

# ARTIFICIAL INTELLIGENCE AND COLLEGE STUDENTS' SELF-DIRECTED LEARNING: A REVIEW OF OPPORTUNITIES, RISKS, AND FUTURE DIRECTIONS

JiaXin Yang, Di Yao\*

*College of Applied Science and Technology, Beijing Union University, Beijing 10010, China.*

*\*Corresponding Author: Di Yao*

**Abstract:** With the rapid development of artificial intelligence (AI), intelligent tools and generative models have increasingly entered higher education and reshaped students' learning processes. AI influences how college students access information, complete academic tasks, and regulate their learning, thereby affecting their self-directed learning. This paper provides a narrative literature review of studies published between 2016 and 2026 in Chinese and international databases. The review examines both positive and negative impacts of AI on college students' self-directed learning. Existing research shows that AI can improve learning efficiency, provide personalized feedback, and support learning strategies. However, it may also lead to over-reliance, academic integrity concerns, and cognitive offloading. The findings further indicate that current studies focus mainly on tool application and learning outcomes, while research on underlying mechanisms and long-term effects remains limited. Future research should explore the pathways through which AI influences self-directed learning and develop appropriate evaluation frameworks in higher education contexts.

**Keywords:** Artificial intelligence; Self-directed learning; Higher education; College students; Narrative review

## 1 INTRODUCTION

In recent years, the application of artificial intelligence in the field of education has continued to deepen, particularly with intelligent recommendation systems, adaptive learning systems, and a new generation of intelligent tools represented by large language models and other artificial intelligence technologies entering teaching and learning contexts in higher education [1]. Related studies have shown that artificial intelligence can, to a certain extent, enhance college students' efficiency in information acquisition, learning resource matching, and feedback throughout the learning process. At the same time, it may also introduce risks such as over-reliance, academic integrity concerns, and "cognitive offloading". Therefore, it is necessary to strike a balance between promoting the development of learners' abilities and preventing the substitution of those abilities by technology. In contexts where artificial intelligence can support college students' learning, learner autonomy is reflected not only in self-planning and self-monitoring but is also increasingly shaped by technological affordances, interactivity, and data-driven feedback mechanisms [2]. Therefore, it is necessary to conduct a comprehensive review of research on the impact of artificial intelligence on college students' self-directed learning within the framework of "artificial intelligence–learning process–learning outcomes". This study aims to review existing research on the impact of artificial intelligence on college students' self-directed learning and identify key research gaps and future directions.

## 2 METHOD

This study adopts a narrative literature review approach to examine existing research on the impact of artificial intelligence (AI) on college students' self-directed learning. Relevant literature was retrieved from both Chinese and international academic databases, including CNKI and Google Scholar. The time span of the search covered publications from 2016 to 2026, a period marked by the rapid development of AI technologies in education.

The main keywords used in the search process included "artificial intelligence", "generative AI", "college students", "higher education", "self-directed learning", and "self-regulated learning". Articles were included if they focused on higher education contexts and discussed the relationship between AI use and students' learning processes, strategies, or autonomy. Studies unrelated to higher education or not directly addressing self-directed learning were excluded.

After screening titles, abstracts, and full texts, a total of over 50 relevant studies were included in this review. The selected literature was analyzed from three dimensions: technological development stages, research focus, and methodological characteristics. Based on this classification, the review summarizes major findings and identifies existing research gaps.

Although this review does not follow a strict systematic review protocol, efforts were made to ensure the comprehensiveness and relevance of the selected studies.

### 2.1 International Research

Research on how artificial intelligence promotes college students' self-directed learning in international contexts can be summarized into three stages based on the pathways of technological application.

### (1) Exploratory stage: intelligent guidance and adaptive support

Early studies mainly focused on the support provided by artificial intelligence for learning efficiency and learning resource matching. That is, AI was used to help increase learning intensity, and to promote college students' self-management and engagement in self-directed learning by supporting personalized goal management and providing immediate feedback [3]. Meanwhile, some studies proposed instructional strategies and risk-prevention ideas from the perspective of "how to enhance college students' independent learning ability in AI-supported contexts", emphasizing embedding technological support into the design of learning tasks and learning environments [4].

### (2) Platform-based stage: online learning, learning analytics, and self-directed learning mechanisms

With the accumulation of online learning platforms and learning data, international research has further combined artificial intelligence with learning analytics, intelligent recommendation, and adaptive learning path planning, focusing on how "process support" can play a role in the formation of self-directed learning. Relevant studies suggest that in the era of artificial intelligence, college students' self-directed learning should be redefined within a "human-machine collaboration" framework, highlighting new dimensions such as technological literacy, critical cognition, and cross-modal integration, and further promoting students' agency through resource recommendation, process prompts, and personalized feedback [4]. Meanwhile, research on cultivating college students' independent learning ability in AI-supported contexts also emphasizes developing systematic solutions at the levels of teaching models, learning strategy guidance, and learning ecology optimization [5].

