

Digital Literacy For Vocational High School Students: A Systematic Review

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ABSTRACT

Digital literacy has become a crucial competence in vocational education as digital technologies increasingly shape learning processes and workplace practices. In vocational high school contexts, digital literacy is essential not only for supporting academic learning but also for preparing students for industry-oriented demands. However, empirical research on digital literacy among vocational high school students remains fragmented and lacks systematic synthesis. This study aims to systematically review empirical studies on digital literacy among vocational high school students, focusing on the types of digital literacy employed, the learning activities supported, and the challenges encountered in implementation.

A systematic literature review was conducted in accordance with the PRISMA guidelines. Google Scholar was used as the sole database to identify relevant empirical studies published between

2019 and 2025. Following the identification of 1,340 records, a structured screening and eligibility assessment process was applied. Thirteen empirical studies met the predefined inclusion criteria and were included in the final qualitative synthesis. Data were analyzed using narrative and thematic synthesis aligned with three research questions.

The findings reveal that digital literacy in vocational education is a multidimensional construct encompassing basic digital literacy, information literacy, technology literacy, and digital learning competence. Digital literacy supports a range of learning activities, including mobile learning, project-based learning, reading-based digital tasks, and vocational software practice. However, the implementation of digital literacy is constrained by persistent challenges, such as limited access to digital infrastructure, insufficient teacher readiness, students' difficulties with self-regulated learning, and misalignment between digital literacy initiatives and vocational curricula.

This review highlights the need for a holistic and context-sensitive approach to digital literacy integration in vocational high schools. The findings provide evidence-based insights for educators, curriculum developers, and policymakers, and suggest directions for future research focusing on equitable access, professional teaching development, and longitudinal impacts of digital literacy interventions.

Keywords: digital literacy; vocational high school; vocational education; systematic literature review; PRISMA

INTRODUCTION

Digital literacy has become an essential competence in contemporary education, particularly in response to the rapid integration of digital technologies into teaching, learning, and workplace practices. In vocational high school contexts, digital literacy plays a critical role not only in supporting academic learning but also in preparing students for industry demands that increasingly require technological fluency, information management skills, and adaptive digital competencies. As

vocational education emphasizes practical skills and employability, the ability to engage effectively with digital tools and environments has become inseparable from vocational competence itself.

The concept of digital literacy extends beyond basic technical skills. Scholars have conceptualized digital literacy as a multidimensional construct encompassing the ability to operate digital devices, evaluate and manage information, use technology for domain-specific tasks, and engage in self-directed learning within digital environments. In vocational education, these dimensions are particularly salient because students are often required to interact with digital learning platforms, vocational software, and online resources aligned with specific occupational fields. Consequently, digital literacy functions not merely as a general educational skill but as a pedagogical and professional enabler in vocational high schools.

In recent years, a growing body of empirical research has examined digital literacy among vocational high school students. These studies have explored diverse aspects, including students' digital literacy levels, the integration of digital literacy into subject learning, and the relationship between digital literacy and outcomes such as academic performance, work readiness, and career adaptability. However, the existing literature is characterized by fragmentation. Individual studies often focus on specific dimensions of digital literacy, particular learning activities, or isolated educational contexts, making it difficult to draw comprehensive conclusions about how digital literacy is conceptualized, implemented, and experienced across vocational education settings.

Moreover, challenges related to digital literacy implementation in vocational high schools are frequently reported but not systematically synthesized. Issues such as unequal access to digital infrastructure, varying levels of teacher readiness, and students' difficulties with self-regulated digital learning appear repeatedly in empirical studies. Yet, without a structured synthesis, these challenges remain dispersed across individual publications, limiting their usefulness for informing policy decisions, curriculum design, and instructional practices in vocational education.

The theoretical rationale for the importance of digital literacy in vocational high school education is grounded in several complementary psychological, pedagogical, and sociocultural frameworks. From a motivational perspective, Self-Determination Theory (SDT) Ryan and Deci (2020) provides a strong explanatory basis for understanding how digital literacy practices can enhance students' engagement in vocational learning. Well-designed digital learning environments have the potential to support students' psychological needs for competence, autonomy, and relatedness. For vocational students, competence is fostered when they successfully operate digital tools, access vocational software, or complete technology-mediated tasks aligned with real workplace practices. Autonomy is supported when students are given opportunities to navigate digital resources, select learning pathways, or engage in self-paced digital learning. Relatedness emerges through collaborative digital activities, online discussions, or shared problem-solving tasks within vocational learning communities. When these needs are fulfilled, students are more likely to develop intrinsic motivation, sustained engagement, and persistence in learning tasks (Ryan & Deci, 2020).

