

Beyond Connectivity: Charting Digital Competence in ASEAN Higher Education Institutions (2020-2025)

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ABSTRACT - The acceleration of digitalisation in higher education across ASEAN has amplified the need to understand how digital competence is conceptualised, assessed, and developed among students and educators. This study aims to map existing literature on digital competence within higher education institutions (HEIs) in ASEAN countries, with specific reference to the DigComp framework. Guided by the Joanna Briggs Institute (JBI) methodology and PRISMA-ScR reporting guidelines, this review applied the PCC framework: Population (higher education students and staff), Concept (digital competence), and Context (ASEAN countries). A systematic search of peer-reviewed journal databases yielded **61 eligible studies** published between 2020 and 2025. Findings show that the DigComp framework is increasingly adopted across ASEAN to assess five key domains: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. However, adaptation and validation of the framework remain inconsistent across local contexts. Students often demonstrate higher competence in digital safety and communication, while content creation and digital problem solving are commonly underdeveloped. Pedagogical strategies such as problem-based learning (PBL), design thinking, heutagogy, and immersive environments (e.g., metaverse) have been integrated to enhance digital capabilities. Institutional factors—such as infrastructure readiness, faculty training, leadership, and digital culture—emerged as critical enablers or constraints. Additionally, digital competence was found to be positively associated with student engagement, civic literacy, employability, and wellbeing. Despite these developments, challenges remain, particularly in addressing the digital divide, ensuring framework relevance, and establishing cross-country benchmarking. This review underscores the importance of developing validated, context-sensitive frameworks for digital competence. It further calls for comprehensive strategies that integrate digital literacy into institutional curricula, staff development, and national higher education policy to advance inclusive and future-ready learning environments across ASEAN.

INTRODUCTION

Nowadays, the digitalisation pace is reshaping the economic and educational fabric of Southeast Asia, with higher education institutions (HEIs) increasingly positioned as key actors in national digital transformation agendas (Wall et al., 2023; Nguyen & Tuamsuk, 2023). As part of the broader Fourth Industrial Revolution and the push toward the ASEAN Digital Masterplan 2025, HEIs are now expected

not only to adopt digital platforms but to produce digitally competent graduates, faculty, and administrators (Flores & Mean, 2025; Lim et al., 2024). It extends beyond basic technical abilities to include cognitive, ethical, and socio-emotional capacities required for engaging with complex digital settings (Subramaniam et al., 2023; Anthonysamy & Sivakumar, 2022). Researchers have identified DC as a key factor influencing student employability, enhancing staff professional growth, and driving innovation within institutions (Ganefri et al., 2025; Thi et al., 2025; Atabik et al., 2024). When embedded systemically, it enables universities to foster more inclusive, resilient, and future-ready learning environments (Truc Tran, 2024; Arham et al., 2024). Despite its recognised importance, the state of digital competence development across ASEAN HEIs remains uneven and fragmented. In Malaysia, students continue to struggle with second- and third-level digital divides, where issues of skill and usage quality persist despite improvements in access (Subramaniam et al., 2023).

In Thailand, digital pedagogy remains underutilised, with educators relying on passive tools such as PDF uploads to LMS platforms without deeper instructional integration (Sriwisathiyakun, 2023; Stefany & Helmi, 2024). In Vietnam, while national reforms are pushing digital transformation, curricular adaptation remains inconsistent across universities (Thi et al., 2024; Pham & Dau, 2024). Indonesia has experimented with heutagogical learning models and digital leadership training, yet these remain pilot-level efforts without system-wide institutional embedding (Mannan et al., 2023; Suryadi et al., 2023). Moreover, entire countries such as Cambodia, Lao PDR, and Timor-Leste are entirely absent from the empirical literature, raising serious concerns about geographic exclusion and research equity within the region (Flores & Mean, 2025; Wall et al., 2023). Moreover, current research continues to overlook certain populations, including students with disabilities, rural learners, and academic support staff (Suwendi et al., 2025; Wiyono et al., 2024; Kok et al., 2025).

If these issues remain unaddressed, the consequences will be substantial. HEIs risk graduating students who are ill-equipped for the digital economy (Ganefri et al., 2025; Dirgatama, 2024), and staff who lack the digital fluency required for instructional innovation (Atabik et al., 2024; Wiyono et al., 2024). Institutions may continue to invest heavily in educational technology without realising its pedagogical or strategic potential (Arham et al., 2024; Nguyen & Tuamsuk, 2023). Digital inequalities will deepen, particularly for already marginalised groups (Suwendi et al., 2025; Kok et al., 2025), and national digital strategies will remain disconnected from institutional realities (Somabut et al., 2024; Suryadi et al., 2023). Present study address these gaps by systematically mapping the empirical research on digital competence in ASEAN HEIs published between 2019 and 2025. Using the PRISMA-ScR methodology and guided by the PCC framework (Population, Concept, Context), the study addresses two research questions:

- i. What key findings have been reported in empirical studies on digital competence within ASEAN higher education institutions between 2019 and 2025?
- ii. Based on the synthesis of current findings, which aspects of digital competence in ASEAN HEIs warrant further exploration in future research?

METHODS AND MATERIALS

The methodological framework used for this scoping review was based on the model developed by Arksey and O'Malley (2005), later refined by Levac et al. (2010), and aligned with the PRISMA-ScR reporting guidelines (Tricco et al., 2018). This framework was chosen due to its effectiveness in mapping broad and methodologically varied literature—particularly relevant in emerging areas where concepts such as “digital competence,” “digital literacy,” and “digital skills” often overlap and lack clear boundaries.

2.1 Research Questions

This review addressed two research questions:

- i. What key findings have been reported in empirical studies on digital competence within ASEAN higher education institutions between 2019 and 2025?
- ii. Based on the synthesis of current findings, which aspects of digital competence in ASEAN HEIs warrant further exploration in future research?

2.2 Identifying Relevant Studies

A structured literature search was conducted across four major databases—Scopus, Web of Science and Emerald Insight to identify empirical studies on digital competencies among students in higher education institutions (HEIs) within ASEAN countries. The search strategy utilised Boolean combinations of three keyword blocks: ("digital competence*" OR "digital skill*" OR "digital literac*") AND ("student*" OR "undergraduate*" OR "university") AND ("ASEAN" OR the names of individual ASEAN countries). The inclusion criteria were limited to peer-reviewed journal articles published between January 2019 and June 2025. The final search was completed on 1 July 2025. Table 1 shows the search query used across the database.

