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Mapping Student Learning Motivation Research Trends (2000–2024): A Bibliometric Analysis Advancing SDG 4 and SDG 10 in Education

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Abstract: This bibliometric review maps two decades of Scopus-indexed literature (2000–2024) to analyze the evolving landscape of student learning motivation and identify emerging thematic dimensions. Using Harzing's Publish or Perish, VOSviewer, and Microsoft Excel, a total of 560 publications were extracted, filtered, and analyzed. Keyword co-occurrence and content analysis were employed to generate thematic clusters and synthesize conceptual dimensions. Findings reveal a steady growth of literature from 2000, with citations peaking in 2013 and again in 2019, reflecting an increased interest in motivational constructs integrated with educational technologies. The ACM International Conference Proceeding Series led in volume of publications, while highly cited articles focused on gamification, augmented reality, mobile learning, and artificial intelligence. From 70 co-occurring keywords, six clusters emerged: (1) Motivated Learning Strategies, (2) Digital Learning Experience and Cognitive Response, (3) Interactive and Language-Based Pedagogy, (4) Teaching Quality and Instructional Depth, (5) Curriculum Innovation and Student-Centered Technology, and (6) Collaborative and Active Learning. These clusters collectively define the overarching framework of Learner-Centered Education in Technology-Enhanced Environments. This study contributes a novel classification of research clusters into coherent, actionable dimensions, offering researchers, educators, and policymakers a thematic roadmap to address gaps and future directions. It highlights the theoretical integration of self-determination, ARCS, and flow theory with emerging pedagogical tools. The findings promote inclusive, adaptable, and technology-enabled learning strategies critical for motivating diverse learners in the 21st century, aligning with SDG 4: Quality Education and SDG 10: Reduced Inequalities. Recommendations are proposed to expand bibliometric coverage, integrate qualitative insights, and support equitable education policy development.

Keywords: Educational technology, learner-centered pedagogy, SDG 4: quality education, SDG 10: reduced inequalities, student learning motivation.

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Introduction

Over the past two decades, student learning motivation has become a cornerstone of research in educational technology and pedagogy, particularly in response to the rapid digital transformation of education systems worldwide (Weng & Zhang, 2025). Motivation is widely acknowledged as a fundamental driver of student engagement, academic success, and lifelong learning (Chiu, 2024). As traditional classroom settings evolve into hybrid, online, and technology-mediated environments, the exploration of how digital tools influence motivational processes has emerged as a vital research frontier. The convergence of educational technologies—such as gamification, augmented reality, and artificial intelligence—with motivational frameworks like Self-Determination Theory and the ARCS model has opened new

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avenues for personalizing instruction, fostering engagement, and improving learning outcomes (El Gharbaoui & El Boukhari, 2023).

This study, titled “Mapping Student Motivation Research Trends (2000–2024): A Bibliometric Analysis Advancing SDG 4 and SDG 10 in Education,” addresses the urgent need to map the shifting landscape of motivational research in technology-enhanced education. By applying bibliometric methods through tools such as Harzing’s Publish or Perish and VOSviewer, this research synthesizes insights from 560 Scopus-indexed publications. These works document a growing scholarly focus on learner-centered approaches, with notable citation surges in 2013 and 2019—periods marked by significant innovation in mobile learning, gamified environments, and adaptive platforms (Irwanto et al., 2023). The study aims not only to trace thematic developments but also to identify conceptual gaps that can guide future research in motivational design within digital education ecosystems.

While the existing literature on student motivation is expansive, it often remains fragmented across disciplines, lacking integration between theoretical perspectives and technological applications. This disconnection hampers the development of coherent models for designing motivationally effective educational technologies. Additionally, innovations such as AI-powered tutoring systems, conversational agents, and multimodal learning analytics are advancing faster than our understanding of how they align with core motivational constructs (Ma & Ismail, 2025). Crucially, equity considerations—especially in meeting the diverse needs of students from varying socioeconomic, linguistic, and cultural backgrounds—have long been recognized but remain insufficiently addressed. As early as 2013, Means et al. highlighted the persistent neglect of these factors in the design of educational technologies and instructional strategies. More than a decade later, the issue remains unresolved. Eden et al. (2024) emphasized that despite growing awareness, educational systems continue to fall short in implementing inclusive practices that meaningfully respond to diverse student experiences, thereby limiting their motivational. By uncovering underexplored themes and advocating for inclusive, adaptive, and learner-sensitive strategies, this study contributes to a more equitable vision of technology-enhanced education.

What distinguishes this research is its innovative focus on learner-centered thematic clusters within the broader field of motivational scholarship. By identifying six emerging clusters—spanning digital learning experiences to curriculum innovation—it captures the shifting priorities and conceptual evolution of motivation research in the context of an increasingly digital educational landscape (c.f., Yu et al., 2023). The integration of current AI-driven educational tools, including personalized gamification and human-centered learning analytics (Alfredo et al., 2024; González-González et al., 2023), highlights the demand for flexible frameworks that bridge technological innovation with motivational theory. The selection of the year 2000 as the analytical starting point marks a critical juncture in educational transformation, capturing the onset of digital pedagogy. By analyzing research trends from 2000 to 2024, this study offers a comprehensive perspective on how motivational research has developed—and must continue to adapt—to meet the pedagogical and technological imperatives of 21st-century learning (Huang et al., 2023; Zhao, 2024).