From a cognitive and pedagogical standpoint, digital literacy aligns with principles of meaningful learning and cognitive engagement. Digital learning activities often require students to search for information, evaluate sources, integrate multimodal content, and apply knowledge to authentic tasks. These processes are consistent with constructivist learning theories, which emphasize active knowledge construction rather than passive reception. In vocational education, digital literacy supports situated learning by allowing students to engage with tools and practices that resemble real-world occupational contexts, such as industry-related software, digital simulations, and online problem-solving tasks. Such activities promote deeper cognitive processing and the transfer of learning to practical vocational settings.

In addition, sociocultural theory Vygotsky (1978) provides a relevant lens for understanding digital literacy as a socially mediated practice. Digital tools function as cultural artifacts that shape how learners interact, communicate, and construct

knowledge. In vocational classrooms, digital literacy development often occurs through guided interaction with teachers, peers, and digital resources. Teachers play a crucial role in scaffolding students' use of digital tools, gradually supporting learners to move from basic operational skills toward more complex and independent digital practices. This perspective highlights that digital literacy is not merely an individual skill, but a socially situated competence shaped by instructional support and learning environments.

Despite its strong theoretical foundations, the empirical evidence on digital literacy in vocational high school contexts remains fragmented and inconclusive. While numerous studies report positive associations between digital literacy and outcomes such as learning achievement, work readiness, and career adaptability, other studies point to persistent challenges, including limited access to digital infrastructure, insufficient teacher readiness, and students' difficulties with self-regulated digital learning. Some research suggests that without adequate pedagogical design and institutional support, digital literacy initiatives may fail to produce meaningful learning gains or may even exacerbate existing educational inequalities.

This inconsistency in empirical findings mirrors the situation observed in other educational domains, where theoretically promising approaches yield varied outcomes in practice. Consequently, there is a pressing need for a systematic synthesis of empirical studies that specifically examine digital literacy among vocational high school students. Such a synthesis is essential to clarify dominant patterns, identify recurring challenges, and provide evidence-based insights that can guide instructional design, teacher professional development, and policy decisions in vocational education.

Research Gap

While previous reviews have addressed digital literacy or technology integration in education more broadly, there remains a notable lack of systematic literature reviews that focus explicitly on digital literacy among vocational high school students. Existing

reviews often combine general secondary education, higher education, and vocational contexts, or they emphasize technological tools rather than students' digital literacy practices and experiences. As a result, vocational education, which has distinct pedagogical goals, learning environments, and industry-oriented demands, has not received sufficient attention in systematic syntheses.

Furthermore, many reviews do not simultaneously examine the types of digital literacy, the learning activities supported by digital literacy, and the challenges encountered during implementation within a single analytical framework. This gap limits the ability to understand digital literacy in vocational education holistically and to identify patterns that cut across different empirical studies.

Research Questions

To address these gaps, the present study conducts a systematic literature review of empirical research on digital literacy among vocational high school students. The review aims to synthesize existing evidence to provide a clearer and more integrated understanding of digital literacy in vocational education contexts. The review is guided by the following research questions:

1. What types of digital literacy are employed by vocational high school students?
2. What learning activities are supported by digital literacy in vocational education?
3. What challenges are reported in implementing digital literacy among vocational high school students?

By systematically addressing these questions, this review seeks to offer evidence-based insights that can inform vocational education practitioners, curriculum developers, and researchers, as well as to identify directions for future research in digital literacy and vocational education.

METHODOLOGY

This study employed a Systematic Literature Review (SLR) approach to synthesize empirical evidence on digital literacy among vocational high school students. The review was designed to ensure

methodological transparency, replicability, and rigor, and was conducted in accordance with the Preferred Reporting Items for Systematic

Reviews and Meta-Analyses (PRISMA) guidelines. The methodological procedures encompassed four main stages: search strategy, inclusion and exclusion criteria, study selection process, and data extraction and synthesis.

