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Research Article

Are Micro-Credentials a New Way of Learning in Higher Education? Bibliometric-Systematic Literature Review (B-SLR)

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ABSTRACT

Micro-credentials have emerged as a transformative innovation in higher education, offering flexible, skill-based learning opportunities that address evolving labor market demands. This study aims to provide a comprehensive analysis of the implementation, significance, and challenges of micro-credentials within global higher education systems. Employing a Bibliometric-Systematic Literature Review (B-SLR) methodology, the research integrates bibliometric analysis and systematic review techniques to examine 167 peer-reviewed documents sourced from Scopus and Web of Science. Key themes include the role of micro-credentials in lifelong learning, competency-based education, and learning mobility, as well as the barriers to their adoption, such as policy fragmentation and technological limitations. The findings highlight the growing relevance of micro-credentials in bridging the gap between academic learning and workforce needs, with implications for policy, institutional leadership, and industry collaboration. However, challenges such as the lack of standardized frameworks and limited longitudinal data on their impact underscore the need for further research. This study concludes that global alignment of policies, cross-sectoral partnerships, and innovative integration of emerging technologies are critical to maximizing the potential of micro-credentials. The research offers strategic insights for stakeholders aiming to advance the development and implementation of micro-credentials as a sustainable and globally recognized component of higher education.

Keywords: Bibliometric-Systematic Literature Review, Higher Education, Micro-credentials.

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INTRODUCTION

The rapid development of technology and the dynamic demands of the modern job market have driven shifts in educational paradigms, particularly in higher education. Traditional degree programs, while comprehensive, often fail to meet the immediate and specific skill requirements demanded by industries. In response, micro-credentials have emerged as a potential solution, offering targeted, flexible, and often self-paced learning opportunities tailored to the needs of learners and market demands. Graduates are no longer merely expected to hold academic degrees; they are also required to possess skills aligned with the evolving demands of the workforce (Alangari, 2024; Gauthier, 2020).

Micro-credentials are short-term certifications designed to develop specific skills (Kayyali, 2025; Tamoliune *et al*., 2023). These certifications enable students to acquire more targeted and relevant competencies for industry needs, surpassing the generalized approach of traditional higher education curricula. The primary advantage of micro-credentials lies in their flexibility to adapt to the ever-changing dynamics of the labor market (Hamutoglu *et al*., 2025; Shanahan and Organ, 2022). Compared to conventional academic degrees, which require years to complete, micro-credentials offer intensive short-term training programs designed to yield immediate impact (Alangari, 2024). Through an outcome-oriented approach, micro-credentials not only equip students with up-to-date skills aligned with market needs but also enable them to adapt swiftly to technological changes. This approach offers substantial competitive advantages, empowering graduates to become active participants in the digital transformation of the workforce.

The Future of Jobs Report 2023 by the World Economic Forum predicts that 61% of workers will require reskilling by 2027. Labor market shifts driven by digital connectivity are compelling employers to adopt skill-based recruitment and micro-credentials as solutions to large-scale skill shortages. Skills-based learning provides fast and equitable pathways to new careers for job seekers while expanding and diversifying the talent pipeline for

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employers. The report highlights the changing skill requirements for the future workforce, influenced by global trends such as automation, digitalization, and AI.

Previous research on micro-credentials in higher education provides valuable insights into their potential and the challenges associated with their implementation. Tamoliune *et al.*, (2021) examined the potential of micro-credentials to support post-COVID-19 recovery through a bibliometric and qualitative analysis of 32 academic articles. Ahsan *et al.*, (2023) highlighted the potential and challenges of implementing micro-credentials in higher education through a systematic literature review of 56 academic articles, resulting in the development of a conceptual framework for implementation. Alsobhi *et al.*, (2023) examined blockchain-based validation of micro-credentials through a systematic literature review, suggesting that blockchain can enhance validation efficiency, though further research is needed. Selvaratnam and Sankey (2021) conducted an integrative literature review to understand the relationship between university intentions and the necessary environment for micro-credential adoption, identifying research gaps. These prior studies employed similar methodologies but focused on different aspects. This study offers a more comprehensive and holistic analysis of micro-credentials in higher education by combining Bibliometric and Systematic Literature Reviews (B-SLR).

The B-SLR methodology integrates bibliometric analysis, which quantitatively evaluates academic literature, with a systematic literature review, a qualitative method that critically assesses and synthesizes existing research (Marzhi *et al.*, 2025). By integrating these methodologies, this study aims to provide a robust and holistic analysis of existing literature on micro-credentials, particularly in higher education. The bibliometric analysis identifies key trends, influential publications, and research networks, while the systematic review examines policies, learning models, and the perceptions of students, educators, and industries.

The implications of this research are multifaceted. First, it contributes to academic discourse by offering a comprehensive overview of the current state of research on micro-credentials. Second, it provides practical insights for policymakers, educational institutions, and industry stakeholders on the potential of micro-credentials to enhance educational outcomes and workforce competitiveness. Finally, this research identifies critical areas for further investigation, guiding future studies to address existing gaps and deepen our understanding of micro-credentials in higher education. By systematically addressing these issues, this paper examines how the adoption of micro-credentials as a transformative learning approach in higher education can meet the demands of the evolving 21st-century workforce?

METHODOLOGY

This study employs a multi-method literature review approach, combining bibliometric analysis with a Systematic Literature Review (SLR), referred to as a Bibliometric-Systematic Literature Review (B-SLR) (Marzi *et al.*, 2025).

