Higher Education and Practice Vol. 2 No. 11, 2025

A Bibliometric Analysis and Visualization of Mobile Teaching Research in Higher Education Institutions

Ronghai Wang[1,2,3], Guoxin Lin[1,2,3,*], Hongwei Wang[1,2,3]
[1]*School of Mathematics and Computer Science, Quanzhou Normal University, Quanzhou, Fujian, China*
[2]*Fujian Provincial Key Laboratory of Data Intensive Computing, Quanzhou, Fujian, China*
[3]*Key Laboratory of Intelligent Computing and Information Processing, Quanzhou, Fujian, China*
**Corresponding Author*

Abstract: **Mobile teaching has become an important area of teaching research in higher education institutions, driven by the widespread use of mobile devices, the integration of learning management systems, and the expansion of online and hybrid instruction. However, existing studies are scattered across disciplines and lack a systematic understanding of the field's overall development and knowledge structure. To address this gap, this study conducts a bibliometric analysis of 697 SCI and SSCI publications retrieved from the Web of Science using topic terms related to mobile teaching and higher education. Descriptive bibliometric methods are employed to examine publication trends, document types, leading journals, country contributions, and citation performance. In addition, VOSviewer is used to visualize collaboration networks, keyword co-occurrence patterns, citation relationships, bibliographic coupling, and co-citation structures. The results show sustained growth since the early 2000s, with core research themes centered on mobile learning and technology-enhanced pedagogy, alongside emerging emphases on immersive technologies, remote teaching, and discipline-specific applications. This study provides a reproducible bibliometric framework and evidence-based insights for advancing mobile teaching research and practice in higher education.**

Keywords: **Mobile Teaching; Higher Education Institutions; Bibliometric Analysis; Vosviewer; Co-authorship; Co-citation; Keyword Co-occurrence**

1. Introduction

Mobile teaching in higher education institutions (HEIs) has progressed from a supplementary "anytime–anywhere" practice to a strategic mode of instruction that shapes how students access resources, communicate, and engage in learning tasks. Early empirical work foregrounded students' lived experiences with smartphones and social media in higher education, revealing both learning opportunities (e.g., flexible access and peer interaction) and persistent challenges (e.g., attention management and boundary issues between formal and informal learning) [1]. At the same time, research on first-year students' technology experiences cautioned against treating HEI learners as uniformly "digitally native," highlighting variability in students' competencies and expectations and implying the need for differentiated support in mobile teaching design and implementation [2].

As mobile teaching practices matured, studies began to test whether specific mobile formats could yield measurable benefits. Evidence from podcast-based revision lectures suggested that well-aligned mobile resources can support self-paced review and enhance learning effectiveness in higher education contexts [3]. To systematize mobile teaching designs, pedagogical frameworks were proposed to categorize mobile learning applications by instructional purpose and learning context, helping researchers and instructors articulate which forms of mobile teaching are being adopted and why [4]. Beyond content delivery, mobile teaching also expanded toward situated and interactive designs; ubiquitous game-based learning demonstrated how mobile-enabled activities can strengthen motivation and learning outcomes by embedding practice in engaging task structures and feedback loops

[5].

In the most recent research wave, attention has increasingly shifted from "using mobile tools" to addressing broader pedagogical and wellbeing concerns within HEIs. For example, mobile media education has been studied as an intervention to reduce problematic smartphone use, indicating that mobile teaching research is now intertwined with responsible technology use and student self-regulation—issues that directly affect learning quality in higher education [6]. Discipline- and context-specific studies further highlight that mobile teaching is not frictionless: pedagogical challenges such as classroom orchestration, task design, and instructor readiness remain salient when mobile technologies are integrated into language teaching in higher education settings [7]. In parallel, systematic literature reviews focusing on mobile learning in higher education show that the field has grown substantially in volume and topical diversity, while also revealing recurring gaps such as uneven methodological rigor, limited longitudinal evidence, and inconsistent outcome measures across studies [8].

Alongside these developments, mobile teaching is increasingly connected to emerging technologies that reshape learning experiences and instructional strategies. Augmented reality (AR) applications, for instance, have been explored in specialized teaching scenarios, suggesting that mobile-supported immersive and creative learning designs can expand the repertoire of higher education pedagogy when aligned with learning goals and constraints [9]. In professional education, mobile mixed reality has drawn sustained interest; evidence syntheses in nursing and healthcare education emphasize its potential for fostering critical thinking while also pointing to implementation constraints such as usability, cognitive load, and curriculum integration [10]. More broadly, systematic reviews examining mobile learning effects on learning outcomes and critical thinking indicate that effectiveness depends heavily on learning design quality, assessment alignment, and the extent to which mobile activities are embedded into coherent instructional sequences rather than appended as add-ons [11].

