

## Article

# Using Artificial Intelligence to Reshape Higher Education Such That It Is in Line with Sustainability: A Systematic Review of Pedagogical and Curricular Innovations

Rongkui Su <sup>1,2</sup>, Caiqi Liu <sup>1</sup>, Xiancheng Ma <sup>1</sup>, Runhua Chen <sup>1</sup>, Yiting Luo <sup>1,3,\*</sup> and Yonghua Chen <sup>1,\*</sup>

<sup>1</sup> College of Ecology and Environment, Central South University of Forestry and Technology, Changsha 410004, China

<sup>2</sup> National Key Laboratory of Woody Oil Resources Utilization, Changsha 410004, China

<sup>3</sup> Business School, Hunan First Normal University, Changsha 410114, China

\* Correspondence: yitingl2021@163.com (Y.L.); chenronghua3333@163.com (Y.C.)

## Abstract

With the rapid advancement of artificial intelligence (AI), higher education is undergoing a significant transformation. AI offers unprecedented opportunities to enhance this field's sustainability through pedagogical and curricular innovations, but there are significant challenges. Traditional teaching models often struggle to meet students' personalized and diverse learning needs. In contrast, AI technologies offer new potential for enhancing education through intelligent data analytics, personalized recommendations, and automated management. Based on research sourced from the Web of Science Core Collection, we employed CiteSpace for visual analysis to map the current research landscape and emerging trends regarding AI in higher education. This review synthesizes these developments to provide a framework for stakeholders, contributing to the discourse on building a sustainable and intelligent higher education ecosystem that balances innovation and ethical governance.

**Keywords:** artificial intelligence; higher education; teaching models; personalized education

## 1. Introduction

Higher education is facing significant challenges in its ongoing transformation [1,2]. Faced with an expanding student population, evolving learning needs, and the pressing demand for innovative talent, the traditional model of higher education is revealing inherent limitations. This situation positions higher education and digital transformation as two domains that are now inextricably and critically linked [3]. The accelerating pace of technological advancement compels higher-education institutions to equip students with the digital competencies essential for the modern workplace and society [4]. Under these conditions, the digital transformation of higher education has evolved from a discretionary option into a strategic imperative, necessitating innovative solutions to fundamentally reshape its educational ecosystem [5].

The rapid advancement of artificial intelligence (AI) provides a pivotal means of addressing these structural challenges. In education, AI is fundamentally disrupting the traditional, standardized paradigm by enabling the creation of highly personalized learning

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pathways [6]. Artificial intelligence tools are transforming conventional experimental methodologies, redefining established paradigms of scientific discovery, and generating novel opportunities to optimize learning processes [7]. Artificial Intelligence has evolved from a mere technological tool into a potentially transformative catalyst, prompting a significant re-evaluation of entrenched paradigms in higher education [8].

Through its innovative applications in intelligent teaching and learning, artificial intelligence is driving the transformation of instructional models in higher education, significantly enhancing their efficiency and effectiveness [9,10]. However, this transformative process is hampered by multifaceted challenges, including the digital divide [11], educational alienation [12], immature technologies, and concerns regarding personal information security [13]. Research and practice in AI-enabled higher education remain fragmented, with substantial discussions focused on isolated scenarios and lacking systematic attention to the synergistic transformation of teaching, learning, administration, and research [14].

In response, this review seeks to synthesize cross-disciplinary advancements and explore pathways toward a future intelligent education ecosystem that balances innovative dynamism with robust risk governance. By critically analyzing key research and representative case studies from 2016 to 2024, this analysis provides higher-education institutions, policymakers, and researchers with a framework that integrates both conceptual insight and practical utility. Specifically, it aims to answer three research questions: (1) What are the key research hotspots and evolutionary trends? (2) How does AI drive innovation in teaching and curriculum design? (3) What are the associated challenges?

## 2. Research Methodology

### 2.1. Data Source

The literature cited in this study was sourced from the Web of Science (WOS) Core Collection. The retrieval criteria applied to the WOS Core Collection database were as follows: TS (Topic Search) = ("AI Education" & "Higher Education" & "Machine Learning" & "Personalized learning" & "Educational reform") AND PY = (2016-01-01 to 2024-12-31). This time frame fully covers the entire cycle from the early exploration phase to the current boom in generative AI, thereby ensuring the comprehensiveness of the research perspective. Document type was limited to research articles, and the language was restricted to English. Through a systematic screening process based on titles, abstracts, and keywords and in accordance with predetermined exclusion criteria, a final corpus of 814 English-language publications was identified.

### 2.2. Statistical Methods

In this study, we employed a mixed-methods approach to address the proposed research questions. First, a bibliometric analysis using CiteSpace was conducted on the collected corpus to map the intellectual landscape and identify trends. This process included keyword co-occurrence analysis and burst detection. Subsequently, a systematic thematic analysis of the literature was performed to delve into the mechanisms of innovation and the associated challenges, synthesizing findings from key empirical studies and theoretical discussions.

## 3. CiteSpace-Based Analysis of Research Status and Hot Topics in the Field of AI in Higher Education

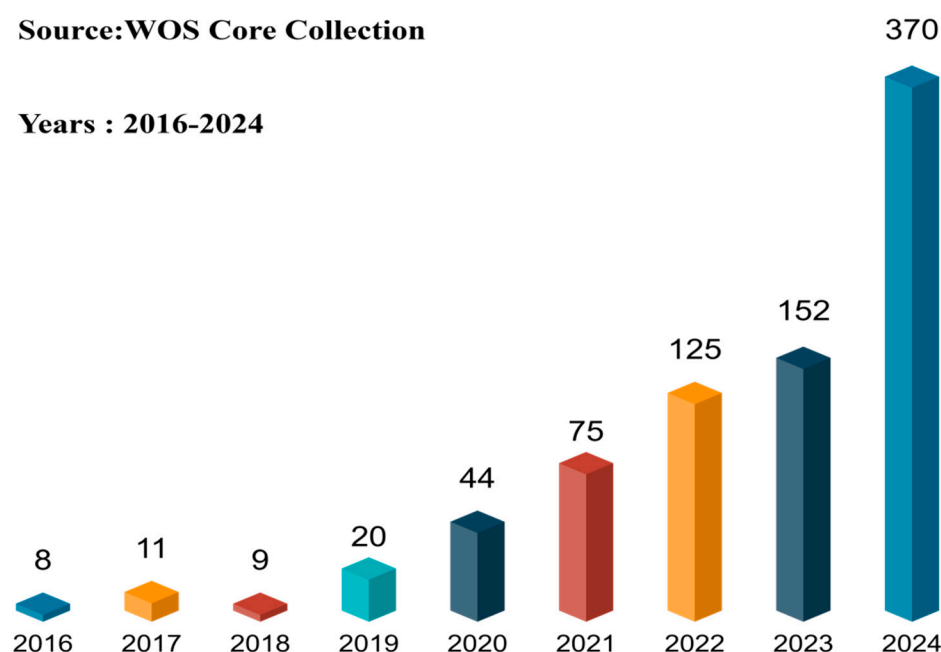
### 3.1. Annual Distribution of the Number of Published Documents

Figure 1 illustrates the volume of research on AI-enabled higher education collected for this analysis. Under the specified retrieval criteria and following relevance screening,

814 pertinent English publications from the Web of Science (WOS) Core Collection were identified. The annual publication count demonstrates a pronounced upward trajectory, surging from 8 articles in 2016 to 370 in 2024, corresponding to a growth exceeding 400%. This marked acceleration, particularly evident since 2023, is likely due to breakthroughs in generative AI technologies, such as ChatGPT, and their widespread impact on global educational practices. This trend signals the field's evolution from a phase of incremental growth into a period of rapid expansion. This exponential growth trajectory not only indicates a surge of attention within academia, but also empirically supports the core premise of this study: the integration of AI into higher education has evolved from a peripheral topic into an urgent and unignorable mainstream research field, providing quantitative evidence for the necessity of this review.

