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Mapping the evolution of digital learning and student engagement: scopus-based bibliometric analysis of themes and trends

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ABSTRACT

This study examines and maps the intellectual structure of research linking digital learning and student engagement, a body of work that has expanded rapidly across several disciplines and become difficult to see as a whole. Addressing the absence of a single consolidated map at this specific intersection, it applies bibliometric analysis to journal articles indexed in Scopus, retrieved with a title–abstract–keyword strategy that combined digital-learning and engagement terms and limited to open-access, final-stage, English-language articles. The retrieved set comprised 771 records; after a transparent, rule-based validation step that set aside one record dated outside the coverage range, 770 articles published between 2023 and 2026 formed the analytical dataset. Keyword co-occurrence, citation, temporal-overlay, and co-authorship analyses were visualised in VOSviewer. Author-keyword analysis shows that the field is organised around a core of online learning (178 occurrences), student engagement (164), and higher education (144), with a recent shift (average publication year ≥ 2025) toward personalised learning, technology-enhanced learning, digital learning, educational technology, and artificial intelligence. Citation influence concentrates in 2023 and centres on chatbots, generative AI, self-efficacy, and interaction in online classes, led by a study on chatbots for goal setting and social presence (224 citations). Scholarly contribution is broadly distributed: 94.5% of the 2,685 contributing authors appear on a single article, indicating a wide community of many independent teams. The study contributes a consolidated, evidence-based map in which engagement functions as the conceptual hinge between the technological and psychological strands of digital-learning research, and it shows that recent attention is moving toward intelligent and personalised digital environments.



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Introduction

Digital learning has moved from the margins of educational practice to its core. What began as a supplement to classroom teaching now shapes how curricula are delivered, how learners reach material, and how institutions organise instruction across schools, universities, and professional training. The acceleration of remote and blended provision during the COVID-19 period consolidated this shift and left behind an

infrastructure and a set of expectations that have not receded. Understanding how learning unfolds in digital settings is therefore no longer a specialist concern but a general question for education.

Within this shift, student engagement has emerged as a decisive dimension. Access to digital content does not by itself produce learning; what matters is whether learners attend, participate, persist, and invest cognitively and emotionally in the tasks before them. Engagement is widely understood as a multidimensional construct with behavioural, emotional, and cognitive facets (Fredricks et al., 2004), and each facet behaves differently when interaction is mediated by a screen. Digital environments can support engagement through immediate feedback and flexible pacing, yet they can also erode it through isolation and distraction, which makes engagement a natural focus for research on digital learning (Henrie et al., 2015). In a bibliometric design these facets are not measured directly in individual learners; rather, they are traced through the vocabulary the literature uses to describe engagement, so that keyword co-occurrence stands in for how researchers themselves frame and connect the construct. Research on digital learning has expanded in several directions at once. Studies of online and e-learning sit alongside work on blended learning, learning analytics, personalised and adaptive systems, and, increasingly, artificial-intelligence-supported instruction and conversational agents. Each strand carries its own vocabulary, methods, and assumptions about what supports learning, so the field has grown wider and more differentiated rather than more unified.

This rapid expansion has produced a widely dispersed knowledge landscape. Contributions arrive from educational research, instructional technology, psychology, and the health-professions education literature, spread across many journals and communities — a dispersion later borne out by the co-authorship results, in which the great majority of authors contribute a single study. A reader entering the field meets an abundance of studies but little consolidated sense of how the parts relate, which ideas anchor the field, and where its centre of gravity is moving. Bibliometric analysis suits this situation. Rather than summarising individual studies, it uses the metadata of a large body of publications to reveal the structure of a field: which themes co-occur, which works attract sustained citation, how emphases shift over time, and how authors cluster into research communities (Donthu et al., 2021). For a domain that has grown quickly and drawn on several disciplines, a systematic map offers what a narrative review cannot provide at scale.

Previous reviews have examined particular slices of this territory, including evidence maps of engagement and educational technology in higher education (Bond et al., 2020) and measurement-focused reviews of engagement in technology-mediated learning (Henrie et al., 2015). What remains less developed is a systematic bibliometric mapping of the relationship between digital learning and student engagement specifically, one that identifies the dominant themes, the most influential publications, the evolution of emphases, the emerging directions, and the collaboration patterns together on a single consistent dataset. Recent syntheses have advanced adjacent questions — for example, updated reporting standards for review methodology (Page et al., 2021) and reviews of newer delivery models such as synchronous hybrid learning (Raes et al., 2020) — yet none offers one data-consistent map of how digital learning and student engagement are joined. The specific contribution of this study is therefore to provide that map and to examine a single proposition: that engagement, rather than any one delivery technology, is the term that binds the field together. This study addresses that gap using journal articles indexed in Scopus and combining keyword co-occurrence, citation, temporal, and co-authorship analyses with VOSviewer visualisations. It is organised around four research questions:

- RQ1. What are the dominant research themes and thematic clusters in digital learning and student engagement research?
- RQ2. Which publications have had the greatest citation influence in this field?
- RQ3. How have research themes evolved over time, and which themes have emerged as recent directions?
- RQ4. What patterns of scholarly collaboration characterise the research landscape?