Search Strategy

This systematic literature review followed the PRISMA guidelines to ensure a transparent, replicable, and rigorous review process, encompassing the stages of identification, screening, eligibility assessment, and inclusion. A structured literature search was conducted to identify empirical studies examining digital literacy among vocational high school students published between 2019 and 2025.

Google Scholar was selected as the sole database for this review due to its broad coverage of multidisciplinary educational publications and its capacity to index both international and Indonesian research relevant to vocational education contexts.

Search database. The electronic search was conducted exclusively in Google Scholar (custom year range applied manually: 2019–2025).

Search keywords and query construction. Search terms were derived from three conceptual domains aligned with the research questions:

a. Digital literacy construct (digital literacy / digital competence / digital skills),

b. Vocational education context (vocational/vocational education / vocational high school), and

c. Target population (students). The primary search strings included:

1. "digital literacy" AND "vocational high school students"

2. "digital literacy" AND "vocational education" AND students

3. "digital competence" AND "vocational students"

4. "digital skills" AND "vocational education"

Quotation marks were used to ensure phrase accuracy, and Boolean operators were applied to narrow results to relevant records.

Search limits and filters

To maintain relevance and feasibility, the following filters were applied manually:

1. Publication year: 2019–2025,
2. Language: English and Indonesian,
3. Accessibility: full-text availability, and
4. Document type focus: peer-reviewed journal articles were prioritized.

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Search yield (identification)

The core search string “digital literacy” “vocational high school students” within the year range 2019–2025 yielded a total of 1,340 records.

Screening scope decision

Due to the large and dynamically ranked output generated by Google Scholar, the initial screening was operationalized by reviewing the first 20 records displayed on the first results page under the applied filters. This decision was made to ensure feasibility while maintaining transparent documentation of the selection pathway. This operational limitation is acknowledged and further addressed in the limitations section.

Inclusion and Exclusion Criteria

Inclusion criteria

Studies were included if they met all of the following conditions:

1. Population: vocational high school students (SMK/secondary vocational students).
2. Focus/Concept: explicitly investigated digital literacy or closely related constructs (e.g., digital competence, technology literacy, digital learning competence).
3. Context: vocational education/TVET/secondary vocational learning settings.
4. Study design: empirical study with clear methods and data (quantitative, qualitative, or mixed methods).
5. Publication years: 2019–2025.
6. Language: English or Indonesian.
7. Accessibility: full-text available for eligibility assessment.

Exclusion criteria

Studies were excluded if they:

1. were non-empirical (conceptual/theoretical/opinion pieces),
2. were review studies (SLR/meta-review) rather than primary research,
3. had a non-target population (e.g., university students/teachers as the main participants),
4. were grey literature outside the review's scope (e.g., dissertations, book chapters, conference proceedings),
5. were duplicates of another record.

Study Selection Process (PRISMA)

The study selection process followed the PRISMA framework, consisting of identification, screening, eligibility assessment, and inclusion stages.

Identification

The initial database search retrieved 1,340 records from Google Scholar within the predefined publication period (2019–2025).

Screening (title and abstract)

Titles and abstracts of the first 20 records were screened against the inclusion criteria. Screening decisions were systematically

documented using a screening table, indicating whether studies were included, provisionally included, or excluded, along with the corresponding rationale.

Eligibility (full-text assessment)

Full texts of the 20 screened records were retrieved and assessed using an eligibility checklist focusing on empirical design, target population, digital literacy focus, and relevance to the research questions (RQ1–RQ3). Reasons for exclusion at this stage were explicitly documented in accordance with PRISMA reporting standards.

Inclusion

Following a full-text eligibility assessment, seven studies were excluded due to non-empirical design, review-based methodology, limited relevance to digital literacy, duplication, or classification as grey literature. Consequently, 13 empirical studies were retained for the final qualitative synthesis.

Following the application of the inclusion and exclusion criteria, the study selection process was conducted following the PRISMA framework, encompassing the stages of identification, screening, eligibility assessment, and inclusion.