Table 1. Search Query Across Database

Database	Search Query Term
Scopus	(TITLE-ABS-KEY("digital competence" OR "digital competency" OR "digital skill*" OR "digital literacy")) AND (TITLE-ABS-KEY("university student*" OR "higher education student*" OR "college student*" OR "HEI student*" OR "undergraduate*" OR "tertiary education")) AND (AFFILCOUNTRY("Malaysia" OR "Indonesia" OR "Thailand" OR "Vietnam" OR "Philippines" OR "Cambodia" OR "Lao PDR" OR "Myanmar" OR "Brunei" OR "Singapore"))
Emerald	"digital competencies" OR "digital competency" AND (Malaysia OR Indonesia OR Thailand OR Vietnam OR Philippines OR Cambodia OR Laos OR Myanmar OR Brunei OR Singapore) AND ("university students" OR "HEI students" OR "higher education students")
Web of Science	TS=("digital competencies" OR "digital competency") AND TS=(Malaysia OR Indonesia OR Thailand OR Vietnam OR Philippines OR Cambodia OR Laos OR Myanmar OR Brunei OR Singapore) AND TS=("university student*" OR "HEI student*" OR "higher education student*")

2.3 Study selection and eligibility criteria

Studies were considered eligible for inclusion if they fulfilled the following criteria: Focused on students enrolled in higher education institutions (HEIs) within ASEAN countries, Empirically examined digital competency or closely related constructs (e.g., digital skills, digital literacy, digital proficiency), were published in English, and were available as full-text peer-reviewed journal articles.

The review excluded conference proceedings, theses, conceptual commentaries lacking empirical data, bibliometric-only studies, and articles focusing solely on non-HEI populations such as school students, professionals, or educators. Title and abstract screening was conducted independently by two reviewers. Subsequently, the full texts of potentially relevant studies were assessed for final inclusion. Any discrepancies between reviewers were resolved through discussion and consensus.

2.4 Data extraction

Data from the included studies (n = 61) were extracted into a structured Excel spreadsheet. Information charted included: authorship, publication year, theoretical framework, methodology, sampling characteristics, variables studied, and key findings. To ensure consistency, the data extraction process was piloted on five studies and refined iteratively.

2.5 Data analysis and synthesis

Descriptive analysis was conducted to summarise publication trends, dominant theories, methods, and sample characteristics. A thematic synthesis approach was applied to group determinants of EI into two major domains: exogenous (environmental) and endogenous (psychological) factors, adapted from the person–environment framework (Gao et al., 2024; Lim & Hassan, 2021). Thematic categories were iteratively refined as coding progressed. Figure 1 shows the methodology framework (Arksey & O'Malley, 2005)

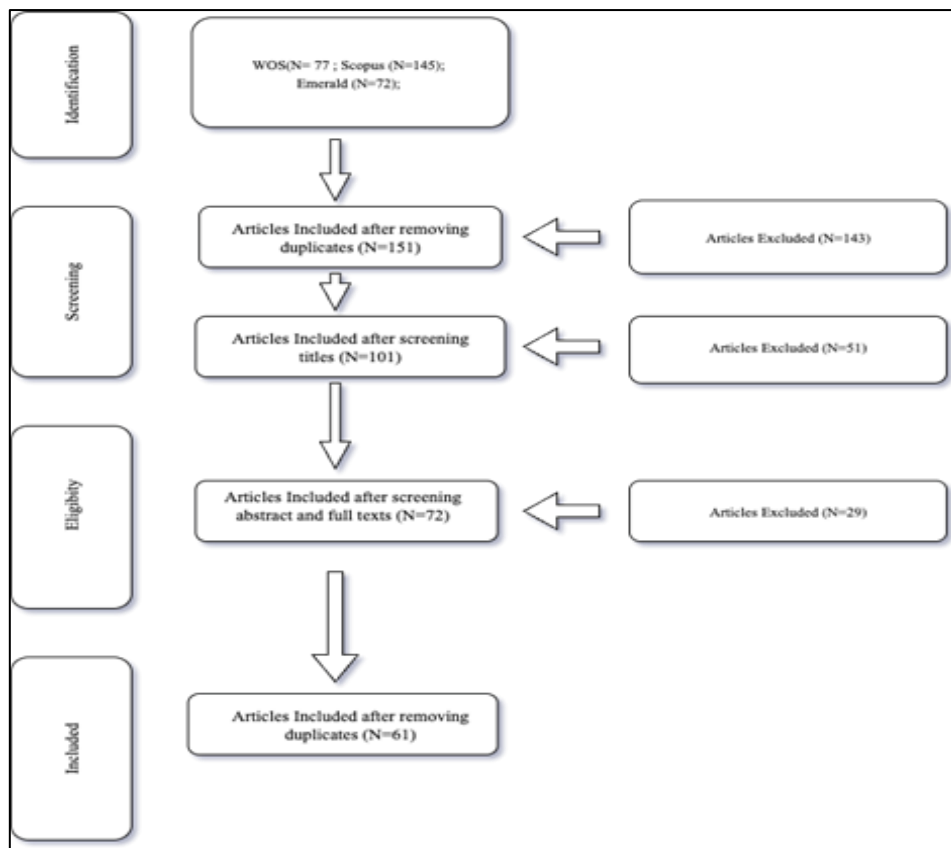


Figure 1. Methodology framework Arksey and O'Malley (2005)

RESULTS

This section presents the results of the scoping review, synthesised according to the two research questions. Descriptive characteristics of the 61 included studies (e.g., publication year, country, methodology) are provided first, followed by thematic findings addressing RQ1 (key insights) and RQ2 (research gaps).

3.1 Descriptive Overview of Included Studies

A total of 61 studies published between January 2020 and May 2025 were analysed in this review. A notable increase in publications was observed after 2021, coinciding with the widespread adoption of online and hybrid learning modes during the COVID-19 pandemic. This trend underscores growing interest in digital competence (DC) in response to educational disruptions across ASEAN. However, significant geographic imbalances persist. Over 90% of studies originated from five countries: Indonesia (40%), Malaysia (18%), Vietnam (13%), Thailand (11%), and the Philippines (8%). In contrast, Cambodia, Lao PDR, and Timor-Leste were entirely unrepresented, while Brunei appeared in only one study (Abubakari et al., 2025). These imbalances highlight ongoing concerns about unequal research capacity and digital accessibility, underscoring a persistent centre-periphery divide within ASEAN higher education systems (Flores & Mean, 2025; Wall et al., 2023).