**Source: WOS Core Collection**

**Years : 2016-2024**



**Figure 1.** The number of articles related to how AI is transforming higher education published in the 2016–2024 period (source: authors).

### 3.2. Journal Analysis

Among the 814 English publications retrieved, the corresponding research findings have been published across 353 academic journals. The data indicate that the top ten journals by publication volume (Table 1) account for 29.91% of the total literature, demonstrating a relatively concentrated distribution of research output. Among these top ten journals, six are ranked in JCR (Journal Citation Reports) Q1, and there are three in Q2. This distribution profile signifies that these periodicals maintain high academic standards overall and play a pivotal role in the scholarly communication and exchange within this field.

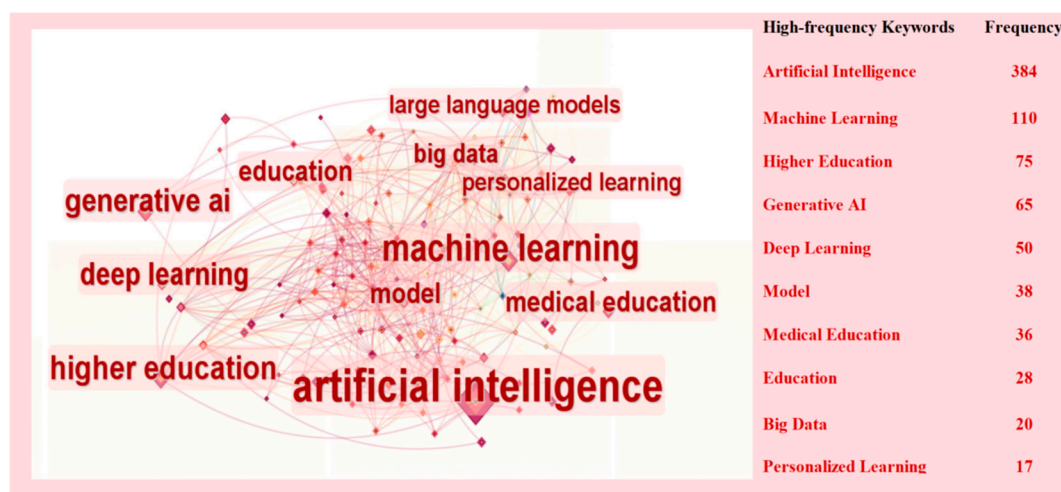
**Table 1.** Top 10 journals in terms of the number of articles on AI-enabled higher-education research.

| Ranking | Journal Name                                        | JCR Broad Categories                         | Publication Count | Proportion (%) | Impact Factor (2024) |
|---------|-----------------------------------------------------|----------------------------------------------|-------------------|----------------|----------------------|
| 1       | Sustainability                                      | Environmental Sciences Q2                    | 80                | 9.83           | 3.9                  |
| 2       | IEEE Access                                         | Computer Science, Information Systems Q2     | 44                | 5.41           | 3.6                  |
| 3       | Applied Sciences-Basel                              | Engineering, Multidisciplinary Q2            | 24                | 2.95           | 2.2                  |
| 4       | Heliyon                                             | Multidisciplinary Sciences Q1                | 24                | 2.95           | 3.4                  |
| 5       | International Journal Of Human–Computer Interaction | Computer Science, Cybernetics Q1             | 17                | 2.09           | 4.9                  |
| 6       | Bmc Medical Education                               | Education and Educational Research Q1        | 14                | 1.72           | 3.2                  |
| 7       | Medical Teacher                                     | Education, Scientific Disciplines Q1         | 11                | 1.35           | 4.28                 |
| 8       | IEEE Transactions On Learning Technologies          | Education and Educational Research Q1        | 10                | 1.22           | 4.4                  |
| 9       | Soft Computing                                      | Computer Science, Artificial Intelligence Q3 | 10                | 1.28           | 2.5                  |
| 10      | Computers & Education                               | Education and Educational Research Q1        | 9                 | 1.11           | 8.9                  |

### 3.3. Keyword Analysis

In CiteSpace, the time span was set from 2016 to 2024. Keyword was selected as the node type, Cosine was chosen for link strength, and the scope was set to within slices. The selection criteria were specified as a g-index with a k-value of 18. Visualization was then performed to generate a knowledge map of keyword co-occurrence (Figure 2). The analysis identified “Artificial Intelligence” as the central node; it exhibits strong linkages with “Machine Learning” and “Higher Education,” together constituting the foundational triad of this research domain. Notably, “Generative AI” emerges as a distinct, densely connected node, reflecting its recent rise as a core driver of development. Furthermore, “Medical Education” forms a separate cluster, underscoring the early and in-depth application of AI within this highly standardized and practice-oriented professional field [15]. Artificial Intelligence (AI) is the discipline focused on creating systems capable of simulating human intelligence, including functions such as learning, reasoning, problem-solving, perception, and natural-language comprehension [16]. In the current landscape, higher education must cultivate adaptability and resilience to equip students for the job market transformations driven by artificial intelligence (AI), machine learning, and big data. Generative AI represents a frontier branch of artificial intelligence [17,18]. Its core function lies in enabling machines to learn patterns from data [19] and create novel, original content (e.g., text, images, code, audio, and video). Such technologies are typically powered by large language models (LLMs) [20], exemplified by generative AI systems like ChatGPT and DeepSeek. In higher education, the primary impact of AI lies in its capacity to enable personalized learning, thereby allowing more-targeted instruction. Furthermore, AI is evolving from a supportive tool into a “transformative agent,” fundamentally restructuring practices in teaching, research, and institutional administration [21].

The network structure explicitly delineates the inherent logical architecture of the research domain. The robust correlation between “generative AI” and “personalized learning” is non-random; it directly proves that the integration of the contemporary technological frontier (generative AI) into the core educational paradigm (personalization) serves as the pivotal thread driving the advancement of this field.



**Figure 2.** Co-presentation map of the keywords pertaining to research on AI's transformation of higher education (source: authors).

By setting the Burstness parameter  $\gamma$  [0,1] to 0.8, we identified the top 10 burst terms in the AI-enabled higher education domain (Table 2). The keyword exhibiting the highest burst strength is “Big Data” (Strength: 4.28), indicating its predominant role as a core driver. It forms, together with AI in education and learning analytics, an essential technological triad that supports the implementation of smart education.

**Table 2.** The top 10 burst terms in the field of AI-transformed higher education.

| Keywords           | Year | Strength | Begin | End  |                                   |
|--------------------|------|----------|-------|------|-----------------------------------|
| Big Data           | 2020 | 4.28     | 2020  | 2023 | <div><div></div><div></div></div> |
| Generative AI      | 2023 | 4.25     | 2023  | 2024 | <div><div></div><div></div></div> |
| AI Education       | 2020 | 3.87     | 2021  | 2023 | <div><div></div><div></div></div> |
| Learning Analytics | 2021 | 3.33     | 2021  | 2023 | <div><div></div><div></div></div> |
| Deep Learning      | 2019 | 3.06     | 2019  | 2022 | <div><div></div><div></div></div> |
| Machine Learning   | 2019 | 2.97     | 2019  | 2020 | <div><div></div><div></div></div> |
| Design             | 2020 | 2.35     | 2023  | 2024 | <div><div></div><div></div></div> |
| System             | 2020 | 2.27     | 2020  | 2021 | <div><div></div><div></div></div> |
| Challenges         | 2017 | 1.74     | 2022  | 2024 | <div><div></div><div></div></div> |
| Data Science       | 2019 | 1.47     | 2021  | 2022 | <div><div></div><div></div></div> |

Legend: Red = the duration of the burst. Blue = the period from 2016 to 2024.

