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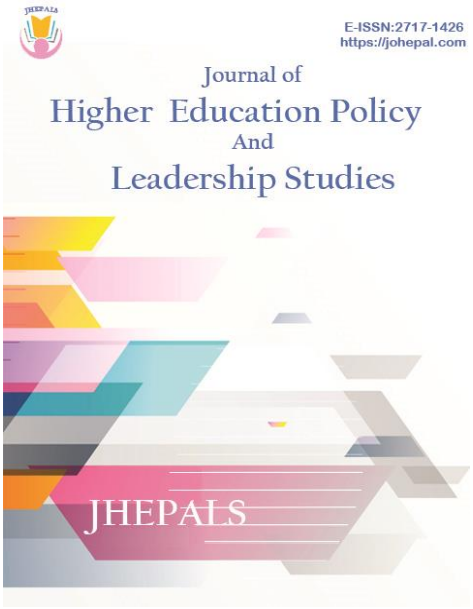
The Integration of Micro-Credentials in Higher Education: A Systematic Review and a Strategic Reset Model



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The Integration of Micro-Credentials in Higher Education: A Systematic Review and a Strategic Reset Model

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Abstract

The rapid digitalization of the labor market has widened the gap between graduate competencies and industry needs, challenging the relevance of traditional higher education degrees. While micro-credentials have emerged as agile solutions to bridge this gap, their integration into formal academic structures remains fragmented and theoretically under-conceptualized. This study aims to analyze the pedagogical, administrative, and legal strategies for integrating micro-credentials into higher education and to identify the barriers hindering this process. A systematic literature review was conducted following the PRISMA 2020 guidelines, analyzing 81 articles published between 2015 and 2025 in the Web of Science and Scopus databases. The thematic synthesis reveals that while stackable degree models and blockchain-based verification are the most prominent integration strategies, the ecosystem is plagued by a trust deficit among employers and a lack of standardized quality assurance frameworks. Furthermore, the findings highlight a critical tension between the labor market's demand for flexibility and the university's need for academic rigor. Based on these findings, the study proposes a Strategic Reset Model, a five-dimensional framework designed to guide higher educational institutes in transforming from mere content providers into accredited competency hubs.

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Keywords: Micro-Credentials; Higher Education; Lifelong Learning; Certificate Programs; Continuing Education

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Introduction

With the rapid pace of technological advancements and the changing dynamics of the labor market, knowledge acquired at the associate or bachelor's degree level loses its validity shortly after graduation. Particularly, digitalization processes have created an ever-widening skill gap between the competencies demanded by employers and those possessed by graduates (Alasmari & Alzahrani, 2024; Cho et al., 2025; Tee et al., 2024). While research predicts that 85% of the professions to be practiced in 2030 do not yet exist, traditional higher education models struggle to keep pace with this rapid change and meet the immediate needs of the job market (Brown et al., 2023). Degrees alone do not guarantee long-term employability, and technical competencies must be continuously updated (Brown et al., 2023).

Lifelong learning has shifted from being an option to a necessity for individuals (Alasmari & Alzahrani, 2024; Wheelahan, 2021). For employees or job seekers to exist in a competitive environment, they must constantly acquire new skills and elevate their existing competencies (Brown et al., 2023; Techanamurthy et al., 2024). Short-term, flexible, and competency-based education models such as micro-credentials—rather than traditional education opportunities—offer a solution to this necessity by providing individuals with learning opportunities at the moment of need throughout their careers (Brown et al., 2023; Wheelahan, 2021). At the same time, micro-credential programs have become a crucial element in ensuring economic and social well-being through continuous development and skill acquisition (Alasmari & Alzahrani, 2024; Techanamurthy et al., 2024).

The European Commission defines a micro-credential as "the record of the learning outcomes that a learner has acquired following a small volume of learning" (European Commission, 2022, p. 10). According to this definition, the most significant component of micro-credentials is that learning outcomes are assessed against transparent and clearly defined standards. The Commission also states that micro-credentials belong to the learner, are shareable and portable, and can stand alone or be combined into larger credentials (Brown et al., 2023; Zdunek, 2024). Another definition by UNESCO (2012) describes a micro-credential as a record of focused learning achievement that verifies what a learner knows, understands, or can do.

It is frequently emphasized in the literature that traditional higher education institutions struggle to respond to the demands of the rapidly changing labor market and student needs; the programs they offer are generally long-term and inflexible, and curriculum renewal processes progress slowly (Brown et al., 2023). Existing curricula are quite dense, making it difficult to incorporate new and necessary competencies into education programs, which causes universities to lag behind industry needs (Bat et al., 2022). To keep their knowledge and skills up to date in a competitive environment, individuals are turning to Massive Open Online Courses (MOOCs) and short-term certificate programs offered by platforms such as Coursera, EdX, and Udacity (Alasmari & Alzahrani, 2024; Kumar et al., 2022). Compared to traditional degrees, alternative education opportunities offer a lower-cost, accessible, and flexible structure, allowing individuals to acquire the knowledge and skills they need instantly (Alasmari & Alzahrani, 2024; Narayanaswamy et al., 2024).

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Micro-Credentials & Higher Education

Because these education opportunities are hosted on different platforms, the acquired gains often remain fragmented and face challenges regarding formalization (Alasmari & Alzahrani, 2024; Brown et al., 2023). Current micro-credential providers exhibit a disorganized structure where quality standards vary and harmony between them is lacking (Alasmari & Alzahrani, 2024). Information regarding micro-credential programs is generally kept only on the educational platform where they were conducted, which restricts the recognition and portability of learned skills in the academic or business world (Cosby et al., 2024; Narayanaswamy et al., 2024). Consequently, the valuable competencies individuals acquire from these platforms face the risk of remaining unrecorded since they cannot be integrated into a formal quality assurance framework (Alasmari & Alzahrani, 2024; Kumar et al., 2022).

An examination of the literature reveals a lack of a globally agreed-upon common definition and conceptual understanding of micro-credentials, leading to a conceptual gap (Alasmari & Alzahrani, 2024). Although international organizations such as UNESCO (2022) and the European Commission (2020) have attempted to establish a common definition and quality framework, uncertainties persist regarding how much employers can trust these certificates and how universities will credit these trainings within their own structures (Brown et al., 2023; Irizarry-Quintero, 2025; McGreal & Olcott, 2022). The absence of standard definitions and transparency in the process leads to uncertainty for employers regarding the reliability of candidates' skills, thereby undermining the validity of certificates in the industry (Alasmari & Alzahrani, 2024; Raj et al., 2024). From the perspective of higher education institutions, numerous questions remain regarding how competencies acquired through micro-credentials will be integrated into existing curricula, how they will be mapped to national qualification frameworks, and how they will be evaluated in the processes of recognizing prior learning (Alasmari & Alzahrani, 2024; Raj et al., 2024). Uncertainties among stakeholders point to trust and quality issues, which are the primary obstacles to the sustainability and acceptance of the micro-credential system (Alasmari & Alzahrani, 2024; Guest et al., 2024; Miller & Jorre, 2024, Mashford-Pringle et al., 2023).

In this study, the process of integrating learning experiences acquired by individuals into formal education structures by higher education institutions via micro-credentials was examined within the context of changing labor market dynamics and lifelong learning requirements. By systematically compiling current practices and different integration models in the literature, the study aims to analyze the opportunities and barriers encountered in this process; accordingly, it intends to offer a feasible roadmap for both policymakers and universities for the sustainability of the ecosystem. Within the scope of the research, answers to the following questions were sought:

RQ_1. Which pedagogical and administrative models do higher education institutions adopt when integrating micro-credential applications into their existing curricula and accreditation processes?