The evidence base remains heavily skewed toward university students, who accounted for 84% of study participants, while academic staff (11%) and administrative personnel (5%) received comparatively little attention. This narrow focus limits insight into how institutions foster digital competence—especially through personnel involved in infrastructure development, policy implementation, and pedagogical support (Wiyono et al., 2024; Atabik et al., 2024). From a methodological perspective, the literature is predominantly shaped by quantitative, cross-sectional survey designs (73%), with relatively few studies employing mixed methods (10%) or qualitative approaches (6%). Although 11% addressed instrument validation (e.g. Abubakari et al., 2025), the heavy reliance on perception-based data constrains insights

into the influence of cultural and institutional contexts on DC (Truc Tran, 2024; Mannan et al., 2023). While theoretical frameworks such as DigComp, TAM, TPB, heutagogy, and design thinking are commonly employed (Ganefri et al., 2025; Anthonysamy & Sivakumar, 2022), many studies adopt them descriptively, with little reflection on their contextual relevance. This risks promoting a universalist, technocratic conception of DC (Sriwisathiyakun, 2023; Wall et al., 2023). In sum, despite growth in the field, notable gaps remain. Future research should be more geographically inclusive, theoretically reflective, and methodologically diverse to develop a deeper, context-sensitive understanding of digital competence in ASEAN HEIs. Table 2 shows the descriptive studies overview of the data.

Table 2. Descriptive Studies Overview

Aspect	Description
Total Studies Reviewed	61
Publication period	January 2020 – May 2025
Publication Trend	Increase after 2021
Main Contributing Countries	Indonesia (40%), Malaysia (18%), Vietnam (13%), Thailand (11%), Philippines (8%)
Other Countries	Brunei (1 study);
Participants	University Student (
Research Design	Quantitative (73), Mixed Methods (10%)
Common Theoretical Frameworks	Digcomp, TAM, TPB, Heutagogy, Design Thinking

3.1.2 Portrait of Respondents

The studies included in this scoping review exhibit a pronounced bias toward student populations, with significantly less attention given to academic staff, administrative personnel, or other stakeholders within higher education institutions (HEIs). Of the 61 reviewed articles, approximately 84% focused exclusively on university students, reflecting a strong inclination toward examining digital competence (DC) at the learner level. These studies predominantly explored students' self-reported perceptions, digital readiness, and engagement with learning technologies, often through cross-sectional surveys (Subramaniam et al., 2023; Razak, 2024; Thi et al., 2025). Academic staff were the focus in only 11% of studies, despite their central role in implementing digital pedagogy and shaping institutional culture.

These studies typically assessed instructors' attitudes toward e-learning platforms, use of ICT in course delivery, and participation in digital training programmes (Truc Tran, 2024; Arham et al., 2024; Wiyono et al., 2024). However, the exploration of pedagogical innovation, reflective practice, or longitudinal upskilling among educators remains limited. Administrative and support staff were even more underrepresented, accounting for only 5% of the sampled literature. The few studies that included them—such as those by Atabik et al. (2024) and Suwendi et al. (2025)—highlighted digital capacity gaps in areas such as quality assurance, resource management, and digital governance. These studies underscore the institutional dependency on non-teaching personnel to support digital infrastructure and strategic implementation.

3.1.3 Instrument of measuring Digital Competences

Drawing on 61 empirical studies, this scoping review categorised digital competence (DC) measurement tools in ASEAN higher education institutions (HEIs) into three types: single-dimensional self-assessments, multi-dimensional framework-based tools, and validation-focused instruments. Most studies utilised self-reported Likert-scale surveys to measure perceived competence. Predominantly, single-dimensional tools gauged overall ICT proficiency or digital engagement without domain-specific granularity, typically constructed by researchers for student contexts such as online learning and digital participation (Subramaniam et al., 2023; Razak, 2024; Limna & Kraiwanit, 2024). In contrast, a number of studies employed multi-dimensional instruments grounded in the DigComp 2.1 framework, which encompasses five core domains: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving.

These tools enabled structured assessments of digital competence across various educational settings and were frequently adapted to local contexts while maintaining fidelity to DigComp's original structure (Thi et al., 2025; Pham & Dau, 2024; Abubakari et al., 2025; Nguyen & Tuamsuk, 2023; Wall et al., 2023). Although less common, several studies focused on instrument validation. Notably, Anwar et al.

(2023) performed psychometric analysis on the Academic Digital Literacy Scale, and Abubakari et al. (2025) validated a DigComp-based instrument across multiple educational systems. Common validation techniques included factor analysis, reliability testing, and pilot trials. A minority of studies employed scenario-based or task-driven assessments—such as digital simulations or LMS-integrated activities—primarily within teacher education and ICT programmes, aligning assessment with pedagogical practice (Truc Tran, 2024; Stefany & Helmi, 2024).

3.2. Antecedents of Digital Competence

Digital competence (DC) does not emerge in a vacuum but is shaped by a constellation of factors operating across individual, institutional, and macro-level domains. Drawing on an ecological perspective, this section synthesises the multilevel antecedents of DC identified across the reviewed literature.

3.2.1 Individual-Level Factors

A substantial number of studies included in this scoping review explored the influence of individual characteristics on digital competence (DC) among students in ASEAN higher education institutions (HEIs). Demographic, academic, experiential, and motivational factors consistently shaped self-reported DC levels. Gender emerged as one of the most frequently analysed variables. Subramaniam et al. (2023) found male students scored higher in digital content creation, while female students exhibited stronger awareness in safety and communication. Thi et al. (2025) similarly noted gender-based differences in confidence across DigComp domains. Nguyen and Tuamsuk (2023) reported greater self-perceived collaboration and responsible digital use among female students, whereas Kok et al. (2025) linked gender to variations in digital engagement and wellbeing. Academic discipline also influenced competence. Students in engineering, ICT, and science-related fields consistently outperformed peers from non-technical backgrounds in tool use, technical tasks, and problem-solving (Disastra et al., 2024; Ganefri et al., 2025; Dirgatama, 2024). Limna and Kraiwanit (2024) observed higher exposure to adaptive and generative AI tools among technically trained students, while Pinta et al. (2024) associated STEM majors with stronger computational thinking and task performance.

Prior digital exposure was another key predictor. Mannan et al. (2023) linked frequent digital platform use with heutagogical learning orientation. Sriwisathiyakun (2023) found prior experience in self-directed digital learning improved learner autonomy and content creation. Stefany and Helmi (2024) reported that both educators and students with earlier online teaching experience showed greater confidence in digital activity design. Razak (2024) associated frequent use of communication and content tools with broader perceived DC, while Pham and Dau (2024) highlighted the role of device familiarity in enhancing digital courseware interaction. Motivational and psychological factors also played a role. Lim et al. (2024) demonstrated that digital self-efficacy and media literacy were significant predictors of student wellbeing and engagement. Similarly, Nuryadi and Widiatmaka (2023) reported positive correlations between civic literacy, digital motivation, and enhanced critical thinking and participatory learning outcomes. Overall, individual characteristics—encompassing demographic, academic, experiential, and attitudinal factors—were consistently linked to variations in digital competence. These associations were typically assessed using self-reported instruments grounded in the DigComp framework and related models.

