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DIGITAL LITERACY IN ASEAN HIGHER EDUCATION: A TWO-DECADE BIBLIOMETRIC REVIEW

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ABSTRACT

This study provides the first comprehensive, two-decade bibliometric review of digital literacy research in ASEAN higher education. While the field is of critical importance for the region's economic and social development, its intellectual and collaborative structure has remained unmapped. Using a dataset of 248 articles retrieved from the Scopus database (2005–2024), we employ performance analysis and science mapping to chart the research landscape. The findings reveal a significant paradox: the field has experienced explosive publication growth, with over 75% of all research published in the last five years, yet it remains profoundly fragmented. Co-authorship analysis at the country, institution, and author levels reveals a community fractured into national and institutional silos with minimal cross-border collaboration. This social fragmentation is mirrored by a disconnected intellectual base, confirmed by a co-citation analysis showing no shared theoretical foundation among the field's foundational scholars. We conclude that the field's rapid, crisis-driven growth has not yet led to maturity. By mapping these structural weaknesses, this study offers a clear, evidence-based agenda for fostering the cohesion needed to build a more impactful and sustainable research ecosystem.

KEYWORDS: DIGITAL LITERACY, BIBLIOMETRIC ANALYSIS, HIGHER EDUCATION, ASEAN, DIGITAL DIVIDE

ABSTRAK

Kajian ini menyediakan ulasan bibliometrik komprehensif pertama selama dua dekad mengenai penyelidikan literasi digital dalam pendidikan tinggi ASEAN. Walaupun bidang ini amat penting untuk pembangunan ekonomi dan sosial serantau, struktur intelektual dan kolaboratifnya masih belum dipetakan. Dengan menggunakan set data 248 artikel yang diperoleh daripada pangkalan data

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Scopus (2005–2024), kami menggunakan analisis prestasi dan pemetaan sains untuk mencarta landskap penyelidikan. Dapatan kajian mendedahkan satu paradoks yang signifikan: bidang ini telah mengalami pertumbuhan penerbitan yang pesat, dengan lebih 75% daripada semua penyelidikan diterbitkan dalam lima tahun terakhir, namun ia kekal terpecah-belah secara mendalam. Analisis penulisan bersama di peringkat negara, institusi, dan pengarang mendedahkan sebuah komuniti penyelidik yang terpisah kepada silo-silo kebangsaan dan institusi dengan kolaborasi rentas sempadan yang minimum. Fragmentasi sosial ini dicerminkan oleh asas intelektual yang tidak berhubung, yang disahkan oleh analisis sitasi bersama yang menunjukkan tiada landasan teori yang dikongsi dalam kalangan sarjana pengasas bidang ini. Kami merumuskan bahawa pertumbuhan pesat bidang ini yang didorong oleh krisis masih belum membawanya kepada kematangan. Dengan memetakan kelemahan struktur ini, kajian ini menawarkan agenda yang jelas dan berasaskan bukti untuk memupuk kepaduan yang diperlukan bagi membina ekosistem penyelidikan yang lebih berimpak dan mampan.

KATA KUNCI: LITERASI DIGITAL, ANALISIS BIBLIOMETRIK, PENDIDIKAN TINGGI, ASEAN, JURANG DIGITAL

1. INTRODUCTION

In an era defined by technological advancement, the line separating academic success from digital literacy has effectively vanished (Thangaraj *et al.,* 2024; Zakir *et al.,* 2025), making a graduate's ability to command digital information tools a prerequisite for entering the knowledge economy (Rosly *et al.,* 2023). This global imperative presents a unique and urgent challenge in the Association of Southeast Asian Nations (ASEAN), a region of vast economic diversity and rapid digital transformation (Ahmad Radhi *et al.,* 2024; Mawang & Lai, 2024). ASEAN was established on August 8, 1967, in Bangkok, with the founding members being Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Brunei joined in 1984, Vietnam in 1995, Laos and Myanmar in 1997, and Cambodia in 1999 (Bhasin & Kumar, 2022). Table 1 below illustrates key indicators of digital transformation across ASEAN, highlighting substantial disparities in internet penetration and ICT development. These figures demonstrate how varying levels of infrastructural readiness continue to shape the pace of digital integration in higher education.

TABLE 1: SELECTED INDICATORS OF DIGITAL TRANSFORMATION IN ASEAN (2024)

Country	Internet penetration (%)	ICT Development Index Rank (2024 est.)	Notes on digital readiness
Singapore	84.5	High	Mature digital infrastructure; advanced e-government and AI initiatives
Malaysia	82.3	Upper-medium	Strong digital policy framework; Industry 4.0 adoption
Thailand	79.0	Upper-medium	Expanding broadband access; regional innovation hub
Indonesia	77.5	Medium	Rapid mobile connectivity; uneven rural access
Philippines	73.2	Medium	Digital learning expansion; connectivity challenges persist
Vietnam	72.8	Medium	Growing tech sector; improving digital literacy integration
Brunei	71.4	Medium	Strong government digitalization; small population advantage
Cambodia	48.9	Lower-medium	Expanding telecom sector; low higher education integration
Myanmar	43.1	Low	Political instability limits progress

Laos	21.9	Low	Limited infrastructure; early stages of digital inclusion

Source: Compiled from Habbal *et al.* (2024); ASEAN ICT Masterplan (2024); and World Bank Digital Readiness Data (2024).

While ASEAN nations belong to the Global South, their pace of digital transformation reveals sharp internal contrasts. In contrast to the Global North, where digital ecosystems have matured through decades of sustained investment, ASEAN's progress remains uneven, often reactive, and shaped by contextual constraints such as infrastructural gaps, policy inconsistency, and socio-economic inequality. Nevertheless, these challenges also foster adaptive innovation: ASEAN's mobile-first strategies, open educational platforms, and community-led digital literacy initiatives exemplify context-sensitive responses to resource limitations. This comparison underscores ASEAN's distinctive developmental trajectory within global digital transformation.

Here, the mission of higher education to cultivate these skills is not merely academic. It is a cornerstone of national competitiveness and social progress (Maji & Laha, 2020). Complicating this mission is the region's significant "digital divide," which extends beyond access to technology to include disparities in digital competencies, pedagogical capacity, and institutional readiness to integrate digital learning ecosystems (Chetty *et al.,* 2018; Paul & Crowe, 2023). If ASEAN is to achieve its goal of a unified digital economy, policymakers and educators need a clear, evidence-based map of the current digital literacy research. This mapping would allow the region to identify strengths, overlaps, and structural gaps in how digital literacy has been conceptualized and implemented across different national contexts.

To date, however, no such map exists. The existing body of literature offers a fragmented picture at best, with most studies confined to single-country analyses or sector-specific discussions that fail to capture the regional interconnectedness of ASEAN's higher education systems. While scholars have examined related themes such as regional "digitalization" (Suranto *et al.,* 2025), digital banking (Tuli, 2023), financial literacy (Drajat Stiawan *et al.,* 2024), and early bibliometric trends (Arya *et al.,* 2024), these studies remain limited in temporal scope (typically under ten years) and conceptual focus, providing snapshots rather than comprehensive overviews. In contrast, the present study bridges this gap through a systematic, two-decade bibliometric review of 248 peer-reviewed publications (2005–2024), offering for the first time an integrated and longitudinal understanding of ASEAN's digital literacy scholarship in higher education.

Our study addresses this gap by providing the field's first comprehensive bibliometric review, spanning from 2005 to 2024. Using performance analysis and science mapping, we move beyond simple metrics to reveal the intellectual architecture of the field. Our findings uncover a central tension: a dramatic acceleration in research output, spurred by the COVID-19 pandemic, coexists with a profound lack of collaborative and thematic integration. To investigate this disconnect and propose a clear agenda, we pose the following research questions (RQs):

RQ1: What has been the publication trend of digital literacy research in ASEAN higher education over the last two decades?
RQ2: Which countries, institutions, and authors are the most productive and influential contributors to digital literacy research in ASEAN higher education?
RQ3: What are the dominant research themes and foundational intellectual structures of the literature on digital literacy in ASEAN higher education?
RQ4: What are the primary research gaps and promising directions for a future research agenda on digital literacy in ASEAN higher education?

2. LITERATURE REVIEW

Digital literacy is a core educational concept that constantly evolves with technology (Jige, 2025). Once defined by narrow technical skills, it has since matured into a rich set of competencies

essential for navigating the modern digital age. This review traces the evolution of digital literacy and establishes its critical importance for higher education in the ASEAN region. This overview of the existing research provides the necessary foundation for the comprehensive bibliometric analysis at the heart of our study.

A Concept in Motion: The Journey of Digital Literacy

The term "digital literacy" has been on a remarkable journey since Paul Gilster introduced it in 1997 (Ahsan *et al.,* 2021; Davydov *et al.,* 2020). Its earliest forms, often called "computer literacy" or "ICT literacy," were tethered to the machine itself, focusing on the practical skills needed to operate hardware and software (Bawden, 2008; Solmaz *et al.,* 2023). But as the internet became essential, this simple definition failed (Tomczyk & Eger, 2020). True literacy was no longer about mastering the machine, but about mastering the flood of information it generated (Aussu, 2023).

This realization sparked a critical evolution. From the field of library science, the idea of information literacy emerged, stressing the ability to locate, vet, and strategically use information (Hicks *et al.,* 2023). In parallel, the rise of social media and the 24-hour news cycle gave birth to media literacy (Cho *et al.,* 2024), which armed individuals with the critical tools to analyse and question the digital content they consumed (Van Zyl *et al.,* 2020). Today's robust understanding of digital literacy, which this study adopts, is a powerful fusion of these elements. According to Park et al. (2020), digital literacy is a multidisciplinary field, a holistic concept that integrates the technical (ICT skills), the cognitive (information and media literacy), and the socio-emotional skills required for any citizen to engage effectively and ethically in the digital world (Martínez-Bravo *et al.,* 2022). This view is vital because it prioritizes the user's critical and ethical reasoning over mere technical skill.