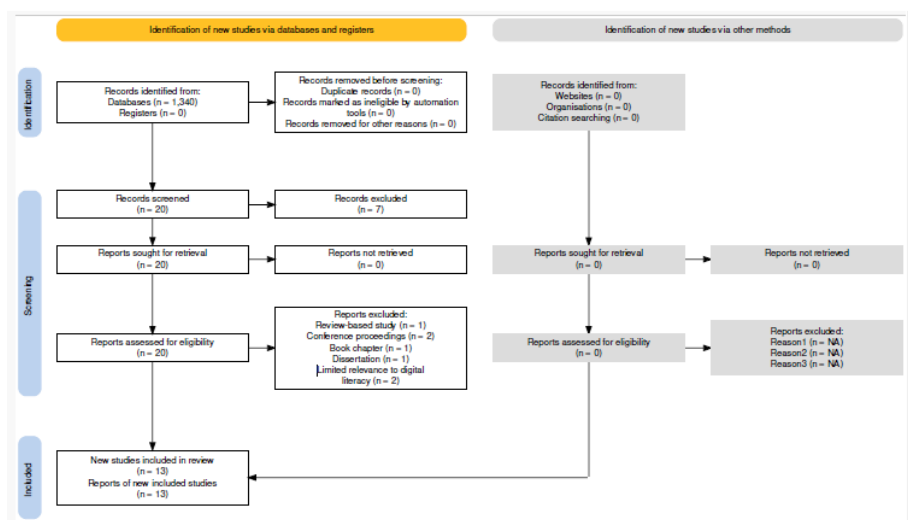


Figure 1. PRISMA Flow Diagram of Study Selection

As illustrated in the PRISMA flow diagram (Figure 1), the initial database search yielded 1,340 records from Google Scholar within the specified time frame (2019-2025). Due to the large volume of results and the dynamic ranking system of Google Scholar, the screening process was operationalized by reviewing the first 20 records under the applied filters. Title and abstract screening resulted in the exclusion of seven studies. The remaining 20 studies were retrieved and assessed for full-text eligibility. Following the eligibility assessment, seven studies were excluded due to non-empirical design, review-based methodology, limited relevance to digital literacy, duplication, or classification as grey literature (e.g., conference proceedings, book chapters, and dissertations). Consequently, thirteen empirical studies were included in the final qualitative synthesis.

Data Extraction and Synthesis

Data extraction

A structured data extraction table was developed to systematically collect and organize information from each included study. Extracted data comprised:

Data extraction. The extracted items included:

1. Bibliographic information (author(s), year, title),
2. Study characteristics (context/setting, research design/methodology),
3. Mapping to research questions:
 - a. RQ1: types/dimensions of digital literacy investigated or evidenced,
 - b. b.RQ2: learning activities supported by digital literacy,
 - c. c.RQ3: challenges/barriers in implementation,
4. Key findings relevant to vocational education

Synthesis approach

Given the heterogeneity of research designs, contexts, and measurement approaches, a statistical meta-analysis was not appropriate. Therefore, the review employed a narrative synthesis supported by thematic synthesis. Findings were organized thematically in alignment with RQ1–RQ3 and presented in tabulated form to facilitate cross-study comparison.

Thematic synthesis procedure

The thematic synthesis followed three analytical stages:

1. Open coding, identifying recurring concepts related to types of digital literacy, learning activities, and challenges.
2. Axial coding, grouping conceptually similar codes into higher-order categories.
3. Theme validation, ensuring that each theme directly addressed the research questions, was conceptually distinct, and was supported by at least two studies

RESULT AND DISCUSSION

Results Characteristics of the Included Studies

This section presents the findings of the systematic literature review based on the final set of studies that met the predefined inclusion and eligibility criteria. Following the PRISMA-guided selection process, thirteen empirical studies were included in the qualitative synthesis. The results are organized to address the research questions systematically, beginning with an overview of the characteristics of the included studies, followed by a thematic synthesis of findings related to types of digital literacy, supported learning activities, and reported challenges in vocational high school contexts.

The final qualitative synthesis comprised 13 empirical studies published between 2021 and 2025, reflecting recent research developments in digital literacy within vocational high school education. All included studies focused explicitly on vocational high school students as the target population and examined digital literacy or closely related constructs in vocational or technical education contexts.