Literature Background

Digital Learning

Digital learning refers to teaching and learning enabled, delivered, or mediated by digital technologies. The term is an umbrella covering fully online instruction, e-learning and electronic learning environments, technology-enhanced and technology-mediated learning, and blended arrangements that interleave face-to-face and digital components. Rather than a single delivery mode, it names a continuum along which the balance between physical and digital interaction varies. What unites these forms is the mediation of learning by tools

that reshape access to content, the rhythm of study, and the channels through which learners and teachers communicate.

Student Engagement in Digital Learning

Student engagement is commonly conceptualised along behavioural, emotional, and cognitive dimensions (Fredricks et al., 2004). Behavioural engagement concerns participation and effort, such as attendance, completion, and time on task. Emotional engagement concerns affective responses, including interest and belonging. Cognitive engagement concerns the depth of learners' investment, from surface compliance to self-regulated study. In digital settings these dimensions become both more visible and more precarious: behavioural traces are captured automatically by platforms, while emotional and cognitive engagement can be harder to sustain without the cues of a shared physical space (Henrie et al., 2015).

Digital Learning and Engagement

The relationship between digital environments and engagement runs through several mechanisms. Interaction with content, peers, and instructors shapes behavioural and emotional involvement; autonomy over pace and path can support motivation consistent with self-determination accounts of intrinsic engagement (Ryan & Deci, 2000); timely feedback sustains effort and self-regulation; personalisation and adaptive sequencing aim to match tasks to learners; and learning analytics render engagement legible so that it can be monitored and supported. The literature therefore treats engagement not as a fixed property of learners but as an outcome co-produced by learners and the design of the digital environment.

Bibliometric Perspective

Bibliometric methods analyse the metadata of scholarly output to describe the structure and dynamics of a field, complementing rather than replacing systematic reviews (Donthu et al., 2021; van Eck & Waltman, 2010). They are well suited to fields that have grown quickly and become dispersed, because they process large volumes of records and surface patterns not visible from reading studies one at a time. This approach has been applied productively across education and digital-media research, including systematic literature reviews of Islamic learning and social media, of students' mental health, and of online counselling on global issues (Ifdil et al., 2025; Herlina et al., 2023; Alfiah et al., 2021), and bibliometric mapping of research trends in mass communication and digital media (Darmawati et al., 2025). The present study extends this line of work to the specific intersection of digital learning and student engagement.

Method

Research Design

This study uses bibliometric analysis to map the intellectual and thematic development of research on digital learning and student engagement. The aim is not to appraise individual studies but to characterise the field as a whole: its thematic clusters, most influential works, the movement of its emphases over time, and the structure of its author communities. This design follows established guidance for conducting and reporting bibliometric analyses (Donthu et al., 2021) and is consistent with prior science-mapping and systematic-review work by the present research group (Darmawati et al., 2025; Ifdil et al., 2025; Herlina et al., 2023; Alfiah et al., 2021).

Data Source

Bibliographic data were retrieved from Scopus, chosen for its broad coverage of peer-reviewed education, technology, and health-sciences journals and for the structured metadata author keywords, index keywords, citation counts, affiliations, and references required for keyword, citation, and co-authorship analysis. A single, high-coverage database was used deliberately, to keep author identifiers, keyword fields, and citation counts internally consistent for network construction; extending the corpus to additional databases such as Web of Science is a natural next step that would broaden coverage while requiring careful record de-duplication and identifier reconciliation.

Search Strategy

The search combined two conceptual blocks in the title, abstract, and keyword fields:

TITLE-ABS-KEY(("digital learning" OR "online learning" OR "e-learning" OR "electronic learning" OR "technology-enhanced learning" OR "technology-mediated learning" OR "digital learning environment*") AND ("student engagement" OR "learner engagement" OR "academic engagement" OR "learning engagement"))

Eligibility and Limitations

The following Scopus limitations were applied: open access (all open access); publication stage (final); source type (journal); language (English); document type (article); and the intended publication period 2021–2026. These limits define a body of finalised, peer-reviewed, openly available journal articles. Open access was chosen so that every record in the corpus is full-text verifiable and the selection is fully reproducible by other researchers; it is treated here as an explicit scope condition rather than a quality filter, and its effect on coverage is revisited in the Limitations.

Dataset Selection and Validation

The initial query returned 1,967 documents, reduced to 771 after the limitations above. Before analysis, the exported file was inspected independently. The file confirmed 771 records, all of document type article, all in English, and all at the final publication stage, with no duplicate DOIs, EIDs, or titles and complete title, abstract, DOI, and citation fields. Because eligibility was determined entirely by explicit, rule-based Scopus filters rather than by subjective screening, the selection is fully reproducible and does not depend on inter-coder judgement. Two features of the retrieved set are noted here for transparency. First, the dataset contained no publications from 2021 or 2022; the records span 2023–2027, with 165 in 2023, 187 in 2024, 257 in 2025, and 161 in 2026. Second, one record was dated 2027, which lies outside the intended window. That single out-of-window record was excluded from the analysis, giving an analytical dataset of 770 documents with an effective coverage of 2023–2026. No other record was added, removed, or recoded. Author keywords were missing for 20 records and index keywords for 532 records (531 in the 770-document analytical set). Because index terms are assigned by the database and accrue over time, their lower coverage in a very recent corpus is expected; the thematic analysis therefore rests mainly on author keywords, which are the more complete and author-intended field, and the coverage of index keywords is noted where relevant.