Digital Literacy in ASEAN: Bridging the Skills Gap

For ASEAN, digital literacy has moved beyond the classroom to become the very engine of socio-economic progress. To unlock the promise of a regional digital economy, the first step is always better connectivity (Chong *et al.,* 2023). Recognizing this, ASEAN has launched a cascade of strategic plans. Initial efforts like the ASEAN ICT Master Plan 2015 aimed to close the digital divide by getting more technology into schools (Prajaknate, 2017). More recently, the ASEAN Digital Integration Framework Action Plan 2019-2025 has taken on tougher challenges, from cybersecurity to persistent skills gaps (Chen *et al.,* 2023). These top-down plans are complemented by collaborative, ground-up efforts like the ASEAN Network on Information Literacy (ASEAN-NIL), which builds partnerships to raise the bar for information literacy across the region (Sacchanand, 2022).

But what does this picture of progress look like on the ground? Dangerously uneven. A deep "digital divide" fractures the region, creating stark inequalities in nearly every sphere of life. The numbers tell a story of two ASEANs: internet penetration soars at 84.45% in Singapore but plummets to just 21.87% in Laos (Habbal *et al.,* 2024). This is more than a gap in access; it is a chasm in development. While nations like Malaysia, Indonesia, and Thailand are accelerating into the digital future, others like Cambodia, Laos, and Myanmar are struggling to build the on-ramps (Suranto *et al.,* 2025). This divergence is painfully clear in education, where investment in school ICT projects varies wildly; some nations have decades of experience while others are just getting started (Prajaknate, 2017). This is the region's core challenge: ensuring the promise of digital development becomes a shared reality, not a privilege for a select few.

The region's economic future can be jeopardised by a significant digital skills deficit caused by the digital divide, and thus, the majority of ASEAN communities can be lacking of digital literacy skills (Li *et al.,* 2024). Thriving in an Industry 4.0 world demands a sophisticated digital toolkit of advanced competencies, from data analysis to virtual collaboration, that makes basic operational skills insufficient (Kipper *et al.,* 2021; Shet & Pereira, 2021). This places ASEAN universities at a

critical juncture, facing immense pressure to embed these skills into their teaching (Chung & Cam, 2024; Khlaisang & Mingsiritham, 2016). A failure to do so will not only curtail the prospects of individuals but will ultimately stifle national innovation and economic vitality (McFarlane *et al.,* 2024; Prajaknate, 2017).

An Uncharted Territory: Mapping the Research Landscape

The growing urgency surrounding digital literacy has naturally sparked scholarly interest for fostering economic growth (Ahmad Radhi *et al.,* 2024), bridging the digital divide (Chong *et al.,* 2023), supporting effective policy-making (Apriliyanti *et al.,* 2021), and thus, promoting an ASEAN identity (Thompson & Sunchindah, 2023). This scenario leads to a steady increase in research that this paper will systematically measure. However, while previous studies have explored parts of this territory, a complete and coherent map has been missing.

While existing thematic reviews offer valuable insights, they tend to provide only narrow glimpses into the larger landscape. A systematic review from Malaysia, for example, shows a research preoccupation with information literacy and communication, typically studied through quantitative surveys (Ahsan *et al.,* 2021). In the same vein, a policy review covering Singapore, Thailand, Indonesia, and Myanmar found a strategic focus on the crucial groundwork of improving network infrastructure and technology access for learners (Machmud *et al.,* 2021). Expanding the focus beyond formal education, other studies highlight the need for culturally adapted digital literacy training for parents and the establishment of ASEAN-wide research networks to create a sustainable digital literacy ecosystem for families (Lukitowati *et al.,* 2025). Collectively, these findings underscore the importance of regional collaborations and inclusive digital strategies that consider the unique socioeconomic contexts of each nation to bridge the digital divide (Suranto *et al.,* 2025). What these studies reveal are important but isolated pieces of a much larger, and still incomplete, puzzle.

This paper, therefore, builds on this earlier work to do something fundamentally new: to conduct the first comprehensive, long-term bibliometric review of digital literacy in ASEAN higher education. By charting the key contributors, intellectual currents, and thematic structures, we aim to provide a clear, evidence-based roadmap for the future.

3. METHODOLOGY

To address the research questions, this study employs a quantitative bibliometric approach to systematically analyse the landscape of digital literacy research in ASEAN higher education. The methodology integrates two key techniques: performance analysis, to measure the productivity and impact of researchers and institutions, and science mapping, to visualise the collaborative and thematic structures of the field (Herrera-Viedma *et al.,* 2016; Li, 2023).

The final dataset were processed and analysed using a combination of specialised software. Microsoft Excel was instrumental in the initial data management phase, used for organizing bibliographic records, ensuring data integrity, and generating the descriptive statistics for the publication trend analysis (RQ1) (Janzen, 2022; Lindquist & Sulewski, 2024). For the subsequent network analysis, VOSviewer was used to construct and visualize the science maps (van Eck & Waltman, 2010; Wei *et al.,* 2025; Zupic & Čater, 2015) (van Eck & Waltman, 2010; Wei *et al.,* 2025; Zupic & Čater, 2015). This allowed for a detailed examination of the collaborative networks (RQ2) as well as the identification of the primary research themes and intellectual structures of the field (RQ3).

Data Source and Search Strategy

The data for this bibliometric review were systematically retrieved from the Scopus database. Scopus was selected as the data source for three primary reasons (Baas *et al.,* 2020): its broad coverage of global and regional literature (Mongeon & Paul-Hus, 2016), which is crucial for a

study focused on the ASEAN region; its high-quality curation by an independent advisory board, ensuring the reliability of the indexed publications; and its provision of rich, comprehensive metadata, including author affiliations and full cited references, which are essential for conducting robust network analyses (Pranckutė, 2021).

A comprehensive search query was developed to identify relevant publications. The query was designed to be both sensitive enough to capture the breadth of the field and specific enough to maintain focus. It consisted of three main conceptual blocks connected by the "AND" operator:

1. Subject matter: A set of nine keywords related to the core concept of digital literacy ("internet literacy" OR "computer literacy" OR "digital literacy" etc.);
2. Population and context: A set of five keywords to limit the search to the higher education context ("higher education" OR "university" etc.); and
3. Geographic scope: A filter using the AFFILCOUNTRY field to include only articles with at least one author affiliated with one of the 10 ASEAN member states: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, or Vietnam.

The search was further refined by two final criteria. The publication year was limited to the 20 years from January 1, 2005, to December 31, 2024, to align with the "Two Decades" scope of the review. The document type was restricted to full research articles (ar) or review articles (re) to ensure the analysis was based on peer-reviewed, substantive scholarly work. The final search was conducted on September 3, 2025.

The search strategy described above was operationalised into a specific query syntax for the Scopus database. The complete and final search string used to retrieve the articles for this review is as follows:

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( TITLE-ABS-KEY ( "internet literacy" OR "computer literacy" OR "digital
literacy" OR "digital competence" OR "digital skills" OR "information literacy"
OR "media literacy" OR "ICT literacy" OR "IT literacy" ) ) AND ( TITLE-
ABS-KEY ( "higher education" OR "university" OR "universities" OR "tertiary
education" OR "undergraduate*" ) ) AND ( AFFILCOUNTRY ( brunei ) OR
AFFILCOUNTRY ( cambodia ) OR AFFILCOUNTRY ( indonesia ) OR
AFFILCOUNTRY ( laos ) OR AFFILCOUNTRY ( malaysia ) OR
AFFILCOUNTRY ( myanmar ) OR AFFILCOUNTRY ( philippines ) OR
AFFILCOUNTRY ( singapore ) OR AFFILCOUNTRY ( thailand ) OR
AFFILCOUNTRY ( vietnam ) ) AND ( PUBYEAR > 2004 AND PUBYEAR <
2025 ) AND ( DOCTYPE ( ar ) OR DOCTYPE ( re ) )
```

Source: Scopus Database

Following the initial database search, a two-stage screening process was conducted to identify the final set of articles for review. To ensure the relevance and quality of the final dataset, a precise set of inclusion and exclusion criteria was developed and applied during this process. The criteria, detailed below, guided the screening of titles and abstracts, followed by a full-text assessment of the potentially relevant articles.

A study was included if it met all of the following conditions:

1. Subject matter: The study must focus on one or more of the core concepts of digital literacy. The title, abstract, or keywords had to contain at least one of the following terms: *"internet literacy", "computer literacy", "digital literacy", "digital competence", "digital skills", "information literacy", "media literacy", "ICT literacy",* or *"IT literacy"*;
2. Population and context: The research must be set within a higher education context. The title, abstract, or keywords had to include terms such as *"higher education", "university", "universities", "tertiary education",* or *"undergraduate"* (and its variations);

3. Geographic scope: The study must originate from Southeast Asia. This was determined by the affiliation of at least one of the authors. The author affiliation country (AFFILCOUNTRY) had to be one of the following: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, or Vietnam;
4. Publication year: The article must be published within the 20 years period from January 1, 2005, to December 31, 2024, inclusive. This aligns with the "Two Decades" scope of the review;
5. Document type: The publication must be a full research article (ar) or a review article (re); and
6. Language: The article must be written in English to be eligible for analysis.

Studies were excluded if they met one or more of the following conditions:

1. Did not meet inclusion criteria: Any article that failed to meet all of the inclusion criteria listed above was automatically excluded;
2. Context mismatch: Studies where the primary focus was not on general education or skill development, even if the keywords were present. This includes; and
   o Studies focused on a specific clinical or health context (e.g., health literacy for patients);
   o Studies focused on a specific non-educational profession (e.g., skills for accountants, lawyers); and
   o Studies focused on highly technical training for a single piece of software (e.g., MATLAB, AutoCAD).
3. Document type mismatch: Publications that were not primary research or review articles. This includes editorials, book reviews, conference announcements, letters to the editor, notes, corrections (errata), and abstracts-only from conferences.

Data Collection and Screening

The data for this bibliometric analysis was systematically collected from the Scopus database on September 3, 2025. An initial search using the comprehensive query detailed in the previous section yielded 372 documents. These records were then subjected to a rigorous screening and selection process to determine the final dataset for analysis. To ensure full transparency, this process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page *et al.,* 2021) as illustrated in Figure 1.

The screening was conducted in two stages. The first stage consisted of a title and abstract review of all 372 articles. This initial screening led to the exclusion of 82 records that were clearly irrelevant due to an incorrect geographic scope (n=42), a context mismatch (n=34), or publication outside the specified date range (n=6). The remaining 290 articles were deemed potentially relevant and advanced to the second stage.

The second stage was a full-text eligibility assessment. The full text of each of the 290 articles was retrieved and read to make a final determination of its suitability based on the inclusion and exclusion criteria. This detailed review resulted in the further exclusion of 42 articles for reasons including an unstated geographic location (n=26), inability to retrieve the full text (n=7), a context or population mismatch (n=7), the article not being in English (n=1), or an incorrect country affiliation (n=1). Upon completion of this two-stage process, a final dataset of 248 articles was included in the bibliometric analysis.
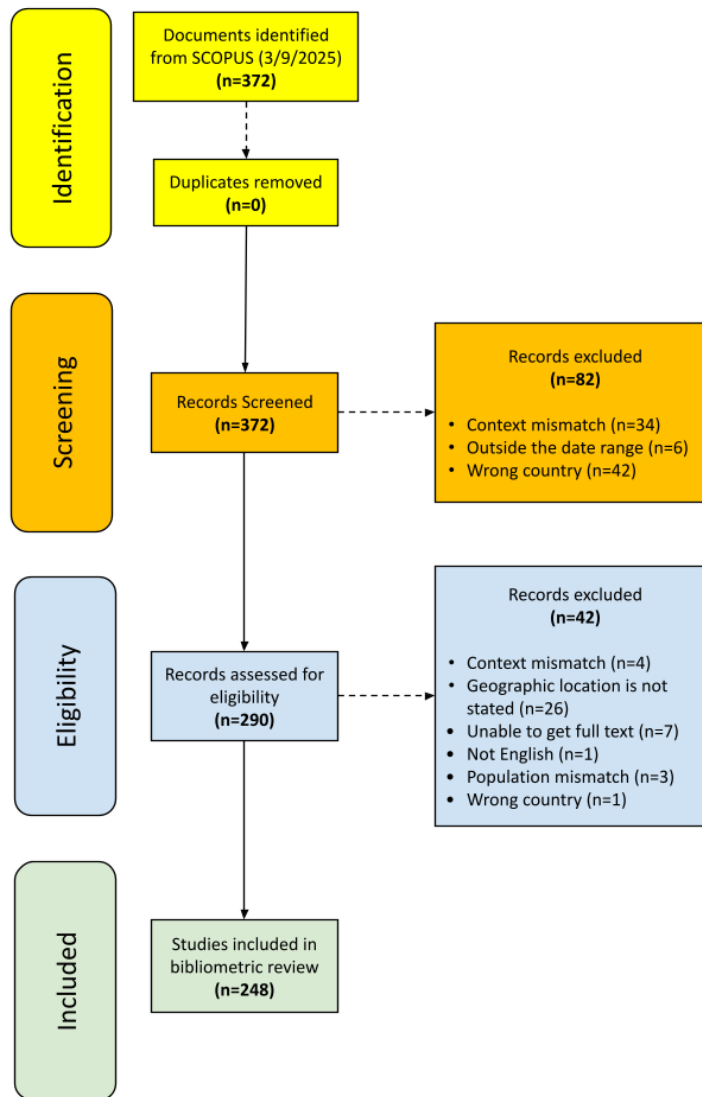
FIGURE 1: THE PRISMA DIAGRAM OF THE STUDY SELECTION PROCESS
Source: Adapted from Page *et al*. (2021)

Data Analysis and Visualisation

The final dataset of 248 articles was analysed using a combination of performance analysis and science mapping techniques to address the four research questions (Donthu *et al.,* 2021). Descriptive statistics were generated using Microsoft Excel, while network analysis and visualization were conducted using VOSviewer (version 1.6.20) (van Eck & Waltman, 2010). VOSviewer was selected because of its robust capacity to visualise bibliometric networks through intuitive, high-quality maps that effectively display relationships among authors, institutions, and keywords. It allows researchers to identify thematic clusters and structural gaps within large datasets efficiently. However, like most co-occurrence tools, VOSviewer has limitations: it offers limited options for advanced statistical modelling, relies heavily on author-supplied keywords that may introduce bias, and cannot automatically harmonise variations in author or institutional names. Despite these constraints, its balance between analytical depth and visual clarity makes it one of the most widely adopted tools in bibliometric research.

To address RQ1 on publication trends, the publication year of each article was used to generate a frequency distribution in Microsoft Excel. The results were visualised as a bar chart to illustrate the annual publication output and identify key growth periods over the two-decade span.

To answer RQ2 regarding the most productive and influential contributors, a series of co-authorship analyses was performed in VOSviewer, with the unit of analysis set to Countries, Organizations, and Authors. In each analysis, productivity was measured by the total number of documents (TD) and influence by the total number of citations (TC). The results are presented in summary tables and as network maps visualizing collaboration patterns.

To address RQ3 on dominant themes and intellectual clusters, two distinct network analyses were conducted. First, to identify the "research front," a co-occurrence analysis of "All Keywords" was performed, as this method effectively maps thematic clusters by assuming that keywords appearing together in articles are conceptually related. Second, to identify the "intellectual base," a co-citation analysis of "Cited Authors" was conducted. This technique is the standard for revealing foundational scholars, as it envisages which authors are cited together in the reference lists of the papers being studied (Passas, 2024; Zupic & Čater, 2015).

Finally, to address RQ4 and propose a future research agenda, the thematic network map was qualitatively analysed. Specifically, we identified the structural holes, the gaps and underexplored spaces between existing research clusters (Burt, 2014). Analysing these areas allowed for the identification of promising and underexplored topics for future investigation.

4. FINDINGS

Publication Trends (RQ1)

To answer RQ1, we analysed the publication trajectory of the 248 articles over the two-decade study period. The findings, illustrated in Figure 2, reveal a field that was largely dormant for its first decade before entering a phase of explosive growth, with the vast majority of research concentrated in the last five years. This dramatic surge can be understood in three distinct phases.
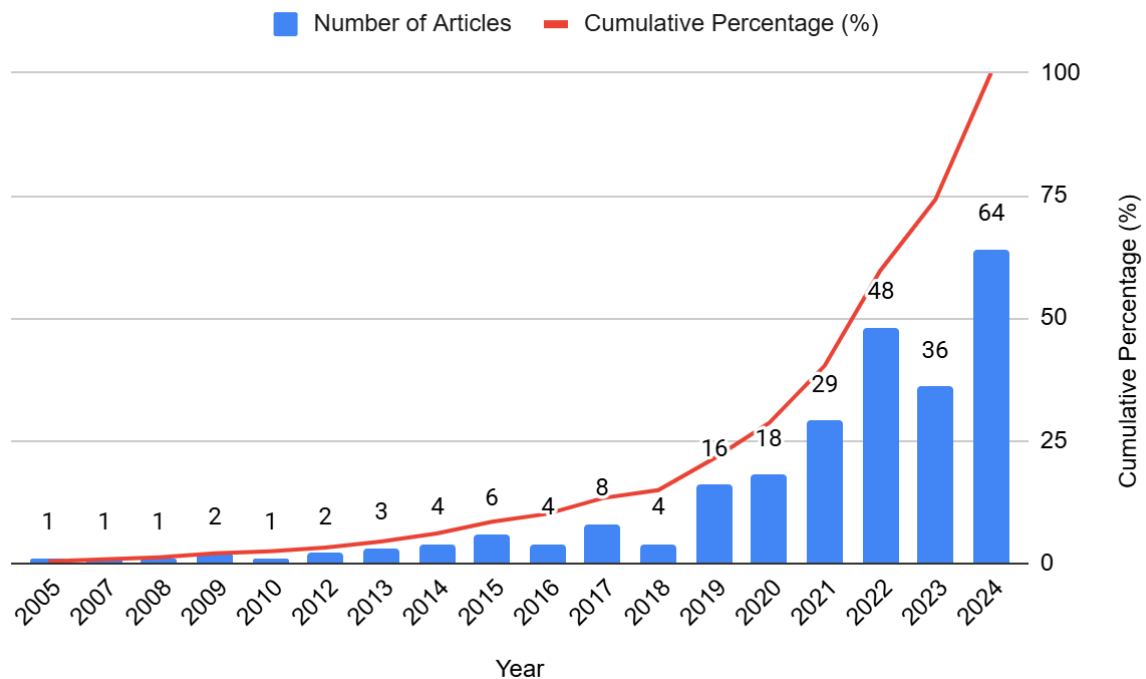
FIGURE 2: A COMBO CHART OF PUBLICATION TRENDS