Recent empirical work has also emphasized motivational and psychological mechanisms in mobile teaching. Studies on mobile augmented reality report improvements in learning achievement, self-efficacy, and motivation, implying that mobile teaching interventions may be most impactful when they simultaneously support cognitive performance and learners' beliefs about capability and engagement [12]. However, successful adoption remains conditional on acceptance and satisfaction: research grounded in UTAUT-2 perspectives shows that HEI students' mobile-learning adoption is shaped by multiple determinants (e.g., perceived value, facilitating conditions, and experience-related factors), reinforcing the importance of institutional support and usability at scale [13].

Looking ahead, HEIs are witnessing the convergence of mobile teaching with AI-supported learning processes. Evidence from blended discussion contexts suggests that ChatGPT-supported mobile instant messaging designs can be structured to enhance discussion quality when paired with scaffolding principles and explicit knowledge-integration guidance, indicating a shift toward "mobile + AI" pedagogical engineering rather than tool-level experimentation [14]. Meanwhile, randomized controlled evidence in nursing education underscores that mobile augmented reality can deliver measurable gains in professional competence for specific assessment tasks, strengthening the case for rigorous evaluation designs and domain-sensitive mobile teaching interventions in higher education [15].

Despite rapid growth—especially in 2023–2025—the literature remains fragmented across disciplines and application contexts, and key questions persist regarding sustainable adoption, equity and student wellbeing, rigorous outcome measurement, and the integration of mobile teaching with AI-enabled learning environments. Therefore, a comprehensive bibliometric analysis combined with VOSviewer-based science mapping is needed to clarify publication patterns, collaboration structures, and thematic evolution within mobile teaching research for higher education institutions. Accordingly, this study analyzes 697 SCI/SSCI publications retrieved from Web of Science and visualizes the knowledge landscape using VOSviewer to identify intellectual bases, research hotspots, and emerging fronts in HEI mobile teaching.

2. Data and Methods

2.1 Data Source and Retrieval Strategy

The bibliographic dataset used in this study was retrieved from the Web of Science Core Collection, including the Science Citation Index Expanded (SCI-EXPANDED) and the Social Sciences Citation Index (SSCI). A topic-based search strategy was adopted to simultaneously capture publications related to both mobile teaching and higher education. Specifically, records indexed under topic terms corresponding to "Mobile Teaching" and "Higher Education" were retrieved and exported in plain-text format. Two download batches were combined, yielding a final dataset of 697 unique records after removing duplicates. Each record contains full bibliographic information, including authors, titles, abstracts, keywords, source journals, affiliation addresses, cited references, and citation counts. This comprehensive data structure enables both descriptive statistical analysis and network-based bibliometric mapping.

2.2 Analysis Workflow

The analytical workflow integrates descriptive bibliometrics with science mapping techniques to provide a systematic overview of the development, structure, and dynamics of mobile teaching research in higher education. First, descriptive statistics were recalculated directly from the original Web of Science records to examine publication growth over time, document type distribution, productive journals, country-level contributions, and citation performance. To ensure consistency in national-level reporting, publications affiliated with Taiwan were merged into China when computing country output and international collaboration indicators. Citation-based measures, including total citations, average citations per paper, median citations, and the dataset-level h-index, were used to assess the academic influence of the retrieved literature.

Second, science mapping analyses were conducted using VOSviewer (version 1.6.20) to explore collaboration patterns, research hotspots, and the intellectual structure of the field. Keyword co-occurrence analysis was performed using a minimum occurrence threshold, and a thesaurus file was applied to merge synonymous and format-variant keywords prior to network construction. Country-level co-authorship networks were generated to visualize international collaboration structures, while co-citation analyses of cited references and cited sources were used to identify the theoretical foundations and core publication venues. In addition, bibliographic coupling and citation network analyses were conducted to capture emerging research fronts and contemporary citation influence. Together, these complementary approaches provide a coherent and reproducible framework for mapping the evolution and knowledge structure of mobile teaching research in higher education.