Data Consolidation

The first methodological stage, data consolidation, focuses on the exploration of micro-credentials in higher education, guided by the primary research question: What are the trends in the adoption of micro-credentials in higher education? This question forms the conceptual foundation for defining the study's scope and research direction. Inclusion criteria were established to ensure that only high-quality and relevant literature was analyzed. Eligible articles needed to address micro-credentials in the context of higher education, be published in peer-reviewed sources such as academic journals or conference proceedings, be written in English, and have reached their final publication stage. Conversely, exclusion criteria omitted non-peer-reviewed literature, reports, or opinion pieces, articles still in press, non-English publications, and studies unrelated to higher education. A Boolean logic search strategy was employed using a combination of terms, such as: ("micro-credential*" OR "microcredential*" OR "micro credential*") AND ("higher education" OR "tertiary education" OR "postsecondary education" OR "university education" OR "college education"). This strategy aimed to capture various terminologies used in micro-credential studies, ensuring comprehensive and relevant coverage. Scopus and Web of Science (WoS) were selected as the primary databases due to their broad academic coverage and ability to provide high-quality peer-reviewed documents. The initial search yielded 96 documents from WoS and 130 from Scopus. The dataset was systematically filtered through stages, including deduplication using R Studio, relevance evaluation based on abstracts and full texts, and the application of inclusion and exclusion criteria. This rigorous filtering and refinement process resulted in a final dataset of 167 documents ready for subsequent analysis.

Preliminary Results Assessment

The second stage, preliminary results assessment, involved data analysis and screening to ensure the completeness, relevance, and quality of the selected literature. Each document in the dataset was critically evaluated to assess its quality standards, impact, and significance to the discourse on micro-credentials in higher education. The evaluation included examining journal reputation, content relevance, and the document's contribution to theoretical and practical advancements. Articles with minimal contributions to academic discussions or insignificant citation impacts were excluded to maintain a focus on meaningful literature. Triangulation was employed to ensure the accuracy of document interpretation and selection. Data from Scopus and

WoS were cross-referenced to identify potential duplications or overlooked significant literature. This process ensured that document selection was conducted with high levels of transparency and precision. Science mapping visualized thematic relationships and research networks through co-occurrence networks and thematic map quadrants, mapping the intellectual structure and identifying trends and potential research areas related to micro-credentials in higher education. Performance analysis evaluated the productivity and impact of documents, authors, journals, and the geographical distribution of research.

Contribution assessment

The final stage, contribution assessment, focused on evaluating the outcomes of systematic and bibliometric analyses. The results of the Systematic Literature Review (SLR) were thoroughly analyzed by examining each thematic cluster identified in the study. This analysis ensured that each cluster provided meaningful insights aligned with the study objectives. Theorization was conducted by developing and validating a theoretical framework derived from the cluster analysis. The conceptual relationships between micro-credentials and the higher education context were explored to examine the framework for micro-credentials in higher education, learning models, and the perceptions of students, educators, and industry stakeholders. The resulting theoretical framework was critically evaluated to ensure it offered significant theoretical contributions (Figure 1).

RESULTS AND DISCUSSION

Evolution of Micro-Credentials in Higher Education Literature

An analysis of publication trends across Scopus and Web of Science (WoS) reveals a significant and sustained increase in scholarly attention to micro-credentials within higher education from 2015 to 2024. As shown in Figure 2, annual scientific production has grown exponentially over the past decade, signaling a transition from conceptual emergence to mainstream academic discourse.

The initial phase (2015-2017) reflects nascent scholarly interest, with fewer than five publications per year and minimal citation impact. The concept was largely exploratory at this stage, with limited theoretical development and low engagement from leading academic journals. Between 2018 and 2020, a moderate increase is observed, coinciding with broader trends in digital education, alternative credentials, and industry-academic partnerships. This period laid the foundation for more structured discourse, although the mean citations per year remained relatively modest.

A marked inflection point occurred in 2021, with both publication volume and citation metrics increasing significantly. This aligns temporally with the COVID-19 pandemic, which catalyzed global shifts toward flexible, skills-based, and digitally delivered education. The Mean Total Citations per Year (TC/Year) reached 5.66, suggesting enhanced impact and visibility of published works.