3.2.2 Institutional-Level Factors

Several studies highlighted institutional-level factors shaping digital competence (DC) within ASEAN higher education institutions (HEIs), including leadership, infrastructure, organisational culture, faculty development, and policy. Digital leadership was consistently linked to positive DC outcomes. Arham et al. (2024) found that when leaders model digital practices and foster a supportive culture, both academic and administrative staff exhibit stronger engagement with educational technologies. Similarly, Suryadi et al. (2023) reported that digitally competent leadership enhanced institutional innovation and ICT-based performance. Infrastructure readiness formed the backbone of institutional DC capacity. Somabut et al. (2024) emphasised that access to digital labs, e-learning platforms, and stable internet underpinned effective online learning in Thai HEIs. Suwendi et al. (2025) noted that AI tools and digital repositories facilitated staff engagement in Indonesian Islamic HEIs. Flores and Mean (2025) observed that robust infrastructure in Cambodian HEIs aligned with national digital education strategies. Organisational culture also influenced engagement, particularly among non-academic personnel.

Wiyono et al. (2024) found that structured training embedded within a supportive environment improved administrative staff's digital task performance. Atabik et al. (2024) showed that integrating digitalisation into quality management systems enhanced procedural consistency and cross-departmental engagement. Faculty development emerged as a key intervention. Sriwisathiyakun (2023) reported that design thinking approaches promoted educators' self-directed use of digital tools. Mannan et al. (2023) showed that heutagogical workshops increased faculty preparedness for student-centred digital instruction. Truc Tran (2024) demonstrated that online formative assessments fostered pedagogical adaptability among language instructors. Institutional digital policy was another critical enabler. Wall et al. (2023) found that clearly defined digital strategies enhanced integration of DC benchmarks into quality assurance systems. Limna and Kraiwanit (2024) observed that mandates for LMS adoption supported consistent digital implementation in teaching practice. Collectively, the studies underscore how institutional structures—particularly leadership, infrastructure, culture, training, and policy—serve as foundational drivers of digital competence development across higher education stakeholders.

3.2.3 Macro-Level Factors

Several studies highlighted the significant role of macro-level policy and governance environments in shaping the development and implementation of digital competence (DC) initiatives within ASEAN higher education institutions (HEIs). These factors include national digital strategies, ministerial directives, funding structures, and regulatory coordination. National digital policies were examined in relation to institutional alignment. Somabut et al. (2024) analysed Thailand's post-COVID digital education strategy and found that its policy direction contributed to the expansion of e-learning infrastructures across public universities. Suryadi et al. (2023) discussed how Indonesia's national digital leadership programme helped guide HEIs in adopting technology-enabled academic services and innovation planning. Ministerial influence was also evident. Wall et al. (2023) reviewed policy guidance issued across several ASEAN countries and reported that top-down frameworks—particularly those from ministries of education or higher education councils—provided strategic reference points for digital governance across institutions.

These frameworks frequently referenced international standards, such as DigComp, in institutional planning. Funding mechanisms were addressed in selected studies. Flores and Mean (2025) showed that Cambodian HEIs that received targeted state support for ICT infrastructure and training demonstrated higher levels of institutional engagement with digital transformation initiatives. Suwendi et al. (2025) reported that funding allocation for digital resources in Islamic HEIs in Indonesia supported increased use of AI tools and internal platforms among faculty members. Cross-ministerial coordination was noted in relation to system-level coherence. Nguyen and Tuamsuk (2023) described how overlapping responsibilities between ICT and education ministries influenced the structure of digital policy implementation in Vietnam. Wall et al. (2023) further observed that inter-agency collaboration contributed to more consistent benchmarking and monitoring of digital transformation across institutions. Policy-practice relationships were examined through institutional case studies. Flores and Mean (2025) highlighted how Cambodian HEIs aligned their institutional digitalisation efforts with broader national strategies, including data systems and professional development agendas. In summary, macro-level factors such as national strategies, ministerial guidelines, funding mechanisms, and governance coordination played an active role in enabling digital competence within higher education systems across the ASEAN region, as documented in multiple country-specific and cross-country studies.

3.2.4 Outcomes of Digital Competence

The studies reviewed reported a wide range of outcomes linked to the development of digital competence (DC) within ASEAN higher education institutions (HEIs). These outcomes include academic engagement, employability, psychological wellbeing, civic participation, and instructional innovation. Academic engagement and learning performance were among the most consistently reported outcomes. Lim et al. (2024) found that students with higher proficiency in digital communication and media literacy demonstrated greater involvement in online learning environments. Razak (2024) showed that digital information, communication, and creation skills were positively related to students' engagement in digital learning activities. Mannan et al. (2023) reported that DC contributed to heutagogical learning, particularly in student-driven, self-regulated learning contexts. Employability-related outcomes were explored in relation to digital entrepreneurship and workplace readiness. Ganefri et al. (2025) reported that engineering students possessing strong digital skills exhibited higher levels

of entrepreneurial intention, particularly in digital-based ventures. Similarly, Thi et al. (2025) found that students with high competence in digital content creation and problem-solving expressed greater confidence in navigating technology-driven career environments. Pham and Dau (2024) also linked digital proficiency to increased readiness for engaging with workplace technologies and remote collaboration.

In addition to career-related outcomes, several studies highlighted psychological wellbeing and adaptability. For instance, Lim et al. (2024) demonstrated that digital self-efficacy and new media literacy were positively associated with student wellbeing. Nuryadi and Widiatmaka (2023) linked civic and digital literacy to students' ability to think critically and participate responsibly in online contexts, reflecting broader dimensions of personal development through digital engagement. Learner satisfaction and support perception were identified as key institutional outcomes. Kok et al. (2025) reported that students who received consistent digital support from educators and the institution showed higher satisfaction in blended learning settings. Truc Tran (2024) further highlighted that digital adaptability among language lecturers contributed to improved student experience in virtual classrooms. Instructional innovation outcomes were reported in studies examining faculty development. Stefany and Helmi (2024) described how educators who received digital pedagogy training designed more interactive online courses. Suwendi et al. (2025) observed that AI-enabled tools introduced in Islamic HEIs were used to support innovative digital teaching practices among lecturers. Collectively, the findings indicate that digital competence across ASEAN HEIs has been associated with positive academic, professional, psychological, and institutional outcomes, as documented across student and educator populations.

3.2.5 Pedagogical and Organisational Interventions

Several studies in this review reported pedagogical and organisational interventions implemented across ASEAN higher education institutions (HEIs) to enhance digital competence (DC) among students, educators, and administrative staff. These interventions included design-based instructional models, faculty development programmes, leadership initiatives, and institutional quality management systems. On the pedagogical side, design thinking, heutagogy, and problem-based learning (PBL) emerged as common frameworks in instructional design. Sriwisathiyakun (2023) applied design thinking to support self-directed learning in Thai HEIs, which was associated with improved student autonomy and content creation. Mannan et al. (2023) incorporated a heutagogical approach in Indonesian classrooms, supporting DC development through student-centred learning processes. Kantathanawat et al. (2025) introduced a mastery-adaptive and problem-solving model (MAPS) that enhanced digital skills and collaborative learning among community college students. Other pedagogical methods included digital storytelling, gamified assessments, and online simulations. Dirgatama (2024) integrated scenario-based digital simulations in classroom settings, while Stefany and Helmi (2024) highlighted how digital course design improved instructional quality among Indonesian educators. Truc Tran (2024) demonstrated that formative online assessment supported adaptability and digital tool use among Vietnamese language lecturers.