3 Results

3.1 Current Status of Mobile Teaching Research in HEIs

The dataset spans 2000–2025, indicating that research explicitly indexed to mobile teaching in HEIs became visible in WoS from the early 2000s. Overall growth is sustained, with noticeable acceleration in the 2010s and continued high output into the 2020s. In the most recent five years, output remains substantial, with 2021 (87), 2022 (96), 2023 (72), 2024 (65), and 2025 (58) publications, reflecting both maturation and diversification of mobile teaching research themes. Beyond publication volume, the composition of document types provides additional insight into the nature and maturity of research output in this field, particularly the balance between empirical studies and integrative syntheses. In this context, analyzing document types helps characterize the dominant forms of scholarly communication in mobile teaching research within higher education.

Table 1 summarizes document types. Research in this area is dominated by journal articles, indicating a mature empirical base.

Table 1. Types of Retrieved Documents

Type of Document	Frequency	Proportion
Article	630	90.39
Review	47	6.74
Article; Early Access	12	1.72
Article; Proceedings Paper	6	0.86
Article; Book Chapter	2	0.29
Total	697	100

The field is distributed across a wide range of education technology, interdisciplinary education, and applied computing journals. The

most productive journals (by publication count in this dataset) include:

- Sustainability (39)
- Education and Information Technologies (34)
- Computers & Education (33)
- Interactive Learning Environments (20)
- Mobile Information Systems (18)
- BMC Medical Education (16)
- IEEE Access (15)
- Nurse Education Today (15)

These outlets illustrate two coexisting streams: (i) general HEI pedagogy and learning technology, and (ii) professional/discipline-specific mobile teaching (e.g., medical and nursing education).

Based on affiliation countries, leading contributors include China (201), USA (105), Spain (86), England (42), and Australia (40) (paper-level counting; one paper may include multiple countries). The dataset shows moderate international collaboration: approximately 38.7% of papers involve authors from more than one country, suggesting a globally connected research community but still leaving room for deeper cross-regional collaboration.

Citation-based indicators further demonstrate the academic influence of the retrieved literature. Across the 697 publications, total citations reach 18,382, with an average of 26.37 citations per paper and a median of 10 citations. The dataset-level h-index is 64, reflecting the presence of a substantial core of highly influential studies. Highly cited works in this field tend to focus on student learning experiences with mobile technologies, early investigations of technology use in higher education, empirical evidence for the effectiveness of mobile learning, and widely adopted pedagogical frameworks. These foundational studies form the conceptual and empirical basis upon which more recent research on immersive technologies, gamification, and mobile-supported assessment has been developed.

3.2 Research Hotspots: Keyword Co-Occurrence Analysis

To identify the major research hotspots in mobile teaching within higher education, a keyword co-occurrence analysis was conducted using VOSviewer based on 697 SCI/SSCI publications retrieved from the Web of Science. A minimum occurrence threshold of six was applied, and a thesaurus file was used to merge synonymous and format-variant keywords. As a result, the final network contained 154 keywords grouped into seven clusters, with 3,586 links and a total link strength of 7,095, indicating a densely connected and thematically diverse research field (Figure 1).

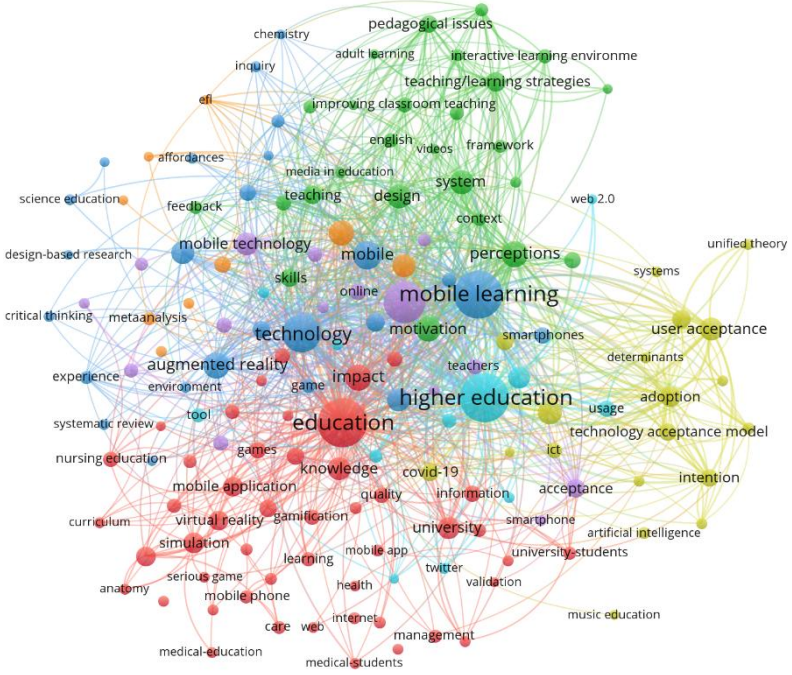

Figure 1. Keyword Co-Occurrence Network of Mobile Teaching Research

Figure 1 visualizes the keyword co-occurrence network, where node size represents keyword frequency, link thickness reflects co-occurrence strength, and colors denote

thematic clusters. The network structure reveals a clear core–periphery pattern centered on higher education and mobile learning research. Table 2 presents the top 10 keywords ranked by total link strength, highlighting the most influential concepts in the knowledge structure.