Literature Review

Student learning motivation plays a pivotal role in shaping academic performance, task persistence, and students’ choices of activities (Chiu, 2024). Foundational research began by distinguishing intrinsic from extrinsic motivation (Deci & Ryan, 2000) and later evolved to incorporate comprehensive frameworks such as Self-Determination Theory, Expectancy-Value Theory, and Achievement Goal Theory (Wang, 2024; Wigfield & Eccles, 2000). Although these theories have deepened our understanding of motivational processes, the rapid evolution of educational environments over the past two decades has outpaced the consolidation of this knowledge. A key issue is the fragmented nature of existing research, which lacks a systematic synthesis of how motivational studies have evolved over time, particularly within technology-enhanced learning contexts. This fragmentation hinders both theoretical clarity and practical application.

With the increasing volume of research publications, bibliometric analysis offers a timely and robust method for mapping the trajectory of student motivation research, identifying influential scholars and foundational works, and revealing neglected yet critical areas of inquiry (Donthu et al., 2021; Zupic & Čater, 2014). Tools such as VOSviewer and Harzing’s Publish or Perish allow for the visualization of research networks and thematic clusters, facilitating a clearer understanding of the field’s development (Van Eck & Waltman, 2010). However, despite the availability of these tools, few studies have applied bibliometric approaches to systematically examine how motivation-related theories and interventions have responded to technological, demographic, and pedagogical shifts between 2000 and 2024. This lack of comprehensive mapping presents a significant research gap that this study aims to fill.

This gap is particularly critical in the context of digital transformation. While technology has created new avenues for enhancing motivation through personalized learning, gamification, and AI-driven platforms, it has also introduced new challenges—such as digital distraction, reduced social interaction, and over-reliance on extrinsic incentives—that can undermine students’ intrinsic motivation (Evans et al., 2024; Ryan & Deci, 2000). Furthermore, educators often lack sufficient evidence to effectively integrate these technologies with motivational theory in practice. At the same time, the increasing diversity of student populations, across cultural, socioeconomic, and linguistic lines, calls for more nuanced

and inclusive approaches to motivation research. Existing literature tends to apply generalized frameworks that may not adequately address the unique needs of underrepresented learners, leading to disengagement and educational inequity (Means et al., 2013; Wigfield & Eccles, 2000).

Moreover, the literature exhibits inconsistency in the application of dominant theories, such as Self-Determination Theory and Expectancy-Value Theory, resulting in conceptual fragmentation and limited theoretical integration (Zhao, 2024). There is also a lack of visibility regarding how motivational research varies globally, particularly between the Global North and Global South, which constrains the development of culturally responsive and context-specific educational strategies (Liu et al., 2025). These unresolved issues point to an urgent need for a data-driven synthesis that not only maps existing knowledge but also identifies underexplored areas and future directions. Therefore, this study conducts a comprehensive bibliometric analysis of Scopus-indexed publications on student learning motivation from 2000 to 2024 to capture thematic trends, conceptual gaps, and regional disparities. By selecting 2000 as the starting point—coinciding with the onset of widespread digitalization in education—this research provides a longitudinal lens through which to understand the evolution of motivation scholarship. Ultimately, this study contributes a much-needed integrative framework for advancing theory, informing practice, and shaping future educational policies in a rapidly changing learning landscape (Huang et al., 2023).

Objective of the Study

This study aims to conduct a comprehensive bibliometric analysis of Scopus-indexed literature on student learning motivation from 2000 to 2024 in order to address critical gaps in theoretical integration, technological alignment, and inclusive educational practice. In doing so, it contributes to advancing the goals of Sustainable Development Goal 4 (Quality Education) by promoting equitable, inclusive, and effective learning strategies, and Sustainable Development Goal 10 (Reduced Inequalities) by highlighting motivation research that addresses disparities across diverse educational contexts. Specifically, it seeks to:

1. Map the evolution of research themes on student learning motivation within the context of digital transformation and learner-centered education, supporting SDG 4 by identifying innovative and inclusive approaches to learning.
2. Identify and analyze the most influential publications, authors, and sources contributing to motivation-related research in technology-enhanced learning environments, with a focus on global accessibility and knowledge equity in line with SDG 10.
3. Visualize co-occurring keyword clusters and synthesize them into cohesive thematic dimensions that reflect current and emerging trends in motivation research, ensuring relevance to diverse learner needs and contexts.
4. Propose a unified and actionable framework—Learner-Centered Education in Technology-Enhanced Environments—that encapsulates the six identified motivational research clusters and reinforces the pursuit of SDG 4 by promoting lifelong, self-regulated learning.
5. Offer insights and recommendations for future research, policy development, and instructional design aimed at sustaining motivation in diverse, technology-rich educational contexts, thereby contributing to educational equity and opportunity as outlined in SDG 10.

Methodology

This study uses bibliometric mapping to detect student learning motivation research trends and keyword clusters in publications to discover research clusters and build significant research themes and dimensions. Academic research mapping, trend identification, and acknowledging leading publications and academics require bibliometric investigations (de Oliveira et al., 2019).