### 3.4. From Analytic Clusters to Thematic Focus: Structuring the Review

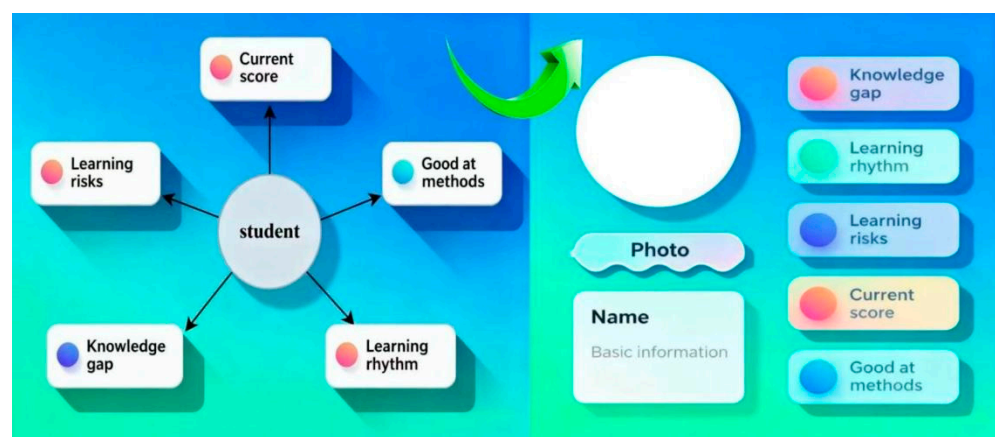
The keyword co-occurrence network (Figure 2) and burst-term detection results (Table 2) reveal not isolated, scattered terms but logically coherent thematic clusters that delineate the core of current academic discourse. To advance the transition from mapping the research landscape to deepening cognitive understanding, the subsequent thematic sections of this review are structured around the identified core clusters, as follows: (1) The cluster centered on personalized learning, generative artificial intelligence (AI), and ChatGPT underscores the prevailing research trend—leveraging emerging generative technologies to develop adaptive, student-centered learning models. (2) The cluster anchored in keywords including learning analytics, smart education, and data mining clarifies that data-driven strategies constitute the fundamental logic underpinning contemporary educational innovation. (3) The cluster associated with core concepts such as higher education, management, and systems demonstrates that the strong correlation between core AI terms and educational governance concepts indicates a critical research trajectory for institutional transformation.

## 4. AI-Driven Reshaping and Innovation of Teaching Models in Higher Education

### 4.1. Artificial Intelligence Facilitates Personalized Learning

Personalized learning, a significant educational trend, refers to a student-centered philosophy that accounts for individual differences in learning-related starting points, goals, pace, and pathways [22,23]. Within this framework, students assume the role of active participants in the learning process. Empowered to select content, set goals, adjust their pace, and demonstrate mastery, they develop key competencies through increased agency and ownership [24,25]. Building on student profiles, AI systems can deliver diverse and adaptive learning resources.

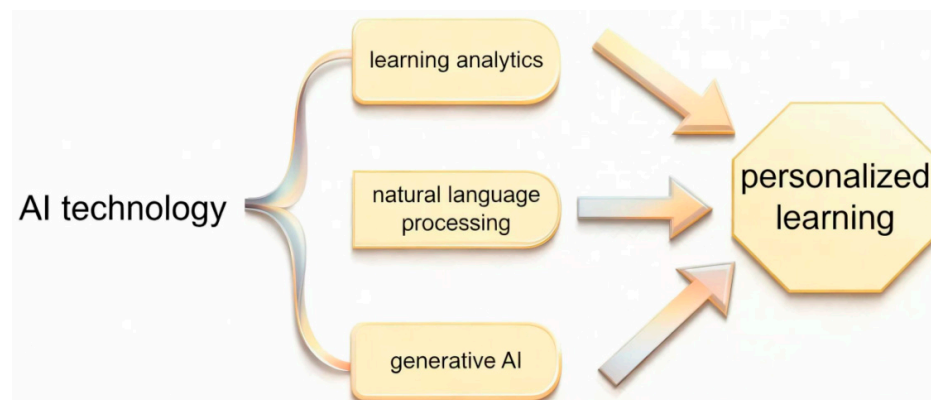
Artificial intelligence is the pivotal enabler that bridges the gap between the theoretical framework of personalized learning and its scalable implementation [26]. Using AI-driven algorithms, educational systems can provide personalized learning pathways that respond to the specific needs of individual students [27]. In conventional instructional settings, educators often struggle to monitor student progress comprehensively. By continuously collecting and analyzing large-scale learning process data, AI instead facilitates real-time, individualized tracking of learning states [28]. By employing machine learning and data-mining techniques, AI builds comprehensive, dynamic “learner profiles” that pinpoint knowledge gaps, learning styles, progress patterns, and potential risks (see Figure 3). The dynamic learner profile illustrates how AI transforms vague learner characteristics into analyzable data dimensions, which serve as the technical cornerstone for shifting from empirical teaching to precision diagnosis. This shift transforms the educational paradigm from one based on experiential intuition to a data-driven, scientifically precise diagnostic approach, effectively operationalizing the principle of “teaching students according to their aptitude” [29].



**Figure 3.** Example of a “Learner Profile” (source: authors).

Furthermore, technologies within the AI domain, particularly natural language processing (NLP) and generative AI, have significantly enriched the dimensions of personalized interaction [30,31]. Students can pose questions to an AI tutor using natural language at any time and receive immediate, heuristic responses [32]. More importantly, generative AI can create personalized learning materials on demand [33], such as a vivid analogy for a student struggling with an abstract concept or an exploratory project proposal for an advanced learner. This intelligent interaction significantly aids student comprehension [34]. In summary, from the construction of dynamic learner profiles to intelligent interaction and feedback, AI-enabled personalized learning constitutes a systematic endeavor underpinned by the integration of multiple technologies, as illustrated in Figure 4. It clarifies that “personalized learning” is not a standalone technical application but a systematic

project that requires the collaboration of multiple technologies, helping to facilitate an understanding of the complexities involved in its implementation.



**Figure 4.** A concise image depicting how AI technology is transforming personalized learning (source: authors).

However, this data-driven learner profiling raises profound ethical concerns. On one hand, continuous data tracking touches the boundaries of student privacy and carries risks of information misuse and security breaches. On the other hand, reducing complex and multidimensional learners into a series of analyzable data points entails the danger of “data simplification,” potentially overlooking key humanistic dimensions—such as emotion, sociality, and creativity—that cannot be quantified. Therefore, while leveraging AI for precise educational diagnosis, it is essential to remain vigilant against its potential to erode student agency and narrow the richness of the educational process.

#### 4.2. Intelligent Upgrading of Classroom Teaching

The intelligent transformation of classroom teaching, empowered by AI, is currently demonstrated primarily through the application of AI teaching assistants [35]. Advances in large language models (LLMs) have driven the widespread deployment of AI teaching assistants across diverse academic disciplines [36]. These intelligent systems are reshaping pedagogical practices and enhancing learning experiences [37]. By efficiently managing time-consuming routine tasks, they alleviate instructors’ workloads, allowing educators to devote greater attention to creative and student-centered instructional activities.

In a controlled study conducted by Tracy Kaitlyn and colleagues, 52 participants were divided into a control group (who received standard instruction) and an experimental group (whose teaching was supplemented with an AI teaching assistant) and instructed to watch a virtual-reality module on bubble sort algorithms [38]. The empirical results demonstrated that the AI-powered teaching assistant significantly improved student engagement and deepened conceptual understanding [39]. Complementary research evaluating virtual teaching assistants conducted by Professor Sajja Ramteja at the University of Iowa confirmed that VTAs effectively increase student participation, reduce faculty workload, and contribute to developing more inclusive and interactive learning environments [40].