RQ_2. How are the perceptions and trust levels of employers and industry stakeholders toward micro-credentials—offered instead of or alongside traditional degrees—positioned in the literature?

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RQ_3. What are the fundamental structural, legal, and pedagogical barriers encountered in transforming informal learning outcomes into a formal structure?

Research Methodology

Research Model

In this study, systematic literature review (SLR) was adopted to conduct an in-depth examination and synthesis of the existing literature on "Micro-Credential Integration Strategies in Higher Education." This approach, which compiles and interprets existing research through organized, reproducible, and transparent methods, is considered one of the most scientifically reliable methods for synthesizing findings on a specific subject (Fisch & Block, 2018; Paul et al., 2021). In the SLR, unlike traditional literature reviews, publications are selected from designated databases based on predefined inclusion and exclusion criteria, followed by content analysis and the synthesis of findings (Tranfield et al., 2003).

Data Collection

To ensure transparency and validity, the data collection process was conducted in full compliance with the PRISMA guidelines (Page et al., 2021). The literature search was completed as of October 2025 and encompasses the Web of Science (Core Collection) and Scopus academic databases. To reach all relevant studies, the following search query was utilized:

("micro-cre*" OR "microcre*") AND ("higher education" OR "lifelong learning" OR "distance education")

The authors made decisions by reaching a consensus on elements such as the keywords to be used, the databases to be examined, inclusion and exclusion criteria for publications, and the publication review form.

Specific inclusion and exclusion criteria were adopted to determine whether the publications accessed through the search would be included in the scope of the research. These criteria played a vital role in ensuring the relevance and reliability of the study in line with its objectives.

Inclusion Criteria:

- The study must be conducted at the higher education level.
- The publication language must be English.
- The publication date must be between 2015 and 2025.
- The publication must be in the format of a research or review article.

Exclusion Criteria:

- Published before the specified date range.
- Conducted in a field other than education.
- Conducted at the K-12 level.
- Outside the scope of the research questions.
- Inaccessibility of the full text.

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Based on the PRISMA guidelines and the adopted criteria, a search was conducted across the selected databases to identify publications suitable for the research objectives. Consequently, 81 articles meeting these criteria were included for review (Figure 1).

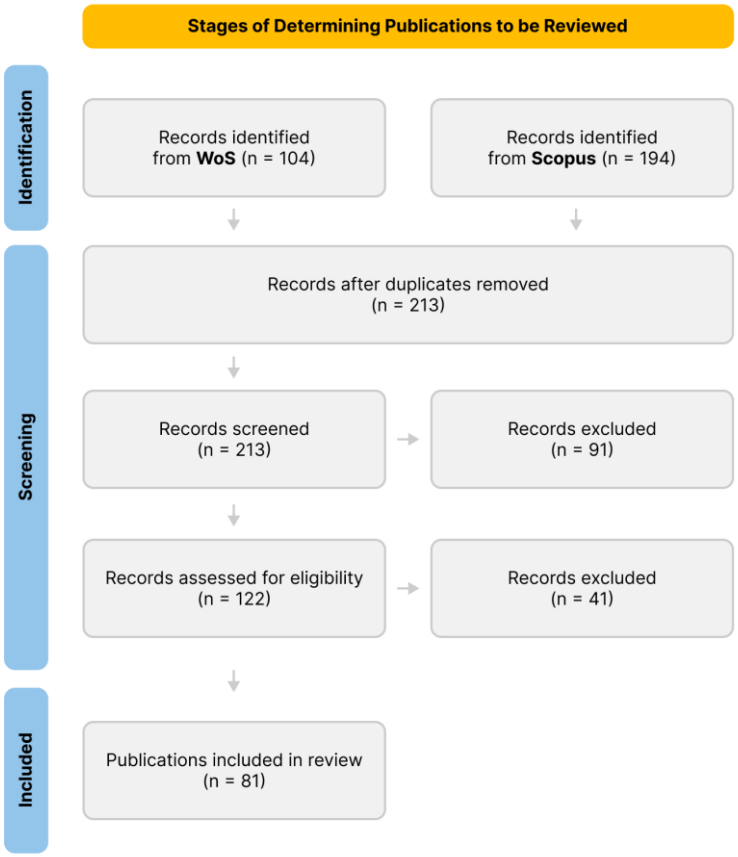

Figure 1. Stages of determining publications to be reviewed

Data Analysis

The articles were analyzed using the thematic analysis method. As a qualitative approach, thematic analysis is a robust method used to identify, evaluate, and report patterns within data (Braun & Clarke, 2006). Thematic analysis was carried out in three stages: data extraction and coding, theme generation, and reporting. In the data extraction and coding stage, a Data Coding Form (Appendix A) was prepared to examine the articles selected for full-text review. Based on the research questions, the dataset was coded for the research method, findings, discussions, and conclusions of the studies. In the second stage, involving theme generation, semantic patterns between the generated codes were merged within the context of the research questions to determine themes, and the findings were subsequently reported.

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Findings

Bibliometric Analysis

Bibliometric analysis was utilized to obtain a bird's-eye view of the literature, proceeding from the general to the specific (Galetsi & Katsaliaki, 2020). In the bibliometric analysis, a word cloud analysis was first conducted using data obtained from the keywords and titles of the compiled articles to reveal the conceptual focus of the literature (Figure 2). The size of the words in the figure is directly proportional to the frequency of the respective concept's usage in the literature.

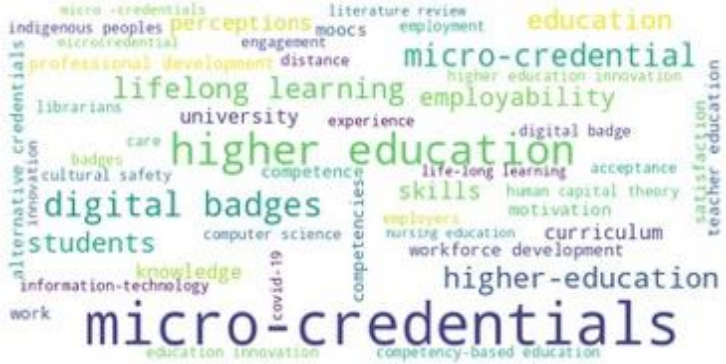

Figure 2. Word cloud of articles

An examination of the word cloud analysis reveals that studies in the literature are shaped around three main axes. The first axis includes the core concepts: "micro-credentials" (n=47) and "higher education" (n=21). This confirms that micro-credentials have ceased to be a peripheral topic and have become a central component of the higher education ecosystem. As the second axis, the concept of "digital badges" (n=12) stands out significantly in the technological and operational dimensions. This proves that digital badge technologies carry great importance in the verification and documentation process of micro-credentials. Simultaneously, it aligns with the "trust and accreditation" theme discussed in the thematic analysis section of the study. Finally, in the third axis, the concepts of "lifelong learning" (n=9), "employability" (n=7), and "skills" (n=6) emerge in the dimension of purpose and outcomes. This indicates that research focuses not only on how this system will be established but also on its utility. The words in this axis support the findings of "employer perceptions and benefit expectations," suggesting that the goal of micro-credentials is to bridge the skill gap in the labor market and support lifelong learning.

The word cloud regarding micro-credential research reveals that studies are currently progressing within a utilitarian and industry-oriented framework rather than pedagogical depth. The relatively lower number of studies examining pedagogical concepts such as learning theories and curriculum design indicates that the field is currently more concerned with how micro-credentials will resonate in the labor market than how they will be taught.