Protocol/Bibliography Analysis

This review of the bibliometric literature is grounded in a systematic and explicit approach (Haixia et al., 2025; Wider et al., 2023) or a mind-mapping method that highlights the boundaries of existing knowledge (Senathirajah et al., 2023). The research design follows Donthu et al.'s (2021) five-stage framework, as presented in Table 1: identifying search keywords, obtaining initial search results, refining the results, and compiling preliminary statistical data (Step 3 in Table 1). This five-step model guides the bibliometric analysis. The bibliometric study is further supported by systematic, integrative, descriptive, and meta-analytic research methodologies to ensure the reliability and validity of its quantitative components (Afjal, 2023).

Table 1. The Procedure for Bibliometric Analysis by Donthu et al. (2021)

Step	Description
Step 1	<i>Define Objectives and Scope:</i> Establish research questions and review literature on student learning motivation (2000–2024).
Step 2	<i>Select Analytical Tools:</i> Use Harzing's PoP, VOSviewer, and Excel for performance and network analysis.
Step 3	<i>Data Collection and Cleaning:</i> Using the key words of "Student learning motivation," Or "Academic achievement, Or "Intrinsic motivation," Or "Academic performance." Extract 1,000 articles from Scopus using a defined search string; refine to 560 relevant articles.
Step 4	<i>Run Bibliometric Analysis:</i> Analyze publication trends, citations, and perform co-occurrence clustering via VOSviewer.
Step 5	<i>Thematic Interpretation:</i> Conduct a manual review of keyword clusters to identify emerging trends and thematic dimensions in student learning motivation research.

The first step in conducting this bibliometric analysis involves establishing clear research objectives and defining the scope of the study. The primary aim is to extract insights and answer specific research questions through a comprehensive review of relevant publications. This study focuses on synthesizing a large body of bibliometric data related to student learning strategies, covering articles published across multiple disciplines between 2000 and 2024.

The second step centers on selecting appropriate analytical tools—the bibliometric "toolbox"—to guide the investigation. Two key types of analysis are employed:

Performance analysis, which evaluates total publications, citation counts, top-performing journals, and the top 10 most cited articles; and Network analysis, which uses cluster analysis based on keyword co-occurrence to identify research patterns and thematic groupings.

In the third step, data collection and preparation were carried out. The articles were retrieved from the Scopus database using a predefined search string that included terms such as "student learning motivation," "academic achievement," "intrinsic motivation," and "academic performance" (see Table 5). To maintain a manageable dataset, the search was limited to a maximum of 1,000 records. Data cleaning was conducted using Microsoft Excel, during which records were filtered based on specific inclusion criteria: publications had to fall within the 2000–2024 range, be classified as either journal articles or conference proceedings, and be in their final publication stage. After this refinement process, a total of 560 articles were retained for bibliometric and content analysis.

The fourth step involves conducting the bibliometric analysis using the selected analytical tools. VOSviewer is utilized to generate keyword co-occurrence maps, which help visualize and identify clusters that signify major research trends within the field of student learning strategies. In this study, six distinct clusters were identified—ranging from red to light blue—based on the co-occurrence of 70 keywords. These clusters collectively illustrate the thematic structure and evolving focus areas in motivation-related research.

The final step involves manual content analysis to interpret and name the identified clusters as themes and dimensions. This process includes evaluating the relationships among keywords, the specificity and abstraction level of terms, and their interdisciplinary relevance. Researchers iteratively review and refine the clusters to ensure accuracy and conceptual clarity (Sinkovics, 2016). This step draws on qualitative content analysis methods (Krippendorff, 2019) to reveal nuanced subthemes and emerging research directions that may not be visible through quantitative keyword clustering alone. Without such manual interpretation, tools like VOSviewer may overlook critical conceptual distinctions and underexplored topics. Overall, this rigorous analytical process offers valuable insights into the evolving landscape of research on student learning motivation.

Results

Performance Trends of Leading Articles on Student Learning Motivation (2000–2024)

From 2000 to 2024, approximately 560 Scopus-indexed articles were published on the topic of student learning motivation. Citation analysis reveals a steady upward trajectory in scholarly attention over this period, with a notable surge in citations beginning in the early 2010s. Citations peaked in 2022, exceeding 370, followed closely by 360 citations in 2023, reflecting heightened interest in motivational research, particularly within technology-enhanced educational contexts. However, a slight decline in citation volume is observed in 2024, which may be attributed to the time lag in citation accumulation for newly published articles. Figure 1 presents a visual representation of citation trends across the

24-year period, highlighting the sustained growth and recent fluctuations in academic engagement with student learning motivation research.

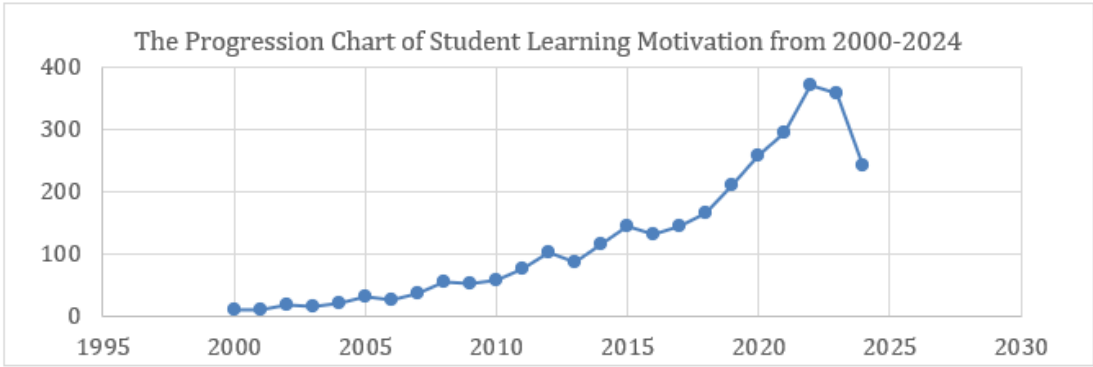


Figure 1. Scopus Database of Citation Count and Year on Student Learning Motivation Research