Source: Authors' analysis based on data retrieved from the Scopus database (search conducted on 3 September 2025) and processed using Microsoft Excel (2024) for descriptive statistics and visualisation.

The publication trend of the 248 articles, illustrated in Figure 2, reveals a clear story of exponential growth, which can be understood in three distinct phases.

1. The nascent phase (2005–2013): For nearly a decade, the field was largely dormant. Publication output was minimal, with most years yielding only one or two articles, indicating a niche and sparsely populated area of research;
2. The emerging phase (2014–2019): This period marked the first signs of life and growing interest in the topic. While inconsistent, publication numbers began to climb, culminating in a notable jump to 16 articles in 2019 that signalled a field on the verge of expansion; and
3. The rapid acceleration phase (2020–2024): The field experienced a dramatic surge in research output beginning in 2020, with publications climbing from 18 to a peak of 64 in 2024. As the cumulative percentage line (red) confirms, the vast majority of this research is remarkably recent; a staggering.

Furthermore, 75% of all publications in the last two decades were published in just the last five years (2020–2024), underscoring the powerful impact of recent global events on the field's trajectory. Therefore, this surge reflects a reactive expansion in scholarly activity largely triggered by the COVID-19 pandemic and the rapid transition to digital learning environments across ASEAN. While this accelerated output demonstrates growing academic interest, it also suggests that the field's development has been driven by short-term, crisis-induced imperatives rather than sustained, strategic research agendas; an issue that subsequent sections of this paper address in greater depth.

Analysis of Productive and Influential Contributors (RQ2)

To address RQ2, we mapped the key players shaping the research landscape by conducting a co-authorship analysis at the level of countries, institutions, and individual authors. This analysis reveals the social structure of the field, identifying not only the most productive and influential

contributors but also the collaborative patterns and significant disconnections, which define the research community.

TABLE 2: PRODUCTIVITY AND IMPACT OF COUNTRIES WITH 3 OR MORE DOCUMENTS

Rank	Country	Total Documents (TD)	Total Citations (TC)	ACPP (TC/TD)	Total Link Strength (TLS)
1	Indonesia	107	811	7.58	16
2	Malaysia	60	911	15.18	15
2	Thailand	60	646	10.77	6
4	Philippines	18	213	11.83	2
5	Singapore	11	456	41.45	2
6	Australia	9	97	10.78	8
7	United States	4	39	9.75	4
8	Saudi Arabia	3	19	6.33	3

Note. TD = Total Documents; TC = Total Citations; ACPP = Average Citations per Paper; TLS = Total Link Strength
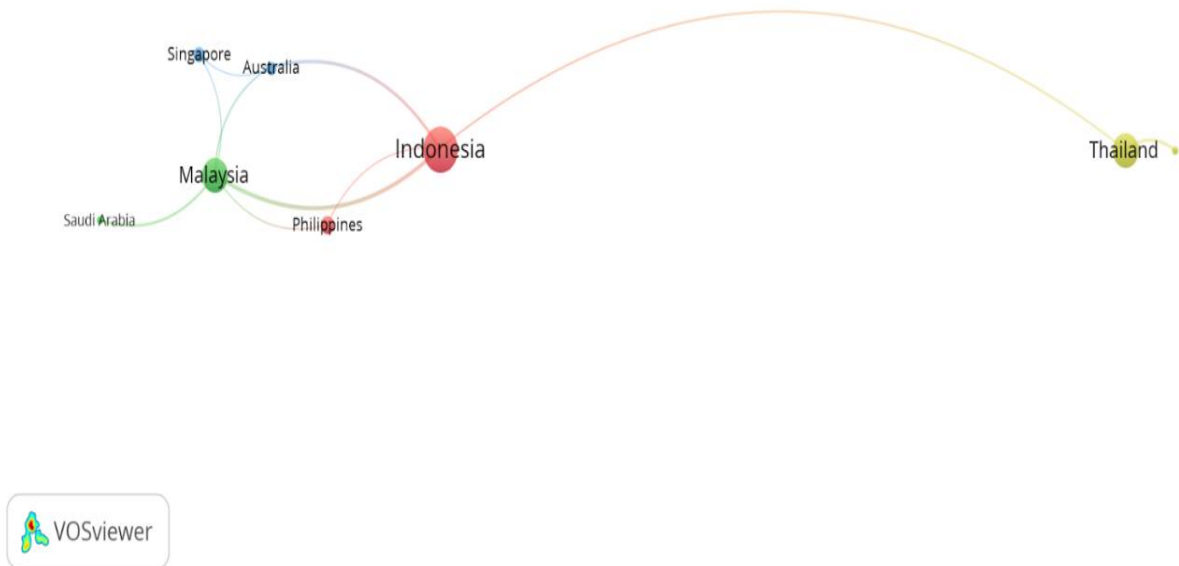Source: Authors' analysis based on data retrieved from the Scopus database

FIGURE 3: CO-AUTHORSHIP NETWORK OF COUNTRIES
Source: VOSviewer Analysis

To identify the most productive and influential countries, a co-authorship analysis was conducted. The findings for all countries with three or more documents are presented in Table 2, and the corresponding collaboration network is visualized in Figure 3. The productivity of each country is shown by the node size in Figure 3 and the Total Documents (TD) in Table 2. The analysis

identifies Indonesia as the most productive country, leading significantly with 107 documents (TD=107). Malaysia and Thailand are tied for the second-most productive, with 60 documents each. The influence was measured in two ways: citation impact and collaboration.

- Citation impact: Table 2 shows that Malaysia has the highest total citations (TC=911). However, for normalised impact, Singapore (ACPP=41.45) has by far the highest average citations per paper, followed by Malaysia (ACPP=15.18); and
- Collaboration: The collaboration network (Figure 3) and Total Link Strength (TLS) scores in Table 2 reveal the collaborative structure. Indonesia (TLS=16) and Malaysia (TLS=15) are the two main collaboration hubs. Figure 3 shows these countries form a large, interconnected cluster with partners like Australia, Singapore, and the Philippines. In sharp contrast, Thailand (TLS=6) is highly isolated from this main cluster, with only one visible link to Indonesia.

TABLE 3: PRODUCTIVITY AND IMPACT OF INSTITUTIONS WITH 3 OR MORE DOCUMENTS

Rank	Institution	Country	Total Documents (TD)	Total Citations (TC)	ACPP (TC/TD)	Total Link Strength (TLS)
1	Universitas Negeri Malang	Indonesia	14	63	4.50	7
2	Universiti Malaya	Malaysia	13	165	12.69	2
3	Universiti Kebangsaan Malaysia	Malaysia	11	97	8.82	3
3	Universiti Teknologi Mara	Malaysia	11	53	4.82	6
5	Universitas Negeri Jakarta	Indonesia	10	62	6.20	4
6	Universitas Negeri Padang	Indonesia	9	27	3.00	6
7	Universitas Negeri Yogyakarta	Indonesia	6	35	5.83	2
8	Uin Alauddin Makassar	Indonesia	5	46	9.20	3
8	Universitas Negeri Semarang	Indonesia	5	50	10.00	2
8	Universitas Pendidikan Indonesia	Indonesia	5	28	5.60	2
8	Universitas Sebelas Maret	Indonesia	5	14	2.80	2
12	Universitas Islam Negeri Syarif Hidayatullah Jakarta	Indonesia	4	24	6.00	1

Rank	Institution	Country	Total Documents (TD)	Total Citations (TC)	ACPP (TC/TD)	Total Link Strength (TLS)
13	Brawijaya University	Indonesia	3	13	4.33	1
13	Universitas Diponegoro	Indonesia	3	8	2.67	2
13	Universitas Islam Negeri Imam Bonjol Padang	Indonesia	3	8	2.67	4
13	Universitas Negeri Surabaya	Indonesia	3	8	2.67	3
13	Universitas Pendidikan Mandalika	Indonesia	3	55	18.33	2

Note. TD = Total Documents; TC = Total Citations; ACPP = Average Citations per Paper; TLS = Total Link Strength

Source: Authors' analysis based on data retrieved from the Scopus database

As shown in Table 3, Universitas Negeri Malang (TD=14) is the most productive institution, followed by Universiti Malaya (TD=13). Universitas Negeri Malang also appears to be the main collaboration hub (TLS=7). This prominence can be attributed to the university's strong research focus on digital pedagogy, information and communication technology (ICT) integration, and teacher training—areas that align closely with national education digitalisation priorities. Additionally, Universitas Negeri Malang has maintained several active Scopus-indexed journals and international collaborations that encourage faculty publishing, thereby amplifying its research output in digital literacy. However, Universitas Pendidikan Mandalika shows the highest average impact (ACPP=18.33) by a significant margin, followed by Universiti Malaya (ACPP=12.69). This suggests that while some institutions produce more, Malang's institutional capacity and supportive research culture underpin its productivity, whereas Mandalika and Malaya lead in per-paper influence. The data indicate that research productivity within the specific scope of this study is heavily dominated by institutions from just two countries: Indonesia and Malaysia. This suggests that the knowledge production in this field is primarily a regional endeavour, centered within Southeast Asia.

FIGURE 4: CO-AUTHORSHIP NETWORK OF INSTITUTIONS
Source: VOSviewer Analysis

Figure 4 envisages the co-authorship network of the 17 institutions that met the 3-document threshold. In this map, the size of each node (circle) corresponds to the institution's productivity (Total Documents). The links (lines) represent co-authorship collaborations, and the colours represent distinct collaborative clusters.

The network is dominated by a few large nodes, with Universitas Negeri Malang (red) and Universiti Malaya (green) being the most prominent, confirming their high productivity as shown in Table 3. The map reveals a structure of two main, dense clusters that are only weakly connected:

1. The Indonesian cluster (Red/Pink/Blue/Yellow): The largest cluster is a dense network of Indonesian institutions. Universitas Negeri Malang (red) is the clear central hub of this group, with the highest Total Link Strength (TLS=7). It is closely linked to other productive institutions like Universitas Negeri Jakarta (blue) and Universitas Negeri Yogyakarta (yellow); and
2. The Malaysian cluster (Green): The second cluster is a smaller, separate network of Malaysian institutions, with Universiti Malaya as its main node.

A single, long link is visible connecting these two major clusters, indicating that while collaboration within national groups is strong, direct collaboration between the primary Indonesian and Malaysian research hubs is less frequent.

TABLE 4: TOP 20 MOST PRODUCTIVE AND INFLUENTIAL AUTHORS

Rank	Author	Country	Total Documents (TD)	Total Citations (TC)	ACPP (TC/TD)	Total Link Strength (TLS)