While AI-driven personalized learning demonstrates tremendous potential in enhancing the precision and interactivity of education, its large-scale implementation is still hindered by multiple challenges, including risks related to data privacy and security, algorithmic biases that may undermine equity, a widening digital divide exacerbated by over-reliance on technology, high implementation costs, and teachers' difficulty adapting to their evolving roles. Collectively, these factors impede the progress from conceptualization to full-scale deployment. From the perspective of constructivist learning, an excessively precise and rigid personalized pathway may deprive learners of critical opportunities to independently explore, experiment through trial and error, and construct their own knowledge frameworks—an outcome that runs counter to the essence of deep learning.

## 5. AI-Augmented Intelligent Course Development and Instructional Design

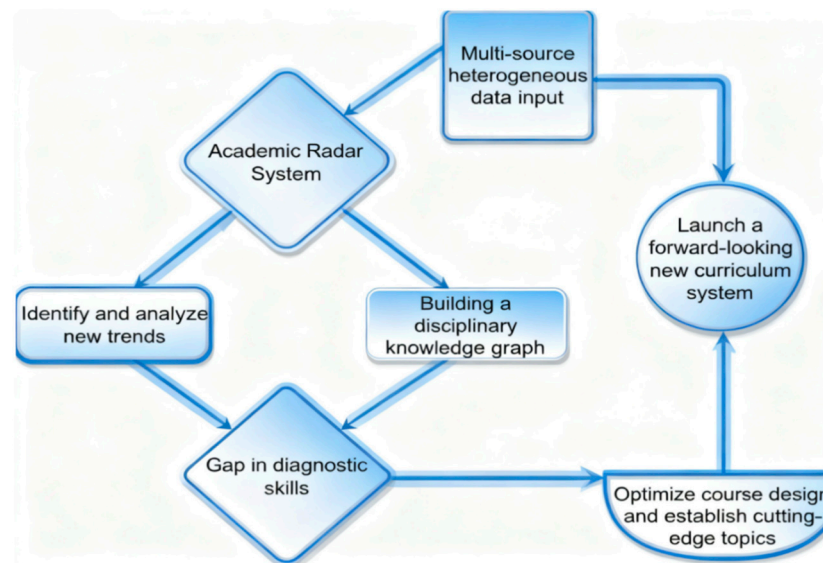
Unlike traditional models reliant on instructors' personal experience and static syllabi, AI-driven intelligent curriculum design constitutes a data-driven [41], dynamically iterative, and highly personalized closed-loop process [42], transforming course design from a static framework into an adaptive dynamic architecture capable of meeting diverse learner-group needs [43].

### 5.1. Data-Driven Precision Requires Analysis in Curriculum Development

The design of higher-education curricula is increasingly shifting from traditional, generalized disciplinary frameworks to models that are directly informed by specific research needs [44]. This transformation is enabled by technologies like natural-language processing and text mining [45], which together constitute an intelligent “academic radar system.” This system performs real-time monitoring and analysis of global knowledge production, with its core function residing in integrated analysis of multi-source, heterogeneous data. By continuously tracking and analyzing leading global journals, research grants, and scientific reports, AI generates a “dynamic knowledge map” that tracks the evolution of research trends and innovation trajectories. Using topic-modeling algorithms, it can identify emerging research frontiers, offering forward-looking guidance for curriculum development [46,47].

Furthermore, AI constructs a “disciplinary knowledge graph” that comprehensively represents the domain's knowledge structure and evolutionary trajectory [48]. By comparing the skill requirements revealed through this graph with existing course content, AI can precisely diagnose “generational gaps” and “curricular deficiencies” within the program architecture [49]. This workflow delivers data-informed decision support for creating and revising courses, enabling curriculum design to transition from experience-based to data-driven and from reactive to agile-forward approaches [50].

The flowchart in Figure 5 not only delineates the procedural steps but also depicts a novel paradigm for curriculum development. It reconstructs the conventionally linear and static design process into a dynamic iterative system with data as the core of feedback, vividly embodying the logical shift of AI-driven curriculum design from predetermination to generative design.



**Figure 5.** Flowchart pertaining to course design transformed by AI technology (source: authors).

### 5.2. The Transformation of Higher-Education Instructional Design Driven by AI

In higher education, the core objective of instructional design is to create a learning environment that fosters students' critical thinking and guides them in autonomous knowledge exploration [51,52]. Within this context, artificial intelligence serves not only as a tool for efficiency but also as a strategic partner that deepens learning engagement and fosters higher-order thinking [53]. This collaborative role drives a fundamental pedagogical shift from a traditional, instructor-centric "lecture-based model" to a more interactive and adaptive "tutorial model" [54]. AI supports educators by enhancing their capacity to design curricula that are both coherent in structure and aligned with the forefront of a given field [55]. By utilizing AI-powered literature analysis tools [56], instructors can swiftly grasp the intellectual landscape and emerging frontiers of their discipline, thereby ensuring the contemporary relevance and academic rigor of their course content. Furthermore, AI can model knowledge systems to assist in optimizing logical sequencing and integration between course modules, thereby laying a solid foundation for developing students' systematic thinking skills.

In supporting students' deep learning, AI enables personalized attention within large-scale instructional scenarios [57]. By analyzing learning behavior data, AI systems can promptly identify students experiencing comprehension difficulties or insufficient engagement, thereby facilitating targeted instructor intervention. Furthermore, utilizing generative AI-powered simulated dialog tools [58], such as virtual conversations with historical figures or classical theorists, can create immersive academic scenarios that significantly stimulate students' interest [59]. A study by Jiyoung Seo and Kim Sunah explored a novel human–AI collaborative paradigm: After having 182 undergraduate students independently construct knowledge frameworks, they compared their results with those generated by ChatGPT-3.5 to investigate their cognitive processes. Questionnaire feedback revealed positive outcomes, with students not only recognizing the activity's value but also developing a strong interest in applying AI for language-learning purposes [60].

In the assessment phase, AI-assisted evaluation systems can provide students with feedback on aspects such as argumentation logic and structural coherence in their writing [61,62], enabling instructors to shift their focus from fundamental corrections to guiding core academic values like scholarly insight and innovativeness [63]. Such a feedback model not only significantly enhances assessment efficiency but also creates a continuous, iterative, and self-improving learning loop for students (Table 3).

**Table 3.** AI transformation in higher-education instructional design: a simplified table.

| Empowerment Area           | Core AI Applications                                                                                                                                         |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Content Development | Analyzing academic frontiers and generating teaching cases and simulated data to ensure there is cutting-edge and practical content.                         |
| Learning Activity Design   | Enabling personalized attention in large classes, acting as a research assistant, and creating simulations to enhance inquiry-based learning.                |
| Assessment and Feedback    | Providing initial feedback on students' papers and checking for compliance and freeing up instructors so that they may focus on guiding academic innovation. |

Despite the broad prospects of AI-driven intelligent curriculum design, its core logical chain is still hindered by notable challenges: From the perspective of data sources, the relied-upon datasets (such as papers published in top journals) may carry systematic biases, leading to distortions in the constructed knowledge graphs and the demand analysis itself. This further causes problems pertaining to design and implementation; namely, dynamic and high-standard curriculum systems present severe tests of teachers' development capabilities and schools' governance models. In the teaching process, this design mode may invisibly encourage students to over-rely on AI tools, thereby inhibiting the development of their in-depth thinking and independent exploration abilities.