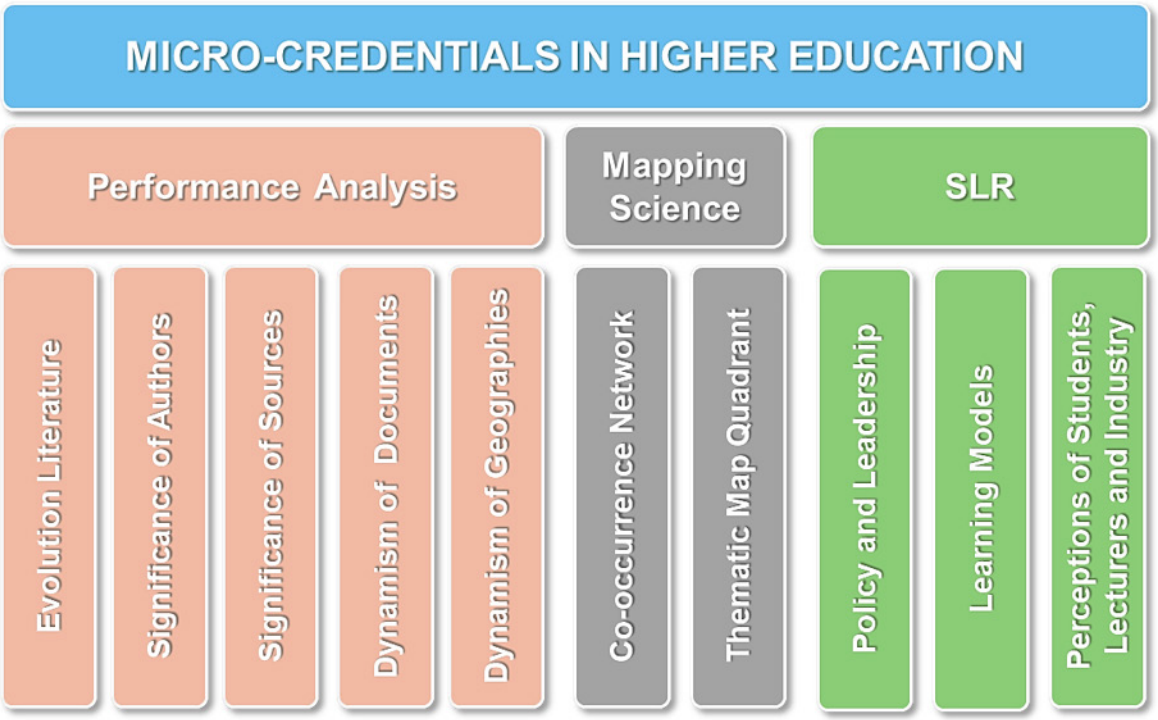


Figure 1: Conceptual Reasearch.

The period from 2022 to 2024 exhibits accelerated scholarly production, with over 50 publications annually, indicating that micro-credentials have become a mature and institutionalized topic within higher education research. Notably, while publication counts rose sharply, citation rates plateaued slightly, possibly due to the short citation window for recent works.

This growth trajectory highlights the increasing relevance of micro-credentials as both a research agenda and a practical response to evolving educational and workforce needs. The trend also suggests the field's transition from theoretical exploration to applied research, policy analysis, and implementation studies.

Significance of Authors

The analysis identified 450 authors who have contributed to the literature on micro-credentials in higher education. A detailed Table 1 highlights eight authors with at least three publications on this topic. The most prolific author is Brown M from Massey University, Palmerston North, New Zealand, with four publications, representing approximately 2.4% of the 167 documents in the dataset. Brown's extensive contributions demonstrate his pivotal role in advancing research on micro-credentials, both in terms of publication volume and thematic coverage.

In terms of impact, measured by Total Citations (TC), the most influential authors are Moodie G from the University of Oxford, UK, and Wheelahan L from the University of Toronto, Canada. Each has amassed a total of 167 citations, underscoring their substantial contributions to the academic discourse on micro-credentials. Despite having fewer publications than Brown M, their high citation counts highlight the significant influence and quality of their work. This suggests that their research is widely recognized and valued as foundational within the field of micro-credentials in higher education.

The Authors' Production over Time graph in Figure 3 offers valuable insights into the distribution of author contributions in recent years. Brown M demonstrates a consistent pattern of productivity since 2021, reflecting sustained engagement with the topic of micro-credentials. In contrast, Moodie G and Wheelahan L exhibit peak contributions within a more concentrated timeframe, yet their work has achieved substantial impact, as evidenced by their high citation counts. Other authors, such as Cheng Z and Newby T, show stable productivity trends over time, although their citation levels are notably lower than those of Moodie G and Wheelahan L. This variation in both productivity and impact among prominent authors highlights the diverse ways contributors shape and influence the development of the literature on micro-credentials in higher education.

Significance of Sources

An evaluation of the most influential publication sources provides insight into the scholarly landscape and knowledge diffusion of micro-credentials in higher education. As shown in Table 2, ten leading journals were identified based on key bibliometric indicators including h-index, g-index, m-index, Total Citations (TC), and Number of Publications (NP).

The International Journal of Information and Learning Technology emerges as the most productive journal, with 10 publications, an h-index of 4, and a g-index of 6. While its total citation count (TC=44) is moderate, its m-index of 1.333 suggests consistent scholarly output over time, indicating a sustained editorial focus on micro-credential topics.

In contrast, the International Journal of Educational Technology in Higher Education demonstrates high citation impact relative to output, with 72 citations across just 3 publications (h-index=3). This reflects the journal's influence per article, likely attributable to its selective editorial scope and focus on contemporary educational innovation.

Notably, Educational Technology Research and Development records the highest total citation count (TC=95) from only 2 publications, suggesting that its contributions are seminal works frequently referenced in foundational discussions. This aligns with its reputation as a theory-driven outlet in the field of instructional design and educational technology.

Other journals such as Education and Information Technologies, Postdigital Science and Education, and Australasian Journal of Educational Technology also demonstrate meaningful contributions, combining consistent output with growing citation

Table 1: Leading authors of ST.

Rank	Author	h_index	g_index	m_index	TC	NP	PY_start
1	Brown M	4	4	0.8	93	4	2021
2	Cheng Z	3	3	0.375	97	3	2018
3	Mcgreal R	3	3	0.75	105	3	2022
4	Moodie G	3	3	0.6	167	3	2021
5	Newby T	3	3	0.375	97	3	2018
6	Olcott D	3	3	0.75	123	3	2022
7	Pirkkalainen H	3	3	0.75	46	3	2022
8	Wheelahan L	3	3	0.6	167	3	2021

Table 2:Significance of Sources.