Bibliometric Procedures

Four analyses were carried out. Keyword co-occurrence analysis identified dominant themes and clusters from author keywords; for each term, occurrence and total link strength (the summed weight of its co-occurrence links) were computed, and its average publication year was used as a temporal indicator. Citation analysis, based on Scopus cited-by counts, identified the most influential publications, kept distinct from views or downloads. Temporal analysis used average publication year to separate established from more recent themes. Co-authorship analysis described author productivity and the structure of collaboration. Keywords, documents, authors, and sources were treated as separate analytical units.

VOSviewer Visualisation

Networks were constructed and visualised in VOSviewer (van Eck & Waltman, 2010): a keyword co-occurrence network and its clusters, an overlay of themes by average publication year, a density visualisation of keyword occurrence and connectivity, a source/journal network, and an author co-authorship network. The keyword maps were generated from all keywords (author and index), which is why database-assigned clinical and methodological terms appear alongside author-assigned themes. Each visualisation was interpreted according to its own analytical unit, so source networks were not read as keyword networks and author networks were not read as citation networks. In VOSviewer, maps were built using association-strength normalisation with the program's default clustering resolution, and a minimum-occurrence threshold was applied to keyword terms so that the network foregrounds recurring rather than one-off keywords; full counting was used for co-occurrence and co-authorship links.

Data Cleaning and Keyword Harmonisation

Author keywords were harmonised before co-occurrence analysis. Singular and plural forms were unified (for example, student and students), spelling and hyphenation variants were standardised (for example, e-learning and elearning, and online-learning and online learning), capitalisation was normalised, and clearly synonymous terms were merged. Conceptually distinct terms were kept separate even where topically related, so that self-efficacy and academic self-efficacy, or online learning and online learning engagement, were only merged where they denoted the same construct. Each substantive harmonisation decision was recorded so that the mapping remains transparent and reproducible.

Results and Discussions

The analysis is organised around the four research questions and opens with a description of the corpus on which it rests. After validation, the analytical dataset comprises 770 journal articles published between 2023 and 2026, appearing in 331 distinct source titles and written by 2685 authors. Output rose across the window, from 165 articles in 2023 to 187 in 2024 and a peak of 257 in 2025, with 161 recorded for 2026, a figure that is

likely partial given the extraction date. This trajectory describes a field in active and sustained expansion; consistent with a young literature, the citation profile is concentrated, with a small number of works attracting most of the attention while the majority, being recent, are still accumulating citations. Table 1 summarises these characteristics together with the coverage of the retrieved set noted during validation. The subsections that follow address, in turn, the dominant research themes (RQ1), the most influential publications (RQ2), the evolution of research emphases and emerging directions (RQ3), and the patterns of scholarly collaboration (RQ4).

Table 1. <Dataset characteristics.>

Characteristic	Value
Database	Scopus
Intended search period	2021–2026
Records after limitations (as exported)	771
Effective coverage in the file	2023–2026 (plus one 2027 record)
Records excluded (out of window: 2027)	1
Analytical dataset	770
Year distribution (2023 / 2024 / 2025 / 2026)	165 / 187 / 257 / 161
Document type / language / stage	Article / English / Final
Distinct source titles	331
Distinct contributing authors	2685
Records missing author keywords	20
Records missing index keywords	531
Mean / median / max citations	8.42 / 3 / 224
Records with zero citations	224

Note. Values computed directly from the exported Scopus file; the analytical set excludes the single out-of-window 2027 record.