Leading Journals and Conference Proceedings Contributing to Student Learning Motivation Research (2000–2024)

A summary of the top four journals and conference proceedings that have made the most significant contributions to the field of student learning motivation is presented, based on an analysis of 560 Scopus-indexed publications published between 2000 and 2024 (Table 2). The ACM International Conference Proceeding Series (ICPS) ranks first, contributing 24 publications on the topic. This is followed by Lecture Notes in Computer Science (LNCS)—including its subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics—which collectively account for 21 papers. Frontiers in Psychology, a prominent open-access journal, ranks third with 14 published articles. These leading sources reflect the interdisciplinary and increasingly technology-oriented nature of motivational research in education.

Table 2. Leading Journals and Conference Proceedings Publishing on Student Learning Motivation (2000–2024)

Rank	Publisher/Source	Description	Country of Origin	Number of Articles (2000–2024)
1	ACM International Conference Proceeding Series (ICPS)	A publication series by the Association for Computing Machinery (ACM), featuring peer-reviewed proceedings in computer science, information technology, and related disciplines. Known for documenting cutting-edge advancements in educational computing.	USA	24
2	Lecture Notes in Computer Science (LNCS) (Including Lecture Notes in Artificial Intelligence and Bioinformatics)	A book series published by Springer, presenting the latest research in computer science, AI, and bioinformatics. Recognized for its role in disseminating conference-based research in educational technologies.	Germany	21
3	Frontiers in Psychology	A multidisciplinary, open-access journal publishing research across all areas of psychology. Frequently cited for its contributions to motivation, cognition, and learner psychology.	Switzerland	14
4	Interactive Learning Environments	A peer-reviewed journal focusing on the design, implementation, and evaluation of technology-enhanced and interactive learning environments across education contexts.		

Trend Analysis (2000–2024) of the Top 10 Most Frequently Cited Articles on Student Learning Motivation

Citation data from 2000 to 2024 reveal notable trends in student learning motivation research, shaped by technological advancements, pedagogical innovations, and evolving priorities within educational psychology and instructional design. As illustrated in Table 3, the most highly cited works highlight how the field has responded to changing learning environments and instructional methodologies. Notably, the peak in citations occurred in 2013, with 442 citations concentrated around themes such as gamification and the use of cognitive tools. This trend evolved in subsequent years,

culminating in a renewed focus on artificial intelligence and educational technology in 2023, which recorded 101 citations. Based on this analysis (see Table 3), ten distinct research trends have been identified, each representing a specific thematic focus that will be further examined in the discussion section. These trends include: (1) Gamified and Cognitive Tools, (2) Immersive Technology, (3) Mobile Learning Era, (4) Language and Motivation, (5) Digital Pedagogy, (6) Pedagogical Strategies, (7) Conversational AI, (8) Interdisciplinary Learning, and (9) AI and Learning Analytics.

Table 3. Thematic Trends Identified in the Top Cited Articles on Student Learning Motivation (2000–2024)

Year	Authors	Citation Count	Publication Trends by Research Theme
2013	Hwang et al.	442	Gamified & Cognitive Tools
2019	Khan et al.	253	Immersive Tech
2008	Rau et al.	211	Mobile Tech Era
2019	L. Jiang et al.	193	Language & Motivation
2019	Dunn and Kennedy	173	Digital Pedagogy
2010	Yang et al.	166	Immersive Tech
2015	Kiemer et al.	151	Pedagogical Strategies
2020	Yin et al.	134	Conversational AI
2019	Kuo et al.	112	Interdisciplinary Learning
2023	Huang et al.	101	AI & Analytics

Predominantly Examined Research Cluster for Student Learning Motivation

Research trends in learning motivation were analyzed through keyword analysis to identify prevailing issues and forecast future research trajectories related to the keywords. Cluster analysis aimed to uncover research patterns aligned with the study's objectives and parameters (Donthu et al., 2021). Each cluster represents closely associated indicators or key phrases summarized by a singular measure (Franceschet, 2009). Using keyword co-occurrence analysis of 560 articles, six clusters were identified from 70 recognized titles (Table 4), as well as the VosViewer visualization in Figure 2. Temporal publication citation trends from 2002 to 2024 are depicted in Table 2.

