

Mapping the Integration of AI into Business Education: Insights from a Decade of Research

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Abstract

This study aims to systematically map the evolving landscape of artificial intelligence (AI) integration into business education, highlighting dominant research themes, emerging gaps, and future research directions. Adopting a bibliometric analysis framework, the study analyzed 213 peer-reviewed journal articles published between 2015 and 2024, extracted from the Dimensions database. Bibliographic coupling and co-word analysis, facilitated through VOSviewer, were employed to uncover intellectual structures, thematic clusters, and conceptual linkages within the field. The results identified four major research clusters: AI-driven business education transformation, innovative digital pedagogies, AI-enhanced personalization of learning, and business education aligned with the digital economy. Co-word analysis further revealed three conceptual trends: technological transformation, integration of generative AI tools, and advancements in educational quality. Persistent gaps emerged concerning curriculum coherence, educator readiness, and assessment validity. This study offers actionable guidance for educators, curriculum developers, and policymakers to design AI-integrated, ethically grounded, and adaptable business education models that meet the demands of an AI-driven global economy. This study provides a comprehensive, empirical foundation for future research agendas and strategic educational reforms.

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Practitioner Points

1. AI integration in business education requires coordinated curriculum and assessment redesign rather than isolated tool adoption.
2. Generative AI necessitates authentic, process-oriented assessment approaches that move beyond content reproduction.
3. Business programs should embed AI literacy, ethical reasoning, and digital competencies into core learning outcomes.
4. Sustained professional development is essential to strengthen educator capability in AI-supported teaching environments.
5. Evidence-informed, program-level planning supports responsible and pedagogically coherent AI adoption in business schools.

Keywords

Artificial intelligence, business education, bibliometric analysis, curriculum innovation, quality education

Introduction

Integrating artificial intelligence (AI) technologies into business education has generated a surge in scholarly research, reflecting the urgency for higher education institutions to adapt to technological transformations (Chen et al., 2022). AI-driven innovations, such as machine learning algorithms, generative AI platforms, chatbots, and adaptive learning environments, are widely recognized for enhancing personalization, scalability, and the overall quality of business education (Fang & Jia, 2024). Scholars have consistently highlighted the role of AI in fostering entrepreneurial competencies, critical thinking, and personalized learning pathways to meet the demands of a digitally oriented economy (Wang & Sun, 2024). However, while the literature increasingly emphasizes the benefits of AI integration, a critical methodological issue remains: the lack of systematic, business education-focused, and pedagogically grounded mapping of how knowledge in this field has evolved.

Despite the growing adoption of AI in business education, existing research remains fragmented and largely case-specific. Many studies focus on specific AI applications such as simulation games, intelligent tutoring systems, and learning analytics for educational support (Lin et al., 2023; Marouf et al., 2024), yet they do not clearly connect these innovations to broader pedagogical concerns such as curriculum coherence, assessment design, educator capability, or discipline-specific instructional practices. Findings from these studies do not accumulate into a clear and integrated understanding that can meaningfully inform teaching practices and curriculum decision-making in business education. Comprehensive and cumulative analyses of AI's transformative influence on business education remain limited (Guermazi et al., 2024). As Kaufmann et al. (2024) argue, the inability to reveal the field's broader intellectual structure, thematic evolution, and interdisciplinary connections often come from the subjective selection criteria in traditional narrative literature review. This finding clearly shows the presence of a significant research gap. It emphasizes the need for methodological approaches that move beyond describing individual innovations to systematically map the thematic landscape and evolution of AI-related research. Traditional literature syntheses are limited in their ability to identify emerging research fronts and shifting conceptual paradigms (Fang & Jia, 2024).

Previous bibliometric and review studies have explored AI in business and entrepreneurship education, but their contributions remain largely descriptive or focused on specific applications. Saleem (2025) maps agentic AI trends across the student life cycle, while Chen et al. (2024) catalogue AI tools and pedagogical designs without synthesizing their implications for curriculum coherence or assessment practices. Other reviews emphasize specific contexts, such as incubation centers (Thottoli et al., 2025) or the broader evolution of entrepreneurship education themes (Talukder et al., 2024). The current study extends literature by interpreting bibliometric clusters through a pedagogical lens, showing how AI reshapes teaching practices, curriculum priorities, and assessment challenges in business education. It reframes AI integration not just as a technological development but also as a pedagogical transformation. Without a holistic, longitudinal, and interdisciplinary examination, fragmented insights may continue to shape the future direction of AI integration in business education instead of an empirically grounded framework. The overarching problem, therefore, lies in the absence of a pedagogically informed synthesis that enables business educators to make informed decisions about teaching, curriculum, and assessment.

In response to these limitations, bibliometric analysis emerges as a highly relevant methodological approach. Bibliometric techniques, including bibliographic coupling and co-word analysis, provide a robust, objective, and replicable approach to examining scholarly communications (Klarin, 2024; Mukherjee et al., 2022). By analyzing citation networks and keyword co-occurrences, bibliometric methods allow researchers to systematically map the structure of knowledge domains, uncover research trends, and identify interdisciplinary linkages that narrative reviews often overlook (Callon et al., 1983; van Eck & Waltman, 2014). Through visualizations generated by tools like VOSviewer, the hidden structure of research becomes visible, revealing dominant themes, emerging topics, and gaps that require further scholarly attention (Zupic & Čater, 2015). In this context, bibliometric analysis not only enriches scholarly understanding but also offers timely, evidence-based insights to support curriculum, assessment, and educator decision-making in business education. By combining bibliographic coupling and co-word analysis, this study interprets how emerging research themes translate into pedagogical priorities, curriculum innovation, and assessment challenges. It offers a pedagogically grounded synthesis that supports evidence-informed decision-making for business educators, curriculum designers, and academic leaders navigating AI-enabled teaching environments. Hence, this study aims to address two research objectives:

Research Objective 1: To explore the main research themes and trends that currently define the integration of AI in business education, and

Research Objective 2: To identify emerging topics and research gaps that may shape future directions in the field.