RQ1. Dominant Research Themes

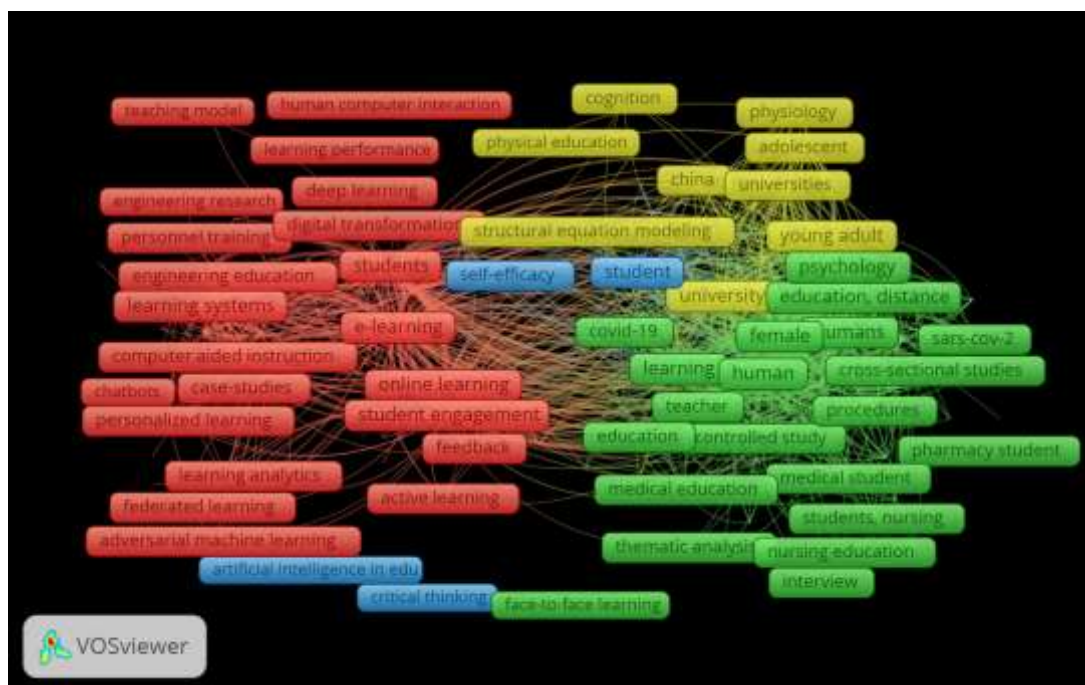


Figure 1. <Keyword co-occurrence network in digital learning and student engagement research (four clusters).>

The keyword co-occurrence network (Figure 1) resolves into four connected clusters. A technology-and-delivery cluster (red) gathers online learning, e-learning, learning analytics, personalised learning, chatbots,

and machine-learning terms such as federated and adversarial machine learning alongside digital transformation and learning systems. A health-professions and empirical-methods cluster (green) links medical, nursing, and pharmacy education with study designs such as cross-sectional and controlled studies and with thematic analysis, reflecting the database-assigned index terms carried by clinical journals. A small motivational cluster (blue) centres on self-efficacy, the student as agent, artificial intelligence in education, and critical thinking, while a developmental-psychology cluster (yellow) gathers cognition, physiology, adolescent, universities, and structural equation modelling.

Table 2 reports the leading author keywords by occurrence and total link strength, computed from the analytical dataset. Three terms dominate: online learning (178 occurrences, total link strength 800), student engagement (164, 780), and higher education (144, 726). These form the conceptual core to which the surrounding terms attach, confirming that the field couples the delivery of learning with the engagement of learners in higher-education settings rather than treating either in isolation.

Table 2. <Top author keywords by occurrence, total link strength, cluster, and interpretation (analytical dataset, n = 770).>

Rank	Keyword	Occ.	Total Link Strength	Cluster	Interpretation
1	online learning	178	800	Online delivery & engagement	Central delivery mode; anchors the field
2	student engagement	164	780	Online delivery & engagement	Core construct, co-produced with delivery
3	higher education	144	726	Online delivery & engagement	Dominant setting for the research
4	e-learning	66	331	E-learning, AI & personalisation	Established mode; bridges to newer tech themes
5	engagement	49	242	Motivation & self-efficacy	General engagement construct
6	learning engagement	46	196	Engagement & academic outcomes	Engagement tied to learning outcomes
7	covid-19	40	197	Online delivery & engagement	Pandemic context; earliest-dated theme
8	blended learning	29	136	Online delivery & engagement	Hybrid delivery mode
9	gamification	27	125	Online delivery & engagement	Engagement-design technique
10	artificial intelligence	26	126	E-learning, AI & personalisation	Emerging intelligent-learning theme
11	motivation	23	104	Motivation & self-efficacy	Motivational mechanism
12	online education	23	113	Online delivery & engagement	Delivery-mode synonym
13	online learning engagement	20	86	Online engagement & ed-psychology	Engagement in online settings
14	learning analytics	20	90	Online delivery & engagement	Data-driven engagement monitoring

Rank	Keyword	Occ.	Total Link Strength	Cluster	Interpretation
15	digital learning	20	93	E-learning, AI & personalisation	Emerging umbrella term

Note. Occurrence and total link strength computed from harmonised author keywords; clusters derived by modularity-based community detection on the author-keyword co-occurrence network, related to but distinct from the all-keyword VOSviewer clusters in Figure 1.

RQ2. Citation Influence

Citation influence was assessed using Scopus cited-by counts. Citations are unevenly distributed: the mean is 8.42 citations per article and the median only 3, while 224 of 770 articles have no citations yet, which is expected for a corpus concentrated in 2024–2026. Table 3 lists the ten most-cited works. The single most influential study, on chatbots for goal setting and social presence in fully online learning, has accumulated 224 citations, followed by studies on students' digital-technology attitude, literacy, and self-efficacy and on generative chatbots in higher education.