Scientific Production and Citation Trends

When the development of the research field is examined (Figure 3), it is observed that academic studies on micro-credentials and higher education integration were in their

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infancy between 2016 and 2020, limited to an annual average of one publication. The field began to receive remarkable interest starting in 2021 (5 publications) and exhibited a steady upward trend in subsequent years, reaching a peak with 12 publications in 2022, 13 in 2023, and 25 annually in 2024–2025.

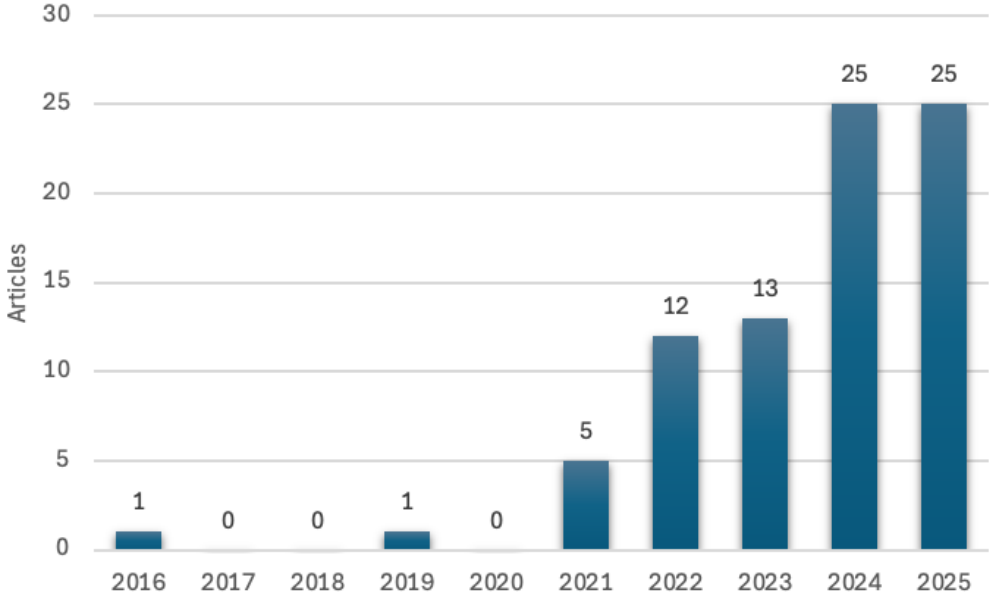

Figure 3. Distribution of articles by year

When the annual average citation counts are analyzed (Figure 4), the highest impact values were reached in 2019 (27 citations/article) and 2022 (24.92 citations/article). Pioneering studies in the field were published in recent years and have shaped the literature.

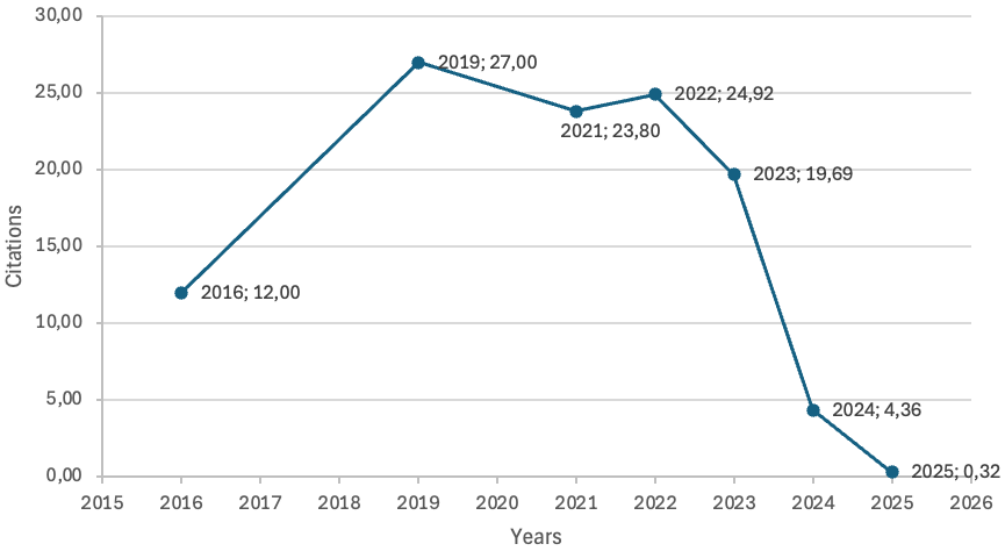

Figure 4. Distribution of articles according to citation counts and year

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Geographical Distribution and Impact Analysis

An examination of the geographical distribution of the research reveals an interesting divergence between scientific production and citation impact. In terms of production capacity, the USA is the clear leader with 57 publications, followed by Malaysia with 26, Australia with 23, and China with 17 (Figure 5).

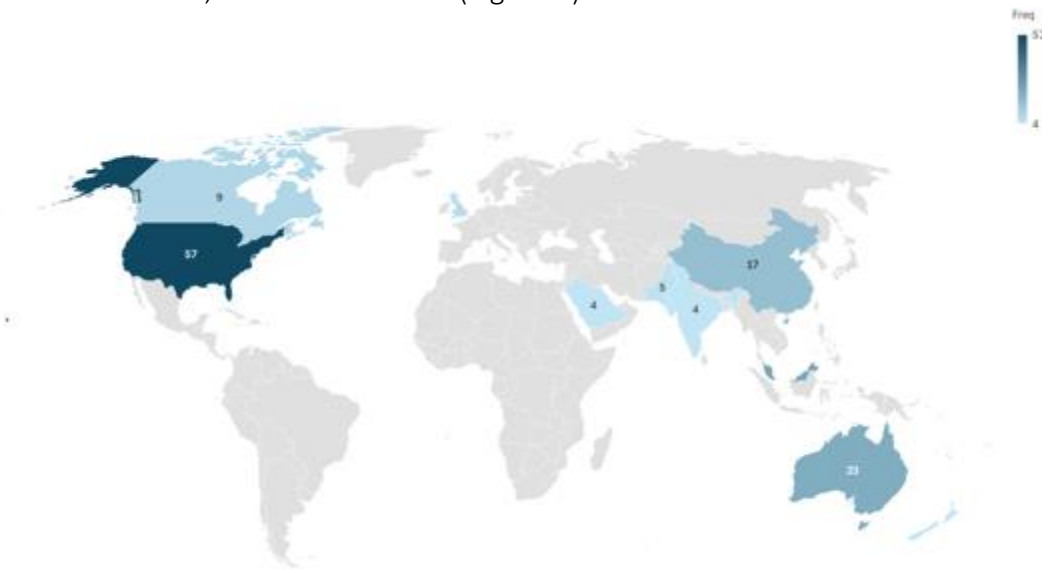

Figure 5. Distribution of articles by country

On the other hand, interestingly, the ranking changes when the academic impact (total number of citations) of the studies is considered. Australia with 197 citations and Canada with 195 citations have emerged as the most influential countries in the field, reaching the highest citation counts despite producing fewer publications compared to other nations (Figure 6). Notably, Canada is the country with the highest qualitative impact, with an average of 32.5 citations per article.