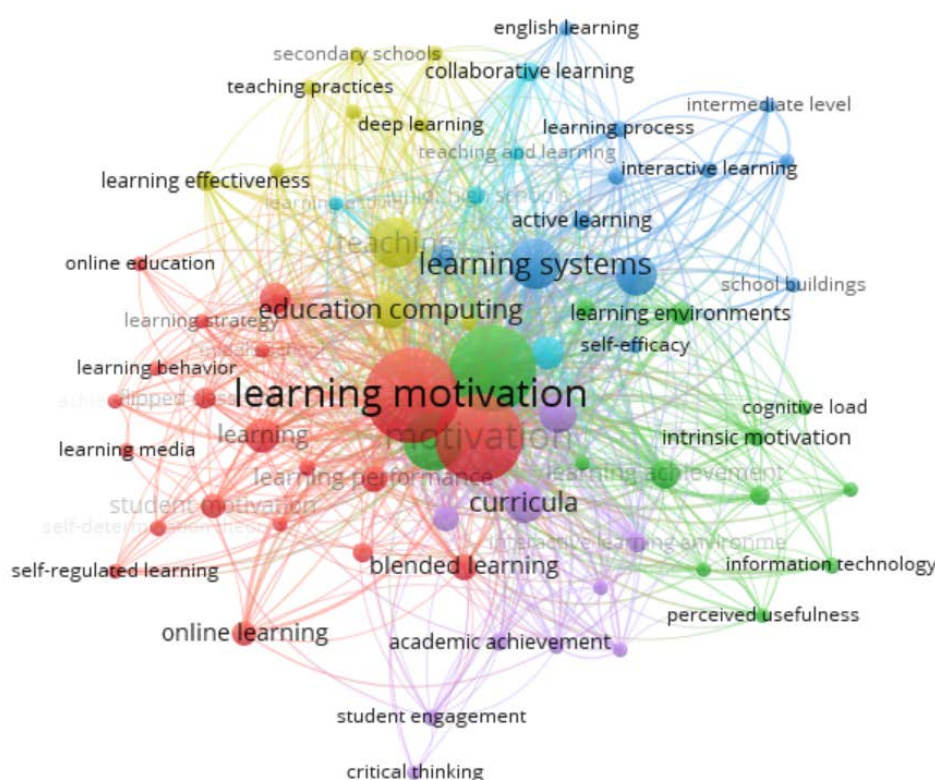


Figure 2. The Vos Viewer Visualization

Table 4. Dimensions Based on VOSviewer Visualization and Cluster Content:

Cluster	Keywords	Dimension	Justification (Tally with Visual & Semantics)
1 Red	"1. achievement, 2.ARCS models,3.blended learning, 4. flipped classroom, 5. flipped learning, 6. learning, 7. Learning behavior, 8. learning media, 9. Learning motivation, 10. Learning outcomes, 11. Learning performance, 12. Learning strategy, 13. Middle school, 14. Motivation, 15. Online education, 16. Online learning, 17. Self-determined theory,18. Self-regulated learning, 19. Student learning motivation, 20. Student motivation."	Motivated Learning Strategies	Central cluster (red) in the VOSviewer; emphasizes instructional design models (ARCS, flipped), digital modes, and motivational constructs
2 Green	"1. cognitive load, 2. E-learning, 3. Education technology, 4. Flow experience, 5. Information technology, 6. Intrinsic motivation, 7. Learning achievement, 8. Learning attitude, 9. Learning environment, 10. learning satisfaction, 11. Perceived usefulness, 12. Problem solving, 13. Students"	Digital Learning Experience & Cognitive Response	Green cluster aligns with psychological and perceptual reactions to technology-enhanced learning (right of center)
3 Blue	"1. active learning, 2. Education, 3. English learning, 4. Interactive learning, 5. Intermediate level, 6. Language learning, 7. Learning material, 8. Learning process, 9. Learning system, 10. School building, 11. Self-efficacy, 12. Teaching method"	Interactive and Language-Based Pedagogy	Blue cluster to the top right focuses on instructional methods in language and interactive learning environments
4 Yellow	"1. academic performance, 2. deep learning, 3. Education computing, 4. Learning effectiveness, 5. Secondary school, 6. Teachers, 7. Teaching, 8. Teaching model, 9. Teaching practices, 10. Teaching strategies."	Teaching Quality and Instructional Depth	Yellow cluster (top left); strong teacher-centered pedagogy, teaching model innovations, and learning depth
5 Purple	"1. academic achievement, 2. Computer-aided instruction, 3. Critical thinking, 4. Curricula, 5. Improving classroom teaching, 6. Learning environment is interactive, 7. Student engagement, 8. Student learning, 9. Teaching learning strategy, 10. Technology enhancement learning."	Curriculum Innovation and Student-Centered Technology	Purple cluster (bottom), reflects curricular enhancement using tech and fostering higher-order thinking
6 Light Blue	"1. collaborate learning, 2. game-based learning, 3. junior high school, 4. learning activity, 5. teaching and learning."	Collaborative and Active Learning	Light blue cluster (top center); focused on engagement through active pedagogy and collaboration, especially in junior contexts

Summary of Findings: Six Thematic Dimensions from VOSviewer Visualization

The VOSviewer analysis of 70 co-occurring keywords generated six distinct clusters, each representing a key thematic dimension within the evolving field of student learning motivation. These clusters not only reflect the semantic proximity of keywords but also align visually in terms of spatial grouping and density, thereby highlighting emerging research priorities from 2000 to 2024.

1. Motivated Learning Strategies (Red Cluster):

This central cluster is characterized by keywords such as learning motivation, ARCS, blended learning, flipped learning, online learning, self-regulated learning, and achievement. The prominence and central positioning of this cluster in the VOSviewer map reflect the foundational role of motivation-enhancing instructional strategies, particularly those integrating digital formats and self-regulation frameworks.