1	Anthonysamy, Lilian	Malaysia	4	221	55.25	0
2	Tuamsuk, Kulthida	Thailand	4	55	13.75	2
3	Edzan, N. N.	Malaysia	4	49	12.25	1
4	Hidayat, Hendra	Indonesia	4	12	3.00	7
5	Sin, Sei Ching Joanna	Singapore	3	243	81.00	4
6	Pimdee, Paitoon	Thailand	3	90	30.00	3
7	Nilsook, Prachyanun	Thailand	3	55	18.33	2
8	Khalid, Fariza	Malaysia	3	52	17.33	2
9	Sukkamart, Aukkapong	Thailand	3	26	8.67	3
10	Kantathanawat, Thiyaporn	Thailand	3	12	4.00	3
11	Heriyanto	Indonesia	3	8	2.67	3
12	Anwar, Muhammad	Indonesia	3	5	1.67	7
13	Yin-Leng, Theng	Singapore	2	215	107.50	2
14	Viriyavejakul, Chantana	Thailand	2	102	51.00	1
15	Kaeophanuek, Siriwatchana	Thailand	2	50	25.00	2
16	Nasongkhla, Jaitip	Thailand	2	49	24.50	2
17	Chavez, Jason V.	Philippines	2	44	22.00	0
18	Khlaisang, Jintavee	Thailand	2	42	21.00	0
19	Daud, Md Yusoff	Malaysia	2	35	17.50	2
20	Dewi, C. A.	Indonesia	2	35	17.50	0

Note. TD = Total Documents; TC = Total Citations; ACPP = Average Citations per Paper; TLS = Total Link Strength

Source: Authors' analysis based on data retrieved from the Scopus database

The performance data in Table 4 highlights two key trends. First, in terms of productivity, the field is led by a group of four authors tied for the top rank with four documents each: Anthonysamy, Lilian (Malaysia), Tuamsuk, Kulthida (Thailand), Edzan, N. N. (Malaysia), and Hidayat, Hendra (Indonesia). The list of top producers is geographically diverse, with a notable concentration of scholars from Thailand (8 authors), Malaysia (4), and Indonesia (4). This can be attributed to a confluence of regional academic priorities, national research funding structures, and the maturation of specific research domains within Southeast Asia.

Second, a clear divergence between productivity and citation impact is evident. While Anthonysamy, Lilian, is both a top producer and highly cited (TC=221), the most influential author by total citations is Sin, Sei Ching Joanna from Singapore (TC=243), who has only three documents. This high-impact, low-volume profile is even more pronounced for another Singaporean author, Yin-Leng Theng (TD=2), who has the highest average citations per paper by a wide margin (ACPP=107.50). In contrast, some of the most productive authors, such as Hidayat, Hendra (TD=4), have a comparatively lower average impact (ACPP=3.00), suggesting a distinction between high-volume research output and high-impact, foundational work.
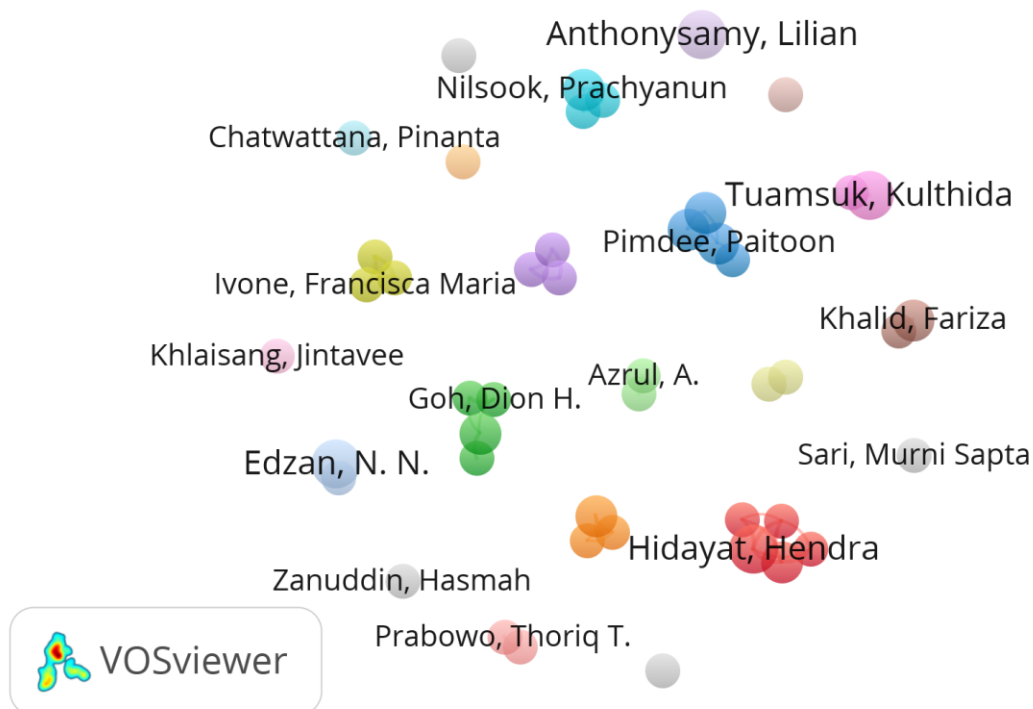

FIGURE 5: CO-AUTHORSHIP NETWORK OF AUTHORS
Source: VOSviewer Analysis

The co-authorship network visualised in Figure 5 provides the most compelling evidence of the field's fragmentation at the author level. Instead of a single, interconnected community, the map reveals a landscape composed of numerous small, isolated collaboration "islands" and many authors who are not connected to any network at all.

This visual finding is quantitatively confirmed by the Total Link Strength (TLS) data in Table 4. Several of the most productive and high-impact authors in the field are "isolated nodes" with a TLS of 0. For instance, Anthonysamy, Lilian, whose productivity likely stems from her sustained work on digital pedagogy, learning analytics, and technology-enhanced education within Malaysia's higher education reform is one of the most productive and influential authors. Her consistent publication record across Scopus-indexed journals and co-authored works on digital competence frameworks contributes to her strong citation impact despite limited cross-border collaboration. Other high-impact researchers like Chavez, Jason V., and Dewi, C. A., are not part of any collaborative cluster within this dataset.

Despite the overall fragmentation, the map does show several distinct collaboration groups. While the labels for some authors may be visually overlapped due to their proximity, the underlying data reveals several key clusters. The largest is the red cluster, an Indonesian research group centred on Hidayat, Hendra, and Anwar, Muhammad, who both have the highest collaboration score (TLS=7).

Other significant clusters include the green cluster, which connects the highly cited author Sin, Sei Ching Joanna, with Goh, Dion H., and the blue cluster, a Thai research group linking the productive author Tuamsuk, Kulthida, with the high-impact author Pimdee, Paitoon. The existence of these small, nationally focused clusters reinforces the finding that collaboration, when it does occur, is primarily local and does not bridge the different national or institutional silos.

Dominant Themes and Intellectual Clusters (RQ3)

Having mapped the social structure of the field, we now turn to its intellectual structure to answer RQ3. This analysis moves from the "who" to the "what," using keyword co-occurrence to identify the dominant research themes and author co-citation analysis to uncover the foundational theoretical pillars upon which the literature is built.

TABLE 5: TOP KEYWORDS AND THEMATICS

Cluster	Cluster name	Keyword	Occurrence
1	COVID-19 and media (mis)information	Covid-19	12
		Social media	10
		Fake news	5
		Media and information literacy	4
		Problem-based learning	4
		Digital media	3
		Internet	3
2	E-learning technologies and systems	E-learning	26
		Self-efficacy	7
		Education computing	6
		Learning systems	5
		Engineering education	4
		Learning strategies	3
		Mobile learning	3
3	Digital pedagogy and transformation	Digital competence	15
		Self-directed learning	7
		Educational technology	4
		Digital leadership	3
		Digital learning	3
		Digital transformation	3
4	Core literacies and foundational skills	Information literacy	45
		Media literacy	12
		21st century skills	6
		Critical thinking	6
		Motivation	4

		ICT	3
5	Student skills and outcomes	Students	32
		Digital skills	9
		Employability	3
		Perception	3
6	Digital literacy models and application	Digital literacy	67
		Blended learning	10
		Self-regulated learning	4
		Tpack	3
7	Learning design and library science	Academic libraries	3
		Instructional design	3

Source: Table by Authors

To identify the dominant research themes (RQ3), a keyword co-occurrence analysis was performed. After cleaning the data, 36 keywords met the 3-occurrence threshold. VOSviewer grouped these keywords into 7 distinct thematic clusters, which are detailed in Table 5. The analysis shows that the research is dominated by a few key concepts that form the hearts of the largest clusters:

- Cluster 6 (Digital literacy models & application): This is the largest and most central theme, built around the most frequent keyword, digital literacy (Occ=67);
- Cluster 4 (Core literacies & foundational skills): This is the second-largest theme, centred on information literacy (Occ=45) and media literacy (Occ=12);
- Cluster 5 (Student skills & outcomes): This is another major theme, anchored by the keyword students (Occ=32);
- Cluster 2 (E-Learning technologies & systems): This theme is led by e-learning (Occ=26); and
- Cluster 1 (COVID-19 & media (mis)information): This theme highlights the importance of the pandemic, led by COVID-19 (Occ=12) and social media (Occ=10).

The remaining clusters, Cluster 3 (Digital pedagogy & transformation) and Cluster 7 (Learning design & library science), represent more specific, niche research areas.
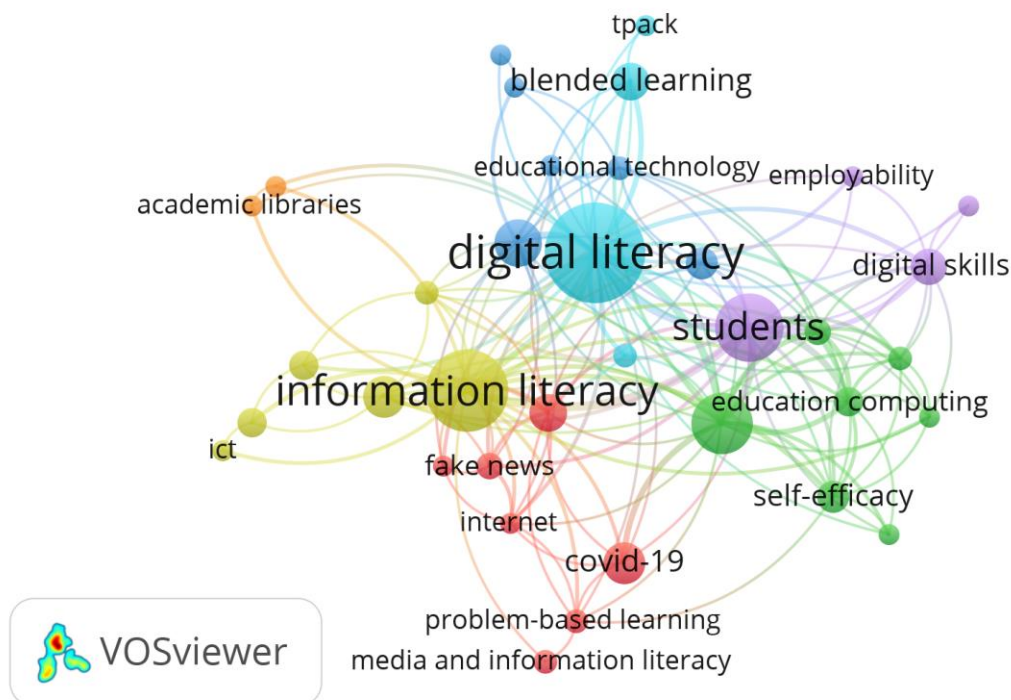
FIGURE 6: CO-OCCURRENCE OF KEYWORDS
Source: VOSviewer Analysis

Figure 6 provides a visual network map of these keywords. In this map, the size of each circle represents the keyword's frequency, and the lines represent their co-occurrence in the literature. While the detailed analysis in Table 4 identifies seven clusters, the visual map simplifies these into five main coloured groups for easier interpretation.

1. The light blue cluster in the map is the largest, corresponding to Cluster 6 (Digital Literacy Models & Application). Its central keyword, 'digital literacy' (Occ=67), acts as the primary bridge connecting all other research themes;
2. The yellow cluster visually groups keywords from Cluster 4 (Core Literacies & Foundational Skills), which is built around the second-most frequent keyword, 'information literacy' (Occ=45);
3. The green cluster represents Cluster 2 (E-Learning Technologies & Systems), led by the keyword 'e-learning' (Occ=26);
4. The purple cluster highlights Cluster 5 (Student Skills & Outcomes), which is anchored by the keyword 'students' (Occ=32) and its links to 'digital skills' and 'employability'; and
5. The red cluster clearly visualizes the recent and important theme of Cluster 1 (COVID-19 & Media (Mis) information), which is centered on 'covid-19' (Occ=12) and 'social media' (Occ=10).