In terms of research design, the studies included demonstrate methodological diversity. Quantitative approaches were predominant, including survey-based studies and correlational designs. Several studies employed mixed-methods or instrument development approaches, while a smaller number adopted experimental, case study, or research and development (R&D) designs. This methodological variation highlights the multifaceted nature of digital literacy research in vocational education and

supports the use of narrative and thematic synthesis rather than statistical meta-analysis.

Regarding research focus, all studies addressed at least one of the three research questions guiding this review. Most studies investigated types or dimensions of digital literacy, such as basic digital skills, information literacy, technology literacy, or digital learning competence. In addition, many studies examined how digital literacy was integrated into learning activities, including mobile learning, project-based tasks, reading-based digital activities, and vocational software practice. Several studies also reported contextual and pedagogical challenges, such as infrastructure limitations, teacher readiness, learner self-regulation, and curriculum alignment issues.

Geographically, most of the included studies were conducted in Indonesia, reflecting the strong relevance of digital literacy issues in Indonesian vocational education. A smaller number of studies were situated in international or comparative contexts, providing broader perspectives on digital literacy practices in vocational settings. This geographical concentration underscores the contextual specificity of the findings while also offering insights applicable to similar vocational education systems.

Overall, the characteristics of the included studies indicate that digital literacy in vocational high schools is an emerging and actively researched area, with increasing attention to empirical evidence, practical implementation, and educational challenges. The diversity of study designs and focal areas provided a rich basis for thematic synthesis in addressing the research questions of this review.

Types of Digital Literacy Applied by Vocational High School Students (RQ1)

This review sought to identify the types of digital literacy employed by vocational high school students as reported in the included empirical studies. The thematic synthesis revealed that digital literacy among vocational students is multidimensional, encompassing more than basic technical skills. Four major types of digital literacy consistently emerged across the reviewed studies:

basic digital literacy, information literacy, technology literacy, and digital learning competence.

Basic Digital Literacy

Basic digital literacy was identified as the foundational form of digital competence among vocational high school students. This type of literacy refers to students' ability to operate digital devices, access online platforms, and use common applications for academic purposes. Several studies reported that basic digital skills, such as navigating learning management systems, using productivity software, and accessing online learning materials, were prerequisites for participation in digitally mediated learning activities (Habibi et al., 2024; Zulkarnain et al., 2024).

The findings indicate that while most vocational students possess basic digital skills, the level of proficiency varies across individuals and school contexts. Unequal access to devices and prior exposure to technology contributed to disparities in students' basic digital literacy, particularly between urban and less-resourced vocational schools.

Information Literacy

Information literacy emerged as a critical dimension of digital literacy, particularly in studies emphasizing students' engagement with digital information sources. This type of literacy involves the ability to search for, evaluate, select, and use digital information effectively and responsibly. Several studies highlighted that vocational students were required to critically assess online information to support academic tasks, career planning, and problem-solving activities (Purmadi et al., 2022; Swastika, 2023)

Information Literacy

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The reviewed studies suggest that information literacy is increasingly important in vocational education, where students must interpret digital information related to industry trends, workplace practices, and technical knowledge. However, the findings

also indicate that students' evaluative skills were not always well developed, leading to challenges in distinguishing reliable sources from less credible digital content.

Technology Literacy

Technology literacy was prominently reported in studies focusing on vocational-specific digital tools and applications. This type of literacy refers to students' ability to use specialized software and digital technologies directly related to their vocational field. For example, studies conducted in mechanical engineering and technical programs highlighted the use of Computer-Aided Design (CAD) software as a key manifestation of technology literacy (Saputra et al., 2025; Tan et al., 2024).

Technology literacy reflects the alignment between digital competence and industry-oriented skills. The findings indicate that vocational students who engaged with field-specific technologies demonstrated higher readiness for workplace demands. Nevertheless, access to licensed software and adequate training remained a challenge in some vocational institutions.

Digital Learning Competence

Beyond technical and informational skills, several studies identified digital learning competence as an essential component of vocational students' digital literacy. This type of competence encompasses students' ability to engage in self-directed learning, adapt to digital learning environments, and manage learning tasks using digital tools. Studies examining work readiness, career adaptability, and independent learning behaviors emphasized the role of digital learning competence in supporting students' long-term educational and professional development (Endeli et al., 2025; Jatmoko et al., 2023).