Rank	Source	h_index	g_index	m_index	TC	NP	PY_start
1	International Journal of Information and Learning Technology	4	6	1.333	44	10	2023
2	International Journal of Educational Technology in Higher Education	3	3	0.75	72	3	2022
3	Asian Journal of University Education	2	3	0.4	42	3	2021
4	Australasian Journal of Educational Technology	2	2	0.333	17	2	2020
5	Educational Technology Research and Development	2	2	0.25	95	2	2018
6	Higher Education	2	2	0.5	53	2	2022
7	IEEE Global Engineering Education Conference, Educon	2	4	0.4	28	4	2021
8	International Journal of Educational Management	2	2	1	12	7	2024
9	Journal of Interactive Media in Education	2	2	0.667	20	2	2023
10	Journal of Teaching and Learning for Graduate Employability	2	2	0.4	78	2	2021

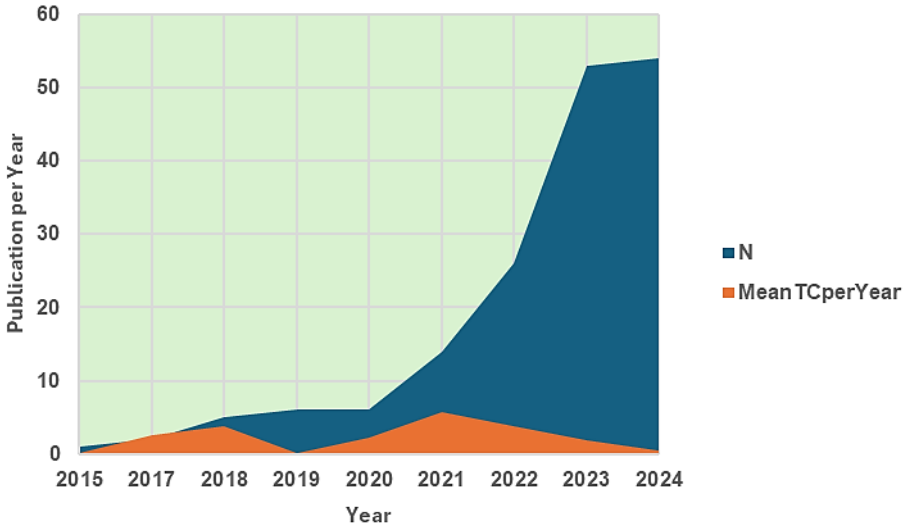


Figure 2: Annual scientific production.

impact. Their presence underscores the interdisciplinary nature of micro-credential research, spanning educational technology, policy, and digital transformation.

In summary, the distribution of scholarly contributions across journals indicates a concentration of high-impact research within a few specialized outlets, while also revealing opportunities for broader engagement in adjacent fields. This trend suggests that micro-credentials are transitioning from a niche topic to a cross-cutting issue with implications for higher education reform, workforce development, and lifelong learning.

Dynamism of Geographies

A geographic analysis of the literature reveals a strong concentration of research output among a few high-performing countries, particularly within the English-speaking Global North. As shown in Table 3, the United States leads in productivity with 54 publications (32.3% of the total) and a total citation count of 176, confirming its central role in shaping global micro-credential discourse.

Australia, while contributing slightly fewer documents (27 publications), demonstrates the highest impact per article, with 279 citations and an Average Article Citation (AAC) of 14.7. Canada, despite having only 6 publications, records a remarkable AAC of 42, highlighting the exceptional influence of a few foundational studies.

Among emerging contributors, Malaysia ranks second in output (28 publications), supported by strong international collaboration (reflected in MCP ratios) and a solid AAC of 6.9. In Europe, Ireland and the United Kingdom contribute 13 and 7 documents respectively, with moderate AAC scores, positioning them as strategic players in regional education policy dialogues.

Overall, the data in Table 3 illustrates a geopolitical imbalance in research leadership, dominated by advanced economies, while

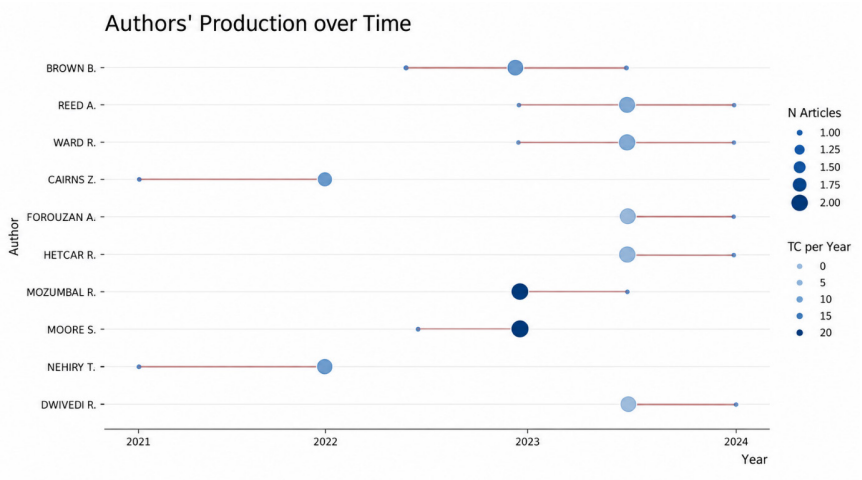


Figure 3: Authors' Production Over Time.

Table 3:Leading Countries.

Rank	Country	NP	TC	AAC
1	USA	54	176	7
2	Malaysia	28	69	6.9
3	Australia	27	279	14.7
4	Ireland	13	50	6.2
5	China	12	10	1.7
6	Saudi Arabia	8	0	0
7	Spain	8	28	7
8	UK	7	39	5.6
9	Austria	6	0	0
10	Canada	6	252	42

also pointing to increasing contributions from the Global South, particularly through collaborative research networks. These patterns emphasize the value of cross-national partnerships in expanding the reach and relevance of micro-credential scholarship worldwide.

Significance of Documents

The analysis identifies the most influential documents in the field of micro-credentials, ranked based on citation metrics. Key indicators of their impact include Total Citations (TC), Annual Citations (TCY), and Average Citations per Year (NTC). These documents encompass a broad range of strategic, theoretical, and practical topics that are critical to the development of micro-credentials in higher education. The high citation counts associated with these works reflect their substantial influence in shaping academic discourse and advancing understanding within this field (Table 4).

