational education. To broaden and diversify the topic overview, the author chose the "all keywords" unit of analysis in VOSViewer, which mixed author and index keywords. The figure of overlay visualization shows that the keyword most used in this topic is vocational education. Vocational education is highly connected with digital competence, literacya, and skills. However, the color explained that it is not new and has been researched in the last 5-10 years and more.

The latest topic within the relationship between vocational education and digital competence is "Generative AI". A previous study described that generative AI has become a big concern, especially in Education, since the launch of *Chat*GPT in 2022 (Wimmer et al., 2024a). Still, the hype of generative AI in academic research is not something new (Liikkanen, 2019). Amongst this milieu, the rise of generative AI so far gives education many benefits, such as personalized learning, assessment tools, and any helpful recognition for learning (Akgun & Greenhow, 2022). The study of Generative AI was really rocketing in 2024, with 7730 documents found on the Scopus database but only 21 papers on generative AI connected with vocational education. Research from Wu (Wu et al., 2025) showed that generative AI in education has excellent intentions, but the results of the risk awareness are still unsupported.

One of the studies in the literature mentioned that there are many digital competence frameworks for both citizens and educators. However, fewer of them are concerned with vocational educators. Vocational educators are highly demanded to be skillful in theory and workplace-applied skills that should be updated with digital technology advancement (Hernández-Serrano et al., 2025). Vocational educators should balance their skills with social competencies and combine them with digital competence to produce a competent student in an actual workplace. Moreover, digital development in education is now highly engaged with AI, which needs teachers with more advanced competence (Bower et al., 2024; Lang et al., 2025; Wu et al., 2025). It can be concluded that, through this literature review, it needs a future digital competence framework that should also be concerned with the vocational education sector and can be adjusted to the needs of the teachers in the TVET area.

The keyword "interaction" is also newly connected with digital competence topics in vocational education. Several articles discuss the importance of interaction in elevating an individual's digital competence, which started in 2010. Even though it was started in 2010, the topic of interaction vocational education and digital competence has increased in the last 5 years, which makes it a newly discussed topic. There are 13 articles explaining the interaction of digital competence in

vocational education. One of the studies focused on how interaction is essential in increasing digital competence between students, teachers, people with disabilities, and employers through a peer community in Ireland since 2015 (Magennis et al., 2015). This community was built to facilitate the individual building of digital skills through peer support.

One of the emerging keywords in the co-occurrence analysis concerning digital competence development is “AI literacy.” Notably, this term is more closely associated with digital competence than vocational education. The discussion around AI literacy has gained traction, particularly following the rapid proliferation of generative AI technologies since 2022. The average year of publication for research on AI literacy is projected to be 2024. This topic primarily explores how AI competencies are interconnected with an individual’s digital skills and how generative AI transforms educational realities and practices (Jemetz et al., 2025). Research on AI literacy often intersects with various components of digital competence, specifically examining which AI skills are encompassed within these components. This connection presents an opportunity to develop a novel research topic and framework for digital competence, suggesting that AI literacy skills should be integrated into the existing components of digital competence.

In this co-occurrence analysis, three significant findings emerge as potential focal points for enhancing digital competence. Firstly, there is a notable connection between digital competence in vocational education and the rise of generative AI. This includes the application of AI in teaching, research, and implementation and its impact on everyday use (Su & Yang, 2023). Secondly, "interaction" has been newly linked to digital competence in vocational education, with most research indicating that digital competence develops through frequent interaction. This aligns with earlier studies by Bergum, which explored how digital interaction and communication influence teachers' careers from the pre-service phase onward (Bergum Johanson et al., 2023). The keyword “AI Literacy” represents the latest development in this area. AI literacy, particularly within vocational education, is crucial because the integration of AI in industry is significant, necessitating a robust framework for technology application in industrial settings (Pillai et al., 2022). It is essential to cultivate a workforce that not only comprehends the technological landscape but also equips vocational students and their teachers to become experts in the evolving domain of technology (King et al., 2019; Wattenberg & Franken, 2019; Wimmer et al., 2024b).