Table 2. Top 10 Keywords Ranked by Total Link Strength

Rank	Keyword	Occurrences	Total Link Strength
1	higher education	143	715
2	mobile learning	132	677
3	education	143	554
4	students	102	527
5	technology	84	454
6	perceptions	41	290
7	performance	37	243
8	impact	40	231
9	system	34	231
10	mobile	46	224

Among these keywords, higher education exhibits the highest total link strength (TLS = 715), followed by mobile learning (TLS = 677) and education (TLS = 554), indicating that institutional context and pedagogical orientation form the backbone of the research domain. Keywords such as students and technology further emphasize the learner-centered and technology-driven nature of mobile teaching studies. In contrast, keywords including perceptions, performance, and impact reflect evaluative and outcome-oriented perspectives, suggesting sustained interest in learners' attitudes and learning effectiveness. Additionally, system and mobile point to the technological and infrastructural dimensions that support mobile teaching practices.

At the cluster level, the seven identified clusters can be broadly interpreted as follows: (1) a core pedagogical cluster focusing on mobile learning design and teaching strategies in higher education; (2) a technology-oriented cluster emphasizing mobile devices, systems, and applications; (3) an acceptance and adoption cluster centered on user perceptions and behavioral intentions; (4) an evaluation cluster addressing learning performance and educational impact; (5) an immersive learning cluster involving augmented and virtual reality; (6) a discipline-specific education cluster, particularly in medical and nursing education; and (7) a contextual cluster associated with online and pandemic-related teaching scenarios. Overall, the keyword co-occurrence analysis demonstrates that mobile teaching research in higher education has evolved into a mature, multi-dimensional field integrating pedagogical, technological, and evaluative perspectives.

3.3 Co-Authorship Analysis

To examine international research collaboration patterns in mobile teaching within higher education, a country-level co-authorship analysis was conducted using VOSviewer. A minimum threshold of five documents per country was applied, resulting in a collaboration network comprising 35 countries grouped into eight clusters. The network contains 101 collaboration links with a total link strength of 167, indicating a moderately connected international research community (Figure 2).

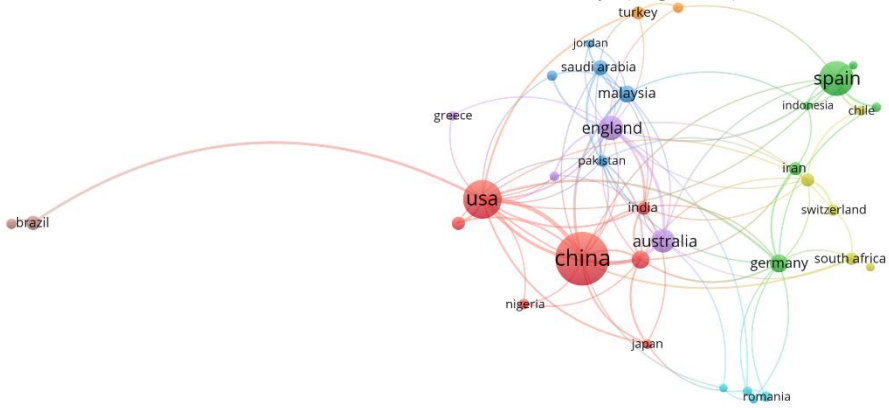

Figure 2. Co-Authorship Network of Mobile Teaching Research

Figure 2 visualizes the international co-authorship network, where node size reflects the number of publications produced by each country, link thickness represents

collaboration intensity, and colors indicate collaboration clusters. The network reveals several prominent hubs that play central roles in international collaboration. As shown in Table 2, the United States exhibits the highest total link strength, highlighting its strong collaborative ties with multiple regions. China ranks second in terms of collaboration strength while also being the most productive country by publication volume, underscoring its growing influence in mobile teaching research. England and Australia also emerge as key contributors, forming important bridges within the Anglophone research cluster.