The study advances a more comprehensive, strategic, and empirically grounded understanding of how AI is redefining business education by employing a rigorous bibliometric methodology. In practice, this study offers a clear pedagogical contribution by clarifying how AI is reshaping the teaching practices, curriculum design, and assessment approaches in business education. By systematically mapping dominant and emerging research clusters, the analysis helps business educators to move beyond isolated AI tools toward a more comprehensive understanding of where AI can meaningfully support entrepreneurial skill development, adaptive learning, and curriculum transformation. Rather than treating AI integration as a technical add-on, the findings of the study highlight distinct pedagogical pathways, ranging from personalization and experiential learning to curriculum redesign aligned with the digital economy, which can guide instructional decisions and program-level planning in business education.

Literature

The rapid integration of AI into business education reflects broader digital transformation in higher education and has generated a growing body of scholarly attention. Previous studies have documented the use of AI technologies, such as machine learning, generative AI, chatbots, and adaptive learning platforms, to enhance personalization, entrepreneurial competencies, and instructional efficiency (Kang, 2022; Li et al., 2022; Zhu & Zhang, 2022). While this literature demonstrates the expanding scope of AI applications, it also highlights important questions regarding how institutions and educators integrate these innovations into teaching, curriculum, and assessment in business education.

Synthesizing prior research reveals that the expansion of AI applications has generated three interrelated pedagogical challenges. First, curriculum coherence remains problematic, as AI tools are frequently introduced as isolated instructional innovations rather than systematically aligned with entrepreneurial learning outcomes and assessment frameworks (Bell & Bell, 2023; Winkler et al., 2023). Second, educator readiness consistently emerges as a constraint, with studies reporting disparities in pedagogical competence, ethical judgment, and assessment literacy that limit the meaningful integration of AI and may exacerbate educational inequalities without systemic support (Alfirević et al., 2024; Mu & Zhao, 2024). Third, assessment validity and instructional authenticity are increasingly challenged in AI-mediated learning environments, where evaluating genuine student learning and maintaining academic integrity become more complex (Adel et al., 2024; Vallis et al., 2024).

Evidence of these challenges appears across multiple strands of the literature. Studies on simulation games, intelligent tutoring systems, and virtual learning environments report improvements in entrepreneurial mindset, critical thinking, and innovation, yet often offer limited guidance on how these tools are integrated into coherent curricula or assessed consistently across programs (Anubhav et al., 2024; Somià & Vecchiarini, 2024). Similarly, research on generative AI highlights its potential to foster entrepreneurial competencies and AI literacy for the digital economy, while leaving unresolved questions regarding pedagogical alignment and educator decision-making (Bell & Bell, 2023).

AI-enabled approaches such as machine learning-supported simulations and AI-generated avatars promote experiential and student-centered learning (Lu et al., 2023; Zhu & Zhang, 2022). However, these approaches also raise concerns regarding instructional authenticity and the validity of assessment practices, particularly when AI mediates learner interaction and output (Alfirević et al., 2024; Vallis et al., 2024). At the institutional level, learning analytics and intelligent systems are increasingly adopted to improve advising and administrative efficiency, yet scholars caution that such applications require careful pedagogical and ethical governance to protect student data and support educational goals (Chen et al., 2023; Liang & Bai, 2024; Xu & Babaian, 2021).

These strands of research suggest that technological adoption has advanced faster than pedagogical integration. Ethical concerns related to algorithmic bias, depersonalization of learning, and data privacy further intensify these challenges by directly influencing instructional judgment and assessment fairness (Adel et al., 2024; Ly & Ly, 2025; Zeb et al., 2024). At the same time, the literature remains fragmented, with many studies examining specific applications without offering broader insight into how AI reshapes curriculum design, pedagogical models, and educator practice across contexts (Dabbous & Boustani, 2023; Fang & Jia, 2024; Lesinskis et al., 2023; Wang & Sun, 2024).

This fragmentation limits the ability of business educators to draw on an integrated evidence base to guide curriculum planning, assessment design, and professional development in AI-enabled teaching environments. As a result, scholars increasingly call for pedagogically grounded frameworks that combine technological innovation with human-centered pedagogy, adaptive learning, and critical digital literacy (Ifenthaler et al., 2023; Sollosy & McInerney, 2022; Thanasi-Boçe & Hoxha, 2024). In this context, bibliometric analysis offers a systematic and objective approach to synthesizing fragmented research, enabling the identification of dominant themes,

pedagogical tensions, and emerging directions that narrative reviews may not fully capture (van Eck & Waltman, 2014; Zupic & Čater, 2015).

Method

Search strategy

The bibliographic data for this study were extracted from the Dimensions database on May 6, 2025, using a refined Boolean search strategy targeting title and abstract text data relevant to the integration of AI in business education (Table 1). This structured search strategy ensured systematic identification of relevant literature while maintaining conceptual alignment with the study's focus on AI integration in business education.

Table 1

Search string used for the database search

Keyword	Justification
"artificial intelligence" OR "AI" OR "machine learning" OR "chatbot" OR "ChatGPT" OR "natural language processing" OR "large language models" OR "generative AI"	To identify literature on artificial intelligence
"business education" OR "teaching business" OR "entrepreneurship education" OR "business pedagogy" OR "business curriculum" OR "business teaching"	To identify literature on business education

The Dimensions database was selected for this study due to its open-access model and extensive multidisciplinary coverage, making it suitable for mapping an emerging and cross-disciplinary field such as AI in business education. As of 2025, Dimensions indexes over 150 million research outputs, encompassing scholarly articles, conference proceedings, books, patents, clinical trials, and datasets, positioning it as one of the most comprehensive and integrative research platforms available (Hook et al., 2018). In contrast to databases that emphasize journal selectivity, Dimensions adopts a broader inclusion strategy across disciplines and publication types, thereby facilitating holistic trend analyses and the identification of emerging topics that may be overlooked in more restrictive indexing systems (Herzog et al., 2020).