Table 3. <Ten most-cited publications in the analytical dataset.>

Rank	First author (source)	Year	Citations	Main focus
1	Hew et al. (J. Comput. High. Educ.)	2023	224	Chatbots for goal setting and social presence in online learning
2	Getenet et al. (Int. J. Educ. Technol. High. Educ.)	2024	199	Digital-technology attitude, literacy, and self-efficacy
3	Ilieva et al. (Information)	2023	170	Effects of generative chatbots in higher education
4	Chen et al. (IJWLTT)	2023	78	Virtual reality and learning engagement (meta-analysis)
5	Sun et al. (Asia-Pac. Educ. Res.)	2023	72	Self-directed learning predicts online learning engagement
6	Huang & Wang (Behav. Sci.)	2023	70	Teacher support, academic self-efficacy, and engagement
7	Huang & Wang (High. Educ.)	2023	69	Motivating engagement in emergency online learning
8	Gherghel et al. (Comput. Educ.)	2023	67	Interaction in online classes and engagement
9	MacNeill et al. (Med. Teach.)	2024	67	Online learning in health-professions education
10	Godsk & Møller (Educ. Inf. Technol.)	2025	63	Engaging students with educational technology

Note. Citation counts are Scopus cited-by values in the exported dataset.

Two patterns stand out. First, citation influence is concentrated in 2023: seven of the ten most-cited works appeared that year, consistent with the time citations need to accrue within a recent corpus. Second, the highly cited studies cluster around engagement mechanisms rather than delivery technology as such. Chatbots and generative AI, self-efficacy and teacher support, self-directed learning, and interaction in online classes recur across the list, which shows that the works drawing the most attention are those that explain why learners engage, not merely how content is delivered. Citation influence therefore aligns with the motivational and interaction-oriented parts of the thematic map rather than with the delivery core alone.

RQ3. Research Evolution and Emerging Themes

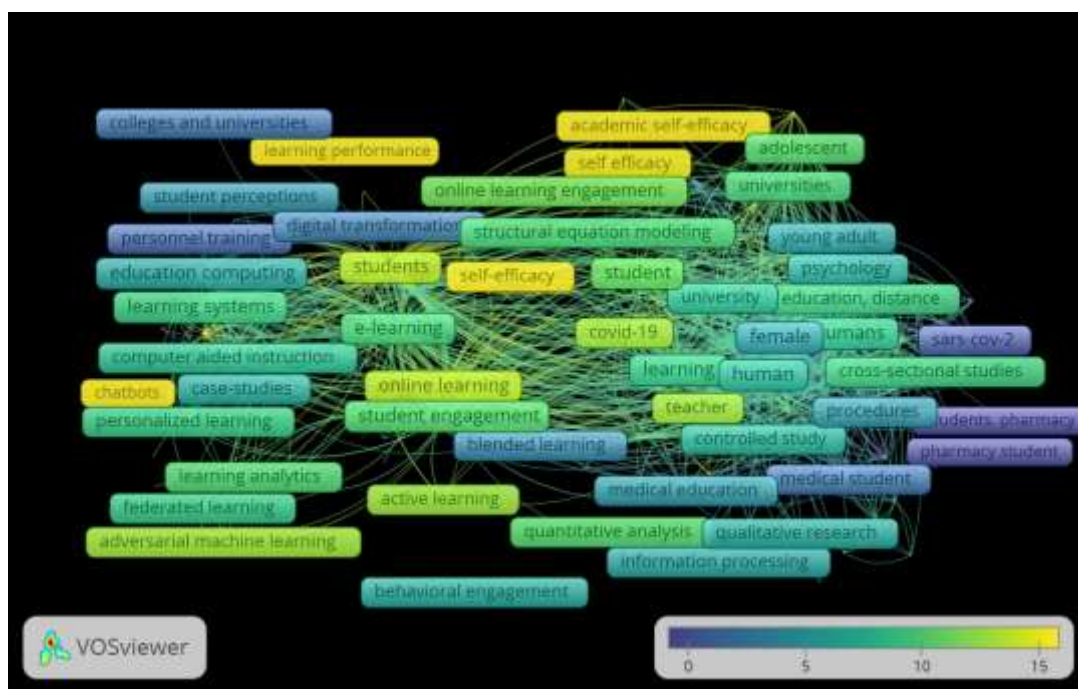


Figure 2. <Overlay visualisation of research themes by average publication year.>