2. Digital Learning Experience and Cognitive Response (Green Cluster):

Positioned right of center, this cluster features terms like intrinsic motivation, cognitive load, learning attitude, satisfaction, e-learning, and information technology. It underscores the psychological and emotional responses learners exhibit in digitally mediated environments, emphasizing the cognitive-affective interplay in technology-enhanced learning contexts.

3. Interactive and Language-Based Pedagogy (Blue Cluster):

Located in the top-right section, this cluster includes keywords such as active learning, English learning, language processing, school buildings, and self-efficacy. It highlights pedagogical approaches centered on interactive, language-driven instruction, often in diverse or multilingual educational settings, emphasizing learner engagement and communicative competence.

4. Teaching Quality and Instructional Depth (Yellow Cluster):

This top-left cluster is defined by terms such as deep learning, teaching strategies, teaching effectiveness, teachers, and secondary schools. It reflects teacher-centric research focused on pedagogical depth, instructional innovation, and the effectiveness of teaching practices in fostering meaningful learning outcomes.

5. Curriculum Innovation and Student-Centered Technology (Purple Cluster):

Appearing in the bottom area of the visualization, this cluster encompasses keywords like academic achievement, critical thinking, student learning, curricula, and technology-enhanced learning. It signifies the intersection of curriculum reform and digital tools aimed at developing student autonomy and higher-order thinking skills.

6. Collaborative and Active Learning (Light Blue Cluster):

Situated at the top center, this cluster includes collaborative learning, game-based learning, and teaching and learning activities. It represents a growing interest in participatory pedagogies that prioritize student collaboration, active engagement, and gamified experiences—particularly in junior or early education contexts.

Collectively, these six dimensions provide a comprehensive thematic framework for understanding the trajectory of motivation-related research in digital education. The VOSviewer visual and semantic alignment of clusters underscores how scholarly focus has shifted—from foundational motivational theories to digitally mediated, interactive, and student-centered learning paradigms. These insights serve as the basis for further discussion and framework development in the subsequent sections.

Conclusion

Drawing upon the findings from a bibliometric analysis of Scopus-indexed literature between 2000 and 2024, this discussion highlights key research trends in student learning motivation, analyzes the impact of the six identified thematic clusters, and outlines their contributions to the advancement of knowledge in the field. The evolving themes not only reflect the progression of motivational research but also demonstrate alignment with the goals of Sustainable Development Goal (SDG) 4: Quality Education, by advocating for inclusive, equitable, and innovative learning strategies. Additionally, the emphasis on contextual and localized approaches across different regions resonates with SDG 10: Reduced Inequalities, particularly in improving learning outcomes for marginalized and underserved populations.

Evolving Trends in Student Learning Motivation Research (2000–2024)

Over the past two decades, research on student learning motivation has undergone a significant transformation, influenced by advancements in educational technology, theoretical diversification, and changing pedagogical landscapes. Early studies were anchored in foundational psychological frameworks such as Self-Determination Theory (Deci & Ryan, 2000) and Expectancy-Value Theory (Wigfield & Eccles, 2000), focusing on intrinsic motivation, goal orientation, and learner autonomy.

With the onset of the digital age, particularly from 2010 onward, the research trajectory expanded to encompass a wider range of technological interventions. Key developments included the application of gamification strategies to enhance cognitive engagement (Hwang et al., 2013), the widespread adoption of mobile learning tools in formal education settings (Rau et al., 2008), and the integration of augmented and virtual reality (AR/VR) to support immersive, experiential learning (Khan et al., 2019; Yang et al., 2010). These approaches aim to democratize access to high-quality learning, in line with SDG 4, and help bridge technological and pedagogical divides, thereby contributing to SDG 10.

A marked citation peak between 2013 and 2019 reflects the increasing global interest in these technology-driven approaches to motivation. From 2021 to 2024, attention shifted toward AI-powered personalized learning and chatbot-based microlearning, in response to the global pivot toward remote and hybrid instruction brought about by the COVID-

19 pandemic (Evans et al., 2024; Huang et al., 2023; Yin et al., 2020). These innovations emphasize learner-centered models and adaptive feedback systems, supporting equitable education access and personalized learning—key tenets of SDG 4.

The progression of research from theory-driven approaches to data-driven, technology-mediated applications demonstrates the field's responsiveness to evolving educational demands. It also reflects a paradigm shift—from viewing motivation as a static individual trait to understanding it as a dynamic, context-sensitive process shaped by digital tools, learning environments, and instructional design—further enabling the reduction of disparities in learning outcomes across socioeconomic and regional boundaries (SDG 10).

Table 5. Evolution of Wave Trends in Student Motivation Research (2000–2024)

Wave	Trend Focus	Key Features
2000–2010	Foundations of EdTech and Mobile Learning	Early focus on <i>motivation, pressure, and performance</i> (e.g., Rau et al., 2008). Gamification begins (Hwang et al., 2013).
2010–2015	Interactive Digital Tools	Emergence of VR/AR, video capture technologies, and digital storytelling; educational games mature (Hwang et al., 2013; Yang et al., 2010).
2015–2020	Interdisciplinary & Localized Studies	Broader focus on <i>STEM + motivation, EMI</i> , and regional pedagogical shifts (L. Jiang et al., 2019; Kuo et al., 2019).
2020–2024	AI, Chatbots, and Personalization	Post-pandemic era emphasizes <i>learner autonomy, engagement analytics, and personalized systems</i> (Huang et al., 2023; Yin et al., 2020).