Screening

For quality control, ensuring temporal consistency and scholarly rigor, this study included only peer-reviewed journal articles published between 2015 and 2024. This period reflects the sustained growth of AI-related research in business education. Non-journal formats, such as book chapters and conference proceedings, were excluded to maintain data standardization and peer-review integrity (Mingers & Leydesdorff, 2015).

Articles were further screened based on their explicit focus on AI within business or entrepreneurship education contexts, as determined through title and abstract review. While these criteria may exclude some practitioner-oriented or emerging conference-based insights, they provide a consistent and methodologically rigorous foundation for systematically capturing the intellectual evolution and thematic structure of AI research in business education.

Data Analysis

This study adopted a bibliometric analysis framework to systematically examine the thematic progression, intellectual foundations, and emerging research trajectories related to the integration of AI in business education. As a quantitative and replicable method, bibliometric analysis enables a rigorous investigation of scholarly outputs by mapping citation networks, authorship patterns, and keyword co-occurrence structures (van Eck & Waltman, 2014). In contrast to traditional narrative reviews, bibliometric approaches allow for the visualization of knowledge structures and the identification of interdisciplinary linkages within and across research domains. This approach directly addressed the central problem by enabling a systematic and comprehensive mapping of AI's impact on business education.

The dataset explored in this study was extracted from the Dimensions database. To gather sufficient and relevant publications to realize the objectives of the study, the dataset was filtered, selected, and extracted for its extensive interdisciplinary breadth and rich metadata coverage (Hook et al., 2018). To address the research objectives, two core bibliometric analysis techniques were utilized: bibliographic coupling and co-word analysis. Together, these techniques enable a multidimensional examination of both the structural and conceptual evolution of AI research in business education.

Bibliographic coupling analysis was employed to assess thematic similarities between documents based on shared citations. When two articles reference the same source, it suggests that they address related research problems or theoretical perspectives (Kessler, 1963). This method is particularly effective for mapping contemporary research fronts, as it connects recent publications around emerging topics, even if they have not yet accumulated significant citation counts (Zupic & Čater, 2015). Moreover, bibliographic coupling facilitates the identification of scholarly clusters that align methodologically or thematically, which is crucial in interdisciplinary fields such as business education innovation. It addresses the fragmentation of the field by revealing how individual studies connect to broader intellectual structures.

Co-word analysis was used to examine terms extracted from titles and abstracts to uncover conceptual structures and emerging research areas. This technique identifies semantic associations between keywords based on their frequency of co-occurrence, offering insights into how research themes are organized and evolve (Callon et al., 1983). Co-word analysis is especially valuable for detecting future research trajectories and mapping evolving conceptual linkages within the field (Tan Luc et al., 2022).

All the data were analyzed using the VOS viewer software. The software was utilized in facilitating the construction of network visualizations for publications, authors, and keywords. These visual maps offer valuable insights into research clusters, their underlying intellectual structures, and the intersections that span disciplinary boundaries. Bibliometric analysis thus provides a rigorous framework for unveiling the knowledge architecture of the field and serves as a foundation for guiding future empirical investigations and theoretical advancements.

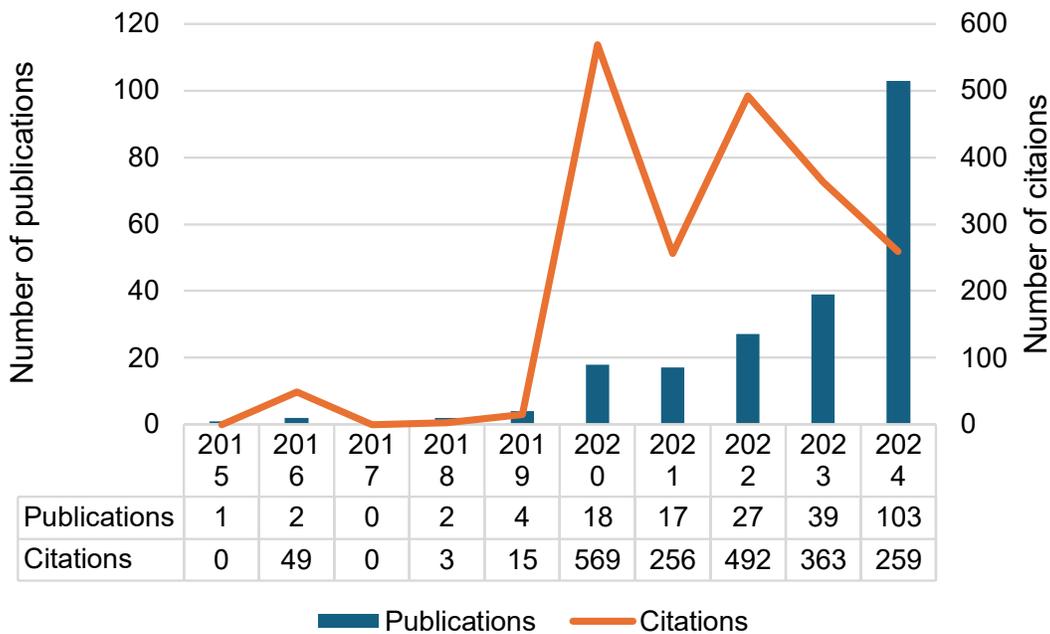
Results

Descriptive analysis

213 publications on AI applications in business education were retrieved from the Dimensions database, covering 2015–2024. The dataset accumulated 2,006 citations, averaging 9.42 citations per publication, with an H-index of 21, indicating emerging but significant scholarly engagement. Figure 1 illustrates annual growth trends, with publication counts rising from 1 in 2015 to 103 in 2024, the most prolific year. Citations peaked in 2020 with 569 citations, reflecting an early surge of academic recognition and foundational contributions to the field. Although citation volumes slightly declined in subsequent years, the persistent upward trend in publication output highlights a sustained and growing momentum toward integrating AI within business education research.