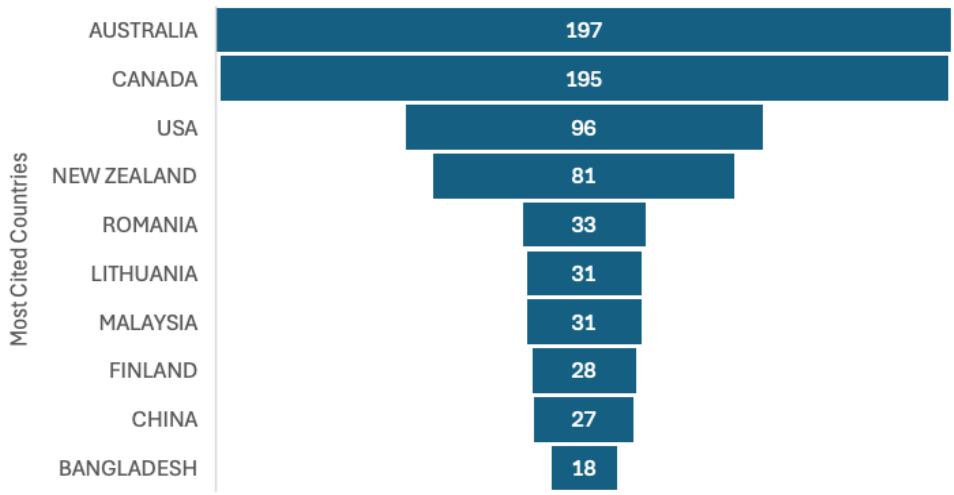

Figure 6. Most cited countries

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It is thought that the fact that studies in the USA are numerically higher but relatively lower in impact stems from the generally institutional and fragmented nature of the practices. Conversely, the high citations for studies from Australia and Canada reveal that their policy-based approaches, which integrate micro-credentials into national qualification frameworks, are more highly valued. This confirms that integration requires not only institutional but also national strategies.

Co-citation Network Analysis

The co-citation network analysis, conducted to reveal the conceptual structure of the field, shows that the research is clustered around specific focal points. According to the Betweenness, Closeness, and PageRank scores on the network map, Brown M. (2021), McGreal R. (2022), and Wheelahan I. (2021) were identified as the most central nodes connecting three different study clusters in the literature (Figure 7). These studies represent the main axis forming the pedagogical foundations of micro-credentials.

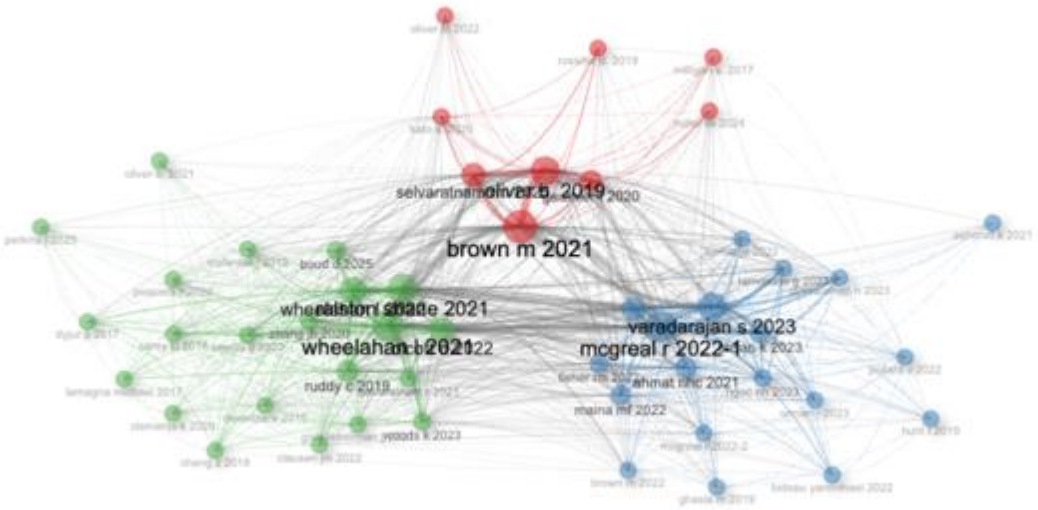

Figure 7. Results of the co-citation network analysis

The names at the center of the co-citation network also map the identity crisis and inquiries regarding micro-credentials in the literature. The fact that Wheelahan's (2021) critical perspective on the marketization of education and McGreal's (2022) operational approach are both centrally located in the same network reveals that a consensus on micro-credentials has not yet been reached in the literature. The literature is divided around the question of whether micro-credentials are a "savior" or a "threat that fragments higher education."

Thematic Analysis

This section presents the findings of the thematic analysis conducted in the context of the research questions, structured around several key themes.

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RQ_1: Which pedagogical and administrative models do higher education institutions adopt when integrating micro-credential applications into their existing curricula and accreditation processes?

Adopted Pedagogical Models

When integrating micro-credential applications into their existing structures, higher education institutions primarily adopt competency-based pedagogical approaches and administrative/accreditation models targeting multi-stakeholder and institutional flexibility (Alenezi et al., 2024; Martín-Gilete & Blanco-García, 2024; Wheelahan, 2021). The adopted pedagogical models are implemented through the integration of micro-credential applications into the curriculum, with learning outcomes focusing on tangible skill acquisition. This integration is largely built upon the competency-based education and skill acquisition approach (Alenezi et al., 2024; Galindo, 2024; Yin et al., 2025).

Micro-credentials verify that students have acquired specific skills and competencies in a particular field (Braxton, 2023; Galindo, 2024; Ward et al., 2024; Vordenberga et al., 2024). In the evaluation process, the verification of a student's competency is generally performance- and evidence-based, such as project tasks in a practical context (Desmarchelier & Cary, 2022; Olcott, 2022; Patterson & Hepburn, 2025). During the instructional design process, the assessment procedure is often designed before the course content is determined, utilizing a "backward design" process (Patterson & Hepburn, 2025).

In the instructional design of micro-credentials, educational content is organized by breaking it down into smaller modules to provide "just-in-time" and personalized learning (Alenezi et al., 2024; Cook, 2021; Tee et al., 2024). Thanks to this modular structure, students can progress at their own pace using learning materials they determine; they can also personalize the learning process according to a curriculum selected in line with their own career goals (Alenezi et al., 2024; Harizan & Ally, 2025; Iucu & Cartis, 2025; Vordenberga et al., 2024;).

Micro-credentials are generally conducted within online or blended learning frameworks (Ahad et al., 2025; Ahsan et al., 2023; Kumar et al., 2022). Due to the flexibility options they offer, they increase access opportunities, especially for individuals who are working or cannot reach traditional education structures (Alenezi et al., 2024; Gamage et al., 2025). In some educational models, learner autonomy is encouraged by supporting a hybrid structure with asynchronous learning, face-to-face or online interaction, and mentorship opportunities (Fennelly-Atkinson, R. & Pakhira, 2024; Kumar et al., 2022;).

In terms of industry integration, it is crucial to collaborate with industry experts and co-design educational content in the development of micro-credentials to directly meet labor market demands (Ahsan et al., 2023; Alenezi et al., 2024; Lang, 2023; Miao et al., 2024; Miller & Jorre, 2024; Rižnar, 2023). Some higher education institutions encourage interdisciplinary micro-credentials to enable and facilitate the acquisition of multifaceted skills by students (Alenezi et al., 2024).

Adopted Administrative Models and Accreditation Approaches

The institutional design of micro-credentials requires restructuring educational programs by aligning academic goals with market demands (McGreal & Olcott, 2022). Micro-credential initiatives are generally organized within units operating in universities, such as Continuing

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Education Centers or Distance Education Centers (Cheng et al., 2024). In successful implementation examples, institutions establish different management structures to ensure the alignment of micro-credentials with the industry, allocate resources, and determine quality standards (Lokey-Vega et al., 2025; Tamoliune et al., 2023). To ensure the long-term sustainability of micro-credential programs, cooperation with other university units, such as finance and career development departments, is required (Lokey-Vega et al., 2025; Tamoliune et al., 2023). Some institutions form specialized micro-credential commissions within their own bodies to undertake tasks such as preparing new micro-credential programs and ensuring their harmony with existing academic processes (Lokey-Vega et al., 2025).