### (3) Generative stage: large language models and "cognitive offloading"

If non-generative artificial intelligence can be likened to a "process coach", then generative artificial intelligence functions more as a "content partner". With the rise of generative artificial intelligence, the focus of international research has shifted toward the dual-edged effect in which "capability enhancement" and "capability substitution" coexist. On the one hand, the intensity of generative artificial intelligence tool use may be positively associated with self-directed learning. In particular, in areas such as writing support, explanatory feedback, and information retrieval, these tools can lower learning thresholds and provide scaffolding for learning [6]. On the other hand, while artificial intelligence can promote innovation ability and self-directed learning, it may also induce risks related to academic integrity and declines in higher-order cognitive abilities, thereby necessitating clearer course regulations, evaluation mechanisms, and boundaries for use [7]. In specific learning contexts, artificial intelligence has also been employed to facilitate college students' self-directed learning in domains such as English learning. Its value is primarily reflected in enhanced learning immersion and the optimization of learning strategies, but it likewise depends on instructional guidance and learners' self-regulation ability [8].

## 2.2 Research in China

In the context of the digital transformation of higher education, domestic research has focused on the educational applications of artificial intelligence, the cultivation of competencies, and governance regulations. From the perspective of technological forms, this body of research encompasses both "non-generative artificial intelligence", such as adaptive learning, learning analytics, and intelligent assessment, and generative artificial intelligence, which has rapidly emerged in recent years. Existing studies may be broadly categorized into three types: theoretical research, content-oriented research, and methodological research.

### (1) Theoretical research: conceptual clarification, value debates, and theoretical alignment

In domestic scholarship, research on the impact of artificial intelligence on college students' self-directed learning is often situated within the broader context of transformations in learning modes in the era of artificial intelligence. Some studies, taking tools such as Chat GPT as a point of departure, have conducted reflective discussions on both opportunities and challenges [1], while other studies have carried out empirical analyses focusing on learning process variables (motivation, interactivity, and usage intensity) and outcome variables (academic performance, innovation ability, and creativity) [2,9]. Overall, domestic research tends to place greater emphasis on actionable strategies and the optimization of implementation pathways within higher education contexts.

### (2) Content-oriented research: application scenarios and dimensions of influence

Some studies have examined the relationships between self-directed learning and outcome variables such as learning performance and creativity in artificial intelligence-supported contexts, and have proposed corresponding training mechanisms and teaching governance recommendations. Taking "Chat GPT related learning needs" as an entry point, these studies indicate that generative artificial intelligence can lower the thresholds for information acquisition and expression, provide college students with immediate feedback, and offer diversified learning scaffolds. However, it may also induce risks such as capability outsourcing, cognitive inertia, and academic integrity concerns. Accordingly, it is necessary to guide students to engage in verification and reflection through task restructuring and process-oriented assessment [10]. In addition, some studies have examined the measurement, structure, and evaluation systems related to learning processes and competencies, including the development of assessment frameworks and evaluation models. Prior research has emphasized the importance of establishing systematic evaluation mechanisms to ensure the reliability and validity of educational outcomes in technology-supported learning environments [11-12]. These evaluation-oriented approaches provide useful methodological references for assessing self-directed learning in artificial intelligence-supported contexts. Meanwhile, research on learning supported by generative artificial intelligence tools has gradually increased, emphasizing that self-directed learning ability plays an important mediating role in improving learning outcomes and creativity in artificial intelligence-supported contexts [13]. Other studies have examined the mechanisms

through which artificial intelligence influences the learning process, including interactivity, usage intensity, feedback support, and resource recommendation [3]. Such studies hold significant practical implications.

### (3) Methodological research: evaluation mechanisms

The application of process evidence and learning analytics methods. Research related to generative AI faces challenges such as "invisible processes" and "difficulty auditing quality". Therefore, how to establish an "auditable learning" mechanism at the course level and use a chain of process evidence to support evaluation and research validation is an important direction of methodological research [2]. This provides valuable references for improving and refining the impact of AI on college students' self-directed learning.

## 2.3 Research Gaps

In recent years, research on artificial intelligence and college students' self-directed learning has increased rapidly. However, several research gaps remain worthy of attention.