Organisationally, multiple studies reported faculty and staff development programmes aimed at enhancing DC. Wiyono et al. (2024) described targeted training initiatives for administrative staff in Indonesian private HEIs that led to improved digital task performance. Arham et al. (2024) found that digital leadership—through strategic planning and modelling of digital behaviours—enhanced institutional uptake of digital tools in teaching and administration. Further, several studies documented the role of quality assurance systems and institutional policy in supporting DC. Atabik et al. (2024) analysed how the digitalisation of internal quality management processes contributed to stronger institutional readiness for digital transformation. Flores and Mean (2025) reported on cross-unit coordination in a Cambodian university that supported DC integration with national policy priorities. Studies also referenced organisational culture and leadership structure as enabling factors. Suryadi et al. (2023) noted that digital innovation efforts were reinforced through leadership support, while Wall et al. (2023) reported that institutions with explicit digital strategies were more likely to institutionalise digital practices in teaching, learning, and administration.

3.2.6 Digital Inequity and Marginalisation

Several studies reported patterns of digital inequity linked to socio-demographic factors such as income level, geographic location, gender, and language environment in ASEAN higher education institutions (HEIs). These patterns were observed through differences in access, digital skill levels, support mechanisms, and engagement with learning technologies. Geographic location was found to influence digital engagement. Kok et al. (2025) reported that students in urban institutions had higher access to reliable digital support and infrastructure, which contributed to greater learner satisfaction in blended learning environments. Somabut et al. (2024) observed that access to ICT tools and stable internet varied across Thai HEIs depending on regional location and institutional readiness. Income level was also discussed in relation to digital usage and connectivity. Razak (2024) found that students from higher-income backgrounds had greater access to communication and content creation tools, which was associated with higher self-perceived competence across DigComp domains. Pham and Dau (2024) similarly reported that students with stronger device familiarity—often linked to socioeconomic status—interacted more effectively with digital learning environments. Gender-based patterns were highlighted in several studies. Subramaniam et al. (2023) found that male students reported stronger competence in technical areas such as digital content creation, while female students performed better in domains related to safety and online communication. Kok et al. (2025) reported that female students who received institutional support exhibited high satisfaction with digital learning systems.

Language and cultural diversity were reflected in instrument application and learning design. Sriwisathiyakun (2023) used culturally adapted digital learning frameworks to support student engagement in Thailand. Wall et al. (2023) noted that several institutions adopted international digital frameworks, including DigComp, and aligned them with national and institutional contexts. Institutional context also shaped how digital equity was experienced. Suwendi et al. (2025) reported that the adoption of digital tools and AI resources within Islamic HEIs supported access to technology-enhanced learning across a range of campus settings. Flores and Mean (2025) described how a Cambodian university integrated digital support systems within its broader infrastructure planning, contributing to broader institutional inclusion. Digital support mechanisms were associated with perceived fairness and accessibility. Truc Tran (2024) found that formative assessment tools allowed lecturers to better adapt digital tasks to different student needs. Stefany and Helmi (2024) reported that Indonesian educators who engaged in structured online training were better able to design inclusive digital learning experiences. In summary, the reviewed studies presented multiple examples of how digital inequity and marginalisation manifest in higher education across ASEAN, particularly in relation to demographic, infrastructural, and institutional factors.

3.3 Research Gaps

3.3.1 Underrepresented Population & Geography

The current body of research on digital competence (DC) in ASEAN higher education institutions (HEIs) exhibits a notable regional imbalance. Among the 61 studies reviewed, the majority were conducted in only four countries—Indonesia, Malaysia, Thailand, and Vietnam—while no studies were identified from Cambodia, Lao PDR, or Timor-Leste. This geographic skew reflects disparities in research infrastructure and access to publication, and risks shaping policy discourse around the priorities of more developed systems, thereby sidelining lower-capacity nations (Somabut et al., 2024; Flores & Mean, 2025; Nuryadi & Widiatmaka, 2023). Indonesia alone contributed over 20% of the literature, often focusing on technical skills, pedagogical integration, and student self-efficacy (Mannan et al., 2023; Disastra et al., 2024; Dirgatama, 2024). In contrast, Cambodia offered only a single institutional case (Flores & Mean, 2025), and no studies addressed Lao PDR or Timor-Leste, creating critical blind spots in regional comparison and inclusive policymaking. Beyond geography, population-level bias was evident. Most studies focused on students (e.g., Pham & Dau, 2024; Ganefri et al., 2025; Subramaniam et al., 2023), while academic staff, administrators, and institutional leaders—key agents of digital change—remained underexplored.

Only a limited number examined the digital competencies of university employees or managers (Wiyono et al., 2024; Atabik et al., 2024; Arham et al., 2024), restricting insights into institutional readiness. Marginalised learner groups, such as students with disabilities, those from rural or low-income backgrounds, and ethnic or linguistic minorities, were largely overlooked. While Kok et al. (2025) included gender and socioeconomic factors in analysing digital support and satisfaction, findings were

not disaggregated to reveal specific disadvantages. Similarly, Suwendi et al. (2025) noted infrastructural limitations in Islamic HEIs but did not address equity frameworks or differentiated impacts. Gender, when considered, was often treated simplistically as a binary variable (Thi et al., 2025; Lim et al., 2024), with no intersectional analysis exploring how it intersects with geography, income, or language. This limits the field's understanding of how layered inequalities shape digital access and competence. In sum, the narrow geographic and demographic scope of existing research undermines its external validity and regional applicability. Expanding empirical attention to neglected contexts and underrepresented stakeholders is critical for developing equitable digital transformation strategies across ASEAN HEIs. Without such inclusivity, scholarship risks perpetuating existing digital disparities rather than resolving them.