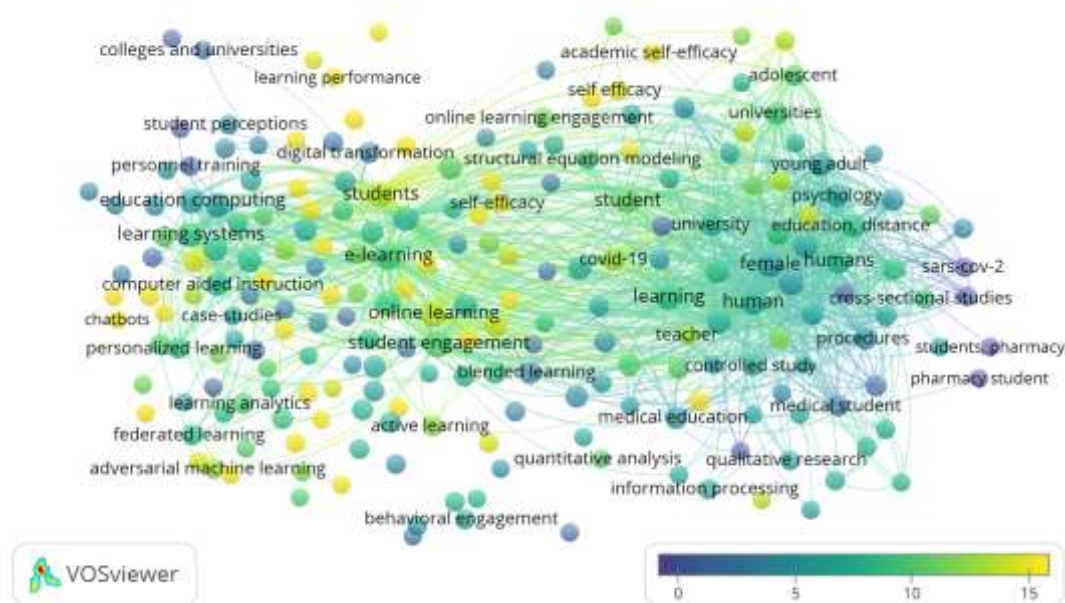


Figure 3. <Density visualisation of keyword occurrence and connectivity.>

The overlay visualisation (Figure 2) colours keywords by average publication year, and the density visualisation (Figure 3) shows where occurrence and connectivity concentrate. Reading colour together with the underlying values rather than colour alone, a clear temporal gradient appears. The oldest theme is covid-19 (average year 2023.92), which anchored the early part of the window and is now receding. The persistent core sits around 2024: online learning (2024.12), student engagement (2024.38), e-learning (2024.45), and learning engagement (2024.54). The most recent terms, with average years at or above 2025, are artificial intelligence (2025.00), educational technology (2025.00), digital learning (2025.10), technology-enhanced learning (2025.19), and personalised learning (2025.35). This gradient supports reading the field as moving from a pandemic-driven concern with emergency online delivery toward intelligence-, personalisation-, and technology-enhanced approaches to engagement.

Table 4. <Established and emerging themes by average publication year (analytical dataset).>

Theme / Keyword	Occurrence	Average Pub. Year	Research status
covid-19	40	2023.92	Established / receding
online learning	178	2024.12	Persistent core
student engagement	164	2024.38	Persistent core
e-learning	66	2024.45	Persistent core
blended learning	29	2024.83	Persistent core
learning analytics	20	2024.65	Persistent core
gamification	27	2024.70	Persistent core
artificial intelligence	26	2025.00	Emerging
educational technology	19	2025.00	Emerging
digital learning	20	2025.10	Emerging
technology-enhanced learning	16	2025.19	Emerging
personalised learning	20	2025.35	Emerging

Note. Status is assigned from average publication year within the 2023–2026 window, not from overlay colour.

RQ4. Scholarly Collaboration

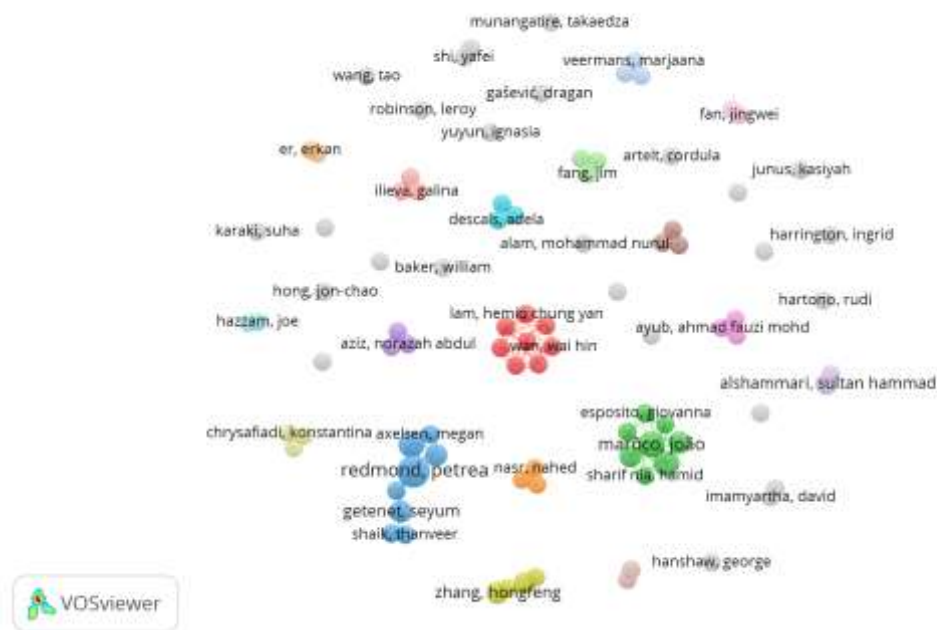


Figure 4. <Author co-authorship network.>

The co-authorship network (Figure 4) shows broadly distributed participation. Rather than one or two large connected components, the map is composed of many small clusters of two to six authors together with numerous individual contributors. This is confirmed by the underlying data: the 770 articles were written by 2685 distinct authors, of whom 2538 (94.5%) appear on only one article. The most productive contributors published a handful of papers each, with no dominant central figure. This pattern describes a field populated by many independent teams working in parallel rather than by a few consolidated schools.