Figure 1

Number of publications and citations on the integration of AI in business education



Bibliographic coupling analysis

From the initial dataset of 213 documents retrieved from the database, 58 documents met the threshold criterion of having at least eight cited references. After further refinement, 33 documents representing the most interconnected publications were retained for analysis. Multiple threshold values were tested to ensure the formation of robust and well-balanced clusters, ultimately selecting a value that avoids overly simplistic or excessively complex visualizations. The final threshold provided the bibliographic coupling network's optimal clarity and thematic coherence.

The analysis revealed that the most strongly coupled publications were Somià & Vecchiarini (2024), with 10 citations and 44 total link strength. These were followed by Vecchiarini & Somià (2023), with 44 citation and ,Kumar et al. (2024) which received 38 citations; both studies recorded a total link strength of 40. Table 2 presents the top ten documents with the highest total link

strength, which indicates the cumulative strength of a publication's connection to other documents. (van Eck & Waltman, 2014).

Table 2

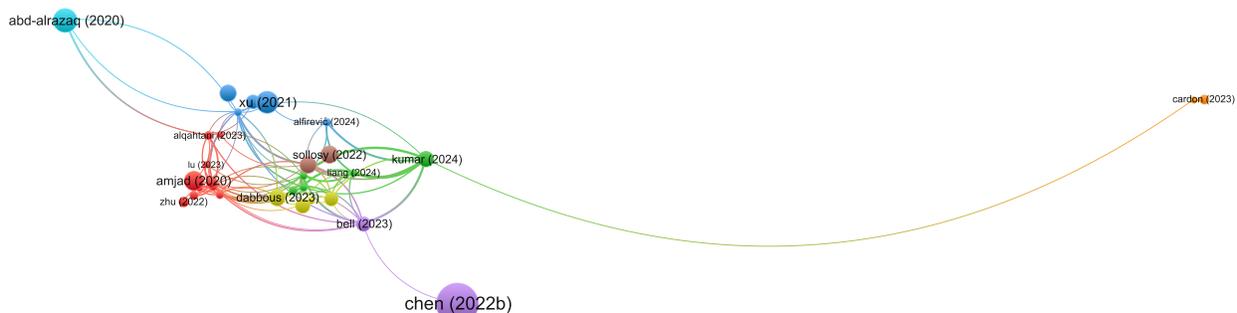
Top 10 documents with the highest total link strength in bibliographic coupling analysis

Documents	Citation	Total link strength
Somià, T., & Vecchiarini, M. (2024). Navigating the new frontier: the impact of artificial intelligence on students' entrepreneurial competencies. <i>International Journal of Entrepreneurial Behavior & Research</i> , 30(11), 236–260.	10	44
Vecchiarini, M., & Somià, T. (2023). Redefining entrepreneurship education in the age of artificial intelligence: An explorative analysis. <i>The International Journal of Management Education</i> , 21(3), 100879.	44	40
Kumar, S., Rao, P., Singhania, S., Verma, S., & Kheterpal, M. (2024). Will artificial intelligence drive the advancements in higher education? A tri-phased exploration. <i>Technological Forecasting and Social Change</i> , 201, 123258.	38	40
Thanasi-Boçe, M., & Hoxha, J. (2024). From ideas to ventures: building entrepreneurship knowledge with LLM, prompt engineering, and conversational agents. <i>Education and Information Technologies</i> , 29(18), 24309–24365.	9	38
Liang, E. S., & Bai, S. (2024). Generative AI and the future of connectivist learning in higher education. <i>Journal of Asian Public Policy</i> , 1–23.	9	36
Anubhav, K., Dwivedi, A. K., & Aashish, K. (2024). Entrepreneurship education in higher education (2002–2022): A technology-empowered systematic literature review. <i>The International Journal of Management Education</i> , 22(3), 100993.	13	32
Bell, R., & Bell, H. (2023). Entrepreneurship education in the era of generative artificial intelligence. <i>Entrepreneurship Education</i> , 6(3), 229–244.	34	29
Chen, L., Ifenthaler, D., Yau, J. Y. K., & Sun, W. (2024). Artificial intelligence in entrepreneurship education: a scoping review. <i>Education and Training</i> .	10	25
Lesinskis, K., Mavlutova, I., Spilbergs, A., & Hermanis, J. (2023). Digital Transformation in Entrepreneurship Education: The Use of a Digital Tool KABADA and Entrepreneurial Intention of Generation Z. <i>Sustainability (Switzerland)</i> , 15(13).	22	22

Based on network visualization, bibliographic coupling analysis produces four distinct clusters. Figure 2 shows the network structure of bibliographic coupling analysis. Each cluster was labeled and characterized based on representative publications according to the authors' inductive interpretation and understanding of the four clusters. These clusters directly respond to the field's fragmentation by providing a system-level overview of how themes in AI and business education are connected.

Figure 2

Bibliographic coupling analysis on the integration of AI in business education



The first cluster (red) is labeled "business education transformation in the AI era" reflects how AI is reshaping business education through evolving expectations for teaching, learning, and professional preparation. Several studies emphasize AI's role in developing entrepreneurial competencies and communication skills critical for the future workforce (Bell & Bell, 2023; Cardon et al., 2024; Somià & Vecchiarini, 2024). Research highlights adopting AI tools like chatbots to support student success (Chen et al., 2023) and explores the authenticity challenges in AI-assisted writing (Coman & Cardon, 2024). Generative AI and large language models are transformative forces in knowledge construction and curriculum design (Liang & Bai, 2024; Thanasi-Boçe & Hoxha, 2024). This cluster suggests that as AI becomes embedded in business education, greater emphasis is placed on educators' pedagogical judgment, ethical awareness, and capacity to design meaningful learning and assessment in AI-enabled environments (Mu & Zhao, 2024).