In the context of accreditation and quality assurance, micro-credentials require a rigorously structured quality assurance process to achieve the same level of credibility as traditional academic degrees, such as bachelor's and associate degrees (Alasmari & Alzahrani, 2024; Alenezi et al., 2024; Scott, 2024).

Significant barriers to the standardization of micro-credentials in the literature include the lack of consensus on the definition of the concept, terminological confusion, the inability to determine upper limits in the crediting process, and a lack of consistency (Brown et al., 2023; Patterson & Hepburn, 2025; Varadarajan et al., 2023). Within the scope of standardization efforts, higher education institutions generally attempt to align with national or international qualification frameworks, such as the European Qualifications Framework (Lang, 2023; Selvaratnam, 2021; Varadarajan et al., 2025).

Many higher education institutions subject micro-credentials to their own internal quality assurance procedures (Hou, 2023). External quality assurance generally focuses on evaluating the effectiveness of the providing institution's internal quality assurance system (Zdunek, 2024).

Micro-credentials are designed in a stackable format to enable students to progress incrementally toward different qualifications (Braxton, 2023; Lang, 2023; Olcott, 2022; Raj et al., 2024; Trede et al., 2025). The recognition of the accumulated credits is typically provided through digital certificates (digital badges) that contain verifiable data demonstrating the student's success and acquired competencies (Alasmari & Alzahrani, 2024; Braxton, 2023; Felton et al., 2023; Gish-Lieberman, 2021; Hall-Ellis, 2016; Howard , 2024; Vordenberga et al., 2024).

When administrative models of micro-credentials are examined, it is evident that they are not limited to academic units; continuous collaboration among all stakeholders—including industry experts, employers, and higher education policymakers—is necessary to determine industry needs and suitability (Alenezi et al., 2024; Lang, 2023; Lokey-Vega et al., 2025; Ruddy & Ponte, 2019; Tamoliune et al., 2023; Varadarajan et al., 2025). This collaboration should cover the entire process, from the design of the micro-credential to its accreditation (Miller & Jorre, 2024).

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RQ_2: How are the perceptions and trust levels of employers and industry stakeholders toward micro-credentials—offered instead of or alongside traditional degrees—positioned in the literature?

Employer Perceptions and Benefit Expectations

In the context of changing labor market conditions, employers and industry stakeholders view micro-credentials as a complementary or alternative option to traditional academic degrees and consider them valuable (Ahad et al., 2025; Alenezi et al., 2024). However, there is insufficient trust in this new type of education due to fundamental issues such as inherent uncertainties, standardization problems, and difficulties in ensuring quality assurance.

Unlike traditional degrees, micro-credentials demonstrate in a concrete and verifiable manner that students have exhibited competency in specific skills (Ahad et al., 2025; Alenezi et al., 2024; McGreal et al., 2022; Miller & Jorre, 2024; Prosen & Ličen, 2025). Employers place greater importance on students possessing practical and application-based skills that can be utilized immediately upon hiring, rather than general theoretical knowledge (Alenezi et al., 2024; Irizarry-Quintero, 2025; McGreal et al., 2022; Narayanaswamy et al., 2024; Sharma et al., 2024; Zdunek, 2024).

From an employability perspective, micro-credentials enrich students' resumes and are seen as a differentiating factor in recruitment processes (Ha et al., 2025; Irizarry-Quintero, 2025; Lokey-Vega et al., 2025; Raghavan et al., 2023; Schutte, 2024). Employers may prefer candidates who hold a micro-credential in a relevant field over those who only possess a traditional degree, particularly in rapidly evolving technical positions (Alenezi et al., 2024).

Micro-credentials accelerate hiring processes by initially verifying candidates' skills and reducing companies' orientation and training costs (Ahsan et al., 2023; Alenezi et al., 2024; Gao, 2025; McGreal et al., 2022; Varadarajan et al., 2023). They also support employers' goals of keeping the workforce up to date by meeting employees' needs for continuous professional development and reskilling (Alenezi et al., 2024; McGreal et al., 2022; Miller & Jorre, 2024; Mitchell et al., 2025; Narong, 2025).

Trust and Accreditation Issues

Although employers' perspectives on micro-credentials are generally positive, trust in these certificates is significantly undermined by inconsistencies in the system and a lack of standards (Alenezi et al., 2024; McGreal et al., 2022; Patterson & Hepburn, 2025; Reynoldson, 2023; Varadarajan et al., 2023).

The absence of a universal consensus on the definition, length, and content of micro-credentials creates major confusion for employers (Alenezi et al., 2024; Hou, 2025; McGreal et al., 2022; Patterson & Hepburn, 2025; Varadarajan et al., 2023; Zdunek, 2024). This uncertainty makes it difficult to evaluate the quality and comparability of certificates obtained from different providers, such as universities, industries, or private platforms (Alenezi et al., 2024; Miller & Jorre, 2024; Olcott, 2022; Raj et al., 2024; Varadarajan et al., 2023). Specifically, the daily increase in the number of micro-credentials carries a risk of "credential inflation" that could diminish the reputation of these certificates (Alenezi et al., 2024). Furthermore, the potential for fraud and forgery in various digital certificates

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presented during the verification process also leads to trust issues (Alasmari & Alzahrani, 2024; Alenezi et al., 2024; Varadarajan et al., 2023).

The value of micro-credentials appears to depend largely on the reputation of the issuing institution (Alasmari & Alzahrani, 2024; Narayanaswamy et al., 2024). Employers value digital certificates (digital badges) that contain verifiable data demonstrating student success or acquired competencies (Alasmari & Alzahrani, 2024). Micro-credentials designed in collaboration with industry partners (Ahsan et al., 2023; Alenezi et al., 2024; Miller & Jorre, 2024) and those reflected on students' transcripts within the university hold the highest perceived value.

Positioning Against Traditional Degrees

The general trend regarding micro-credentials is that they are complementary to traditional degrees rather than a replacement for them (Hou, 2025; Irizarry-Quintero, 2025; Miller & Jorre, 2024; Narayanaswamy et al., 2024; Olcott, 2022). Micro-credentials should provide a competitive advantage by supplementing students' core academic competencies and helping them stand out from other job seekers (Alasmari & Alzahrani, 2024; Hou, 2025; McGreal et al., 2022; Narayanaswamy et al., 2024; Olcott, 2022).

While employers view university-level degrees as a hiring barrier (Miller & Jorre, 2024), they emphasize the importance of micro-credential programs being aligned with industry standards and linked to academic integrity to enable students to overcome this barrier (Narayanaswamy et al., 2024).

Studies on collaborative solutions (Ahsan et al., 2023; Alenezi et al., 2024; Cosby et al., 2024; Hanshaw, 2025; Irizarry-Quintero, 2025; Lang, 2023; McGreal et al., 2022; Miller & Jorre, 2024; Smith et al., 2025; Varadarajan et al., 2023; Woods & Woods, 2023) show that it is of vital importance for higher education institutions to form partnerships with employers and industry organizations to create micro-credential programs that cover sector-oriented skills and increase their reliability. These collaborations should not be limited to educational content but should extend from the design of micro-credentials to accreditation processes (Alenezi et al., 2024).