Table 5. <Most productive authors (analytical dataset).>

Rank	Author	Documents	Note
1	Li X.	7	Common surname; may aggregate several

Rank	Author	Documents	Note
			individuals
2	Zhang H.	7	Common surname; may aggregate several individuals
3	Zhang Y.	6	Common surname; may aggregate several individuals
4	Redmond P.	6	
5	Li L.	5	Common surname; may aggregate several individuals
6	Chen L.	5	Common surname; may aggregate several individuals
7	Chen J.	5	Common surname; may aggregate several individuals
8	Wang Z.	4	Common surname; may aggregate several individuals
9	Wang X.	4	Common surname; may aggregate several individuals
10	Li S.	4	Common surname; may aggregate several individuals

Note. Author counts are exact document counts; frequent surnames may aggregate distinct individuals and are flagged accordingly.

The source/journal network (Figure 5) is analysed separately from the keyword and author maps. Publication is spread across many outlets, led by *Frontiers in Psychology* (24 articles), *Frontiers in Education* (21), and *Sustainability (Switzerland)* (17), with education-specialist and psychology journals both prominent. This dispersion across educational, psychological, and multidisciplinary venues mirrors the interdisciplinary character seen in the keyword and author analyses.

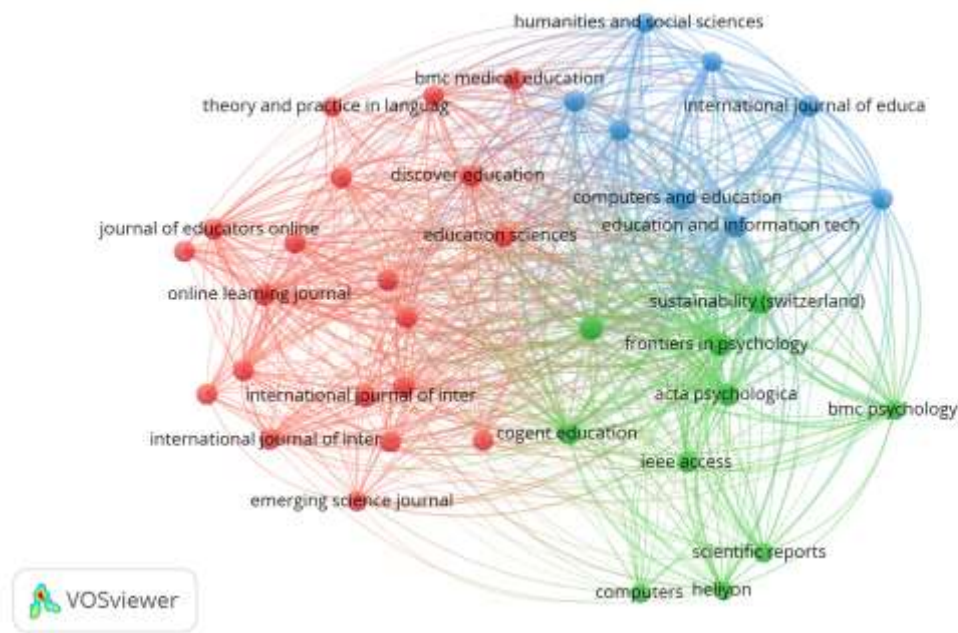


Figure 5. <Source/journal network (three journal clusters).>

Conceptual structure and dominant themes

The thematic map indicates that research on digital learning and student engagement is organised around a delivery-and-engagement core set in higher education, with satellite clusters that specialise it. The presence of a motivational cluster around self-efficacy alongside a delivery cluster around online and e-learning shows that the field has not remained purely technological; it couples how learning is delivered with why learners persist, consistent with multidimensional conceptions of engagement (Fredricks et al., 2004; Henrie et al., 2015). The prominent health-professions cluster, carried largely by index keywords from clinical journals, shows that a substantial share of empirical work is situated in medical, nursing, and pharmacy education, where digital delivery and measurable engagement outcomes are of immediate concern.

Why certain works became influential

The most-cited works are not the most generic delivery studies but those that explain engagement mechanisms. Chatbots and generative AI appear at the very top of the citation ranking (Hew et al., 2023; Ilieva et al., 2023), as do studies of self-efficacy and teacher support (Getenet et al., 2024; L. Huang & Wang, 2023) and of interaction and self-directed learning in online classes (Gherghel et al., 2023; Sun et al., 2023). Their influence reflects timing and content together: they appeared early in the window, when the field was consolidating after the pandemic, and they addressed questions how conversational agents, autonomy, and interaction shape engagement that many later studies build on. Citation influence thus concentrates in the motivational and interaction-oriented regions of the map rather than in delivery technology alone.