The second cluster (green) is labeled "innovative digital pedagogies in AI-enhanced business education" focuses on the integration of AI technologies into pedagogical design within business education, particularly through innovative and experiential learning approaches. Studies in this cluster show how machine learning, deep learning, and simulation tools enhance entrepreneurial attitude, intention, and education quality (Chen et al., 2022; Lu et al., 2023; Zhu & Zhang, 2022). To bridge the pedagogical gaps, researchers advocate for digital transformation models and design-driven pedagogies (Amjad et al., 2020; landoli, 2023). Integrating AI and virtual reality environments offers new avenues for immersive learning (Chen et al., 2022; Li et al., 2022). This cluster suggests that while AI-enabled pedagogical innovations are advancing rapidly, their

educational value increasingly depends on how coherently such approaches are integrated across courses and aligned with shared curricular and assessment goals.

The third cluster (blue) is labeled "AI-driven personalization in business education" highlights the growing emphasis on personalized learning enabled by AI in business education. Several studies highlight the role of AI tools such as customized chatbots and AI-generated avatars in enhancing, but sometimes complicating, teaching effectiveness (Alfirević et al., 2024; Vallis et al., 2024). Scoping reviews highlight AI's pedagogical potential for entrepreneurship and business curricula (Chen et al., 2024; Xu & Babaian, 2021), while learning analytics and self-assessment models support individualized learning (Ifenthaler et al., 2023). This cluster portrays AI as a catalyst for personalization and engagement, while drawing attention to emerging questions about instructional authenticity and how student learning is evaluated in increasingly adaptive, AI-mediated environments.

The fourth cluster (yellow) is labeled "transforming business education for the AI-driven digital economy" captures how business education is evolving in response to broader digital transformation and the increasing presence of AI. Studies highlight how AI experiences, intelligent personal assistants, and digital platforms are reshaping active learning and entrepreneurial intentions (Dabbous & Boustani, 2023; Wang & Sun, 2024). Innovative teaching strategies are emphasized as essential to equip students for the digital economy (Mavlutova et al., 2020; Sollosy & McInerney, 2022). Redefining entrepreneurship education in light of generative AI is another emerging theme, focusing on adapting pedagogies to cultivate new mindsets and competencies (Vecchiarini & Somià, 2023; Winkler et al., 2023). This cluster suggests that curriculum design in business education is increasingly shaped by the need to balance responsiveness to digital economy demands with pedagogically coherent and assessable learning structures.

Table 3 summarizes the bibliographic coupling analysis by presenting its clusters, cluster labels, number of articles, and representative publications.

Table 3

Bibliographic coupling clusters on AI integration in business education

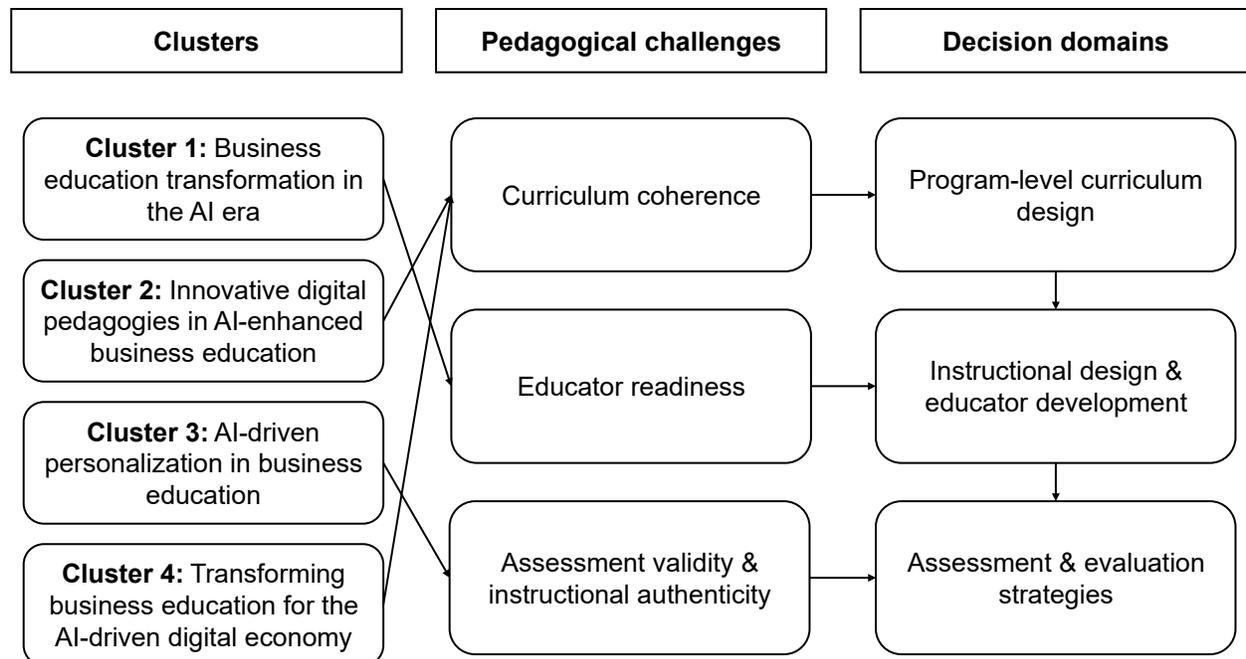
Cluster No and color	Cluster label	Number of articles	Representative publications
1 (red)	Business education transformation in the AI era	10	Bell & Bell, 2023; Cardon et al., 2024; Chen et al., 2023; Coman & Cardon, 2024; Kumar et al., 2024; Laptev & Feyzrakhmanova, 2021; Liang & Bai, 2024; Mu & Zhao, 2024; Somià & Vecchiarini, 2024; Thanasi-Boçe & Hoxha, 2024
2 (green)	Innovative digital pedagogies in AI-enhanced business education	10	Amjad et al., 2020; Anubhav et al., 2024; Chen et al., 2022; Chen, 2022; landoli, 2023; Lesinskis et al., 2023; Li et al., 2022; Lu et al., 2023; Zhu & Zhang, 2022