In addition to these major hubs, countries such as Canada, India, and Germany demonstrate stable collaborative engagement, often linking regional research communities. Emerging contributors, including Pakistan, Malaysia, and Spain, show comparatively lower publication volumes but meaningful collaboration strengths, suggesting increasing integration into the global research network. Overall, the country-level co-authorship analysis indicates that mobile teaching research in higher education is characterized by a core group of highly collaborative countries surrounded by a broader set of regionally connected participants. Strengthening cross-regional and cross-cluster collaboration may further enhance knowledge exchange, methodological diversity, and the global applicability of research findings in this field.

3.4 Co-Citation, Bibliographic Coupling, and Citation Mapping

To further uncover the intellectual foundations and research dynamics of mobile teaching in higher education, co-citation analysis, bibliographic coupling, and citation network mapping were conducted using VOSviewer. These complementary techniques provide insights into the field's knowledge base, current research fronts, and influential publication venues.

Figure 3 presents the co-citation network of cited references, constructed with a minimum citation threshold of 12, resulting in 35 highly cited references grouped into three clusters with a total link strength of 982. The network reveals a well-defined intellectual base dominated by foundational works on technology acceptance and adoption, pedagogical frameworks for mobile and technology-enhanced learning, and methodological contributions related to research design and statistical analysis. Seminal studies by Davis, Venkatesh, and related scholars form central nodes, indicating that theories such as the Technology Acceptance Model and unified models of technology adoption continue to underpin empirical research on mobile teaching in higher education.

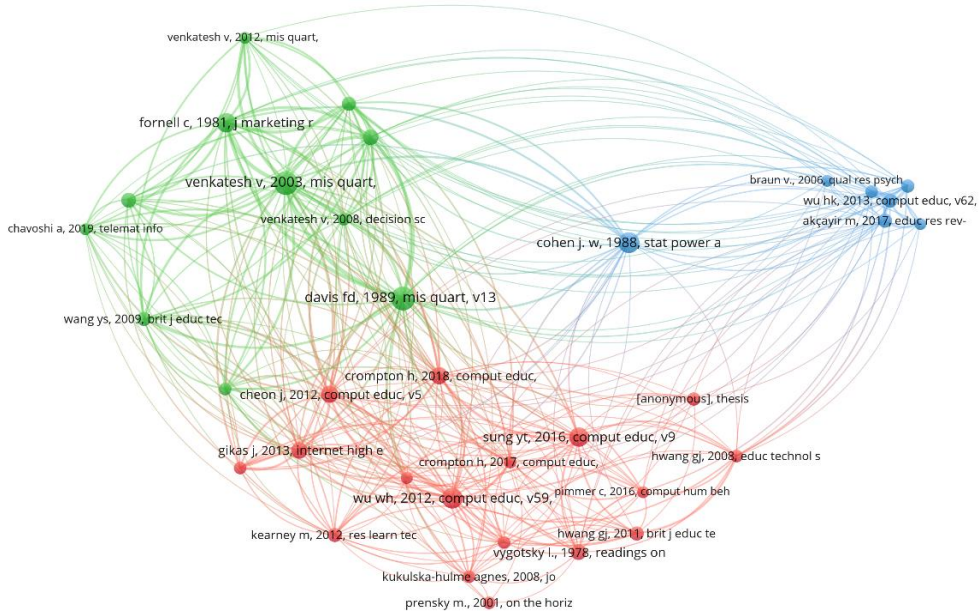

Figure 3. Co-Citation Network of Cited References in Mobile Teaching Research

Figure 4 illustrates the co-citation network of cited sources, based on 60 journals meeting the minimum citation threshold of 50. Five distinct clusters are identified, with a very high total link strength of 97,548, reflecting a stable and mature journal-level knowledge structure. Core

education technology journals, including Computers & Education, Computers in Human Behavior, and Educational Technology & Society, function as major knowledge anchors. At the same time, the presence of journals from psychology, information systems, and discipline-specific education highlights the interdisciplinary nature of mobile teaching research in higher education.