The remaining clusters identified in Table 4, Cluster 3 (Digital Pedagogy & Transformation) and Cluster 7 (Learning Design & Library Science), represent more specific, niche research areas that are visually grouped with the larger clusters in the network map.

In summary, the co-occurrence analysis reveals that digital literacy research in ASEAN is a well-structured field with a strong core (digital and information literacy) that has expanded to include distinct themes of e-learning technologies, student outcomes, and recent societal challenges like the COVID-19 pandemic.
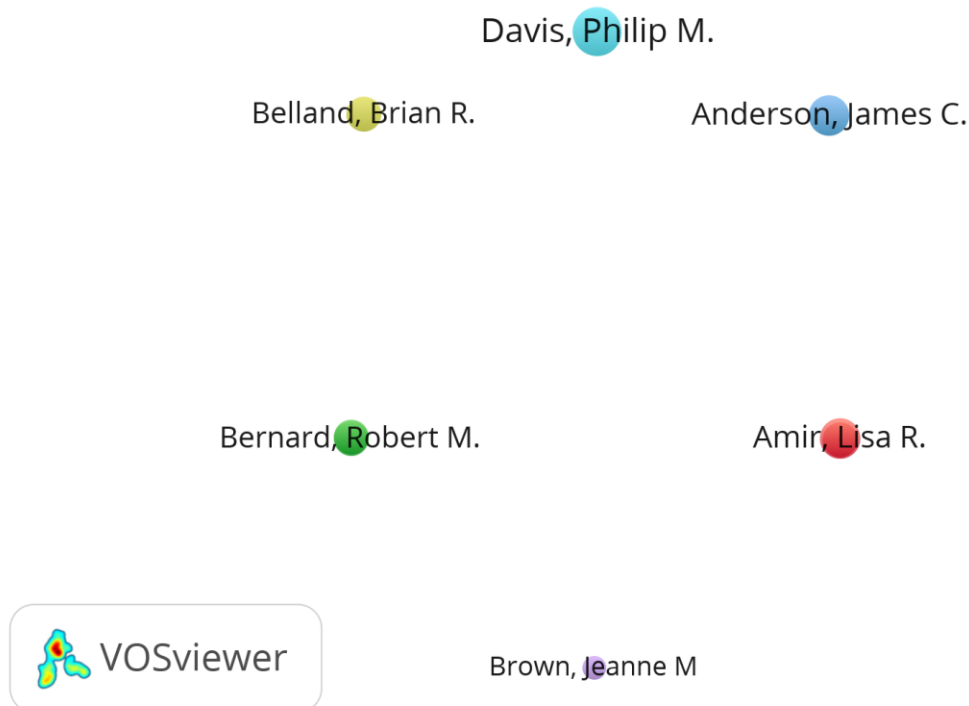
Davis, Philip M.

Belland, Brian R.   Anderson, James C.

Bernard, Robert M.   Amir, Lisa R.

VOSviewer   Brown, Jeanne M

FIGURE 7: CO-CITATION OF CITED AUTHORS
Source: VOSviewer Analysis

To identify the intellectual base of the field (RQ3), a co-citation analysis of cited authors was conducted. This method maps the foundational "pillars" of the research by visualizing which influential authors are cited together by the articles in the dataset. The resulting network of the most frequently cited authors is shown in Figure 7. The network visualizes the relationships between the most frequently cited authors in the dataset. Each node represents an author. The complete absence of links between the nodes indicates a fragmented intellectual structure, suggesting that the foundational authors are not cited together by researchers in the field.

The most significant finding from this analysis is the complete fragmentation of the field's intellectual base. As visualized in the map, there are no co-citation links connecting the most influential authors. The authors are positioned far apart as isolated nodes, each in their own cluster, indicating they are not cited together in the reference lists of the papers analysed in this study.

This suggests that digital literacy research in ASEAN higher education does not draw upon a single, unified theoretical foundation. Instead, researchers in the region are building their work upon several separate and distinct "intellectual pillars" that do not interact with one another. The map identifies several of these isolated foundational authors, including Davis, Philip M., Bernard, Robert M., Belland, Brian R., and Anderson, James C., among others.

This finding of a fragmented intellectual base is consistent with the fragmented collaboration networks observed among the publishing authors, institutions, and countries (answering RQ2), painting a picture of a research field that is siloed at both the social (collaboration) and intellectual (citation) levels.

5. DISCUSSION

This bibliometric review provides the first comprehensive map of digital literacy research in ASEAN higher education, and the landscape it reveals is one of profound paradox. While the field has experienced an explosive surge in publications, it remains deeply fragmented at its

collaborative, thematic, and intellectual core. This discussion will now interpret these principal findings to explain the current state and trajectory of the field.

The first part of this story is about the field's growth (RQ1). Our analysis shows that this is a young area of study, powerfully catalysed by crisis. The dramatic acceleration of publications from 2020 onwards, which accounts for over 75% of all articles, is a direct consequence of the COVID-19 pandemic. The forced, large-scale shift to online learning across the region created an urgent, real-world laboratory for researchers, transforming the topic from a niche academic interest into a critical research priority. This suggests that the field's current momentum is largely a reaction to an external shock, rather than the result of a long-term, strategic research agenda.

The second major finding is that this rapid growth has not created a cohesive research community (RQ2). The co-authorship maps for countries, institutions, and authors all tell the same story of disconnection. While productivity is concentrated in three nations: Indonesia, Malaysia, and Thailand, the community is fractured into national and institutional silos with minimal collaboration between the most active hubs. The institutional network, for example, is split into a dense Indonesian cluster and a separate Malaysian cluster, with almost no collaborative bridges between them. This finding is critical, as it suggests that while research is booming within certain countries, the cross-border knowledge sharing needed for regional advancement is critically underdeveloped.

Finally, this social fragmentation is mirrored by a disconnected intellectual structure (RQ3). While our thematic analysis confirms a well-defined set of research topics, the co-citation analysis reveals that the intellectual base of this research is completely fragmented. There are no discernible connections between the field's foundational scholars, which suggests that researchers in the ASEAN region are not building upon a unified body of established theory. Instead, they appear to be drawing from separate, parallel "intellectual pillars," leading to the development of isolated "islands" of research that do not inform or build upon one another.

6. CONTRIBUTIONS

The findings of this study offer significant theoretical, practical, and methodological contributions to the understanding of digital literacy research in the ASEAN region.

Our primary theoretical contribution is the empirical validation of the field's structural fragmentation. By providing the first holistic map of the research landscape, this study moves beyond analysing individual papers to reveal a systemic weakness. It challenges the common assumption that a high growth rate in publications equals field maturity, demonstrating instead that a field can expand rapidly while failing to develop the collaborative and theoretical cohesion necessary for sustained scholarly impact.

From a practical standpoint, our findings have direct implications for key stakeholders across ASEAN. The clear visualization of national and institutional silos provides policymakers, university administrators, and funding bodies with an evidence base for targeted interventions aimed at fostering collaboration. For educators and curriculum designers, the identified thematic gaps, particularly the need to move beyond functional skills towards more critical and discipline-specific literacies, can inform the development of more strategic research agendas and highlight the need for a more integrated theoretical base when designing effective curricula.

Finally, the methodological contribution of this paper is a transparent and replicable bibliometric model for analysing a regional research field. Researchers in other regions or disciplines can adopt the multi-stage analysis used in this study to map their own fields, identify similar structural weaknesses, and develop their own evidence-based agendas for future research.

7. CONCLUSION, LIMITATIONS AND FUTURE RESEARCH

This study set out to map the landscape of digital literacy research in ASEAN higher education, charting its evolution over the last two decades. We began by tracing the concept of digital literacy itself, from its early focus on technical skills to its modern, holistic understanding as a core competency for life in a digital society. Our literature review confirmed that while this topic is critically important for the region's economic and social future, a comprehensive, long-term overview of the research field was a significant gap.

To fill this gap, we employed a rigorous bibliometric methodology, systematically collecting and analysing 248 articles from the Scopus database. Our findings reveal a fundamental paradox: the field is simultaneously experiencing explosive growth and profound fragmentation. The volume of research has surged, with over 75% of all publications appearing in just the last five years, largely driven by the COVID-19 pandemic. However, this rapid expansion has not led to a cohesive research community. Instead, our analysis uncovered a landscape fractured into national and institutional silos, with minimal collaboration between the most productive researchers and countries. This social fragmentation is mirrored by a disconnected intellectual base, where foundational theories are not shared across the community.

By providing the first empirical evidence of this structural weakness, our study concludes that the field's rapid growth has not yet translated into maturity. The urgent, defining challenge for the coming decade is to move beyond crisis-driven research and begin the deliberate work of building the collaborative and theoretical bridges needed to create a truly cohesive and impactful field of study for the ASEAN region..