3 (blue)	AI-Driven personalization in business education	7	Alfirević et al., 2024; Chen et al., 2024; Ifenthaler et al., 2023; Vallis et al., 2024; Xu & Babaian, 2021
4 (yellow)	Transforming business education for the AI-driven digital economy	6	Dabbous & Boustani, 2023; Mavlutova et al., 2020; Sollosy & McInerney, 2022; Vecchiarini & Somià, 2023; Wang & Sun, 2024; Winkler et al., 2023

Figure 3 synthesizes the bibliographic coupling results by illustrating how dominant research clusters on AI in business education are interpreted through core pedagogical challenges, namely curriculum coherence, educator readiness, and assessment validity in AI-mediated learning environments. Rather than treating AI integration as a purely technological shift, the mapping highlights how these challenges shape key decision domains related to program-level curriculum design, instructional practice, and evaluation strategies. By positioning pedagogical challenges as the interpretive lens connecting research themes to educational decision-making, the figure highlights that effective AI integration in business education emerges from coordinated pedagogical judgment rather than isolated adoption of digital tools.

Figure 3

Conceptual mapping of clusters, pedagogical challenges, and decision domains in the integration of AI in business education



Co-word analysis

From the 6,731 keywords extracted from titles and abstracts, 65 met the minimum threshold of 10 occurrences, forming three clusters. Since VOSviewer captures all terms, including irrelevant terms such as generic words, methodological phrases, and short or ambiguous expressions.

Thus, data cleaning was necessary to refine the results. The researcher performed an initial co-word analysis using the binary counting method, which records term presence rather than frequency to minimize bias from longer abstracts. Irrelevant terms were excluded through a thesaurus. The cleaning and validation processes were repeated multiple times, ensuring accuracy. After applying the thesaurus and exclusion criteria, a final review confirmed the relevance and precision of the terms selected for the co-word analysis.

The final analysis showed that the keywords with the highest co-occurrence were artificial intelligence (119), education (110), and student (106). Table 4 summarizes the top 15 co-occurring keywords, their number of occurrences, and relevance. These dominant terms reflect the field's strong emphasis on technological foundations and learner-centered dimensions within AI-enabled business education.

Table 4

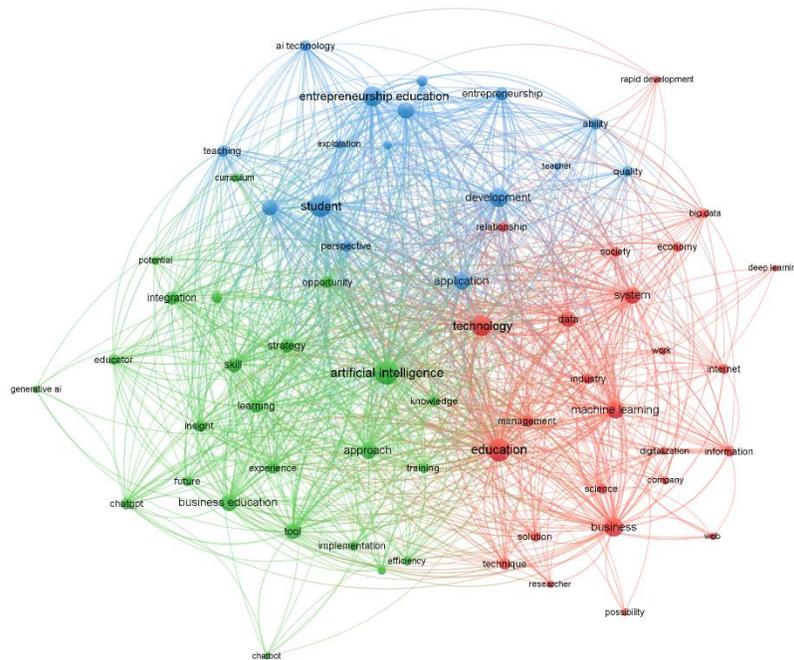
Top 15 keywords in the co-occurrence of keywords analysis

Ranking	Keyword	Occurrences	Relevance
1	artificial intelligence	119	0.14
2	education	110	0.32
3	student	106	0.48
4	technology	91	0.13
5	entrepreneurship education	79	0.72
6	business	78	1.40
7	development	75	0.19
8	machine learning	63	0.75
9	approach	58	0.14
10	innovation	57	0.50
11	application	57	0.19
12	system	56	0.50
13	business education	55	0.91
14	higher education	54	0.61
15	tool	54	0.42

Figure 4 presents a network map of the co-word analysis. The map produced three clusters, which were classified and labeled based on the author's inductive interpretation of the occurring words. Co-word analysis is particularly suited to detecting evolving conceptual linkages and highlighting emerging directions for future AI and business education research.

Figure 4

Co-word analysis on the integration of AI in business education



The first cluster (red) with 25 keywords is labeled “technological transformation in business education” reveals a strong intersection of technology (big data, machine learning, deep learning) with business education. This underscores the digital transformation reshaping how knowledge is created, distributed, and applied in business contexts (Chen et al., 2023). Digitalization and rapid development drive new solutions and systems for personalized learning and management efficiency (Xu & Babaian, 2021). Relationships between researchers, society, and economy highlight the societal impact of AI-based educational reforms (Ifenthaler et al., 2023). This co-word structure aligns with advances in learning analytics and adaptive systems. The cluster indicates a shift from traditional business education models toward AI-driven, technology-mediated approaches. Emerging gaps include the need for frameworks that balance technological innovation with human-centered pedagogy. These connections enrich understanding of how AI, digital systems, and economic trends are co-evolving to redefine business education landscapes.