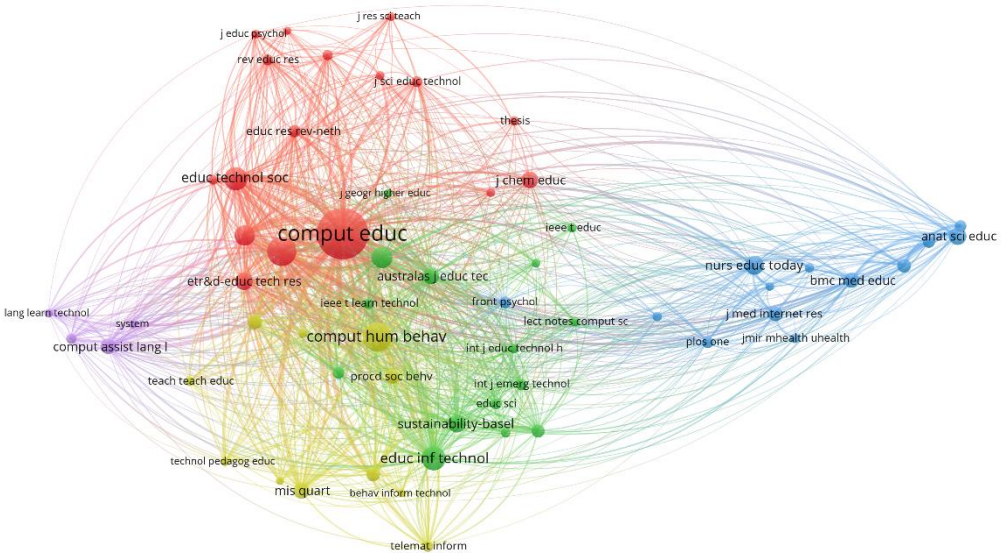

Figure 4. Co-Citation Network of Cited Sources in Mobile Teaching Research

Bibliographic coupling analysis focuses on the research front by linking documents that cite similar references. As shown in Figure 5, 369 documents meet the minimum citation requirement of eight and are organized into 15 clusters, with a total link strength of 9,246. Compared with co-citation networks, the coupling structure is more fragmented, indicating diversified and rapidly evolving research themes. Prominent clusters correspond to emerging and application-oriented topics, such as augmented and virtual reality–supported mobile learning, mobile-based assessment and feedback, learner engagement and motivation, and institutional responses to large-scale online and hybrid teaching.

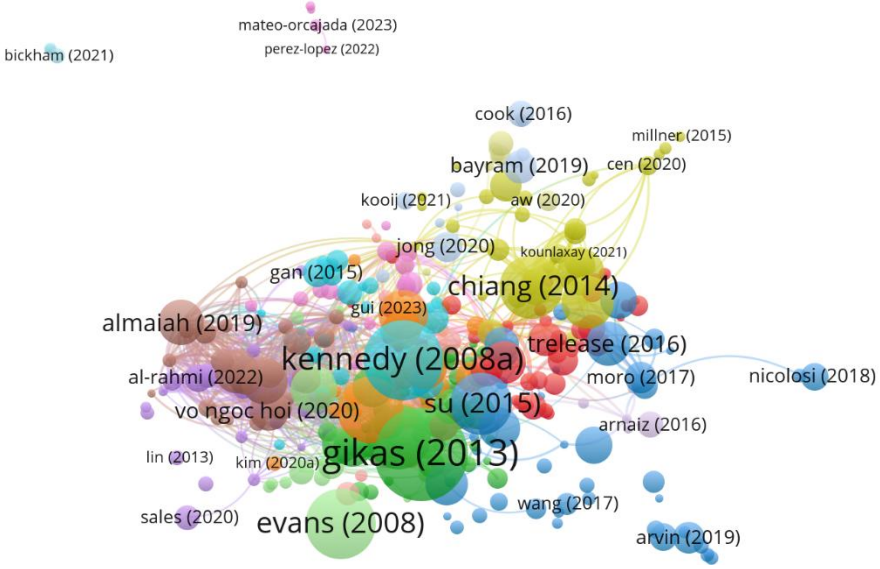

Figure 5. Bibliographic Coupling Network of Documents in Mobile Teaching Research

Finally, Figure 6 depicts the citation network of sources, constructed using a minimum threshold of three documents per source. The resulting network consists of 45 sources distributed across 13 clusters, with a total link strength of 217. This map highlights the journals that exert direct citation influence within the retrieved corpus, complementing the co-citation results by emphasizing contemporary impact rather than historical

intellectual foundations. Together, these analyses demonstrate that mobile teaching research in higher education is grounded in a solid theoretical base, while simultaneously expanding toward diverse pedagogical applications and interdisciplinary integration.