From established concepts to newer themes

The temporal reading shows movement from a pandemic-era concern with emergency online delivery toward mechanism- and intelligence-oriented themes. COVID-19 is the oldest theme and is receding, while online learning, e-learning, and student engagement form a persistent 2024 core. The terms with the most recent average years artificial intelligence, educational technology, digital learning, technology-enhanced learning, and personalised learning mark where attention is shifting. This trajectory supports the interpretive expectation that the field is moving from the technological delivery of learning toward the adaptive and intelligent conditions that make digital learning engaging, and it is reported as an evidence-based reading of average publication years rather than a claim about any single keyword's colour.

Collaboration and the maturity of the field

The broadly distributed co-authorship structure, with almost 95% of authors contributing a single article, indicates a field that is wide, open, and actively growing, with participation shared across many independent

teams rather than concentrated in a few dominant groups. This diversity of teams supports a wide range of questions and contexts, and it points to a constructive opportunity: as the field matures, greater integration, shared measures, and cross-team replication can build on this broad base. A widely distributed structure of this kind is characteristic of vigorous, rapidly growing interdisciplinary areas.

Theoretical Contribution

Taken together, the results support reading the field as moving along a path from technology-centred learning toward learner-centred digital learning, and increasingly toward intelligent, personalised, and analytics-supported learning environments. The evidence is the coexistence of an established delivery core with a motivational cluster and a set of the most recent terms artificial intelligence, personalised learning, and technology-enhanced learning carrying the highest average publication years. The study's contribution is to make this structure explicit and to show that engagement operates as the conceptual hinge between the technological and psychological strands of the literature. The model is offered as an interpretation grounded in the mapped data rather than a claim that every part of the field follows the same trajectory.

Practical Implications

For teachers and lecturers, the prominence of engagement mechanisms alongside delivery modes suggests that digital instruction should attend as much to feedback, autonomy, and self-efficacy as to platform choice. For instructional designers, the analytics and personalisation terms point to concrete levers adaptive sequencing, timely analytics-informed intervention, and support for self-regulation. For institutions, the concentration of empirical work in health-professions education offers transferable models for measuring and supporting engagement in high-stakes programmes. For educational-technology developers, the rise of chatbot, AI, and personalised-learning terms indicates demand for tools judged by their effect on engagement and outcomes, not only by novelty. For researchers, the map shows where the field is dense and where it is thin, which helps target new work.

Future Research Directions

The emerging themes point to specific directions. Priorities supported by the data include AI- and chatbot-mediated engagement, which already dominates the citation ranking and carries a recent average year; personalised and adaptive digital learning and its effects on the behavioural, emotional, and cognitive dimensions of engagement; the use of learning analytics to detect and respond to disengagement in time to act; self-efficacy and academic self-efficacy as mechanisms in digital environments; and the extension of engagement research beyond the health-professions settings that currently supply much of the empirical base. Each direction follows from a cluster or emerging theme identified in the analysis rather than from a general call for more research.

Limitations

Several limitations qualify these findings. The analysis draws on a single database, Scopus, and inherits its coverage boundaries. The open-access, English-language, and article-only limits exclude non-open-access work, non-English scholarship, and conference and review outputs. The coverage of the retrieved set spans 2023–2026 after a single out-of-range record was set aside; the results therefore describe a recent and highly active phase of the field rather than its full history, and the search can be re-run to extend coverage as the literature grows. Citation counts depend on Scopus and on the short time available for citations to accrue, which favours 2023–2024 publications and leaves most 2025–2026 articles with few or no citations. Index keywords were missing for most records, so the thematic analysis rests mainly on author keywords. Keyword normalisation involves judgement, and frequent surnames in the author analysis may aggregate distinct individuals. Bibliometric visualisations describe structure and association rather than causal or qualitative meaning and should be read alongside close reading of key studies.

Conclusions

This study mapped the development of research linking digital learning and student engagement across 770 Scopus articles from 2023–2026, and the four analyses converge on a single reading of the field: engagement, rather than any particular delivery technology, is the concept that holds the literature together. The thematic structure (RQ1) is organised around a core of online learning, student engagement, and higher education, with clusters spanning technology and analytics, motivation and self-efficacy, developmental psychology, and health-professions education. Citation influence (RQ2) is concentrated in a small number of 2023 works on chatbots, generative AI, self-efficacy, and interaction, led by a chatbot study with 224 citations — that is, in the works that explain why learners engage. The temporal reading (RQ3) shows a clear movement from a

pandemic-era focus on emergency online delivery toward artificial intelligence, personalised learning, and technology-enhanced learning, which carry the most recent average publication years. Collaboration (RQ4) is broadly distributed, with roughly 95% of authors contributing a single article, describing a wide and open community of many independent teams. Taken together, these patterns show a field shifting its attention from delivering content to sustaining the engagement that makes digital learning effective, and they locate the AI-, analytics-, and personalisation-oriented directions where that engagement will most likely be studied next.

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