The findings suggest that digital learning competence is closely associated with students' motivation, self-regulation, and learning autonomy. While digital platforms provide opportunities for

flexible learning, not all students are equally prepared to manage these demands independently.

Summary of RQ1 Findings

In summary, the reviewed studies demonstrate that vocational high school students employ multiple and interrelated forms of digital literacy. Basic digital literacy serves as a foundation, while information literacy, technology literacy, and digital learning competence represent more advanced and context-specific dimensions. These findings underscore the need to conceptualize digital literacy in vocational education as a comprehensive and layered construct, rather than a single, uniform skill set.

Learning Activities Supported by Digital Literacy in Vocational Education (RQ2)

This section presents the learning activities supported by digital literacy in vocational high school contexts, as reported in the included empirical studies. The thematic synthesis identified four dominant categories of learning activities facilitated by digital literacy: mobile learning, project-based learning, reading-based digital tasks, and vocational software practice. These activities reflect both general academic learning and field-specific vocational training.

Mobile Learning (m-Learning)

Mobile learning emerged as one of the most frequently reported digital literacy-supported activities in vocational education. Several studies documented the use of mobile applications and online platforms that enabled students to access learning materials, complete assignments, and engage in self-paced practice beyond the classroom setting (Purmadi et al., 2022).

The findings indicate that mobile learning increased flexibility and accessibility, allowing students to learn at their own pace and revisit instructional content when needed. Mobile-based learning activities were particularly useful for supporting independent practice and reinforcing digital literacy skills through continuous interaction with digital tools.

Project-Based Learning

Project-based learning was identified as a key instructional approach supported by digital literacy across multiple studies. In this approach, students were engaged in digital projects that required collaboration, problem-solving, and the application of vocational knowledge using digital resources and tools (Jatmoko et al., 2023; Setiyawan et al., 2023).

Digital literacy enabled students to search for information, create digital products, and present project outcomes using various digital platforms. The reviewed studies suggest that project-based activities provided opportunities for students to integrate digital skills with vocational competencies in authentic learning tasks.

Reading-Based Digital Tasks

Several studies highlighted the use of reading-based digital tasks as a means of integrating digital literacy into vocational learning. These tasks included analyzing editorial texts, interpreting digital reading materials, and engaging with online content relevant to vocational subjects (Rohmawati et al., 2024).

Reading-based digital activities supported the development of both literacy and critical thinking skills. The findings indicate that digital texts were used not only for content comprehension but also to enhance students' ability to navigate and interpret digital information within vocational education contexts

Vocational Software Practice

Vocational software practice represented a field-specific category of learning activities supported by digital literacy. Studies conducted in technical and mechanical engineering programs reported the use of industry-related software, such as Computer-Aided Design (CAD) applications, as part of instructional activities (Saputra et al., 2025; Tan et al., 2024).

These activities allowed students to apply digital literacy skills directly to vocational tasks that mirror workplace practices. The findings suggest that software-based learning activities play a significant role in linking digital literacy with employability and job-related competencies.

3.3.5. Summary of RQ2 Findings

Overall, the reviewed studies demonstrate that digital literacy supports a wide range of learning activities in vocational high

schools, encompassing both general learning practices and specialized vocational training. Mobile learning, project-based learning, reading-based digital tasks, and vocational software practice collectively illustrate how digital literacy functions as an enabler of diverse instructional activities within vocational education.

Challenges in Implementing Digital Literacy in Vocational High Schools (RQ3)

The synthesis of the included studies identified several recurring challenges that constrain the effective implementation of digital literacy in vocational high school contexts. These challenges are grouped into four main categories.

Access and Infrastructure Limitations

Access to adequate digital infrastructure was the most frequently reported challenge across the reviewed studies. Several studies highlighted the limited availability of digital devices, unstable internet connectivity, and unequal access between urban and rural vocational schools. These constraints restricted students' participation in digital learning activities and reduced the effectiveness of technology-supported instruction (Habibi et al., 2024; Jatmoko et al., 2023).