## 6. AI-Transformed Advancement of Scientific Management and Decision-Making in Education

The enabling role of AI extends beyond the front-end of teaching and curriculum to profoundly permeate the back-end of educational management and decision-making, ensuring the coordination and efficiency of the entire educational ecosystem [64]. At the level of educational management and decision-making, AI significantly enhances the intelligence of "institutional research." While traditional analyses often rely on static, isolated data, AI technologies—particularly machine learning and predictive analytics models [65,66]—can integrate and process massive datasets from admissions, career services, research, and other departments in real time, revealing dynamic trends and deep correlations that are difficult to detect manually [67]. From the perspective of the sociotechnical system, the introduction of AI is not merely an upgrade of management tools but also a profound transformation of organizational decision-making logic. The growing authority of data-driven decision-making is likely to reshape the internal power relations and trust foundations of institutions. In disciplinary and program planning, AI drives the optimization of program structures and the development of emerging disciplines by analyzing the relationships between industries, employment, and curricula, thereby precisely aligning with regional economic needs.

Beyond educational management, AI's impact is particularly profound with respect to research administration, where it can serve as a powerful, multi-faceted research support tool [68]. AI-powered tools help researchers quickly grasp cutting-edge developments, identify research gaps, and refine project design [69]. They can process many types of experimental data and complex social network information, accelerating the scientific discovery process. For research administrators, AI enables systematic analysis of institutional output, collaboration networks, and scholarly impact, helping to identify strong research teams and potential areas for growth [70]. This provides an evidence-based foundation for strategic resource allocation and interdisciplinary collaboration, thereby enhancing an institution's overall research vitality and innovative capacity.

## 7. Comprehensive Discussion of Challenges

The comprehensive intelligent transformation of teaching, curriculum, and administration is not a straightforward process; it conceals numerous risks and challenges at both technological and ethical levels. Empowering higher education with artificial intelligence is a profound change that touches the core of education itself [71]. The essence of education lies in its humanistic attributes, emphasizing emotional communication and value formation, while AI's technological logic is grounded in data and algorithms. Over-reliance on data metrics may lead to the loss of education's "human touch" [72,73], thereby eroding the cultivation of students' creativity, critical thinking [74], and humanistic care—the most precious elements of education. At the ethical level, the challenges extend far beyond personal information security, encompassing the more profound systemic harm algorithmic bias inflicts on educational equity. If the data used to train AI models contain historical biases, the resulting recommendations, predictions, and evaluation outcomes will perpetuate and potentially amplify these inequities [75,76]. The integration of AI into higher education is far from a linear process of technological dividend realization. As many scholars have cautioned, we must guard against a tendency toward "technological solutionism"—the simplistic assumption that technology alone can automatically resolve complex social and educational challenges. Current practices often re-frame educational issues as engineering problems awaiting technological optimization, potentially overlooking the deeper political, economic, and cultural contexts in which they are embedded.

The traditional higher-education system has established a stable structure and management model [77]. However, the advancement of AI-driven personalized learning necessitates the development of more flexible educational infrastructure. This transformation is driving a shift in the teacher's role from knowledge transmitter to learning facilitator while simultaneously requiring students to develop new competencies to navigate intelligent learning environments [78]. Nevertheless, the empirical foundation for such systemic change remains weak. Current research on AI education is largely confined to short-term pilot studies, lacking long-term evidence regarding its impact on critical thinking and other higher-order skills.

The practical implementation of this transformation is clouded by uncertainties regarding cost-effectiveness [79]. Universities must make substantial ongoing investments in AI infrastructure, platform acquisition, and curriculum development. However, the manifestation of educational outcomes is inherently a long-term process and delayed [80]. When massive-scale resource consumption fails to yield quantifiable immediate returns, the sustainability of such initiatives becomes questionable. Consequently, many AI education projects struggle to move beyond the pilot stage; they cannot achieve the crucial transition from isolated tool-based applications to comprehensive educational paradigm innovation [81].

## 8. Conclusions and Prospects

The integration of artificial intelligence into higher education has become a prominent and, likely, enduring development [82]. This study explores the integration of artificial intelligence (AI) and higher education via three focused research questions and arrives at the following key findings. First, bibliometric analysis indicates that this domain is undergoing a phase of explosive growth, with research hotspots evolving rapidly from foundational concepts such as big data and learning analytics to cutting-edge application-oriented topics, including generative AI and task analysis. The sharp surge in the volume of publications since 2023 underscores the transformative implications of large language models (LLMs) for the field. Second, further in-depth analysis elaborates on concrete AI-

driven innovations, ranging from the construction of dynamic learner profiles to enable personalized instruction to the deployment of AI teaching assistants in order to augment classroom teaching and the utilization of data analytics to facilitate agile curriculum development. Existing empirical evidence demonstrates that these innovations have yielded measurable gains in boosting student engagement, enhancing teaching efficiency, and improving diagnostic precision. Nevertheless, this study also cautions that such innovations are inextricably associated with systemic challenges, encompassing algorithmic biases that jeopardize educational equity, the “datafication” risk that undermines the humanistic essence of education, ambiguities surrounding the evolving role of teachers, problems upholding academic integrity, and issues relating to sustainable cost-effectiveness. In conclusion, the integration of AI into higher education is not a linear, benefit-driven process but rather a sophisticated dynamic in which opportunities and challenges are inherently interdependent and mutually constitutive. Looking ahead, the deep integration of AI into higher education will evolve in multiple dimensions [83]. Instructors will transition from knowledge transmitters to learning designers and developmental guides. Simultaneously, the educational ecosystem [84] will become more open, transcending traditional disciplinary boundaries and spatiotemporal constraints. The ultimate objective of AI-enabled higher education is to construct a new educational ecology characterized by human–machine collaboration [85] and mutual reinforcement between teaching and learning. Achieving this goal requires striking a balance between technological innovation and pedagogical principles to promote high-quality development in higher education [86]. Future research should place greater emphasis on evaluating the long-term effects of AI applications in education and exploring how technology can more effectively serve the mission of talent development [87]. The long-term educational impacts of AI will be verified through longitudinal tracking and causal research, and a comprehensive evaluation framework integrating environmental, economic, and social dimensions will be developed so as to guide higher education to achieve an inclusive and sustainable transformation in the intelligent era.

This study systematically delineates the enabling pathways regarding artificial intelligence in higher education, not only providing a theoretical foundation and practical framework for building a more adaptive, equitable, and efficient future educational ecosystem but also injecting intelligent momentum into the long-term sustainable development of the education system through talent cultivation, resource optimization, and model innovation.