Strategic contributions, such as McGreal and Olcott Jr. (2021) and Brown *et al.*, (2021), emphasize the alignment of micro-credentials with institutional goals and global policy frameworks. These works have the highest citation impact (TCY=18.5; 11.8), indicating their role in shaping institutional strategies.Critical discourse, including Ralston (2021) and Wheelahan and Moodie (2021), interrogates the ideological underpinnings of micro-credentials. Positioned within postdigital and Bernsteinian frameworks, these papers highlight concerns over commodification, vocationalism, and educational precarity-providing essential counterpoints to predominantly utilitarian narratives.Technological studies focus on validation mechanisms such as digital badges (Carey and Stefaniak, 2020; Cheng *et al.*, 2022) and blockchain-based systems (Alsobhi *et al.*, 2022). Notably, Alsobhi *et al.*, achieve the highest NTC (8.52), reflecting growing interest in secure, scalable credentialing infrastructures.Together, these documents not only represent the most cited literature in the field but also map the conceptual diversity that characterizes micro-credential research. Beyond citation metrics, they serve as foundational references for theorizing, critiquing, and operationalizing digital credential ecosystems in higher education.

Co-Occurrence Network Analysis

The co-occurrence network analysis identifies key thematic structures in the literature on micro-credentials in higher education. As visualized in Figure 4, the network reveals seven conceptual clusters, reflecting the field's multidimensional nature. Notably, higher education and micro-credentials occupy central positions in the network, with high between-ness centrality (109.676 and 407.285, respectively), underscoring their foundational role in shaping scholarly discourse.

Cluster 1 (Core Concepts) highlights the centrality of micro-credentials as mechanisms for lifelong learning, employability, and digital recognition. These terms frequently co-occur, indicating a strong research focus on how micro-credentials respond to labor market demands through flexible learning systems (Steyn and Eybers, 2023; Maina *et al.*, 2022). Cluster 2 (Technology and Behavioral Intentions) reflects the critical role of user acceptance and technological readiness in implementation. The prominence of terms like behavioral

intention and attitude to use indicates that successful adoption depends not only on infrastructure, but also on stakeholder perception and capability (Reed, 2023; Scott *et al.*, 2024).

Clusters 3 and 4 relate to implementation challenges and learning mobility, respectively. Research emphasizes barriers such as policy misalignment and fragmented infrastructure (Fischer *et al.*, 2022), while also recognizing the potential of micro-credentials to enhance cross-border recognition and flexible learning pathways (Ikeda *et al.*, 2024; Felton *et al.*, 2023).

Cluster 5 (Competency-Based Education) aligns micro-credentials with efforts to validate specific, job-relevant skills, often through digital badges and goal-oriented frameworks (Braxton, 2023; Guest *et al.*, 2024). Cluster 6 explores the badging ecosystem, raising issues of credibility and interoperability, especially where traditional qualifications dominate (Salmon, 2023; Halim *et al.*, 2024). Finally, Cluster 7 (Capability Development) illustrates a broader trend toward personalized learning and upskilling, emphasizing how micro-credentials can support adaptability and individual growth in dynamic labor markets (Tammeleht *et al.*, 2023).

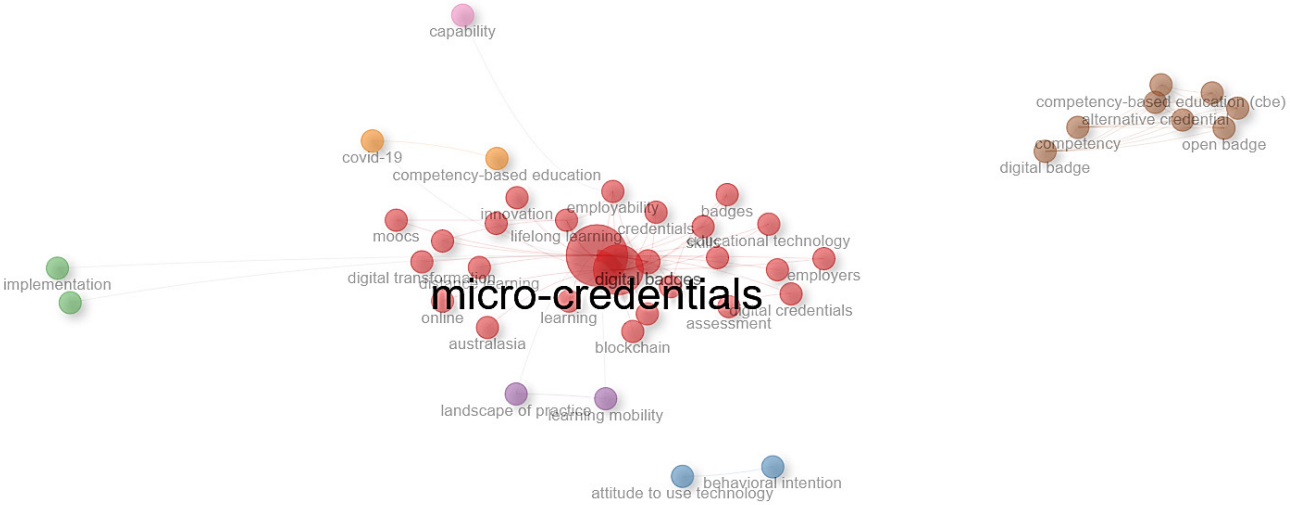


Figure 4: Co-occurrence Network.

Table 4: Significance of Documents.