3.3.2 Methodological Gaps

A common methodological limitation observed across the reviewed studies is the heavy reliance on cross-sectional survey designs employing self-reported Likert-scale instruments. Although these approaches are useful for exploratory analysis, they limit deeper insights into the developmental trajectory of digital competence (DC), its responsiveness to targeted interventions, and its variability across different sociocultural contexts (Subramaniam et al., 2023; Lim et al., 2024; Pham & Dau, 2024). Most studies adopted quantitative designs, relying on descriptive statistics, correlations, or structural equation modelling (e.g., Thi et al., 2025; Razak, 2024; Dirgatama, 2024). Although basic reliability tests such as Cronbach's alpha and exploratory factor analysis were common, few applied more rigorous validations like confirmatory factor analysis (CFA) or measurement invariance testing (Abubakari et al., 2025; Kok et al., 2025), limiting the generalisability of findings in multilingual, diverse ASEAN settings. Notably absent were longitudinal, experimental, or quasi-experimental designs. No study tracked DC progression over time or assessed intervention outcomes using pre-post or control group setups. Even innovative pedagogies—like design thinking (Sriwisathiyakun, 2023) and heutagogy (Mannan et al., 2023)—relied solely on post-intervention self-assessments, lacking counterfactuals or delayed measures.

Consequently, conclusions remain perception-based and short-term. Qualitative and mixed methods were also underutilised, with few studies employing interviews, focus groups, or document analysis to examine sociocultural and institutional influences on digital engagement (e.g., Truc Tran, 2024; Flores & Mean, 2025). These approaches are critical for uncovering the affective and ethical dimensions of DC often missed by survey-driven designs. Moreover, widespread adoption of European-derived frameworks, particularly DigComp, presents validity concerns. While some studies translated and adapted these tools, few reported linguistic or cultural validation processes (Nguyen & Tuamsuk, 2023; Wall et al., 2023), raising questions about construct relevance in non-European contexts. Overall, research on digital competence (DC) in ASEAN higher education institutions remains methodologically limited, with a predominant reliance on self-reported instruments, minimal psychometric validation, and a lack of methodological diversity. Advancing the field will require the adoption of multi-method approaches, the development of contextually sensitive measurement tools, and the use of longitudinal or experimental designs to generate more robust and policy-relevant insights into digital transformation.

3.3.3 Conceptual and Instrumental Issues

A recurring concern across the literature is the uncritical reliance on the European Commission's DigComp framework in ASEAN higher education (HE), often without adequate adaptation to local cultural, linguistic, or institutional contexts. Although DigComp offers a comprehensive framework for digital competence (DC)—encompassing domains such as information literacy, communication, digital content creation, safety, and problem-solving (Vuorikari et al., 2022)—its direct application in Southeast Asian contexts has repeatedly raised concerns about construct validity and cultural relevance (Nguyen & Tuamsuk, 2023; Wall et al., 2023).

Over half of the reviewed studies, particularly from Malaysia, Indonesia, and Vietnam (e.g., Subramaniam et al., 2023; Razak, 2024; Pham & Dau, 2024), employed DigComp, often through literal translation of survey instruments with minimal contextualisation (Sriwisathiyakun, 2023; Thi et al., 2025). For example, Sriwisathiyakun (2023) noted that translated survey items often failed to align with the digital norms and practices of Thai learners, raising concerns about cultural validity. Few studies undertook formal validation procedures. Abubakari et al. (2025) conducted confirmatory factor analysis (CFA) in Brunei and Malaysia, while Thi et al. (2025) employed structural equation modelling in Vietnam.

Notably, Kantathanawat et al. (2025) introduced the MAPS model—a hybrid framework that integrates local pedagogical traditions with digital skills development—representing a rare culturally grounded alternative. Nonetheless, such initiatives remain uncommon. Methodologically, most studies continued to rely on self-reported Likert-scale instruments, often without rigorous psychometric validation (Lim et al., 2024; Ganefri et al., 2025; Chardnarumarn et al., 2023). Though practical, these tools suffer from response bias and offer limited behavioural insight. Performance-based assessments—such as digital simulations or log data—were notably absent, raising concerns over ecological validity (Wiyono et al., 2024; Pujasari et al., 2024). Another gap lies in neglecting the affective, ethical, and socio-cultural dimensions of DC, crucial in Southeast Asia’s pluralistic digital environments.

Few tools addressed these areas in depth. Truc Tran (2024), for instance, stressed the need for critical reflexivity and socio-emotional awareness in educators’ digital adaptation—dimensions often overlooked in rigid, Western-centric competency models. Moreover, measurement tools were overwhelmingly student-focused, with little attention to staff, administrators, or institutional leaders, limiting insight into broader organisational digital readiness (Wiyono et al., 2024; Atabik et al., 2024). Collectively, these conceptual and methodological limitations reflect a pattern of “translation without transformation,” where Eurocentric models dominate at the expense of local relevance. This risks generating partial or distorted understandings of digital engagement in multilingual, collectivist, and religiously influenced HE contexts. Moving forward, there is a critical need to develop locally validated, culturally resonant, and theoretically robust DC frameworks aligned with the sociotechnical realities of ASEAN higher education.

3.3.4 Limited Systems-Level Research

Although digital transformation in ASEAN higher education has gained traction, most empirical studies on digital competence (DC) remain confined to individual or institutional levels, with limited attention to systems-level dynamics. Consequently, macro-structural elements—such as national policies, regulatory frameworks, inter-agency coordination, and structural funding—are rarely foregrounded as units of analysis. This narrow focus limits understanding of the broader governance and ecological conditions shaping DC adoption and sustainability.

Only a handful of studies examine how national strategies interface with institutional realities. For example, Somabut et al. (2024) analysed Thailand’s ICT agenda and its university-level implementation, exposing gaps between policy rhetoric and institutional capacity. Similarly, Suryadi et al. (2023) showed how Indonesia’s digital leadership mandate hinged on organisational readiness and internal alignment. At the regional level, comparative studies remain scarce. A notable exception is Wall et al. (2023), who reviewed ASEAN-wide digital governance and found a lack of shared indicators and benchmarking tools, hampering cross-national policy harmonisation. In Cambodia, Flores and Mean (2025) offered a rare governance-focused case study, tracing ministerial directives through to budget allocation and on-campus implementation. However, such analyses are fragmented and largely disconnected from broader ASEAN-level initiatives like the ASEAN Digital Masterplan 2025. Moreover, the influence of quality assurance bodies, accreditation agencies, and public research funding schemes on DC policy remains underexplored. While some studies reference national digital strategies—e.g., Malaysia’s MyDigital and Indonesia’s SPADA—these are typically cited descriptively, without assessing their institutional uptake, coherence, or outcomes (Nguyen & Tuamsuk, 2023; Arham et al., 2024).

Critically, the lack of systems-level inquiry hinders exploration of how structural inequalities—such as urban–rural divides, institutional disparities, or infrastructural gaps—are reproduced or redressed through policy. For instance, Flores and Mean (2025) highlighted that limited investment in digital staff development in Cambodian HEIs reflects deeper systemic constraints, which are rarely theorised in the regional literature. Overall, current research seldom treats DC as a systemically embedded capability. Addressing this gap requires multi-level theoretical approaches, drawing from implementation science and policy studies, and incorporating cross-sectoral data to examine how national agendas, governance infrastructures, and regulatory logics shape institutional reform and individual DC outcomes in ASEAN HEIs.