Micro-credentials conducted by higher education institutions and reflected on students' transcripts are perceived to have higher value by both students and industry representatives compared to certificates obtained from commercial platforms (Narayanaswamy et al., 2024). This stems from the institutional trust that academia brings to micro-credentials (Alasmari & Alzahrani, 2024; Narayanaswamy et al., 2024).

In addition to positive perceptions, there are critical approaches toward some micro-credentials. It is argued that they may prioritize employment while pushing educational goals into the background, thereby attempting to change the fundamental purpose of higher education and potentially devaluing degrees (Alenezi et al., 2024; Irizarry-Quintero, 2025; Lokey-Vega et al., 2025; Schutte, 2024; Tjong et al., 2022; Wheelahan, 2021).

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RQ_3: What are the fundamental structural, legal, and pedagogical barriers encountered in transforming informal learning outcomes into a formal structure?

Structural and Administrative Barriers

The lack of global standardization and definition of micro-credentials—due to their implementation by institutions in varying capacities, lengths, and formats—is a primary structural issue that complicates the comparison of their value (Alasmari & Alzahrani, 2024; Brown et al., 2023; Gamage et al., 2025; Patterson & Hepburn, 2025; Pirkkalainen, 2023; Varadarajan et al., 2023). Regarding institutional alignment and resistance, traditional higher education institutions exhibit resistance to the integration of micro-credentials into the curriculum to avoid disrupting the academic status quo (Ahsan et al., 2023; Cheng et al., 2024; Lokey-Vega et al., 2025; McGreal & Olcott, 2022; Pirkkalainen, 2023; Varadarajan et al., 2025). The perception of micro-credentials as an additional burden on existing workflows hinders strategic planning and implementation processes (McGreal & Olcott, 2022; Varadarajan et al., 2023).

Furthermore, there are deficiencies in the allocation of financial resources and, particularly, human resources—such as faculty and technical staff—required for the development, execution, and sustainability of micro-credential programs (McGreal & Olcott, 2022; Varadarajan et al., 2025). In terms of sustainability and governance, the difficulty higher education institutions face in managing micro-credentials with a strategic vision, often focusing on short-term goals instead, threatens the long-term sustainability of these programs (McGreal & Olcott, 2022; Varadarajan et al., 2025).

Legal and Accreditation Barriers

Uncertainties regarding the legal status and quality assurance processes of micro-credentials represent the most significant legal barriers to formal recognition. There is a lack of nationally or internationally accepted policy or legal frameworks that define the scope, size, and quality of micro-learning experiences (Alasmari & Alzahrani, 2024; Fisher & Leder, 2022; Hou, 2025; Lokey-Vega et al., 2025; McGreal & Olcott, 2022; Raj et al., 2024; Reynoldson, 2023; Schutte, 2024; Varadarajan et al., 2023). This situation complicates accreditation processes within traditional education systems. Existing external quality assurance mechanisms are traditionally designed for long-term, credit-bearing academic programs. Consequently, implementing an agile and scalable accreditation process compatible with the modular and rapid development nature of micro-credentials poses a significant challenge and barrier (Cheng et al., 2024; McGreal & Olcott, 2022; Raj et al., 2024; Zdunek, 2024).

Regarding recognition and transferability, institutional resistance is encountered concerning the conversion of micro-credentials into academic credits, their stackability, and their acceptance or transferability by different institutions or national systems (McGreal et al., 2022; Pirkkalainen, 2023; Raj et al., 2024; Varadarajan et al., 2023).

Barriers related to financing have been expressed as follows: student loans and scholarships allocated for traditional learning cannot be used to access micro-credentials, which makes them more costly compared to traditional education (Alasmari & Alzahrani, 2024; Patterson & Hepburn, 2025; Varadarajan et al., 2023). In terms of reliability, the risk

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of forged digital certificates and uncertainty regarding the reliability of authentication mechanisms are considered major legal challenges undermining trust in micro-credentials (Raj et al., 2024; Reynoldson, 2023; Varadarajan et al., 2023).

Pedagogical and Theoretical Barriers

The "just-in-time" learning approach inherent in the structure of micro-credentials brings about pedagogical challenges that conflict with the fundamental principles of traditional academic education.

Since micro-credentials consist of short-term, goal-oriented programs, the fragmentation of the curriculum poses a risk of disrupting the integrity of knowledge, which is structured according to the principles of consistency, sequence, and hierarchy in traditional programs (Raj et al., 2024; Wheelahan, 2021; Wheelahan & Moodie, 2021). This may lead students to acquire context-independent, superficial skill sets instead of achieving an in-depth understanding of a subject (Ha et al., 2023; Wheelahan & Moodie, 2021).

On the other hand, many micro-credentials tend to focus solely on technical or practical skills. This may hinder the development of broader, transferable skills such as critical thinking, problem-solving, and communication (Alenezi et al., 2024; Desmarchelier & Cary, 2022; Wheelahan & Moodie, 2021; White, 2021).

In the context of assessment and evaluation processes, the competency-based nature of micro-credentials necessitates assessment systems that focus on measuring skills and competencies rather than traditional exams (Patterson & Hepburn, 2025). For institutions, designing, implementing, and ensuring the reliability of performance- and evidence-based assessments requires a high level of pedagogical and technical expertise (McGreal & Olcott, 2022; Raj et al., 2024).

Participating in and successfully completing these educational programs typically requires students to possess high levels of self-regulation and digital literacy (Ahsan et al., 2023; Kumar et al., 2022; Tamoliune et al., 2023; Xu et al., 2024). For learners lacking these skills, micro-credentials can present significant learning barriers, such as loss of motivation and low completion rates (Ahsan et al., 2023; Pirkkalainen, 2023; Ramirez-Montoya, 2022; Tamoliune et al., 2023)

Discussion

This study examined the process of integrating individuals' learning experiences into formal education structures through micro-credentials by higher education institutions, within the context of changing labor market dynamics and lifelong learning requirements. Today, individuals are turning toward lifelong learning opportunities that adopt flexible pedagogical models—such as competency-based and modular structures aligned with industry needs—to ensure their employability in line with their education. Consequently, they are no longer sufficed with only a university degree but are becoming equipped with the qualifications required by the labor market. Industry representatives also have a positive perception of micro-credentials, as they facilitate connections with a workforce aligned with their needs. Micro-credential programs conducted by various institutions enable individuals to acquire expertise in specific knowledge, skills, and competencies through short-term learning experiences (European Commission, 2020; Brown et al., 2023; Tamoliune et al., 2023;

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Zdunek, 2024). It is considered vital that the valuable competencies acquired from micro-credential platforms—run by universities and private educational institutions—do not remain unrecorded and are instead placed within a formal quality assurance framework. However, integrating the pedagogical flexibility inherent in micro-credentials into the institutional structure of the traditional higher education system, in compliance with accreditation standards, requires meticulous effort. Traditional educational institutions may exhibit resistance to curriculum integration due to their tendency to preserve the academic status quo (Ahsan et al., 2023; Cheng et al., 2024; Lokey-Vega et al., 2025; McGreal & Olcott, 2022; Pirkkalainen, 2023; Varadarajan et al., 2025). Therefore, the integration of micro-credentials into higher education should be evaluated not merely as a technical curriculum update but also as a delicate balance established between academic credibility, standardization, and industry demands.