Four Key Thematic Waves in Student Learning Motivation Research (2000–2024)

The bibliometric analysis of Scopus-indexed literature from 2000 to 2024 reveals four distinct thematic waves in student learning motivation research, each driven by advances in technology, pedagogical innovation, and shifting global educational priorities. These phases reflect how motivation research has adapted to emerging educational contexts and tools, leading to more learner-centered, inclusive, and technologically enhanced practices.

Wave 1: Laying the Foundations – Educational Technology and Mobile Learning (2000–2010)

The early 2000s marked an exploratory phase, focusing on integrating motivational theory into the growing domain of educational technology. Research during this period emphasized mobile-assisted learning and digital communication tools as enablers of student engagement. Foundational studies (e.g., Rau et al., 2008) highlighted how mobile technologies enhanced student participation and learning immediacy, setting the stage for digital-motivation integration.

Wave 2: From Passive to Interactive – Gamification and Immersive Tools (2010–2015)

A turning point occurred with the rise of interactive digital tools, such as virtual reality, educational games, and flipped classrooms. Motivation research expanded to include immersive, gamified environments, transforming students from passive receivers into active participants. Seminal studies like Hwang et al. (2013) demonstrated that concept map-based educational games significantly enhanced both motivation and learning performance in science education.

Wave 3: Contextualization and Diversity – Interdisciplinary and Localized Research (2015–2020)

During this period, research broadened to examine motivation through interdisciplinary and culturally responsive lenses. Motivation was studied in relation to STEM, project-based learning, and English as a Medium of Instruction (EMI). While global citation rates dipped, the field saw a diversification of themes and learner contexts. For example, L. Jiang et al. (2019) explored how EMI in China reshaped motivation and teaching practice, reflecting a shift toward localized educational models.

Wave 4: Intelligent Personalization – AI and Post-Pandemic Learning (2020–2024)

The most recent phase reflects the influence of artificial intelligence, personalized learning, and hybrid education models catalyzed by the COVID-19 pandemic. Motivation research increasingly explores adaptive learning environments powered by chatbots, analytics, and gamification. Studies such as Xu et al. (2024) highlight how AI-driven systems foster higher engagement and metacognitive skills, ushering in a new era of autonomous, data-informed learner motivation.

Synthesizing the Clusters: Toward a Learner-Centered Digital Paradigm

The six keyword clusters identified through VOSviewer—Motivated Learning Strategies, Digital Learning Experience and Cognitive Response, Interactive and Language-Based Pedagogy, Teaching Quality and Instructional Depth, Curriculum Innovation and Student-Centered Technology, and Collaborative and Active Learning—collectively represent a shift toward Learner-Centered Education in Technology-Enhanced Environments. This shift aligns directly with SDG 4, advocating for inclusive, high-quality learning experiences through digital equity and innovative pedagogy. Moreover, the rise of culturally responsive, context-specific research—particularly from underrepresented regions such as the Global South—addresses long-standing gaps in global education discourse, reinforcing the equity goals of SDG 10. These emerging trends signify a growing recognition of the need for diverse perspectives, adaptive tools, and localized strategies to sustain motivation across varied learning environments (Georgalakis & Siregar, 2023).

These six clusters interconnect with the four Wave Trends identified from 2000 to 2024, which provide a longitudinal understanding of how motivational research themes have evolved in tandem with technological innovation and educational reform. For example, Wave 1 laid the groundwork for integrating educational technologies into motivational models (Clusters 1 and 2), while Wave 2 built upon this by emphasizing gamified and immersive learning experiences (Clusters 3 and 6). Wave 3 emphasized localized pedagogy and interdisciplinary approaches—mirrored in Clusters 4 and 5—highlighting the cultural and contextual shifts in motivational strategies. Finally, Wave 4 corresponds with the rise of AI, chatbots, and personalized learning environments, reinforcing the need for learner-centric, adaptive systems (Cluster 1 and 2).

These wave clusters represent more than just chronological milestones—they showcase a deepening alignment with SDG 4 by promoting quality education through personalized and inclusive strategies, and SDG 10 by ensuring these approaches consider marginalized groups across geographic and digital divides. This layered synthesis offers a novel contribution by connecting temporal waves with thematic clusters, forming a dual-framework model that can guide future research and practice in motivation-enhanced digital education.

Study Limitations and Recommendations for Future Research

This bibliometric analysis has offered valuable insights into the evolution of student learning motivation research from 2000 to 2024, revealing six key thematic clusters and the growing emphasis on learner-centered, technology-enhanced education. However, as with all research, several limitations should be acknowledged, and directions for future investigation proposed.

*Study Limitations**Language and Regional Bias*

The study exclusively analyzed English-language publications indexed in Scopus. As a result, significant research published in other languages—particularly in regions like Latin America, East Asia, and Africa—may have been excluded. This language bias restricts the diversity of cultural perspectives and context-specific motivational strategies.

Methodological Constraints of Bibliometrics

While bibliometric analysis efficiently identifies publication trends and keyword co-occurrences, it lacks the capacity to interpret educational impact or contextual depth. High citation frequency does not necessarily reflect practical relevance or effectiveness in diverse classroom settings.

Limited Scope of Data Sources

The analysis relied primarily on Scopus-indexed journal articles and conference proceedings, omitting valuable insights from grey literature (e.g., dissertations, government reports, or practitioner-authored materials) and interdisciplinary sources in psychology, neuroscience, or digital media studies.