The second cluster (green) consists of 24 keywords is labeled "curriculum integration of generative AI tools in business education" highlights the strategic role of AI, particularly generative AI and tools like ChatGPT, in reshaping business education and curriculum design. Central themes include integrating AI-driven tools into educator practices, enhancing efficiency, learning experiences, and training outcomes (Strielkowski et al., 2024). The cluster highlights a shift toward future-oriented skills development, knowledge building, and strategy innovation (Wang & Sun, 2024). Emphasis on opportunity, potential, and insight suggests that AI improves current educational methodologies and opens new research avenues for understanding AI’s evolving role (Alam & Mohanty, 2023). This co-word structure points to a gradual shift toward adaptive, AI-supported learning contexts and how such tools are pedagogically integrated into coherent curricula in business education.

The third cluster (blue) comprises 16 keywords is labeled "advancing quality in business education through AI" reflects the intersection of AI technology with the development of business

education. Core themes include leveraging platforms, applications, and innovations to enhance students' and teachers' effectiveness, quality, and ability (Chen et al., 2024). Focusing on teaching and learning effectiveness emphasizes the need for technology-enhanced pedagogical models in entrepreneurship training (Somià & Vecchiarini, 2024). The analysis highlights the trend toward exploratory approaches that promote agile skill development and real-world application (Thanasi-Boçe & Hoxha, 2024). This cluster connects with experiential learning models and AI-driven adaptive learning platforms. Research gaps remain in evaluating platform-driven interventions' longitudinal impacts. This cluster portrays AI as a catalyst for pedagogical innovation and quality enhancement, while implicitly highlighting the need for sustained evaluation of how such innovations translate into coherent and durable educational practice.

Table 5 summarizes the co-word analysis represented by the cluster label, number of keywords, and representative keywords.

Table 5

Co-word analysis on the integration of AI in business education

Cluster No and color	Cluster label	Number of keywords	Representative Keywords
1 (red)	Technological transformation in business education	25	technology, big data, machine learning, deep learning, digitalization, education, company, management, industry, rapid development
2 (green)	Curriculum integration of generative AI tools in business education	24	artificial intelligence, generative AI, ChatGPT, chatbots, business education, curriculum
3 (blue)	Advancing quality in business education through AI	16	AI technology, entrepreneurship education, higher education, quality, teacher, student, teaching

Taken together, the bibliographic coupling and co-word analyses directly address the study's two objectives by revealing not only the dominant themes and trends shaping AI integration in business education such as technological transformation, innovative pedagogies, personalization, and alignment with the digital economy but also how these themes respond to core pedagogical challenges identified in the literature, namely curriculum coherence, educator readiness, and assessment validity in AI-mediated learning environments. The analyses uncover critical gaps, particularly around ethical frameworks, inclusivity, and professional capacity building, which signal areas where pedagogical guidance remains underdeveloped. By systematically mapping these clusters and conceptual linkages through a pedagogical lens, the results move beyond thematic description to clarify how existing research informs, and at times fails to inform, concrete instructional, curricular, and professional decisions faced by business educators and academic leaders. In doing so, the findings provide the comprehensive,

longitudinal perspective that has been missing in prior fragmented analyses and align closely with the study's intended contributions.

Discussion

This discussion explores key research streams shaping the integration of AI in business education, building on the bibliographic coupling and co-word analyses. Moving beyond thematic description, the results reveal a broader pedagogical transformation within business education. The identified research clusters collectively signal changes in curriculum design, assessment practices, educator roles, and institutional strategy that align with ongoing debates in digital pedagogy, authentic assessment, and learner-centered education.

AI-driven transformation of business education structures

The bibliographic coupling and co-word analyses point to a structural transformation in business education, in which AI increasingly shapes how curricula, pedagogical approaches, and entrepreneurial competencies are conceptualized. The literature reflects its growing influence on program design, knowledge construction, and the organization of learning experiences. Strong thematic linkages around generative AI, chatbots, digital platforms, and entrepreneurial competency development suggests a reconfiguration of how knowledge is constructed and how professional preparation is framed within business programs (Kumar et al., 2024; Somià & Vecchiarini, 2024), while co-word patterns emphasize AI's integration across education, management, and digital economy contexts (Chen et al., 2023), underscoring its systemic influence.

The clustering patterns suggest that research attention has shifted from experimentation with discrete AI applications toward broader concerns of curriculum coherence and learning system integration. The recurring linkage between AI technologies and constructs such as competence development, knowledge construction, and learning design indicates that the literature increasingly frames AI as a structural element of educational environments rather than as an auxiliary enhancement.

The emergence of educator readiness as a recurring theme across clusters further signals a transition in how responsibility for AI integration is conceptualized. Rather than focusing only on student interaction with AI tools, the literature increasingly foregrounds the educator's role in mediating technological affordances, shaping learning conditions, and sustaining pedagogical intent (Ifenthaler et al., 2023). This shift reflects a movement in the research landscape from tool-centered inquiry to capability-centered inquiry.

Similarly, the co-word analysis highlights growing attention to assessment validity, authenticity, and evaluation processes. The alignment of generative AI themes with assessment-related terminology suggests that the literature increasingly recognizes the implications of AI for how learning is evidenced and judged. Rather than concentrating exclusively on adoption challenges, research appears to be engaging more deeply with questions of coherence between intended learning outcomes and evaluative practices.

These patterns indicate that AI research in business education has matured from exploratory studies of technological implementation toward more systemic engagement with curriculum structure, educator capability, and assessment design. The findings, therefore, suggest that AI

integration is increasingly conceptualized as a pedagogical reconfiguration within business education rather than as a technological disruption.

Curriculum innovation and adaptive learning through generative AI in business education

The bibliometric analyses reveal a growing emphasis on curriculum innovation in business education driven by the integration of generative AI. Research increasingly focuses on how tools such as ChatGPT and other machine learning platforms support adaptive learning environments that emphasize flexibility, learner agency, and responsiveness to individual learning needs. Bibliographic coupling highlights scholarship exploring AI-enhanced pedagogical approaches to entrepreneurship education (Liang & Bai, 2024; Thanasi-Boçe & Hoxha, 2024), while co-word patterns point to a broader shift toward technology-rich learning ecosystems aligned with the demands of the digital economy (Wang & Sun, 2024).