In the first dimension of the research, integration models of micro-credentials into higher education were examined, revealing a debate over whether these programs provide flexibility or lead to fragmentation. Since micro-credentials are by nature systems where learner autonomy is realized at the highest level, the necessity for flexibility on the academic side has come to the fore. The findings obtained in this study indicate that while micro-credentials enable just-in-time learning and increase accessibility through their modular structure, they also carry the risk of threatening the consistency of traditional education (Raj et al., 2024; Wheelahan, 2021; Wheelahan & Moodie, 2021). Wheelahan & Moodie (2021) stated that micro-credentials prepared by fragmenting the curriculum and presenting it in small modules may lead learners to acquire context-independent and superficial skill sets instead of gaining in-depth knowledge. Other supporting studies (Alenezi et al., 2024; Ferguson, 2025; Irizarry-Quintero, 2025; Lokey-Vega et al., 2025; Schutte, 2024; Wheelahan, 2021) criticize micro-credentials as instruments of an economic model that narrows the holistic purpose of education and has the potential to devalue degrees.

To manage the risk of fragmentation, higher education institutions are restructuring their pedagogical models by adopting a competency-based education approach (Alenezi et al., 2024; Wheelahan, 2021). While institutions maintain the modular structure (Alenezi et al., 2024; Iucu & Cartis, 2025; Vordenberga et al., 2024), they are simultaneously transitioning to concrete, practically evidence-based, authentic, and performance-oriented assessment methods for learning outcomes. As a critically important strategy in this context, institutions are integrating interdisciplinary structures into micro-credential designs (Ahsan et al., 2023; Alenezi et al., 2024; Lang, 2023; Miller & Jorre, 2024). Specifically, the aim is to balance the academic foundation of the program with industry requirements through content developed in collaboration with industry experts (Alenezi et al., 2024; Lang, 2023; Lokey-Vega et al., 2025; Tamoliune et al., 2023; Varadarajan et al., 2025). Micro-credentials inherently tend to focus on technical and practical skills to respond to the rapidly changing demands of the labor market (Alenezi et al., 2024; Irizarry-Quintero, 2025; McGreal et al., 2022; Narayanaswamy et al., 2024; Sharma et al., 2024; Zdunek, 2024). However, this also raises concerns that training focused on rapid adaptation to industry needs may undermine the development of broader, higher-level skills such as critical thinking, problem-solving, and communication (Alenezi et al., 2024; Desmarchelier & Cary, 2022; Wheelahan & Moodie, 2021).

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When the second dimension of the research, employer perception, is examined, a trust deficit in the literature becomes evident. Although the labor market supports skill-based hiring, it maintains certain reservations regarding micro-credentials. The findings show that while employers find micro-credentials valuable as indicators of job readiness, they do not yet fully provide the same level of trust offered by traditional degrees (Alasmari & Alzahrani, 2024; Brown et al., 2023). At the root of this distrust, as frequently emphasized in the research findings, are the lack of standardization in training (Alasmari & Alzahrani, 2024; Raj et al., 2024) and the risks of credential inflation (Alenezi et al., 2024). The varying quality levels among micro-credential programs organized by providers such as universities, MOOC platforms, and commercial training platforms lead to a devaluation of certificates. In this regard, the prominent results of the research determined that micro-credentials inspire more trust when blockchain-based verification systems are present (Alasmari & Alzahrani, 2024; Braxton, 2023; Vordenberga et al., 2024) and when they are organized by universities (Alasmari & Alzahrani, 2024; Narayanaswamy et al., 2024). The use of blockchain-based verification systems was identified as one of the most common measures to eliminate certificate forgery and reliability issues. Employers place more trust in micro-credentials that are designed in collaboration with industry partners, reflected on transcripts under the academic supervision of universities. The results also confirm that micro-credentials should be positioned not as alternatives to traditional degrees but as reinforcements that complement them.

In the third dimension focusing on the barriers to the integration of micro-credentials into higher education, it is observed that universities struggle with rigid structural rules. The integration of micro-credentials into higher education will be possible through a micro-credential ecosystem structured as stackable degrees (Braxton, 2023; Lang, 2023; Olcott, 2022; Raj et al., 2024) that can transform into full degrees over time. In this model, the goal is to transform the fragmented learning accumulations acquired by learners via micro-credentials into a larger and more recognized qualification (Braxton, 2023; Lang, 2023; Olcott, 2022; Raj et al., 2024). Learning outcomes in the program are documented through digital certificates (digital badges) with verifiable metadata (Alasmari & Alzahrani, 2024; Braxton, 2023; Vordenberga et al., 2024). The lack of global consistency in the definition, volume, and quality of these educational programs constitutes a serious barrier that makes it difficult to compare their values (Alasmari & Alzahrani, 2024; Brown et al., 2023; Gamage et al., 2025; Patterson & Hepburn, 2025; Pirkkalainen, 2023; Varadarajan et al., 2023). The absence of a nationally or internationally accepted policy or legal framework disrupts formal recognition and transferability processes. Research (McGreal et al., 2022; Pirkkalainen, 2023; Raj et al., 2024; Varadarajan et al., 2023) reveals that institutional resistance is encountered regarding the conversion of micro-credentials into academic credits and their acceptance by different national systems. Since existing external quality assurance mechanisms are designed for traditional educational programs, the implementation of an agile accreditation process compatible with the modular structure of micro-credentials is not seen as realistic (Cheng et al., 2024; McGreal & Olcott, 2022; Raj et al., 2024; Zdunek, 2024). On the other hand, studies in the literature (Hou, 2025; Irizarry-Quintero, 2025; Miller & Jorre, 2024; Narayanaswamy et al., 2024; Olcott, 2022) reveal that micro-credentials play a complementary role rather than replacing traditional degrees. As emphasized by research

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in the field (Alasmari & Alzahrani, 2024; Hou, 2025; McGreal et al., 2022; Narayanaswamy et al., 2024; Olcott, 2022), micro-credentials must provide sector-specific, practice-based, and just-in-time skills that support students' core academic competencies. Higher education institutions must adopt a hybrid education model to maintain academic rigor during the integration process of these programs, which have different structures and characteristics from conventional educational programs. In this hybrid model, universities should design micro-credential programs in continuous collaboration with industry experts, employers, and policymakers.

Although studies in the literature offer a comprehensive perspective on integration strategies, a methodological evaluation reveals significant limitations that restrict the generalizability of the findings. This situation creates research gaps. Primarily, it is observed that studies currently consist predominantly of descriptive case studies and cross-sectional surveys measuring stakeholder perceptions, such as perceived employability or intention to use. As seen in our systematic review, the lack of longitudinal research tracking the actual labor market outcomes of micro-credential holders over time is striking. Consequently, existing studies provide more information about stakeholders' perspectives on these trainings rather than what micro-credentials actually provide.

Furthermore, it is observed that studies largely include self-reported data. Research based on personal experiences and opinions carries the risk of creating a biasedly positive perception regarding micro-credentials. The literature lacks experimental or quasi-experimental research designs intended to measure the impact of micro-credentials by isolating them from other variables, such as prior education or work experience. Without control groups, it is methodologically difficult to assert causal links between micro-credentials and employment success.

When the distribution by country is evaluated, a significant geographical imbalance is evident, as the research originates primarily from Australia, North America, and Europe. The small number of studies regarding how micro-credential ecosystems operate and how training in this structure is perceived in developing economies also limits the understanding of these countries.

To address the research gaps in the literature, it is recommended that there be a shift from exploratory research toward evidence-based studies. In this context, it is suggested to conduct longitudinal studies following the 3-5 year career progression of graduates post-certification; comparative policy analyses examining integration models across different legal and regulatory environments; and studies using actual recruitment data and salary benchmarks instead of relying solely on employer satisfaction surveys.