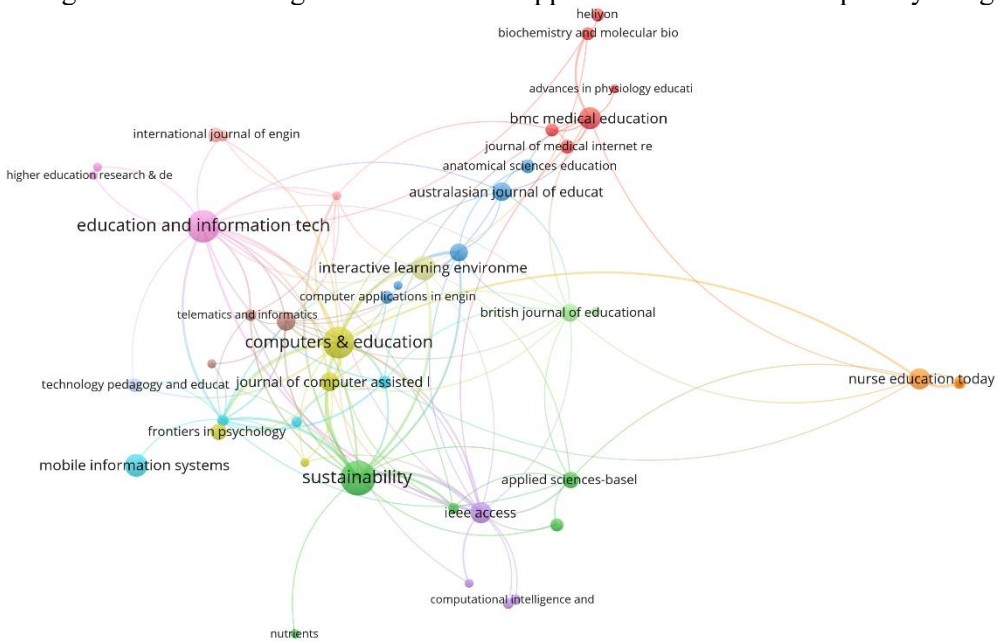

Figure 6. Citation Network of Sources in Mobile Teaching Research

4. Discussion

This bibliometric study offers a comprehensive perspective on how mobile teaching research in higher education institutions has evolved over the past two decades. The results indicate that the field has moved well beyond its initial exploratory phase, which focused primarily on the feasibility and acceptance of mobile technologies, toward a more mature and multi-dimensional research landscape integrating pedagogy, technology, and institutional practice. The sustained growth in publication output, together with the expansion of thematic clusters identified through keyword co-occurrence and bibliographic coupling analyses, suggests that mobile teaching has become an established component of higher education research rather than a transient technological trend.

The keyword co-occurrence structure highlights the coexistence of several interrelated research orientations. Pedagogical concerns, particularly those related to learning design, student engagement, and teaching strategies in higher education contexts, form the conceptual core of the field. At the same time, technology-oriented themes, including mobile systems, applications, and immersive technologies such as augmented and virtual reality, reflect continuous innovation at the technological level. The prominence of discipline-specific clusters, especially in medical and nursing education, indicates that mobile teaching research is strongly shaped by applied contexts in which practical training, visualization, and flexible access to learning resources are critical. In addition, context-sensitive themes related to large-scale online and hybrid teaching, especially during and after the COVID-19 period, illustrate how external disruptions have accelerated both adoption and scholarly attention.

The collaboration and citation analyses further suggest that mobile teaching research in higher education is supported by a relatively stable intellectual foundation, while simultaneously exhibiting diversification at the research front. Core theoretical frameworks related to technology acceptance, learning sciences, and educational design continue to underpin empirical studies, as revealed by co-citation networks of cited references and sources. In contrast, bibliographic coupling patterns demonstrate that recent research increasingly addresses application-driven questions, such as the integration of immersive technologies, mobile-supported assessment, and institution-wide digital teaching strategies. This divergence between a stable knowledge base and an expanding set of research fronts is characteristic of a field transitioning toward

maturity.

Taken together, these findings imply several directions for future research. First, there is a need to shift emphasis from isolated evaluations of mobile tools toward design-oriented and theory-informed studies that explicitly link mobile teaching interventions to learning outcomes, inclusiveness, and long-term educational value. Second, the moderate level of international collaboration observed at the country level suggests that more cross-institutional and cross-regional studies could enhance the generalizability and comparability of research findings. Finally, as mobile teaching increasingly relies on data-intensive practices, issues related to ethics, governance, and sustainability, including learner privacy, algorithmic transparency, and academic workload, are likely to become central concerns for both researchers and higher education decision-makers.