*Recommendations for Future Research**Expand Language and Regional Inclusion*

Future bibliometric studies should incorporate non-English databases and multilingual publications to ensure a more comprehensive global representation. Emphasizing research from the Global South will also support a more equitable understanding of how motivation manifests across different socio-cultural and educational systems—especially in relation to SDG 10 (Reduced Inequalities).

Combine Bibliometric and Qualitative Methods

To overcome the interpretive limitations of bibliometric tools, future research should adopt mixed-method designs. Integrating bibliometric mapping with qualitative approaches—such as expert interviews, case studies, or content analysis—can provide richer insights into the effectiveness, adaptability, and contextual relevance of motivational interventions.

Align Motivation Research with Post-Pandemic Innovation and SDG 4

Given the shift toward digital and personalized learning accelerated by COVID-19, future studies should focus on emerging technologies such as AI, gamified platforms, and remote learning systems. Emphasizing how these tools affect motivation, inclusion, and student agency will help bridge research and practice in ways that directly support the goals of SDG 4 (Quality Education for All).

This study provides a groundbreaking contribution to the field of educational psychology and technology-enhanced learning by offering a comprehensive bibliometric synthesis of student learning motivation research from 2000 to 2024. Through rigorous co-occurrence analysis and VOSviewer-driven clustering of 70 keywords across 560 Scopus-indexed publications, six coherent thematic dimensions were identified: (1) Motivated Learning Strategies, (2) Digital Learning Experience and Cognitive Response, (3) Interactive and Language-Based Pedagogy, (4) Teaching Quality and Instructional Depth, (5) Curriculum Innovation and Student-Centered Technology, and (6) Collaborative and Active Learning. These clusters converge under the overarching construct of "Learner-Centered Education in Technology-Enhanced Environments," which marks a novel conceptual synthesis within the literature.

The study's originality lies in its ability to consolidate fragmented motivational research into a unified and data-driven framework that not only traces the historical trajectory of scholarship but also predicts future research avenues. The findings underscore the dynamic evolution of motivational constructs from foundational theories—such as Self-Determination Theory and the ARCS model—to current innovations involving gamified learning, immersive digital tools, and AI-powered personalization. Each cluster represents a distinct yet interconnected dimension of learner-centered pedagogical design, reaffirming the need for adaptable, inclusive, and evidence-based strategies in modern education.

Importantly, this study goes beyond traditional bibliometric reviews by integrating content analysis to validate the semantic and conceptual coherence of each cluster. This methodological fusion enhances the depth of the analysis, allowing the clusters to function not merely as keyword groupings, but as strategic categories with theoretical, practical, and policy relevance. By articulating how trends evolved—from mobile learning and gamification to conversational AI and self-regulated learning—this research delivers an actionable roadmap for educators, instructional designers, and policymakers aiming to sustain student motivation in diverse learning environments.

This bibliometric analysis does not merely chart what has been studied—it reshapes how the field of student learning motivation can be understood. It provides a novel, six-dimensional taxonomy grounded in rigorous data and theory, offers conceptual clarity in a fragmented research landscape, and sets a forward-looking agenda for how technology-enhanced environments can empower learners across contexts. In doing so, it directly advances the aims of Sustainable Development Goal 4 (Quality Education) by promoting inclusive, equitable, and innovative learning models, and contributes to Sustainable Development Goal 10 (Reduced Inequalities) by highlighting culturally responsive, context-sensitive, and accessible motivational strategies that can reduce educational disparities across socio-economic and geographic divides. This work thus stands as both a scholarly synthesis and a strategic blueprint for fostering educational innovation that leaves no learner behind. Additionally, this study introduces a Wave Trend Framework that outlines four pivotal stages in student learning motivation research—ranging from early mobile and educational technologies (2000–2010), to immersive and gamified learning (2010–2015), to interdisciplinary and context-specific strategies (2015–2020), and finally to personalized, AI-enhanced approaches (2020–2024). These waves align closely with the six VOSviewer-generated thematic clusters, collectively advancing a comprehensive and temporal-thematic map of how motivation research has evolved in the digital age.

This integration of thematic clustering with wave progression offers a novel analytical lens not previously explored in bibliometric studies. It highlights the interplay between technological milestones and motivational theory development, thereby filling a significant gap in literature synthesis. Importantly, this dual-lens model contributes to new knowledge by proposing a layered analytical structure that accounts for both thematic richness and temporal dynamics—critical for advancing motivational theory and its application in diverse, digitally-mediated educational settings. In line with SDG 4 and SDG 10, the wave-cluster model reinforces the imperative for inclusive educational technologies that support not only learner autonomy but also cultural relevance and digital equity. Policymakers and educators can use this framework as a roadmap to prioritize interventions that are not only evidence-based but also context-responsive, thereby reducing global disparities in motivation-driven educational outcomes.

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Generative AI Statement

The author has not used generative AI or AI-supported technologies.

Authorship Contribution Statement

Fauzee: analysis, writing. Al-Zu'bi: Conceptualization, design. Al-Mseidin: Editing/reviewing. Singh: supervision. Habibie: interpretation, drafting manuscript. Al-Mawadieh: Conceptualization, design. Mahmood: drafting manuscript, critical revision of manuscript. Rashidah M.S: admin, technical, and material support. Abdullah: supervision, final approval. Yaakob: writing.

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