Moreover, this study has clear boundaries that point the way for future work. First, our decision to use the Scopus database, while ensuring high-quality and comprehensive data, means that we have not included research from non-indexed regional journals or other platforms like Web of Science. A valuable next step would be a comparative analysis across different databases to create an even more complete map of the field. Second, our analysis was intentionally limited to English-language publications. We acknowledge that this may underrepresent the rich body of scholarship published in the national languages of Southeast Asia, and a future multilingual study, though complex, would be an important contribution..

Finally, to answer RQ4, we propose a future research agenda built directly from the structural gaps this study has identified. To move from a fragmented present to a cohesive future, we argue for three strategic priorities:

1. The most urgent priority is to dismantle the national and institutional silos that currently define the field. To forge a unified regional knowledge base, ASEAN must institutionalize cooperation, moving beyond ad-hoc projects to build lasting collaborative structures. This requires two key actions. First, implementing effective network governance that brings together state and non-state actors is essential (Sundram, 2025). Second, developing a clear regional action plan to guide capacity building is needed, a strategy that has proven effective in other critical sectors (Trajano & Caballero-Anthony, 2020). The foundation for this already exists; successful mechanisms like the Initiative for ASEAN Integration (IAI) provide a model for pooling regional resources to tackle shared challenges (Bae, 2022). By leveraging these frameworks, both new and existing, the influential but isolated research communities in Indonesia, Malaysia, Thailand, and Singapore can finally be connected, creating the representative knowledge base the region needs;
2. Beyond connecting researchers, the field must deliberately weave together its fragmented themes and theories. This requires moving past siloed topics to undertake the challenging work of interdisciplinary synthesis. For instance, by applying established models of "digital literacy" to the modern fight against misinformation. However, such deep, transdisciplinary research cannot succeed without dedicated funding instruments designed to support long-term

investigation (Zscheischler *et al.,* 2017). While ASEAN's global scientific collaborations are growing, the crucial intra-regional partnerships needed to build a shared intellectual core are still lagging (Stek, 2024). To address this, the field needs a new wave of systematic reviews and meta-analyses. The goal of these should not be to simply map the landscape again, but to synthesize the different findings and construct the coherent theoretical framework that the ASEAN context currently lacks. For any of this to be successful, it must be supported by real efforts to build public awareness and acceptance for these regional initiatives (Miranda *et al.,* 2021); and

3. To mature, the field's research agenda must expand beyond its current focus on functional skills and crisis-driven technology adoption. Future studies should explore the broader implications of technology adoption (Nimanandh *et al.,* 2025) and develop tailored policy recommendations to guide the region's digital transformation (Derouez & Ifa, 2025). The agenda must also pivot towards two critical frontiers. The first is critical digital literacy, which involves equipping students with the skills to critically analyze digital sources and navigate ethical challenges (Milković *et al.,* 2025). The second is discipline-specific literacy. A significant gap exists in understanding what digital literacy means for professions like medicine, law, or engineering, which requires a combination of technical, cognitive, and socio-emotional competencies tailored to the unique context of Southeast Asia (Suranto *et al.,* 2025).

REFERENCES

Ahmad Radhi, A. S. I., Ma'In, M., Mohd Shakil, N. S., Osman, I., & Universiti Teknologi MARA. (2024). Digitalisation and economic growth: an analysis of selected Asean countries. *Journal of Sustainability Science and Management*, *19*(11), 123–138.

Ahsan, M. H., Ayub, N., & Azman, N. S. (2021). Digital literacy in Malaysia: a systematic literature review on methodological approaches. *Malaysian Journal of Qualitative Research*, *7*(1823), 107–125.

Apriliyanti, I. D., Kusumasari, B., Pramusinto, A., & Setianto, W. A. (2021). Digital divide in ASEAN member states: analysing the critical factors for successful e-government programs. *Online Information Review*, *45*(2), 440–460.

Arya, N., Hidayatullah, F., Zainuddin, Z. I., & Pasha, S. S. W. D. (2024). Bibliometric analysis: the graphic growth of digital literacy research on the Scopus database in Southeast Asia. In A. R. Cangara, A. Ismail, & M. C. Ansar (Eds.), *Proceedings of the World Conference on Governance and Social Sciences (WCGSS 2023)* (Vol. 843, pp. 547–558). Atlantis Press SARL.

Aussu, P. (2023). Information overload: coping mechanisms and tools impact. *Research Challenges in Information Science: Information Science and the Connected World*, 661–669.

Baas, J., Schotten, M., Plume, A., Côté, G., & Karimi, R. (2020). Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quantitative Science Studies*, *1*(1), 377–386.

Bae, K.-H. (2022). Regionalizing development cooperation? examining intra-ASEAN regionalism via IAI. *Global Governance: A Review of Multilateralism and International Organizations*, *28*(1), 103–124.

Bawden, D. (2008). Origins and concepts of digital literacy. *Digital Literacies: Concepts, Policies and Practices*, *30*(2008), 17–32.

Bhasin, S., & Kumar, B. (2022). ASEAN — The geopolitical factors and its impact on growth of the region. In V. Ratten (Ed.), *Cultural Entrepreneurship*. USA: Springer.

Burt, R. S. (2014). Structural holes. In D. B. Grusky (Ed.), *Social Stratification: Class, Race, and Gender in Sociological Perspective* (4th ed., p. 5). UK: Routledge.

Chen, K., Jye, Q. S., & Guan, T. K. (2023). Addressing Key Trends in ASEAN's Digital Economy. In *The ASEAN Digital Economy* (1st ed., pp. 160–185). Taylor and Francis.

Chetty, K., Qigui, L., Gcora, N., Josie, J., Wenwei, L., & Fang, C. (2018). Bridging the digital divide: measuring digital literacy. *Economics*, *12*(1), 1–20.

Cho, H., Cannon, J., Lopez, R., & Li, W. (2024). Social media literacy: a conceptual framework. *New Media & Society*, *26*(2), 941–960.

Chong, M.-T., Puah, C.-H., Abu Mansor, S., & Teh, C.-S. (2023). Digital connectivity bridging digital Asean. *International Journal of Economics and Management*, *17*(1), 139–149.

Chung, N. H. T., & Cam, T. A. (2024). Clarivate research fronts in the digital education: perspectives from Asean higher education system. *Journal of Ecohumanism*, *3*(8), 12630–12645.

Davydov, S., Logunova, O., Maltseva, D., Sharikov, A., & Zadorin, I. (2020). Digital Literacy Concepts and Measurement. In *Internet in Russia: Societies and Political Orders in Transition*. (pp. 103–120). USA: Springer.

Derouez, F., & Ifa, A. (2025). Assessing the sustainability of southeast Asia's energy transition: a comparative analysis. *Energies*, *18*(2), 287.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: an overview and guidelines. *Journal of Business Research*, *133*, 285–296.

Drajat Stiawan, Ahmad Rosyid, Retno Wahyuningsih, & Vanessa Imeldalia. (2024). Research study of financial literacy in southeast Asia, especially Indonesia and Malaysia: a bibliometric analysis. *Velocity: Journal of Sharia Finance and Banking*, *4*(2), 165–181.

Habbal, A., Mkpojiogu, E. O. C., Cottrell, L., White, B., Hassan, S., & Zulhumadi, F. (2024). Socio-economic development indices and their reflection on internet performance in ASEAN countries. *ASEAN Engineering Journal*, *14*(1), 19–29.

Herrera-Viedma, E., Herrera, M., & Martinez, M. A. (2016). Bibliometric tools for discovering information in database. In H. Fujita, M. Ali, A. Selamat, J. Sasaki, & M. Kurematsu (Eds.), *Trends in Applied Knowledge-Based Systems and Data Science*. USA: Springer.

Hicks, A., McKinney, P., Inskip, C., Walton, G., & Lloyd, A. (2023). Leveraging information literacy: mapping the conceptual influence and appropriation of information literacy in other disciplinary landscapes. *Journal of Librarianship and Information Science*, *55*(3), 548–566.