Paper	DOI	TC	TCY	NTC
A strategic reset: micro-credentials for higher education leaders	10.1186/s40561-022-00190-1	74	18.50	4.76
Higher Education's Microcredentialing Craze: a Postdigital-Deweyan Critique	10.1007/s42438-020-00121-8	73	14.60	2.58
Analysing micro-credentials in higher education: a Bernsteinian analysis	10.1080/00220272.2021.1887358	69	13.80	2.44
An exploration of the utility of digital badging in higher education settings	10.1007/s11423-018-9602-1	62	7.75	2.04
Gig qualifications for the gig economy: Micro-credentials and the 'hungry mile'	10.1007/s10734-021-00742-3	59	14.75	3.80
The Global Micro-credential Landscape: Charting a New Credential Ecology for Lifelong Learning	10.56059/jl4d.v8i2.525	59	11.80	2.09
An integrative literature review of the implementation of micro-credentials in higher education: Implications for practice in Australasia	10.21153/jtlge2021vol12no1art942	57	11.40	2.02
Block chain-based micro-credentialing system in higher education institutions: Systematic literature review	10.1016/j.knosys.2022.110238	46	15.33	8.52
Goal Setting and Open Digital Badges in Higher Education	10.1007/s11528-018-0249-x	40	5.00	1.32
Micro-Credentials in Higher Education Institutions: Challenges and Opportunities	10.24191/ajue.v17i3.14505	39	7.80	1.38

Together, these clusters provide a comprehensive map of the field's intellectual structure, revealing a strong emphasis on practical application, user acceptance, and system-level challenges. However, the fragmentation of themes also points to a need for greater theoretical integration and comparative studies across regional and institutional contexts.

Dynamics of Research Themes

The thematic map presented in Figure 5 provides a strategic overview of the intellectual structure of micro-credential research, based on centrality (relevance) and density (development). The map divides keywords into four quadrants, Motor Themes, Basic Themes, Niche Themes, and Emerging or Declining Themes, allowing for an evaluation of both thematic importance and maturity (Figure 5). Thematic Map Quadrant: Relevance vs. Development of Research Themes in Micro-Credentials.

Motor Themes, located in the upper-right quadrant, include COVID-19, MOOCs, and Competency-Based Education. These themes are both highly developed and central, indicating their role in driving research momentum. The prominence of COVID-19 suggests that the pandemic served as a catalyst for pedagogical innovation, accelerating interest in digital learning and skill-based education. Likewise, the centrality of competency-based education aligns with a broader shift toward flexible learning architectures that directly address labor market demands.

In contrast, Basic Themes such as micro-credentials, higher education, and digital badges (lower-right quadrant) are highly relevant but underdeveloped, serving as foundational constructs in the field. Their positioning suggests that while these themes anchor most studies, there remains substantial room for deeper theoretical exploration and empirical validation. These concepts represent the core vocabulary of the discourse, but their operationalization varies widely across contexts.

Niche Themes (upper-left quadrant), including behavioral intention, educators, and future readiness, are well-developed but peripheral. These themes focus on micro-level factors such as individual attitudes and institutional preparedness, offering valuable insights for implementation studies. However, their lower centrality indicates limited integration with the field's dominant theoretical or strategic concerns. They are often context-specific and require cross-cutting linkage to broader frameworks.

The Emerging or Declining Themes quadrant (lower-left) features topics like soft skills, learning analytics, and doctoral education. These themes are characterized by low centrality and density, indicating either nascent interest or diminishing scholarly attention. Nevertheless, their presence signals potential future trajectories, particularly in relation to personalized learning and advanced digital credentials.

In synthesis, the thematic landscape reveals a field in transition, with high interest in pandemic-driven educational reform and competency-based innovation, but relatively less maturity in foundational and systemic integration. Bridging the gap between core concepts (micro-credentials, digital badges) and strategic transformation (competency-based learning, technology adoption) remains a key challenge, and opportunity, for future research.

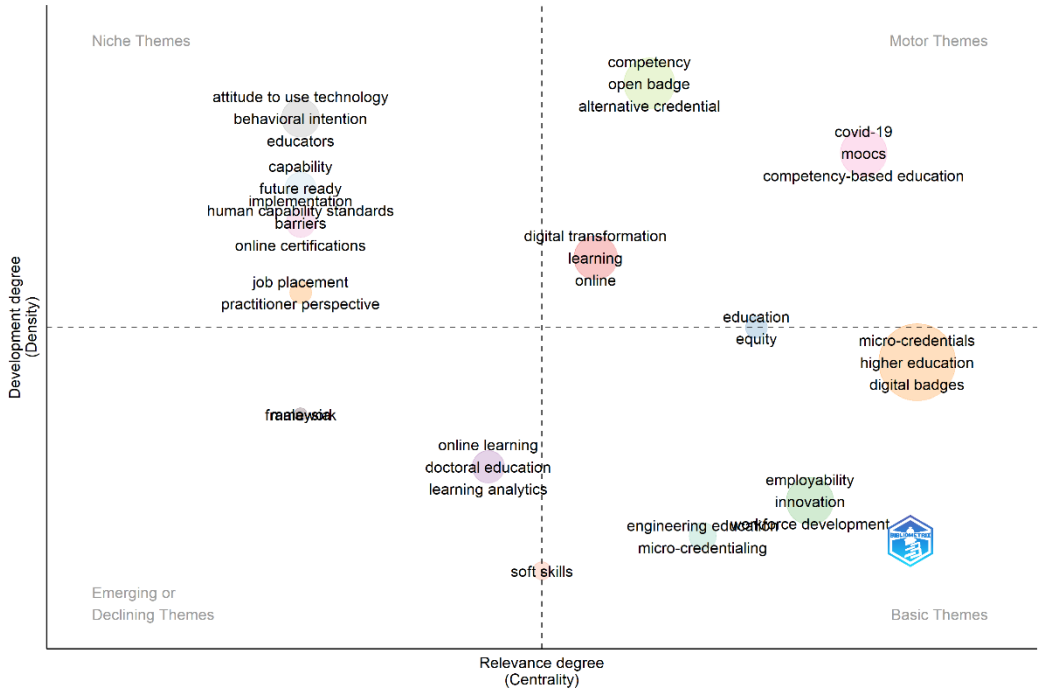


Figure 5: Thematic Map Quadrant.