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## References

1. Giesenbauer, B.; Müller-Christ, G. University 4.0: Promoting the Transformation of Higher Education Institutions toward Sustainable Development. *Sustainability* **2020**, *12*, 3371. <https://doi.org/10.3390/su12083371>.
2. Shestakova, I.; Morgunov, V.; Novikova, E.; Bylieva, D. Analysis of the Advantages and Disadvantages of Distance Education in the Context of the Accelerated Digital Transformation of Higher Education. *Sustainability* **2025**, *17*, 4487. <https://doi.org/10.3390/su17104487>.
3. Bygstad, B.; Ovreid, E.; Ludvigsen, S.; Dæhlen, M. From Dual Digitalization to Digital Learning Space: Exploring the Digital Transformation of Higher Education. *Comput. Educ.* **2022**, *182*, 104463. <https://doi.org/10.1016/j.compedu.2022.104463>.
4. Klave, E.; Cane, R. DIGITAL TRANSFORMATION OF HIGHER EDUCATION: INTEGRATING MULTIMEDIA SYSTEMS INTO THE STUDY PROCESS. *Environ. Technol. Resour. Proc. Int. Sci. Pract. Conf.* **2024**, *2*, 168–174. <https://doi.org/10.17770/etr2024vol2.8017>.
5. Zhuang, T.T.; Liu, B.C. Sustaining Higher Education Quality by Building an Educational Innovation Ecosystem in China-Policies, Implementations and Effects. *Sustainability* **2022**, *14*, 7568. <https://doi.org/10.3390/su14137568>.
6. Kim, S.; Kyung, C.M. AI-Based Educational Platform Analysis Supporting Personalized Mathematics Learning. *Commun. Math. Educ.* **2022**, *36*, 417–438. <https://doi.org/10.7468/jksmee.2022.36.3.417>.
7. Jiang, X.M.; Wang, R.; Hoang, T.; Ranaweera, C.; Dong, C.Z.; Myers, T. AI-Powered Gamified Scaffolding: Transforming Learning in Virtual Learning Environment. *Electronics* **2025**, *14*, 2732. <https://doi.org/10.3390/electronics14132732>.
8. Hayashi, Y. Prospects for Revolutionary and Popular AI Technology following the Launch of ChatGPT in 2023. *Electronics* **2024**, *13*, 0290. <https://doi.org/10.3390/electronics13020290>.
9. Zhou, M.; Peng, S. The Usage of AI in Teaching and Students' Creativity: The Mediating Role of Learning Engagement and the Moderating Role of AI Literacy. *Behav. Sci.* **2025**, *15*, 0587. <https://doi.org/10.3390/bs15050587>.
10. Alfirevic, N.; Hell, M.; Rendulic, D. Pedagogical Qualities of Artificial Intelligence-Assisted Teaching: An Exploratory Analysis of a Personal Tutor in a Voluntary Business Higher-Education Course. *Appl. Sci.* **2025**, *15*, 8764. <https://doi.org/10.3390/app15158764>.
11. Singh, S.; Singh, U.S.; Nermend, M. Sustainability in a Digitized Era Analyzing the Moderation Effect of Social Strata and Digital Capital Dependence on Digital Divide. *Sustainability* **2022**, *14*, 14508. <https://doi.org/10.3390/su142114508>.
12. Choi, C.-G.; Kang, M.-K. Concepts and Measurements of Educational Alienation in Lifelong Education. *Asia-Pac. J. Multimed. Serv. Conver. Art Humanit. Sociol.* **2019**, *9*, 343–352. <https://doi.org/10.35873/ajmahs.2019.9.9.030>.
13. Li, G.; Ma, W.J. The Innovation and Reform of Higher Education Teaching Mode Under the Empowerment of Artificial Intelligence. *High. Educ. Pract.* **2024**, *1*, 146–149. <https://doi.org/10.62381/h241723>.
14. Ko, Y.-J. An Analysis of Artificial Intelligence Education Research Trends Based on Topic Modeling. *J. Korea Soc. Comput. Inf.* **2024**, *29*, 197–209. <https://doi.org/10.9708/jksci.2024.29.02.197>.
15. Sharma, A.; Al-Haidose, A.; Al-Asmakh, M.; Abdallah, A.M. Integrating Artificial Intelligence into Biomedical Science Curricula: Advancing Healthcare Education. *Clin. Pract.* **2024**, *14*, 1391–1403. <https://doi.org/10.3390/clinpract14040112>.
16. Cao, L.B. A New Age of AI: Features and Futures. *Ieee Intell. Syst.* **2022**, *37*, 25–37. <https://doi.org/10.1109/mis.2022.3150944>.
17. Daniels, C.P. Exploring Artificial Intelligence Literacy and Engagement in Higher Education Stakeholders. *Int. Assoc. Comput. Inf. Syst.* **2025**, *26*, 201–216. [https://doi.org/10.48009/1\\_iis\\_116](https://doi.org/10.48009/1_iis_116).
18. Trigka, M.; Dritsas, E. The Evolution of Generative AI: Trends and Applications. *IEEE Access* **2025**, *13*, 98504–98529. <https://doi.org/10.1109/access.2025.3574660>.
19. Yoon, S.; Choi, A.; Kim, C.; Sohn, S.; Oh, S.; Park, M. A Study of Generative AI Trends and Applications. *J. Conver. Cult. Technol.* **2024**, *10*, 607–612. <https://doi.org/10.17703/JCCT.2024.10.4.607>.
20. Asproni, G. Phillip Carter on Observability for Large Language Models. *IEEE Softw.* **2024**, *41*, 93–96. <https://doi.org/10.1109/ms.2024.3410728>.
21. Yu, H.T.; Mi, Y. Application Model for Innovative Sports Practice Teaching in Colleges Using Internet of Things and Artificial Intelligence. *Electronics* **2023**, *12*, 0874. <https://doi.org/10.3390/electronics12040874>.
22. Kevin, A.; Bakker, M.; van Loon, A.M.; Kral, M.; Camp, G. Young learners' motivation, self-regulation and performance in personalized learning. *Comput. Educ.* **2025**, *226*, 105208. <https://doi.org/10.1016/j.compedu.2024.105208>.
23. Ma, Y.J.; Wang, L.; Zhang, J.T.; Liu, F.J.; Jiang, Q.Y. A Personalized Learning Path Recommendation Method Incorporating Multi-Algorithm. *Appl. Sci.* **2023**, *13*, 5946. <https://doi.org/10.3390/app13105946>.