Teacher Readiness

Teacher readiness emerged as a significant pedagogical challenge. The reviewed studies reported that insufficient digital competence, limited experience with educational technologies, and a lack of targeted professional development hindered teachers' ability to integrate digital literacy meaningfully into classroom practices. As a result, digital tools were sometimes used in a superficial manner rather than as instruments to support deeper learning (Sappaile, 2025; Zulkarnain et al., 2024).

Student Self-Regulation and Motivation

At the learner level, challenges related to self-regulation and motivation were frequently identified. Several studies noted that vocational high school students experienced difficulties in managing independent digital learning tasks, sustaining attention, and regulating their learning behavior in digital environments.

These issues were associated with reduced engagement, procrastination, and inconsistent learning outcomes (Azzahra et al., 2025; Endeli et al., 2025).

Policy and Curriculum Alignment

Policy and curriculum alignment were identified as an institutional-level challenge. Some studies reported misalignment between curriculum objectives, assessment practices, and digital literacy goals. The absence of clear guidelines and standardized integration of digital literacy within vocational curricula limited institutional support and affected the sustainability of digital literacy initiatives (Wahjusaputri et al., 2022).

In summary, the challenges associated with digital literacy implementation in vocational high schools are multifaceted, encompassing infrastructural, pedagogical, learner-related, and institutional dimensions. These findings indicate that successful digital literacy integration requires coordinated support across technological resources, teacher development, learner guidance, and curriculum policy.

DISCUSSION

This systematic literature review aimed to examine the types of digital literacy employed by vocational high school students, the learning activities supported by digital literacy, and the challenges encountered in its implementation. The discussion interprets the synthesized findings in relation to established theories of digital literacy and vocational education, as well as prior empirical research.

Digital Literacy as a Multidimensional Competence in Vocational Education

The findings of this review indicate that digital literacy among vocational high school students is not a single, uniform skill but a multidimensional competence encompassing basic digital literacy, information literacy, technology literacy, and digital learning competence. This aligns with conceptualizations of digital literacy proposed by scholars such as Gilster and Glistler (1997), who emphasize that digital literacy integrates technical, cognitive, and learning-oriented dimensions rather than merely operational skills.

In vocational education contexts, the prominence of technology literacy and digital learning competence reflects the increasing alignment between digital literacy and workforce readiness. The use of vocational software, such as CAD applications, illustrates how digital literacy extends beyond general ICT skills to include domain-specific technological competencies. This finding supports the view that digital literacy in vocational education must be contextualized and embedded within occupational practices rather than treated as a generic transversal skill.

Digital Literacy as a Pedagogical Enabler of Learning Activities

The results demonstrate that digital literacy functions as a pedagogical enabler that supports diverse learning activities, including mobile learning, project-based learning, reading-based digital tasks, and vocational software practice. These activities reflect a shift from teacher-centered instruction toward more learner-centered and experiential learning approaches in vocational education.

Mobile learning and project-based learning resonate with constructivist and experiential learning theories, which emphasize active engagement, problem-solving, and authentic task completion. The integration of digital tools in project-based contexts enables vocational students to apply digital literacy in meaningful ways that mirror real-world vocational demands. Furthermore, reading-based digital tasks highlight the intersection between digital literacy and language literacy, especially in contexts where students are required to critically engage with digital texts.

Persistent Challenges in Digital Literacy Implementation

Despite the pedagogical potential of digital literacy, the findings reveal persistent challenges at multiple levels. Infrastructure limitations and unequal access to digital resources remain major barriers, particularly in under-resourced or rural vocational schools. These challenges suggest that digital literacy development is contingent upon systemic support and cannot rely solely on individual student or teacher initiative.

Teacher readiness emerged as a crucial factor influencing the effectiveness of digital literacy integration. Limited digital competence and insufficient professional development

opportunities constrain teachers' ability to design and implement meaningful digital learning experiences. This finding reinforces the importance of teacher professional development as a key component of successful digital transformation in vocational education.

At the learner level, challenges related to self-regulation and motivation indicate that digital literacy integration must be accompanied by pedagogical scaffolding. Without adequate guidance, students may struggle to manage independent digital learning tasks, leading to disengagement or superficial learning. Additionally, policy and curriculum misalignment highlight the need for coherent institutional frameworks that explicitly embed digital literacy into vocational curricula and assessment systems.