Figure 6: Policy and Leadership Framework for Implementing Micro-Credentials.

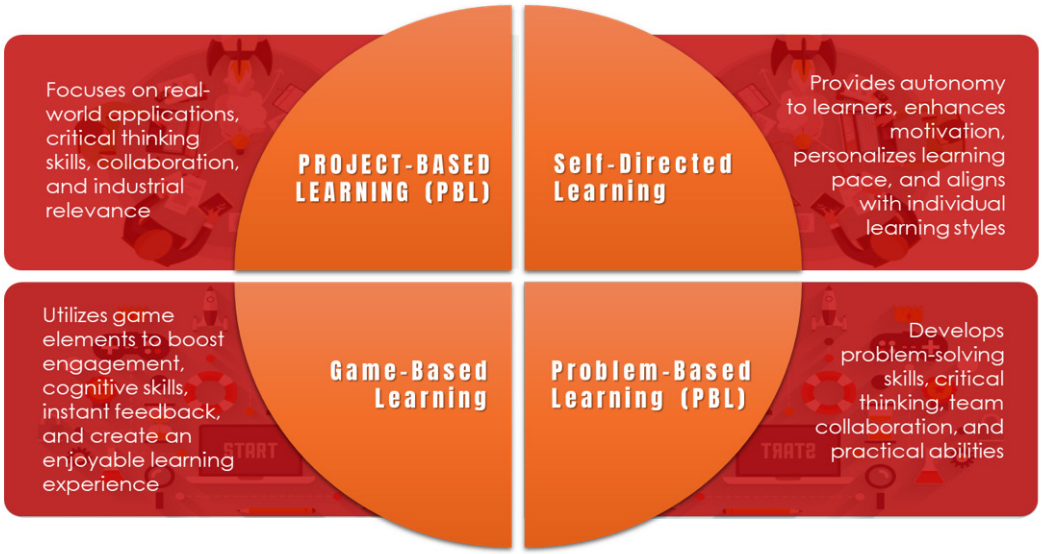


Figure 7: Learning Models for Micro-Credentials in Higher Education.

Systematic Literature Review (SLR)

Policies and Leadership

Discourse on policy and leadership in the implementation of micro-credentials reveals substantial regional diversity. In Southeast Asia and Japan, efforts emphasize community-based initiatives (e.g., SOI Asia) and the use of e-portfolios to support reflective learning. Leadership in these contexts often involves younger faculty engagement and aims to reinforce institutional autonomy (Ikeda *et al.*, 2024). In Malaysia, policy frameworks address implementation barriers through infrastructure development and capacity building (Keoy *et al.*, 2024). In the Middle East and North Africa (MENA) region, focusing on standardization, accountability, and interoperability, with leadership fostering multi-stakeholder collaboration (Alasmari and Alzahrani, 2024).

European contexts such as Estonia prioritize targeted program development (e.g., research ethics, leadership) and rely on inter-institutional collaboration (Tammeleht *et al.*, 2023). In Mauritius, integration into the National Qualification Framework (NQF) legitimizes micro-credentials, with leadership emphasizing structured, competency-based pathways (Santally *et al.*, 2024). Meanwhile, in the United States, policy is closely aligned with labor market needs, and leadership involves risk management and business model innovation at the institutional level (Olcott Jr, 2022). Figure 6 illustrates a synthesized framework for policy and leadership, highlighting the importance of national-level structures, stakeholder collaboration, and adaptive leadership in successful micro-credential implementation.

Effective policies for micro-credentials should include the establishment of clear national frameworks, active stakeholder collaboration, and adequate resource allocation to ensure seamless implementation. Leadership plays a pivotal role in the

success of these initiatives by fostering a strong vision, creating robust support structures, and ensuring active engagement from all relevant parties. A combination of progressive policy development and adaptive leadership practices is essential for integrating micro-credentials into sustainable and globally relevant higher education systems.

Learning Models for Micro-Credentials in Higher Education

Micro-credentials in higher education are delivered through diverse pedagogical models that respond to varying learner needs and institutional contexts. Prominent among these are Project-Based Learning (PBL), Self-Directed Learning, Problem-Based Learning, and Game-Based Learning (GBL), each offering distinct instructional affordances and learning outcome.

Project-Based Learning (PBL) fosters deep engagement by situating learning in authentic, real-world tasks. It facilitates the development of critical thinking, collaboration, and industry-relevant competencies, aligning educational activities with workplace expectations (Cook, 2021; Sousa-Vieira *et al.*, 2021). Self-Directed Learning enables learners to manage their own learning trajectories, enhancing autonomy, motivation, and personalized learning. This model is particularly effective for adult learners and lifelong learning environments where flexibility and self-pacing are essential (Kumar *et al.*, 2022; Clausen, 2022; Uanhoro and Young, 2022).