The clustering patterns suggest that generative AI is associated not only with new instructional tools but also with the reconsideration of curriculum structure and learning design. Terms linked to adaptability, innovation, and competency development suggest that the literature increasingly conceptualizes curriculum as dynamic rather than static, with AI positioned within an evolving learning landscape. This shift reflects a movement toward learning environments that emphasize application, iteration, and contextual problem-solving.

At the same time, the co-occurrence of generative AI with themes related to assessment, academic integrity, and evaluation signals an emerging tension within the research landscape. The findings indicate that while AI-enabled systems support personalization and skill acceleration, they also provoke renewed scrutiny of how learning is evidenced and judged. Rather than focusing on misconduct prevention, the literature increasingly engages with questions of assessment authenticity, process visibility, and alignment between intended learning outcomes and evaluative practices.

The prominence of ethical considerations and educator AI literacy gaps further suggests that curriculum innovation unfolds alongside questions of professional capacity and instructional judgment (Chen et al., 2024). Across clusters, the integration of AI is linked to the educator's role in structuring meaningful tasks, guiding reflective engagement with AI outputs, and sustaining coherence across learning activities. These patterns indicate that adaptive, AI-enabled curricula are not defined by tool adoption, but by the deliberate coordination of learning objectives, instructional design, and assessment processes.

The findings suggest that generative AI is reshaping how curriculum is conceptualized within business education, prompting a shift toward more iterative, context-sensitive, and capability-oriented learning models.

Theoretical implications

This study advances understanding of AI integration in business education by conceptualizing it as a structural reconfiguration of curriculum, assessment, and educator practice rather than as the adoption of discrete technological tools. The bibliometric analyses demonstrate that generative AI and machine learning are increasingly positioned within the literature as integral to curriculum design, knowledge construction, and the organization of learning systems (Chen et al., 2023; Somià & Vecchiarini, 2024). This repositioning signals a shift in how business education

defines graduate capabilities, instructional design, and evaluative practices in digitally mediated environments.

The emergence of clusters centered on educator readiness, curriculum coherence, and assessment validity suggests that AI integration intensifies foundational questions about alignment between learning outcomes, teaching strategies, and evaluation methods. Rather than displacing established pedagogical principles, AI amplifies the need for coherence across program design, instructional intent, and assessment authenticity. In this sense, AI functions as a catalyst that exposes tensions between automation and judgment, efficiency and reflection, and technological capability and ethical responsibility.

Furthermore, the findings indicate that emerging conceptual models in business education must incorporate AI literacy, digital ethics, and adaptive learning processes as core constructs. The patterns identified in the literature point toward hybrid educational configurations in which technological systems, educator expertise, and learner agency interact dynamically to shape learning experiences. By framing AI integration within these interconnected dimensions, the study advances a more integrated understanding of how curriculum structures, assessment practices, and educator capability evolve in response to generative technologies. These insights position AI not as an external disruption but as a pedagogically embedded force reshaping how knowledge is constructed, demonstrated, and evaluated in contemporary business education.

Practical implications

The findings of this study offer practical insights for educators, curriculum designers, and academic leaders navigating the integration of AI in business education. The integration of AI tools such as chatbots, intelligent assistants, and adaptive platforms suggests immediate opportunities to enhance personalized learning, entrepreneurial skill-building, and student engagement (Liang & Bai, 2024; Wang & Sun, 2024). Rather than approaching AI as an isolated technological enhancement, the results suggest that its effective incorporation depends on coherent curriculum design and alignment across learning outcomes, instructional strategies, and assessment practices. Embedding AI-related competencies within program structures supports intentional development of analytical judgment, ethical reasoning, and adaptive problem-solving capacities central to contemporary business education.

At the program level, this requires systematic curriculum mapping and clearly articulated learning outcomes that define how AI literacy, critical evaluation, and professional responsibility are progressively developed across courses. Such alignment ensures that technological integration strengthens, rather than fragments, the educational experience.

At the instructional level, the emphasis on educator readiness across clusters underscores the importance of professional learning opportunities that develop pedagogical, ethical, and assessment-related capacities for AI-enabled teaching. This includes the capacity to guide reflective engagement with AI outputs, facilitate dialogue around ethical implications, and design tasks that foreground reasoning and application rather than reproduction.

From an evaluative perspective, the growing use of generative AI draws attention to the need for assessment approaches that prioritize authenticity, process, and reflective learning. Tasks that require interpretation, contextual application, collaborative inquiry, and iterative refinement are less susceptible to automation and more closely aligned with professional practice. In this context,

assessment design becomes a site of pedagogical innovation rather than merely a safeguard against misconduct.

Finally, recurring concerns related to inclusivity, access, and AI governance indicate that responsible AI integration extends beyond instructional technique. Sustainable implementation requires institutional strategies that address equity of access, transparent policy frameworks, and shared ethical standards. In this way, AI adoption becomes embedded within broader commitments to fairness, accountability, and educational integrity.

Conclusion

This study addressed the problem of fragmented, case-specific research on AI in business education by systematically mapping the field's intellectual structure through bibliographic coupling and co-word analyses. The results reveal how AI integration has evolved around key themes, including technological transformation, curriculum innovation, and AI-driven personalization, while also highlighting persistent gaps related to ethical governance, educator readiness, and equitable access. The findings show that AI is not merely reshaping instructional tools but influencing curriculum coherence, assessment practices, and professional judgment in business education. By visualizing and synthesizing these research trajectories, the study provides a structured evidence base that supports pedagogically informed decision-making and advances theoretical understanding of AI-enabled educational ecosystems. Future research can build on this foundation by examining how ethical, inclusive, and pedagogically coherent approaches to AI integration can be sustained across diverse business education contexts.

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