Implications for Vocational Education Practice and Policy

Taken together, the findings suggest that effective digital literacy integration in vocational high schools requires a holistic approach that addresses technological infrastructure, teacher competence, learner support, and curriculum alignment simultaneously. Digital literacy should be positioned as a core component of vocational education that supports both academic learning and employability, rather than as an auxiliary or optional skill.

From a policy perspective, the findings underscore the importance of clear curricular guidelines and institutional support mechanisms to ensure the sustainability of digital literacy initiatives. At the classroom level, teachers need ongoing professional development to strengthen both their digital competence and their pedagogical strategies for integrating technology meaningfully into vocational instruction.

To further integrate the empirical findings with relevant theoretical perspectives and to highlight their pedagogical significance, this review synthesizes the key results into a conceptual interpretation. Table 1 presents a thematic mapping of the main findings in relation to established educational theories and their implications for vocational education practice.

Table 1. Conceptual Interpretation of Digital Literacy in Vocational Education

Table 1. Conceptual Interpretation of Digital Literacy in Vocational Education

Key Findings from the Review	Theoretical Perspective	Implications for Vocational Education
Digital literacy is multidimensional (basic, information, technology, and digital learning competence)	Multidimensional view of digital literacy (Gilster & Glister, 1997).	Digital literacy should be embedded across vocational subjects rather than treated as a standalone skill
Technology literacy is closely linked to vocational software use (e.g., CAD)	Situated learning and vocational competence	Instruction should integrate industry-relevant digital tools to enhance work readiness
Mobile learning and project-based learning are supported by digital literacy	Constructivist and experiential learning theories	Learning tasks should be authentic, problem-based, and digitally mediated
Teacher readiness influences effective digital literacy implementation	Sociocultural theory (Vygotsky, 1978)	Teacher professional development should emphasize pedagogical uses of digital technology
Students experience self-regulation and motivation challenges in digital learning	Self-Determination Theory (Ryan & Deci, 2020)	Digital learning environments require scaffolding and learner support mechanisms

Table 1 illustrates how the core findings of this systematic review can be interpreted through established theoretical frameworks and translated into practical implications for vocational high school contexts. Rather than presenting additional empirical data, the table provides an integrative synthesis that links the identified dimensions of digital literacy, supported learning activities, and implementation challenges to broader educational theories.

The table demonstrates that digital literacy in vocational education extends beyond basic technical skills and encompasses cognitive, pedagogical, and contextual dimensions. By aligning these findings with theories such as multidimensional digital literacy, constructivist learning, sociocultural theory, and self- underscores

the role of digital literacy as both a pedagogical enabler and a strategic component of vocational education reform determination theory, the table highlights the necessity of embedding digital literacy within vocational curricula, teaching practices, and institutional support systems.

Conclusion

This systematic literature review synthesized empirical studies on digital literacy among vocational high school students published between 2019 and 2025. The review aimed to identify the types of digital literacy employed by vocational students, the learning activities supported by digital literacy, and the challenges encountered in its implementation.

The findings indicate that digital literacy in vocational education is a multidimensional construct encompassing basic digital literacy, information literacy, technology literacy, and digital learning competence. These dimensions reflect the integration of digital skills with vocational learning demands, particularly in contexts that require the use of specialized software and technology-based learning environments. Digital literacy was found to support a range of learning activities, including mobile learning, project-based learning, reading-based digital tasks, and vocational software practice, which collectively promote learner engagement and the application of vocational competencies.

However, the review also highlights persistent challenges that constrain the effective implementation of digital literacy in vocational high schools. These challenges include limited access to digital infrastructure, insufficient teacher readiness, learner difficulties related to self-regulation and motivation, and misalignment between digital literacy goals and vocational curricula. Taken together, these findings suggest that digital literacy integration in vocational education requires coordinated efforts across technological, pedagogical, and institutional levels.

To provide an overarching synthesis of the findings, this study proposes a conceptual framework that integrates the key dimensions of digital literacy, the learning activities it supports, and the challenges affecting its implementation in vocational high school contexts.

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