Problem-Based Learning, often applied in health and engineering disciplines, emphasizes solving complex, open-ended problems. It cultivates analytical reasoning, collaborative problem-solving, and independent inquiry, which are essential for 21st-century employability (O'Keeffe *et al.*, 2022). Game-Based Learning (GBL) introduces gamification elements to increase learner engagement, cognitive activation, and emotional involvement. Empirical evidence supports GBL's role in enhancing both cognitive and affective domains, particularly through interactive tasks and immediate feedback mechanisms (Nallaluthan *et al.*, 2023; Wiesner *et al.*, 2017; Mozelius *et al.*, 2015).

Figure 7 presents a typological mapping of these learning models, illustrating their varied pedagogical structures, levels of learner agency, and targeted competencies. These models are complementary rather than mutually exclusive. Institutions aiming to implement micro-credentials should adopt a context-driven instructional design approach, aligning the model with learner profiles, subject matter, and intended skill outcomes. As the landscape of higher education evolves, integrating these models, potentially in hybrid formats, can enhance the effectiveness, scalability, and recognition of micro-credential programs.

Perceptions of Students, Educators, and Industry

Perceptions of micro-credentials in higher education vary across stakeholder groups, reflecting differences in expectations, familiarity, and institutional readiness. Students generally express positive attitudes toward micro-credentials, citing increased engagement, relevance, and career alignment. For instance, tourism students in Malaysia reported that micro-credentials enhanced their subject interaction and learning motivation (Azmi *et al.*, 2004). Despite this, large-scale empirical data on student perceptions remain limited, suggesting a need for broader and more longitudinal studies.

Educators recognize the potential of micro-credentials to innovate pedagogy and increase learning flexibility. However, studies highlight a persistent gap in their ability to integrate micro-credentials within traditional curricula. In Mauritius, for example, educators valued micro-credentials conceptually but lacked clarity regarding their implementation and alignment with formal qualifications (Santally *et al.*, 2024). This reflects a broader institutional challenge in fostering academic acceptance and operational integration.

Industry stakeholders present more nuanced and critical views. While employers increasingly acknowledge micro-credentials as indicators of initiative, adaptability, and lifelong learning, they often express concerns about quality assurance, standardization, and comparability with conventional degrees. In the Australian context, Thi Ngoc Ha *et al.*, (2024) noted that the perceived value of micro-credentials varies depending on the characteristics of learners and institutional issuers. Booth *et al.*, (2024) similarly observed employer appreciation for non-degree credentials but emphasized that they remain supplementary rather than substitutive of traditional qualifications. Concerns around credibility were further echoed in environmental sciences and human resources sectors, where calls have been made for clearer standards, stronger regulatory frameworks, and the involvement of industry professionals in credential design (Miller and Jorre de St Jorre, 2024; Stabauer *et al.*, 2024). Across all stakeholder groups, confidence in micro-credentials depends not only on perceived utility but also on trust in their design, delivery, and recognition mechanisms.

In summary, while students and educators display growing interest in micro-credentials, their successful adoption hinges on institutional support, educator training, and curricular integration. Meanwhile, industry demands greater transparency, standardization, and strategic alignment with labor market needs. Bridging these perspectives requires collaborative ecosystem-building, wherein academia, industry, and policy actors co-create credentialing standards that are credible, portable, and impactful.

CONCLUSION

This study presents a systematic and bibliometric review of micro-credentials in higher education, offering an integrated perspective on their policy frameworks, pedagogical models, and stakeholder perceptions. The findings underscore the transformative potential of micro-credentials in bridging formal education with evolving labor market needs, promoting lifelong learning, and enhancing the personalization of learning pathways.

From a theoretical standpoint, this review contributes to the ongoing discourse by mapping emergent thematic clusters and proposing a multi-stakeholder model that situates micro-credentials within broader institutional and policy ecosystems. The study illustrates that while enthusiasm for micro-credentials is widespread, effective implementation is contingent upon institutional readiness, policy standardization, and inter-sectoral collaboration.

The practical implications of this research are threefold. First, policymakers are urged to develop harmonized regulatory frameworks and quality assurance mechanisms to enhance the credibility and global portability of micro-credentials. Second, higher education institutions must foster adaptive leadership and invest in staff development to enable successful integration. Third, industry stakeholders should co-create competency-based programs with academic institutions to ensure relevance and alignment with workforce demands.

Despite these contributions, several limitations remain. The lack of definitional consensus and regional variation in implementation practices limits the generalizability of findings. Moreover, the scarcity of longitudinal and empirical studies constrains a comprehensive understanding of the long-term outcomes associated with micro-credential adoption.

To address these gaps, future research should prioritize the development of globally interoperable frameworks that accommodate regional diversity while ensuring consistency in standards. Longitudinal studies are also needed to assess the sustained impact of micro-credentials on employability, learner autonomy, and institutional transformation. Additionally, interdisciplinary inquiry into the convergence of micro-credentials with emerging technologies, such as AI, block chain, and learning analytics, will be essential for understanding their scalability, trust mechanisms, and pedagogical innovation.

By advancing both theoretical and practical dimensions, this study aims to inform policy, practice, and scholarship in reimagining higher education systems that are more flexible, inclusive, and responsive to the demands of a knowledge-driven global society.

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ABBREVIATIONS

AAC: Average Article Citation; **AI:** Artificial Intelligence; **B-SLR:** Bibliometric-Systematic Literature Review; **GBL:** Game-Based Learning; **MCP:** Multiple Country Publications; **MOOCs**: Massive Open Online Courses; **NP**: Number of Publications; **NQF:** National Qualification Framework; **NTC:** Normalized Total Citations; **PBL:** Project-Based Learning; **PY:** Publication Year; **SLR:** Systematic Literature Review; **TC:** Total Citations; **TCY:** Total Citations per Year; **WoS:** Web of Science.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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