Janzen, S. (2022). Advancing the advanced search: improving the web of science user experience with a spreadsheet search query tool. In C. Stephanidis, M. Antona, & S. Ntoa (Eds.), *HCI International 2022 Posters* (pp. 292–299). Springer.

Jige, S. B. (2025). Role of digital technologies in the education. In M. N. A. Muhammad Anshari & P. Ordóñez de Pablos (Eds.), *Multi-Industry Digitalization and Technological Governance in the AI Era* (pp. 51–72). USA: IGI Global Scientific Publishing.

Khlaisang, J., & Mingsiritham, K. (2016). Engaging virtual learning environment system to enhance communication and collaboration skills among Asean higher education learners. *International Journal of Emerging Technologies in Learning (iJET)*, *11*(04), 103.

Kipper, L. M., Iepsen, S., Dal Forno, A. J., Frozza, R., Furstenau, L., Agnes, J., & Cossul, D. (2021). Scientific mapping to identify competencies required by industry 4.0. *Technology in Society*, *64*, 101454.

Li, J. (2023). The performance of bibliometric analyses in the health sciences. *Current Medical Research and Opinion*, *40*(1), 97–101.

Li, L., Dou, Y., Cao, X., & Ding, W. (2024). The impact of digital divide on the level of high-quality economic development: evidence from China-Asean. *Journal of the Knowledge Economy*, *16*(2), 7235–7249.

Lindquist, J. M., & Sulewski, C. A. (2024). Microsoft excel: the universal tool of analysis. In N. M. Scala & J. P. Howard II (Eds.), *Handbook of Military and Defense Operations Research* (2nd ed.). USA: CRC Press.

Lukitowati, S., Paramita, E. P., & Triansyah, A. (2025). Mapping asean research trends on digital parenting and digital literacy. *Jurnal Pendidikan Progresif*, *15*(3), 1653–1669.

Machmud, M. T., Widiyan, A. P., & Ramadhani, N. R. (2021). The development and policies of ICT supporting educational technology in Singapore, Thailand, Indonesia, and Myanmar. *International Journal of Evaluation and Research in Education (IJERE)*, *10*(1), 78.

Maji, S. K., & Laha, A. (2020). State of digital economy in Asia-pacific region: delineating the role of digital skill. *International Journal of Public Administration in the Digital Age*, *7*(2), 38–54.

Martínez-Bravo, M. C., Sádaba Chalezquer, C., & Serrano-Puche, J. (2022). Dimensions of digital literacy in the 21st century competency frameworks. *Sustainability*, *14*(3), 1–13.

Mawang, Z., & Lai, W. S. (2024). Digital economy's transformative impact on regional growth: evidence from Asean countries. *Jurnal Ekonomi Malaysia*, *58*(2), 1-11.

McFarlane, D., Mieruch, Y., & Wann Si, N. L. (2024). Closing the digital divide in education: an innovative review of demand and supply side policies in four Asean member states. *International Journal of Evaluation and Research in Education (IJERE)*, *13*(6), 3827–3837.

Milković, M., Vuković, D., & Kerum, F. (2025). Critical digital literacy as a key skill in higher education: attitudes of students and professors. *Proceedings of the 16th International Conference on Society and Information Technologies (ICSIT 2025)*, 14–21.

Miranda, A. V., Wiyono, L., Rocha, I. C. N., Cedeño, T. D. D., & Lucero-Prisno, D. E. (2021). Strengthening virology research in the association of Southeast Asian nations: preparing for future pandemics. *The American Journal of Tropical Medicine and Hygiene*, *105*(5), 1141–1143.

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics*, *106*(1), 213–228.

Nimanandh, K., Andrews, T. G., Rowley, C., Oh, I., & Chandrasapth, K. (2025). Business research in association of Southeast Asian nations (Asean): recapitulation and prospects. *Asia Pacific Business Review*, *31*(3), 560–566.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The prisma 2020 statement: an updated guideline for reporting systematic reviews. *International Journal of Surgery*, *372*, 105906.

Park, H., Kim, H. S., & Park, H. W. (2020). A scientometric study of digital literacy, ICT literacy, information literacy, and media literacy. *Journal of Data and Information Science*, *6*(2), 116-138.

Passas, I. (2024). Bibliometric analysis: the main steps. *Encyclopedia*, *4*(2), 1014–1025.

Paul, H. W., & Crowe, M. M. (2023). Digital literacy inequities, higher education, and the new digital divide. *International Journal of Intelligent Computing Research*, *14*(1), 1177–1180.

Prajaknate, P. (2017). Information communication technologies (ict) for education projects in Asean: can we close the digital divide? In *Sustainable Development Goals in the Asian Context* (pp. 107–133). Springer Nature Singapore Pte Ltd. https://doi.org/10.1007/978-981-10-2815-1_6

Pranckutė, R. (2021). Web of science (WOS) and Scopus: the titans of bibliographic information in today's academic world. *Publications*, *9*(1), 12.

Rosly, N. A., Jambari, H., Hamzah, M. F., Mihad, U. S., Osman, S., & Pairin, M. R. (2023). Students' digital readiness in vocational college for industrial revolution 4.0. In F. Hassan, N. Sunar, M. A. Mohd Basri, M. S. A. Mahmud, M. H. I. Ishak, & M. S. Mohamed Ali (Eds.), *Methods and applications for modeling and simulation of complex systems* (Vol. 1911). USA: Springer.

Sacchanand, C. (2022). Development of Asean network model on information literacy. Journal of *Information Science Theory and Practice*, *10*(1), 18–29.

Shet, S. V., & Pereira, V. (2021). Proposed managerial competencies for industry 4.0 – implications for social sustainability. *Technological Forecasting and Social Change*, *173*, 121080.

Solmaz, E., Özcan, S., & Coşkun, B. K. (2023). Digital and ICT literacy in distance education: a systematic review of definitions and transformations. In C. Baskaran & S. Dhanavandan (Eds.), *Information literacy skills and the role of social media in disseminating scholarly information in the 21st century* (pp. 1–14). USA: IGI Global Scientific Publishing.

Stek, P. E. (2024). Science and engineering knowledge production in Asean global emergence, fading regionalism. *Journal of Southeast Asian Economies*, *41*(1), 70-86.

Sundram, P. (2025). Network governance in Asean: Fostering regional cooperation and integration. *Frontiers in Political Science*, *7*, 1–15.

Suranto, B., Kovač, N., Haryono, K., Abdul Rahman, S. F., Mohd Shukri, A. F., Suder, M., Kusa, R., & Žugić, D. (2025). State of digitalization in the southeast Asia region – bibliometric analysis. *Quality & Quantity*, 1-28.

Thangaraj, R., Raghunandan, G., Benedict, J., Seshadri, V., & Nagaraj, A. (2024). Relationship between digital learning, digital literacy and academic performance of higher education students: moderated mediation role of critical thinking. *International Research Journal of Multidisciplinary Scope*, *5*(3), 39–50.

Thompson, E. C., & Sunchindah, A. (2023). Chapter 4: an asean identity. In J. Dosch & F. Kliem (Eds.), *The Elgar Companion to ASEAN* (pp. 49–61). UK: Edward Elgar Publishing Limited.

Tomczyk, & Eger, L. (2020). Online safety as a new component of digital literacy for young people. *Integration of Education*, *24*(2), 172–184.

Trajano, J. C., & Caballero-Anthony, M. (2020). The future of nuclear security in the Asia-pacific: expanding the role of Southeast Asia. *International Journal of Nuclear Security*, *6*(2), 1–17.

Tuli, E. (2023). Exploring digital banking adoption in developing Asian economies: systematic literature review and bibliometric analysis. *International Social Science Journal*, *74*(252), 399–426.

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523–538.

Van Zyl, A., Turpin, M., & Matthee, M. (2020). How can critical thinking be used to assess the credibility of online information? In M. Hattingh, M. Matthee, H. Smuts, I. Pappas, Y. K. Dwivedi, & M. Mäntymäki (Eds.), *Responsible design, implementation and use of information and communication technology* (Vol. 12067, pp. 199–210). Springer International Publishing. https://doi.org/10.1007/978-3-030-45002-1_17

Wei, X., Wang, M., Yu, S., Han, Z., Li, C., Zhong, Y., Zhang, M., & Yang, T. (2025). Mapping the knowledge of omics in myocardial infarction: A scientometric analysis in r studio, VOSviewer, Citespace, and Scimat. medicine, *104*(7), e41368.

Zakir, S., Hoque, M. E., Susanto, P., Nisaa, V., Alam, Md. K., Khatimah, H., & Mulyani, E. (2025). Digital literacy and academic performance: the mediating roles of digital informal learning, self-efficacy, and students' digital competence. *Frontiers in Education*, *10*, 1590274.

Zscheischler, J., Rogga, S., & Busse, M. (2017). The adoption and implementation of transdisciplinary research in the field of land-use science: a comparative case study. *Sustainability*, *9*(11), 1926.

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*(3), 429–472.