24. Li, H.; Gong, R.R.; Zhong, Z.M.; Xing, L.B.; Li, X.; Li, H.N. Research on personalized learning path planning model based on knowledge network. *Neural Comput. Appl.* **2023**, *35*, 8809–8821. <https://doi.org/10.1007/s00521-022-07658-8>.
25. Li, H.J.; Xu, J.Y.; Jin, M.; Yin, A.Y. Personalized Federated Learning With Global Information Fusion and Local Knowledge Inheritance Collaboration. *J. Supercomput.* **2025**, *81*, 158. <https://doi.org/10.1007/s11227-024-06529-4>.
26. Kanchon, M.K.H.; Sadman, M.; Nabila, K.F.; Tarannum, R.; Khan, R. Enhancing Personalized Learning: AI-Driven Identification of Learning Styles and Content Modification Strategies. *Int. J. Cogn. Comput. Eng.* **2024**, *5*, 269–278. <https://doi.org/10.1016/j.ijcce.2024.06.002>.
27. Oyebola Olusola, A.; Nancy Mohd Al, H.; Onyebuchi Nneamaka, C.; Blessing, O.; Ololade Elizabeth, A. AI in Education: A Review of Personalized Learning and Educational Technology. *GSC Adv. Res. Rev.* **2024**, *18*, 261–271. <https://doi.org/10.30574/gscarr.2024.18.2.0062>.
28. Mane, P.A.; Jagtap, D.S. AI-Enhanced Educational Platform for Personalized Learning Paths, Automated Grading, and Real-Time Feedback. *Int. J. Sci. Res. Eng. Manag.* **2024**, *8*, 1–7. <https://doi.org/10.55041/ijrsrem39921>.
29. Silva, G.; Godwin, G.; Jayanagara, O. The Impact of AI on Personalized Learning and Educational Analytics. *Int. Trans. Educ. Technol. (ITTE)* **2024**, *3*, 36–46. <https://doi.org/10.33050/itee.v3i1.669>.
30. Zampieri, M.; Nakov, P.; Scherrer, Y. Natural language processing for similar languages, varieties, and dialects: A survey. *Nat. Lang. Eng.* **2020**, *26*, 595–612. <https://doi.org/10.1017/s1351324920000492>.
31. Muniyandi, A.P.; Balusamy, B.; Dhanaraj, R.K.; Ellappan, V.; Murali, S.; Sathyamoorthy, M.; Nkenyereye, L. Privacy Preserved Reinforcement Learning Model Using Generative AI for Personalized E-Learning. *IEEE Trans. Consum. Electron.* **2024**, *70*, 6157–6165. <https://doi.org/10.1109/tce.2024.3398824>.
32. Liu, R.; Zhang, X.L. A review of methodologies for natural-language-facilitated human-robot cooperation. *Int. J. Adv. Robot. Syst.* **2019**, *16*, 1729881419851402. <https://doi.org/10.1177/1729881419851402>.
33. Chinemelum Goodness, U. The role of generative AI in personalized learning for higher education. *World J. Adv. Eng. Technol. Sci.* **2025**, *14*, 205–207. <https://doi.org/10.30574/wjaets.2025.14.2.0077>.
34. Chen, W.; Yu, M.Y.; Hou, J. Synergistic Relationship, Agent Interaction, and Knowledge Coupling: Driving Innovation in Intelligent Construction Technology. *Buildings* **2024**, *14*, 0542. <https://doi.org/10.3390/buildings14020542>.
35. Chen, J.; Lu, H. Evaluation Method of Classroom Teaching Effect Under Intelligent Teaching Mode. *Mob. Netw. Appl.* **2022**, *27*, 1262–1270. <https://doi.org/10.1007/s11036-022-01946-2>.
36. Yu, F.H.; Lv, J.N.; Han, H.; Zhang, Y.J.; Zhang, J. Application of AI teaching Assistant to College Education of Principles of Chemical Engineering. *Educ. Chem. Eng.* **2025**, *53*, 138–148. <https://doi.org/10.1016/j.ece.2025.08.004>.
37. Zhao, H.Y.; Min, Q.F. Exploring Continued Usage of an AI Teaching Assistant among University Students: A Temporal Distance Perspective. *Inf. Manag.* **2024**, *61*, 104012. <https://doi.org/10.1016/j.im.2024.104012>.
38. Rahmani, M.K.I. Smart Bubble Sort: A Novel and Dynamic Variant of Bubble Sort Algorithm. *Cmc-Comput. Mater. Contin.* **2022**, *71*, 4895–4913. <https://doi.org/10.32604/cmc.2022.023837>.
39. Tracy, K.; Spantidi, O. Impact of GPT-Driven Teaching Assistants in VR Learning Environments. *IEEE Trans. Learn. Technol.* **2025**, *18*, 192–205. <https://doi.org/10.1109/tlt.2025.3539179>.
40. Sajja, R. AI-Driven Virtual Teaching Assistants for Enhanced Learning: A Framework for Personalized Support, Analytics, and Scalability in Higher Education. Ph.D. Thesis, The University of Iowa, Johnson County, IA, USA, 2025; pp. 1–227.
41. Kushwaha, P.; Namdev, D.; Kushwaha, S.S. SmartLearnHub: AI-Driven Education. *Int. J. Res. Appl. Sci. Eng. Technol.* **2024**, *12*, 1396–1401. <https://doi.org/10.22214/ijraset.2024.58583>.
42. Li, T. AI-Driven Multi-Modal Interactive Learning Environment Using Deep Learning and Chain-of-Thought Reasoning. *Int. J. Pattern Recognit. Artif. Intell.* **2025**, *39*, 2552001. <https://doi.org/10.1142/s0218001425520019>.
43. Ryu, M.-Y.; Gwan, H.S. The Direction of AI Classes using AI Education Platform. *J. Korea Soc. Comput. Inf.* **2022**, *27*, 69–76. <https://doi.org/10.9708/jksci.2022.27.05.069>.
44. Garay, S.M. Advancing Instructional Design with AI: A Study on AI Literacy in Higher Education. Ph.D. Thesis, University of South Alabama, Mobile, AL, USA, 2025; pp. 1–352.
45. Shamshiri, A.; Ryu, K.R.; Park, J.Y. Text Mining and Natural Language Processing in Construction. *Autom. Constr.* **2024**, *158*, 105200. <https://doi.org/10.1016/j.autcon.2023.105200>.
46. Wheelock, L.B.; Pachamano, D.A. Acceptable Set Topic Modeling. *Eur. J. Oper. Res.* **2022**, *299*, 653–673. <https://doi.org/10.1016/j.ejor.2021.11.024>.
47. Shrestha, S.; Das, S. Exploring Gender Biases in ML and AI Academic Research Through Systematic Literature Review. *Front. Artif. Intell.* **2022**, *5*, 976838. <https://doi.org/10.3389/frai.2022.976838>.

48. Zheng, L.Y.; Ge, D. Cultivating Key Disciplinary Competencies among University Students Against the Background of China's New Engineering Education Initiative Education Initiative. *PLoS ONE* **2025**, *20*, 0318561. <https://doi.org/10.1371/journal.pone.0318561>.
49. Lee, J.H.; Cho, J.W. Artificial Intelligence Curriculum Development for Intelligent System Experts in University. *Int. J. Adv. Sci. Eng. Inf. Technol.* **2024**, *14*, 409–419. <https://doi.org/10.18517/ijaseit.14.2.18860>.
50. Cha, S.E.; Loeser, M.; Seo, K. The Impact of AI-Based Course-Recommender System on Students' Course-Selection Decision-Making Process. *Appl. Sci.* **2024**, *14*, 3672. <https://doi.org/10.3390/app14093672>.
51. Ma, G.; Shi, W.B.; Hou, P. Exploring University Teacher Construction for Higher Education Sustainability in China: Perspective from Policy Instruments. *Sustainability* **2023**, *15*, 0362. <https://doi.org/10.3390/su15010362>.
52. Young, C.S. A Study on the Understanding and Solving Tasks of AI Convergence Education. *J. Ind. Conver.* **2023**, *21*, 147–157. <https://doi.org/10.22678/JIC.2023.21.1.147>.
53. Wooding, J.G. Inviting Educators into Their Learning The Relationship Between Personalized Professional Learning and K-5 Teacher Academic Optimism. Dissertation/Thesis, The University of Findlay, 2024:1-168.
54. Chen, X.; Song, J.; Wen, H.; Zhang, L. Mentor-Student Relationship and Graduate Students' Satisfaction With Mentors: A Moderated Mediation Model. *J. Adv. Nurs.* **2025**, *Early View*. <https://doi.org/10.1111/jan.70229>.
55. Chul, D.I.; Kim, N.; Jeon, Y. Unification Education in the Age of AI: A Study on the Direction for Building an AI Platform for Unification Education. *J. North Korean Stud.* **2024**, *49*, 88–121.
56. Pan, L.; Luo, H.Q.; Gu, Q.Z. Incorporating AI Literacy and AI Anxiety Into TAM: Unraveling Chinese Scholars' Behavioral Intentions Toward Adopting AI-Assisted Literature Reading. *IEEE Access* **2025**, *13*, 38952–38963. <https://doi.org/10.1109/access.2025.3546572>.
57. Bonggyu, L.; Hyeonjin, K. Exploring the Potential for Developing Instructional Design Principles through Archive-Based Qualitative Analysis: Focusing on Collaborative Instructional Design Principles for Teacher and Generative AI. *J. Korean Assoc. Educ. Inf. Media* **2024**, *30*, 743–766. <https://doi.org/10.15833/kafeiam.30.3.743>.
58. So, C.H.; Khvan, A.; Choi, W. Natural Conversations with a Virtual Being: How User Experience with a Current Conversational AI Model Compares to Expectations. *Comput. Animat. Virtual Worlds* **2023**, *34*, e2149. <https://doi.org/10.1002/cav.2149>.
59. Lin, J.; Tomlin, N.; Andreas, J.; Eisner, J. Decision-Oriented Dialogue for Human-AI Collaboration. *Trans. Assoc. Comput. Linguist.* **2024**, *12*, 892–911. [https://doi.org/10.1162/tacl\\_a\\_00679](https://doi.org/10.1162/tacl_a_00679).
60. Jiyoung, S.; Kim, S. Generative AI as a Virtual Conversation Partner in Language Learning. *Int. J. Adv. Cult. Technol.* **2024**, *12*, 7–15. <https://doi.org/10.17703/IJACT.2024.12.2.7>.
61. Sajadi, S.; Huerta, M.; Ryan, O.; Drinkwater, K. Harnessing Generative AI to Enhance Feedback Quality in Peer Evaluations within Project-Based Learning Contexts. *Int. J. Eng. Educ.* **2024**, *40*, 998–1012. Available online: <https://webofscience.clarivate.cn/wos/alldb/full-record/WOS:001385273300001> (accessed on 3 February 2026).
62. Kooli, C.; Yusuf, N. Transforming Educational Assessment: Insights into the Use of ChatGPT and Large Language Models in Grading. *Int. J. Hum.-Comput. Interact.* **2025**, *41*, 3388–3399. <https://doi.org/10.1080/10447318.2024.2338330>.
63. Chang, D.H.; Lin, M.P.C.; Hajian, S.; Wang, Q.Q. Educational Design Principles of Using AI Chatbot That Supports Self-Regulated Learning in Education: Goal Setting, Feedback, and Personalization. *Sustainability* **2023**, *15*, 12921. <https://doi.org/10.3390/su151712921>.
64. Mittal, U.; Sai, S.; Chamola, V.; Sangwan, D. A Comprehensive Review on Generative AI for Education. *IEEE Access* **2024**, *12*, 142733–142759. <https://doi.org/10.1109/access.2024.3468368>.
65. Li, G.; Cherukuri, A.K. Embrace Open-Environment Machine Learning for Robust AI. *Natl. Sci. Rev.* **2023**, *11*, 20955138. <https://doi.org/10.1093/nsr/nwad300>.
66. Majeed, A.; Hwang, S.O. Technical Analysis of Data-Centric and Model-Centric Artificial Intelligence. *It Prof.* **2023**, *25*, 62–70. <https://doi.org/10.1109/mitp.2023.3322410>.
67. Ebert, C.; Nawalramka, P. Generative AI for Data Science. *IEEE Softw.* **2025**, *42*, 20–24. <https://doi.org/10.1109/ms.2025.3562046>.
68. Lawrence, N.D.; Montgomery, J. Accelerating AI for Science: Open Data Science for Science. *R. Soc. Open Sci.* **2024**, *11*, 231130. <https://doi.org/10.1098/rsos.231130>.
69. Barbierato, E.; Gatti, A. Toward Green AI: A Methodological Survey of the Scientific Literature. *IEEE Access* **2024**, *12*, 23989–24013. <https://doi.org/10.1109/access.2024.3360705>.
70. Pu, Z.J.; Shi, C.L.; Jeon, C.O.; Fu, J.Y.; Liu, S.J.; Lan, C.H.; Yao, Y.L.; Liu, Y.X.; Jia, B.L. ChatGPT and Generative AI are Revolutionizing the Scientific Community: A Janus-Faced Conundrum. *Imeta* **2024**, *3*, e178. <https://doi.org/10.1002/imt2.178>.