Table 3. Finding Analysis Table

Research Question	Theme	Finding	Author(s) & Year
RQ1: What are the key findings?	Antecedents of Digital Competence – Individual-Level Factors	Gender, Academic Discipline, Prior Digital Exposure, Motivation & Self-efficacy	Subramaniam et al. (2023), Thi et al. (2025), Nguyen & Tuamsuk (2023), Kok et al. (2025), Disastra et al. (2024), Ganefri et al. (2025), Dirgatama (2024), Limna & Kraiwanit (2024), Pinta et al. (2024), Mannan et al. (2023), Sriwisathiyakun (2023), Stefany & Helmi (2024), Razak (2024), Pham & Dau (2024), Lim et al. (2024), Nuryadi & Widiatmaka (2023)
	Antecedents – Institutional-Level Factors	Digital Leadership, Infrastructure, Organisational Culture, Training, Policy	Arham et al. (2024), Suryadi et al. (2023), Somabut et al. (2024), Suwendi et al. (2025), Flores & Mean (2025), Wiyono et al. (2024), Atabik et al. (2024), Sriwisathiyakun (2023), Truc Tran (2024), Mannan et al. (2023), Wall et al. (2023), Limna & Kraiwanit (2024)
	Antecedents – Macro-Level Factors	National Policy, Ministerial Directives, Funding, Inter-Agency Coordination	Somabut et al. (2024), Suryadi et al. (2023), Wall et al. (2023), Flores & Mean (2025), Suwendi et al. (2025), Nguyen & Tuamsuk (2023)
	Outcomes of Digital Competence	Engagement, Employability, Wellbeing, Civic Participation, Innovation	Lim et al. (2024), Razak (2024), Mannan et al. (2023), Ganefri et al. (2025), Thi et al. (2025), Pham & Dau (2024), Nuryadi & Widiatmaka (2023), Kok et al. (2025), Truc Tran (2024), Stefany & Helmi (2024), Suwendi et al. (2025)
	Pedagogical & Organisational Interventions	Design Thinking, Heutagogy, PBL, Digital Leadership, QA Systems	Sriwisathiyakun (2023), Mannan et al. (2023), Kantathanawat et al. (2025), Dirgatama (2024), Stefany & Helmi (2024), Truc Tran (2024), Wiyono et al. (2024), Arham et al. (2024), Atabik et al. (2024), Flores & Mean (2025), Suryadi et al. (2023), Wall et al. (2023)
Digital Inequity & Marginalisation	Socioeconomic, Geographic, Gender, Language, Support Systems	Kok et al. (2025), Somabut et al. (2024), Razak (2024), Pham & Dau (2024), Subramaniam et al. (2023), Sriwisathiyakun (2023), Wall et al. (2023), Suwendi et al. (2025), Flores & Mean (2025), Truc Tran (2024), Stefany & Helmi (2024)	
RQ2: What are the research gaps?	Underrepresented Population & Geography	Geographic bias towards 4 countries (Indonesia, Malaysia, Thailand, Vietnam); lack of studies in Cambodia, Lao PDR, Timor-Leste; overfocus on students; minimal inclusion of marginalised learners or institutional staff	Somabut et al. (2024), Flores & Mean (2025), Nuryadi & Widiatmaka (2023), Mannan et al. (2023), Disastra et al. (2024), Dirgatama (2024), Pham & Dau (2024), Ganefri et al. (2025), Subramaniam et al. (2023), Wiyono et al. (2024), Atabik et al. (2024), Arham et al. (2024), Kok et al. (2025), Suwendi et al. (2025), Thi et al. (2025), Lim et al. (2024)
	Methodological Gaps	Over-reliance on cross-sectional survey designs; limited validation; lack of longitudinal, experimental, or qualitative approaches;	Subramaniam et al. (2023), Lim et al. (2024), Pham & Dau (2024), Thi et al. (2025), Razak (2024), Dirgatama (2024), Abubakari et al. (2025), Kok et al. (2025), Sriwisathiyakun (2023), Mannan et al. (2023), Truc Tran (2024), Flores & Mean

continued

Continue

	minimal use of performance-based tools	(2025), Nguyen & Tuamsuk (2023), Wall et al. (2023), Wiyono et al. (2024), Pujasari et al. (2024), Ganefri et al. (2025), Chardnarumarn et al. (2023)
Conceptual & Instrumental Issues	Heavy dependence on DigComp without localisation; limited psychometric adaptation; absence of culturally grounded models; lack of tools for diverse institutional roles	Nguyen & Tuamsuk (2023), Wall et al. (2023), Subramaniam et al. (2023), Razak (2024), Pham & Dau (2024), Sriwisathiyakun (2023), Thi et al. (2025), Abubakari et al. (2025), Kantathanawat et al. (2025), Lim et al. (2024), Ganefri et al. (2025), Chardnarumarn et al. (2023), Wiyono et al. (2024), Pujasari et al. (2024), Truc Tran (2024), Atabik et al. (2024), Arham et al. (2024)
Limited Systems-Level Research	Lack of research on national policies, regulatory ecosystems, governance, and ASEAN-wide digital integration; limited use of systems-level theoretical frameworks	Somabut et al. (2024), Suryadi et al. (2023), Wall et al. (2023), Flores & Mean (2025), Nguyen & Tuamsuk (2023), Arham et al. (2024)

DISCUSSION

Digital transformation has emerged as a central priority within ASEAN higher education institutions (HEIs), elevating digital competence (DC) to a critical capability for students, educators, and administrative personnel. This scoping review synthesised findings from 61 empirical studies published between 2020 and 2025, mapping individual, institutional, and macro-level factors influencing DC development. Research activity has increased steadily since 2020, particularly post-COVID-19, with most studies employing quantitative, cross-sectional designs and focusing predominantly on student populations in Indonesia, Malaysia, Vietnam, and Thailand. However, the field remains heavily reliant on self-reported data and Eurocentric frameworks—especially DigComp—often adopted with minimal contextual localisation (Subramaniam et al., 2023; Nguyen & Tuamsuk, 2023; Thi et al., 2025). At the individual level, demographic and psychological factors consistently shaped DC outcomes. Gender differences were evident, with males excelling in technical skills and females in communication and safety domains (Nguyen & Tuamsuk, 2023; Kok et al., 2025), while students in STEM disciplines outperformed those in the humanities (Disastra et al., 2024; Dirgatama, 2024). Digital exposure, self-efficacy, and confidence were also positively associated with competence (Lim et al., 2024; Nuryadi & Widiatmaka, 2023). Institutionally, DC was strongly linked to organisational readiness—particularly digital leadership, infrastructure investment, and innovation culture (Arham et al., 2024; Suryadi et al., 2023). Faculty development, including structured training and leadership support, further enhanced staff competence (Wiyono et al., 2024; Atabik et al., 2024), although digital initiatives were seldom embedded within institutional quality assurance frameworks.