5. Conclusion

This study provides a systematic bibliometric mapping of mobile teaching research in higher education institutions based on 697 SCI and SSCI publications retrieved from the Web of Science. By combining descriptive statistics with VOSviewer-based science mapping, the analysis reveals the publication dynamics, influential journals and countries, collaboration structures, and intellectual foundations of the field. The results demonstrate sustained growth since the early 2000s, accompanied by the emergence of diversified research themes encompassing mobile learning pedagogy, immersive learning technologies, discipline-specific applications, and large-scale online and hybrid teaching practices.

The network-based analyses further show that mobile teaching research in higher education is grounded in a stable theoretical core while simultaneously expanding toward multiple application-oriented research fronts. Co-citation and citation networks identify key conceptual and publication anchors, whereas bibliographic coupling and keyword analyses highlight areas of ongoing innovation and thematic convergence. Together, these findings illustrate a research domain that has reached a level of maturity characterized by both continuity and adaptation.

Beyond its substantive findings, this study contributes methodologically by presenting a transparent and reproducible bibliometric workflow, including data preprocessing decisions and visualization procedures using VOSviewer. The approach outlined in this paper can be readily applied to related topics in educational technology and higher education research. Overall, the results offer evidence-based insights for researchers seeking to advance theoretical and empirical work on mobile teaching, as well as for higher education institutions aiming to develop informed, sustainable, and context-sensitive mobile teaching strategies.

Acknowledgment

This work was supported by the Fujian Province Young and Middle-aged Teachers' Education Research Project under Grant JAT190542; by the Research Project on Education and Teaching Reform of Quanzhou Normal University under Grant 2023JGX008; and by the Pilot Course on "Artificial Intelligence Empowering Teaching Reform" of Quanzhou Normal University under Grant 2025kc044.

References

[1] Gikas J., Grant M. M. Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media. Internet and Higher Education, 2013, 19: 18–26.

[2] Kennedy G. E., Judd T. S., Churchward A., Gray K., Krause K.-L. First year students' experiences with technology: Are they really digital natives? Australasian Journal of Educational Technology, 2008, 24(1): 108–122.

[3] Evans C. The effectiveness of m-learning in the form of podcast revision lectures in higher education. Computers & Education, 2008, 50(2): 491–498.

[4] Park Y. A pedagogical framework for mobile learning: Categorizing educational applications of mobile technologies into four types. International Review of Research in Open and Distributed Learning, 2011, 12(2): 78–102.

[5] Liu T.-Y., Chu Y.-L. Using ubiquitous games in an English listening and speaking course: Impact on learning outcomes and motivation. Computers & Education, 2010, 55(2): 630–643.

[6] Gui M., Gerosa T., Argentin G., Losi L. Mobile media education as a tool to reduce problematic smartphone use: Results of a randomised impact evaluation. Computers & Education, 2023, 194: 104705.
[7] Zhang J., Yu S. Investigating pedagogical challenges of mobile technology to English teaching. Interactive Learning Environments, 2023, 31(5): 2767–2779.
[8] Naveed Q. N., Choudhary H., Ahmad N., Alqurashi E., et al. Mobile learning in higher education: A systematic literature review. Sustainability, 2023, 15(18): 13566.
[9] Cui K. Artificial intelligence and creativity: Piano teaching with augmented reality applications. Interactive Learning Environments, 2023, 31(10): 7017–7028.
[10] Stretton T., Cochrane T., Sevigny C., Rathner J. Exploring mobile mixed reality for critical thinking in nursing and healthcare education: A systematic review. Nurse Education Today, 2024, 133: 106072.
[11] Pedraja-Rejas L., Muñoz-Fritis C., Rodríguez-Ponce E., et al. Mobile learning and its effect on learning outcomes and critical thinking: A systematic review. Applied Sciences, 2024, 14(19): 9105.
[12] Aldeeb F. H., Sallabi O. M., Elaish M. M., Hwang G.-J., et al. Enhancing students' learning achievements, self-efficacy, and motivation using mobile augmented reality. Journal of Computer Assisted Learning, 2024, 40(4): 1823–1837.
[13] Sebastian M., Garcia de Blanes, et al. UTAUT-2 predictors and satisfaction: Implications for mobile-learning adoption among university students. Education and Information Technologies, 2025, 30(3): 3201–3237.
[14] Lee H.-Y., Wu T.-T. Enhancing blended learning discussions with a scaffolded knowledge integration-based ChatGPT mobile instant messaging system. Computers & Education, 2025, 237: 105375.
[15] Sezgunsay E., Basak T. The efficacy of a mobile augmented reality application in improving competence in pressure injury assessment: A randomized controlled trial. Nurse Education Today, 2025, 148: 106643.