71. Wang, X.; Zhao, S.; Xu, X.; Zhang, H.; Lei, V.N.-L. AI Adoption in Chinese Universities: Insights, Challenges, and Opportunities from Academic Leaders. *Acta Psychol.* **2025**, *258*, 105160. <https://doi.org/10.1016/j.actpsy.2025.105160>.
72. Li, Q.J.; Ban, M.; Liu, Y.J.; Xu, D. Online Instruction for a Humanized Learning Experience: Techniques Used by College Instructors. *Comput. Educ.* **2022**, *189*, 104595. <https://doi.org/10.1016/j.compedu.2022.104595>.
73. Martins, G.C. Reform of Secondary Education Reform: Advances, Setbacks and Challenges. Master's Thesis, Universidade do Oeste de Santa, Joaçaba, Brazil, 2024; pp. 1–114.
74. Xie, H. Critical Thinking and Selfhood in the Age of Globalization: A Case Study of Transnational Chinese Undergraduates in the United States. Ph.D. Thesis, University of California, Los Angeles, CA, USA, 2022; pp. 1–849.
75. Bulathwela, S.; Pérez-Ortiz, M.; Holloway, C.; Cukurova, M.; Shawe-Taylor, J. Artificial Intelligence Alone Will Not Democratise Education: On Educational Inequality, Techno-Solutionism and Inclusive Tools. *Sustainability* **2024**, *16*, 0781. <https://doi.org/10.3390/su16020781>.
76. Lee, I.J. A Study on Ways of AI Ethics Education Using AI Ethics Guidelines. *Korean Elem. Moral Educ. Soc.* **2022**, *76*, 157–180. <https://doi.org/10.17282/ethics.2022.76.157>.
77. Sun, X.F.; Qin, Y.K. The Model Practice of Reconstructing Education Management Based on Web 3.0 Technology Blended Learning under the People-Oriented Concept. *Comput. Appl. Eng. Educ.* **2024**, *32*, e22629. <https://doi.org/10.1002/cae.22629>.
78. Zheng, W. Intelligent E-Learning Design for Art Courses Based on Adaptive Learning Algorithms and Artificial Intelligence. *Entertain. Comput.* **2024**, *50*, 100713. <https://doi.org/10.1016/j.entcom.2024.100713>.
79. Foffano, F.; Scantamburlo, T.; Cortes, A. Investing in AI for Social Good: An Analysis of European National Strategies. *AI Soc.* **2023**, *38*, 479–500. <https://doi.org/10.1007/s00146-022-01445-8>.
80. Zhang, S.; Rehman, S.; Zhao, Y.; Rehman, E.; Yaqoob, B. Exploring the Interplay of Academic Stress, Motivation, Emotional Intelligence, and Mindfulness in Higher Education: A Longitudinal Cross-Lagged Panel Model Approach. *BMC Psychol.* **2024**, *12*, 732. <https://doi.org/10.1186/s40359-024-02284-6>.
81. Payton, M.J. Analyzing Artificial Intelligence Trustworthiness Characteristics Risks and Impacts in Insurance. Ph.D. Thesis, Marymount University, Arlington, VA, USA, 2024; pp. 1–123.
82. Kshetri, N.; Voas, J. Adapting to Generative Artificial Intelligence: Approaches in Higher Education Institutions. *Computer* **2024**, *57*, 128–133. <https://doi.org/10.1109/mc.2024.3422589>.
83. Mogoale, P.D.; Pretorius, A.; Mogase, R.C.; Segooa, M.A. Ethical Considerations in Artificial Intelligence-Driven Environments for Higher Education. *S. Afr. J. Inf. Manag.* **2025**, *27*, 2007. <https://doi.org/10.4102/sajim.v27i1.2007>.
84. Jornet, A.; Penuel, W.R.; Esteban-Guitart, M.; Akkermann, S. Socio-Educational Ecologies for Learning, Social Change, and Future Thinking: Expanding Educational Psychology's Boundaries. *Acta Psychol.* **2025**, *258*, 105156. <https://doi.org/10.1016/j.actpsy.2025.105156>.
85. Ren, M.L.; Chen, N.Y.; Qiu, H. Human-machine Collaborative Decision-making: An Evolutionary Roadmap Based on Cognitive Intelligence. *Int. J. Soc. Robot.* **2023**, *15*, 1101–1114. <https://doi.org/10.1007/s12369-023-01020-1>.
86. Katsamakos, E.; Pavlov, O.V.; Saklad, R. Artificial Intelligence and the Transformation of Higher Education Institutions: A Systems Approach. *Sustainability* **2024**, *16*, 6118. <https://doi.org/10.3390/su16146118>.
87. Alotaibi, N.S. The Impact of AI and LMS Integration on the Future of Higher Education: Opportunities, Challenges, and Strategies for Transformation. *Sustainability* **2024**, *16*, 10357. <https://doi.org/10.3390/su162310357>.

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