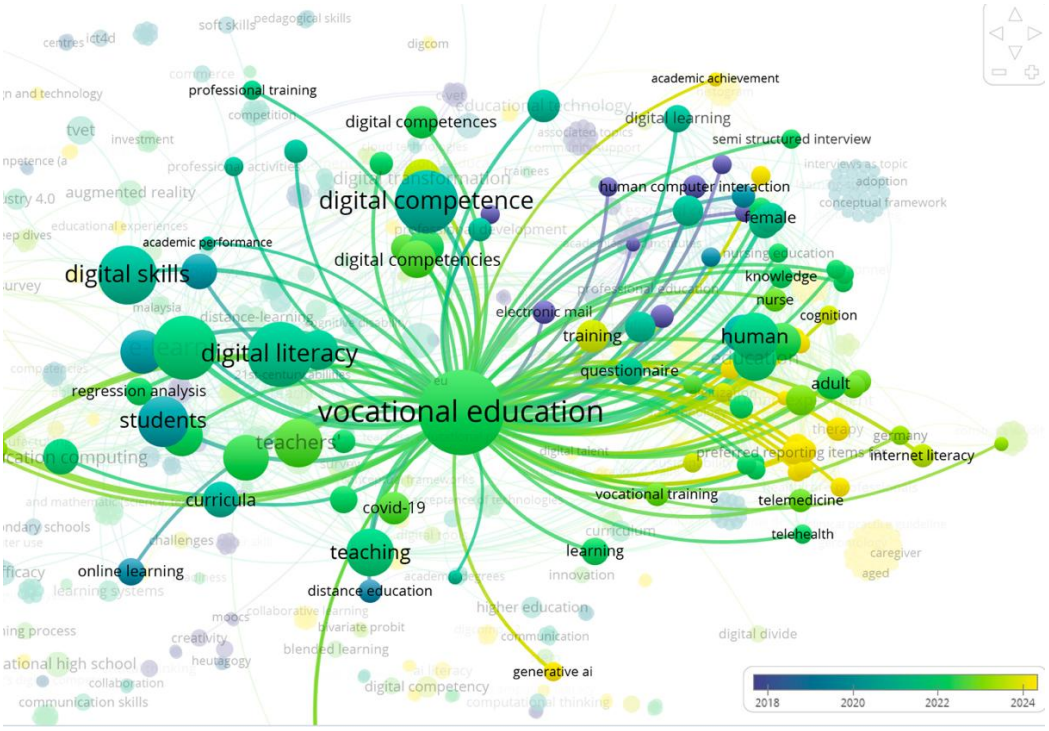

Fig 4: Co-occurrence analysis using overlay visualization

c. Systematic Literature Review (SLR) Results

This study utilized a specific keyword for its systematic literature review (SLR) to intentionally explore the relationship between digital competence and social competence in vocational education. The research question guiding the SLR is, "How significant are the relationships between digital and social competence?" The search using these specific keywords yielded only two articles addressing digital and social competence. The first article, authored by Hernandez in 2025, concentrated on developing a framework that integrates digital and social competence. (Hernández-Serrano, Cullen, et al., 2025). The study indicates that digital and social competencies should work in tandem with vocational education teachers. Integrating these competencies into vocational education and training (VET) frameworks represents a crucial advancement in meeting the evolving demands of the 21st-century labor market.

The article highlights the importance of equipping VET instructors with comprehensive, adaptable, and contextually relevant skills that address technical innovations and socio-professional challenges for educators and learners. This article is supported by another article that is not included in the search results by Abdellah (Elfeky et al., 2023). The study investigated the impact of big data on electronic social competence. It defined big data in conjunction with the social competence scale among investment diploma students, highlighting its role in enhancing their

academic goals throughout the semester. The relationship between digital and social competence is crucial for improving individuals' social skills.

Digital competence is believed to be connected to social competence, especially as the advantages of digital technology have become more pronounced. Research indicates that digital environments can foster individuals' social skills, particularly in areas such as empathy, self-regulation, cooperation, and overall interpersonal abilities (McNaughton et al., 2018). The first study emphasized the connection between digital competence and social competence for VET teachers. The findings indicate a significant correlation between the digital competence of vocational education and training (VET) teachers and their social competence and collaborative intelligence. This relationship was substantiated through statistical analysis, particularly utilizing a t-test, which revealed a notable reduction in scores following examination. In contrast, the data concerning creativity did not yield statistically significant results, suggesting that while digital and social competencies are interrelated, creativity may require further investigation to establish its connection with digital competence in this context (Hernández-Serrano, Morales-Romo, et al., 2025b).

The second study conducted by researcher Maria addressed the integration of digital and social competencies within the context of vocational education. This investigation successfully developed a comprehensive framework designed to amalgamate these competencies through a unified project. The project was implemented as a pilot across five distinct countries—namely the United Kingdom, Sweden, Germany, Italy, and Spain—thereby aiming to attain a more generalized outcome. Using the change theory method, the findings delineated three primary domains within the framework, which categorize the competencies into distinct yet interrelated areas: the digital competence domain, the domain encompassing both digital and social competencies, and the social competence domain. The final framework is known as FLEXI-COMP (Hernández-Serrano, Cullen, et al., 2025).

These two studies represent a fresh perspective on the topic of digital competence within vocational education, particularly concerning teachers' competencies. Previous research has primarily focused on the challenges teachers face in developing their digital skills, the factors influencing their level of digital competence, and the current state of such competence across various educational levels (Astuti et al., 2021; Cattaneo et al., 2022b; Guillén-Gámez et al., 2021; Lucas et al., 2021; Sánchez-Cruzado et al., 2021b; Warno, 2020). Notably, this new study introduces an additional component to the concept of digital competence, which could serve as a significant point of interest for future research developments. It emphasizes the need for implementing,

developing, or evaluating these studies further. This study highlights several emerging areas within the field of vocational education and digital competence that are infrequently addressed. Notably, it reveals that digital competence in vocational education is increasingly intertwined with the rapid advancement of artificial intelligence, as well as with social competence. These three components could be integrated into a single research topic for further empirical investigation.

Conclusion

This study addressed two research questions and examined general trends as well as the specific connection between digital, social competence and AI competence using bibliometrics results. The findings revealed several insights. Notably, the development of digital competence research in vocational education is particularly robust in Indonesia, which has the highest number of published articles and numerous authors investigating this area. However, the current literature rarely emphasizes the relationship between digital competence and advancements in artificial intelligence (AI), particularly concerning the interaction between AI development in schools and industry and its implications for digital competence. Nonetheless, two recent studies have explored the importance of both digital and social competence for teachers in vocational education. This research introduced new perspectives that warrant further investigation. Future empirical studies could focus on the intersection of digital competence and AI literacy within vocational education, as well as the relationship between digital and social competence and the latest technological developments in the vocational field. This study is limited by the data gathered from a single database. Therefore, it is recommended that future literature reviews expand their scope by utilizing multiple prominent databases.

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