Conclusion and Recommendations

In conclusion, systematic analyses of micro-credentials reveal that this innovative educational model is moving toward a permanent paradigm shift within the higher education system. For this transformation to be successful and sustainable, it is imperative to restructure pedagogical, administrative, and technological infrastructures in a simultaneous and harmonious manner. Micro-credentials offer significant opportunities for individuals to meet their increasingly essential lifelong learning needs (Alasmari & Alzahrani, 2024; Wheelahan, 2021) and to ensure alignment with their careers (Brown et al., 2023;

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Wheelahan, 2021). Studies (Alasmari & Alzahrani, 2024; Cho et al., 2025; Tee et al., 2024) demonstrate that micro-credentials help bridge the skill gap between traditional degree programs and the labor market. At this juncture, universities must move beyond their roles as mere content providers in the future educational ecosystem. Higher education institutions must be repositioned as the primary providers of academic rigor, transparency, and reliability within the flexible and partitioned learning process offered by micro-credentials. The academic and institutional credibility of micro-credentials can only be ensured by subjecting them to rigorous quality assurance processes. Micro-credentials reflected in university records hold a higher perceived value compared to certificates obtained from commercial platforms. Consequently, the integration of micro-credentials into higher education must be addressed through a holistic approach that requires competency-based methods for measuring learning outcomes (Alenezi et al., 2024; Galindo, 2024), modular curriculum designs (Alenezi et al., 2024; Cook, 2021; Tee et al., 2024), and continuous collaboration among stakeholders (Alenezi et al., 2024; Lang, 2023; Lokey-Vega et al., 2025; Tamoliune et al., 2023; Varadarajan et al., 2025).

Strategic Reset Model for Micro-Credentials

In light of the findings and discussions obtained in this study, a new end-to-end structured strategy model for the integration of micro-credentials into higher education has been developed by the authors (Figure 8).

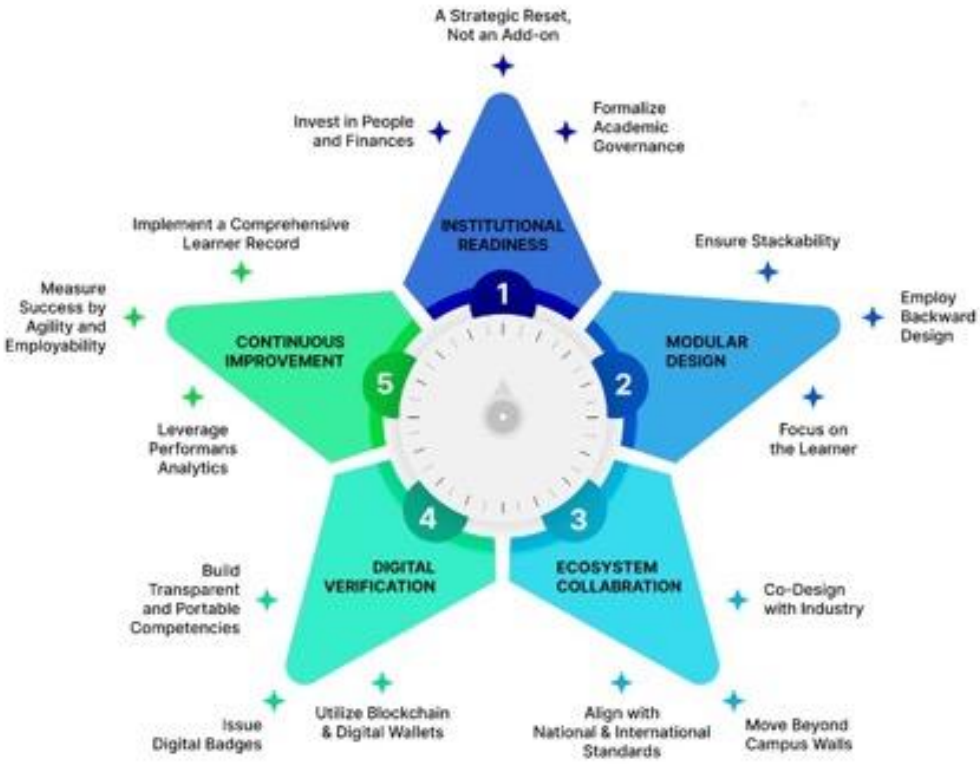

Figure 8. Strategic Reset Model for Micro-Credentials

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The Strategic Reset Model for Micro-Credentials developed within the scope of this research offers a five-dimensional architecture aimed at bridging the widening competency gap between the rigid structure of traditional academic institutions and the dynamic demands of the industry. Built upon institutional readiness, modular design, ecosystem collaboration, digital verification, and continuous improvement, the model aims to position micro-credentials as a strategic element of higher education rather than merely a supplementary educational activity.

In the Institutional Readiness stage, which is the core component of the model, it is suggested that universities should reposition micro-credentials not as a revenue stream, but as an essential component of their academic activities. In this structure, where university senates serve as the decision-making authority, institutions should establish a policy foundation that clearly outlines accreditation processes, defines quality assurance standards, and guarantees institutional recognition. Simultaneously, sustainable budget models should be created to manage financial administration, enhance the competencies of educators in micro-learning design, and provide them with financial support during this production process.

The second dimension involves Modular Design. In this framework, a modular structure is adopted rather than organizing the curriculum based on semesters. Tangible competencies demanded by the labor market should be identified, curricula should be created in a modular format for the required workforce, and subsequently, assessment tools should be designed to measure these outcomes. The resulting educational programs should be transformed into stackable learning units.

The third dimension centers on Ecosystem Collaboration to be established among the components of the ecosystem. Universities must move beyond closed-circuit operational structures and conduct this process in collaboration with industry representatives and policymakers. The design of the curriculum should not be determined solely by the work of academics; instead, it should evolve into a co-production process based on current market data with the direct participation of industry representatives. The validity of the acquired competencies should be guaranteed by ensuring full compliance with universal quality standards, such as ECTS or national qualification frameworks.

The fourth dimension features Digital Verification. The documentation of learning gains should be provided through digital badges enriched with metadata that transparently reveal content and evaluation criteria. By establishing secure blockchain-based digital wallets, students should be offered the opportunity to freely document and prove their acquired competencies across institutions and national borders.

The fifth and final dimension involves regulations regarding the Continuous Improvement of the micro-credential ecosystem. Within the system, a cyclical evaluation mechanism based on continuous improvement and performance analytics should be established. Data analytics tools should be structured to monitor the real-time impact of micro-credentials on employment, allowing the curriculum to adapt agilely to market demands. With the integration of "Comprehensive Learner Record" systems, individuals should receive credit not only for academic courses but also for activities such as volunteering and internships. In this way, a structure will be established that enables higher education institutions to transform from "degree factories" into future-ready competency centers.

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Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Human Participants

Ethical permission was not required for this study as it is a systematic literature review. The researchers did not interact with any human participants or subjects, and no identifiable private information was obtained. The research was conducted by synthesizing and analyzing existing, publicly available academic publications.

Originality Note

This is the authors' original work and proper citations are included where applicable. The data that support the findings of this study are available in the supplementary material of this article. The list of analyzed studies and the coding protocol (Appendix) are available as an online supplementary file.

Use of Generative AI/ AI-assisted Technologies Statement

During the preparation of this manuscript, the authors acknowledge that the paper was proofread and edited with the assistance of [DeepL] and [Gemini]. The authors reviewed all AI-generated suggestions to ensure accuracy and retain full responsibility for the final content. No further use of these technologies are also confirmed by the authors to write different parts of the research.

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