At the macro level, national strategies—such as MyDigital and SPADA—shaped institutional capacity, but their practical implementation was uneven and often constrained by fragmented governance (Somabut et al., 2024; Wall et al., 2023; Flores & Mean, 2025). Notably, Cambodia emerged as a rare example where ministerial reform translated into institutional action (Flores & Mean, 2025). In terms of outcomes, DC was linked to improved academic performance, higher online learning engagement, and enhanced employability (Lim et al., 2024; Ganefri et al., 2025), with some studies also reporting associations with wellbeing, civic participation, and psychological resilience—though typically based on non-longitudinal or self-reported metrics (Razak, 2024; Nuryadi & Widiatmaka, 2023). However, ethical and critical literacies remained underexplored. Pedagogical innovations such as design thinking, problem-based learning (PBL), and heutagogy showed promising results in pilot contexts (Sriwisathiyakun, 2023; Mannan et al., 2023), while leadership-driven reforms and cross-departmental strategies improved institutional digital maturity (Atabik et al., 2024; Flores & Mean, 2025). Still, few studies employed longitudinal or experimental designs to assess sustained impact. Overall, while the literature on DC in ASEAN HEIs is expanding, it remains methodologically uneven and theoretically

underdeveloped. Future work must move beyond descriptive mapping to engage more deeply with the structural, pedagogical, and cultural complexities of digital engagement in the region.

CONCLUSIONS

A Digital competence (DC) has become a foundational skill for navigating teaching, learning, and institutional operations in an increasingly digitised higher education (HE) landscape. In the context of ASEAN, where disparities in infrastructure, policy capacity, and pedagogical readiness are highly pronounced, the ability to engage with digital tools meaningfully is not merely a technical issue—but a question of educational equity, institutional resilience, and regional competitiveness. This scoping review synthesised 61 peer-reviewed articles published between January 2020 and May 2025, providing a comprehensive overview of how digital competence (DC) is conceptualised, assessed, and implemented across higher education institutions (HEIs) in the ASEAN region. The findings indicate a clear growth in scholarly attention to DC, particularly following the COVID-19 pandemic, with a strong concentration of studies in Indonesia, Malaysia, Vietnam, Thailand, and the Philippines. Through thematic analysis, we identified key patterns across five domains: individual-level predictors, institutional enablers, macro-policy environments, pedagogical and organisational interventions, and reported outcomes.

The evidence shows that DC is associated with a range of positive outcomes—including academic engagement, employability, wellbeing, and self-regulated learning—while also being shaped by complex socio-demographic and contextual factors such as gender, field of study, and digital access. However, many institutional initiatives remain pilot-based, and the use of Eurocentric frameworks such as DigComp—without adequate localisation—raises questions about cultural fit and measurement validity. Importantly, this review also underscores the policy-practice disconnect at the macro level, with few studies engaging deeply with national digital strategies, quality assurance regimes, or systems-level governance. These findings carry practical implications: educators must rethink their pedagogical models to include reflexive, culturally responsive uses of technology; institutional leaders must embed DC into performance and QA systems; and policymakers must close the gap between national agendas and HEI implementation realities.

LIMITATIONS

This study is subject to several limitations. First, it exclusively included peer-reviewed publications in English, which may have excluded valuable studies published in local ASEAN languages. Given the region's multilingual research landscape, this language bias may underrepresent perspectives from lower-resourced or non-English dominant systems. Second, the review excluded studies focused broadly on digital literacy, ICT skills, or digital infrastructure that did not explicitly operationalise DC. While this was done to maintain conceptual precision, it may have omitted adjacent work with practical relevance to DC development. Third, as a scoping review, this study did not include an assessment of the methodological quality of the included literature. Unlike systematic reviews, which aim to critically appraise and synthesise the strength of evidence, scoping reviews are intended to map the scope, range, and nature of existing research. Future systematic reviews could build on these findings by undertaking a more rigorous evaluation of the methodological robustness of the current evidence base.

FUTURE RESEARCH

Building on the identified gaps, this review proposes several directions to advance digital competence (DC) research in ASEAN higher education institutions (HEIs). First, there is a critical need for locally grounded conceptual frameworks that move beyond the uncritical adoption of DigComp. ASEAN-responsive models should account for multilingualism, collectivist cultures, and religious influences to enhance theoretical relevance and contextual fit. Second, improved measurement practices are essential. Most existing tools rely on self-reported Likert scales with limited psychometric validation. Future research should prioritise performance-based instruments that capture behavioural engagement, ethical reasoning, and affective components of DC across diverse stakeholder groups—not limited to students. Third, methodological pluralism remains insufficiently developed within the current body of research.

There is a need for longitudinal, experimental, and quasi-experimental designs to evaluate the long-term impacts of digital interventions and to support causal inferences. Complementary qualitative approaches—such as ethnographic studies, focus groups, and case studies—are also essential for unpacking the sociocultural dynamics that influence digital adoption, resistance, and adaptation within higher education institutions. Fourth, issues of equity and inclusion require greater scholarly attention. Marginalised groups—including students with disabilities, individuals from rural or low-income backgrounds, and non-majority language speakers—remain significantly underrepresented in the literature, limiting the generalisability and inclusiveness of current findings.. Future studies should adopt intersectional frameworks that disaggregate findings by gender, geography, and socioeconomic status to uncover structural disparities.

Fifth, systems-level dynamics remain underexplored. Research should examine how national policies, accreditation standards, cross-ministerial coordination, and funding mechanisms enable or constrain institutional digital readiness. Comparative ASEAN-wide studies using policy implementation frameworks could generate valuable insights into structural enablers of digital transformation. Finally, there is a pressing need for applied intervention research. Only a limited number of studies provide evidence on scalable and sustainable approaches to enhancing digital competence (DC). Future research should prioritise the co-design, implementation, and rigorous evaluation of institutional development strategies, faculty capacity-building programmes, and digital inclusion initiatives—especially within under-resourced higher education systems.

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CONFLICT OF INTEREST

"The authors declare no conflicts of interest

AUTHORS CONTRIBUTION

Nor Faiz Bin Azizan: Conceptualisation, Methodology, Data Curation, Formal Analysis, Writing - Original Draft. Hardy Loh Rahim: Supervision, Writing - Review & Editing, Project Administration. Syed Zannierah Syed Marzuki: Validation, Writing - Review & Editing. Faizal Samat: Resources, Writing - Review & Editing.

AVAILABILITY OF DATA AND MATERIALS

Data available on request from the authors.

DECLARATION OF GENERATIVE AI

During the preparation of this work, the author(s) used Claude to enhance the clarity of the writing. After using the Claude, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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