First, research orientations have shown a tendency toward concentration. Existing studies have largely focused on tool application and risk governance, while insufficient attention has been paid to the mechanisms and boundary conditions through which artificial intelligence influences self-directed learning. In particular, factors such as meta-cognitive level, task complexity, and evaluation systems have not been adequately validated. Moreover, there is a lack of research designs that are replicable and comparable within authentic course-based tasks.

Second, the research subjects and disciplinary contexts remain relatively generalized. Most existing studies treat "college students" as a homogeneous overall sample, with insufficient attention given to the alignment between the characteristics of learning tasks in specific disciplinary groups and corresponding forms of artificial intelligence support. As a result, the contextual explanatory power of the findings remains limited.

Finally, there is a lack of mechanism testing and longitudinal research. On the one hand, some studies remain at the level of usage attitudes or subjective perceptions, without empirically examining the mediating pathway of "artificial intelligence use-learning strategies-self-regulation-ability enhancement". On the other hand, the long-term effects of artificial intelligence use on self-directed learning, such as ability transfer, the formation of dependency, and changes in learning quality, still lack longitudinal data support.

## 3 CONCLUSION

This review synthesizes existing literature on the impact of artificial intelligence on college students' self-directed learning and provides a comprehensive overview of key opportunities, risks, and research gaps.

International research indicates that non-generative artificial intelligence primarily supports college students' planning and monitoring through resource matching, process feedback, and the regulation of learning pace. Generative artificial intelligence, by contrast, enhances learning convenience through content generation and interactive support. However, it also introduces risks related to academic integrity and "cognitive offloading", thereby necessitating clearly defined usage guidelines and ability-oriented instructional design.

Domestic research indicates that, in the era of artificial intelligence, the pathways for enhancing college students' self-directed learning are primarily concentrated in three areas. First, there is an emphasis on constructing evaluation tools and dimensional frameworks for self-directed learning that are more closely aligned with artificial intelligence-supported learning contexts. Second, improving learning motivation, interactivity, and effective usage intensity is viewed as a means of increasing engagement in learning strategies, thereby enhancing both self-directed learning and learning outcomes. Third, scholars stress the incorporation of artificial intelligence-supported task design into instructional activities in order to achieve a balance between ability development and risk control [14-15].

However, several issues remain. Research orientations show a tendency toward concentration, the research subjects and disciplinary contexts remain relatively generalized, and there is a lack of mechanism testing as well as longitudinal tracking studies.

In conclusion, greater attention should be directed toward specific disciplinary learning tasks in order to establish adaptive mechanisms that align artificial intelligence support with the cultivation of professional competencies. It is also essential to strengthen systematic evaluations of both the facilitating effects and the potential substitutive effects of artificial intelligence on self-directed learning, thereby providing more robust evidence to support ability-based governance in higher education.

## COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

## FUNDING

This research was supported by the 2025 College-Level Scientific Research Project of the College of Applied Science and Technology, Beijing Union University, entitled "Research on the Integration Mechanism of Teaching and Learning in Application-Oriented Universities under the Background of Generative Artificial Intelligence Empowering the Integration of Vocational and General Education" (No. YKKY202515).

## REFERENCES

- [1] Jin Y, Gong P, Bao Y, et al. Opportunities and Challenges for the Development of College Students' Self-Directed Learning Ability in the Era of Strong Artificial Intelligence—A Reflection Based on ChatGPT. *Journal of Xinyang Normal University (Philosophy and Social Sciences Edition)*, 2023-12-29.
- [2] Wang R, Yu F. The Impact of Perceived Interactivity of Generative Artificial Intelligence on College Students' Self-Directed Learning Ability. *Foreign Economic Relations & Trade*, 2024-07-29.
- [3] Xu J. Impact of Artificial Intelligence-assisted Learning Intensity on College Students' Self-directed Learning Ability. *SHS Web of Conferences*, 2025, 222: 01002. DOI: 10.1051/SHSCONF/202522201002.
- [4] Yan L. Research on Strategies for Improving College Students' Independent Learning Ability in the Context of Artificial Intelligence. *Modern Management Science & Engineering*, 2024, 6(3). DOI: 10.22158/MMSE.V6N3P269.
- [5] Liu X, Zhou D. Exploring Pathways and Strategies for Cultivating Autonomous Learning Abilities of College Students in the Artificial Intelligence Era. *Education Research and Innovation*, 2025, 1(6). DOI: 10.62639/SSPERI08.20250106.
- [6] Lin B. The influence of the usage intensity of generative Artificial Intelligence tools by college students on their autonomous learning ability. *SHS Web of Conferences*, 2025, 222: 01003. DOI: 10.1051/SHSCONF/202522201003.
- [7] Wang D, Liu Y, Jing X, et al. Catalyst for future education: An empirical study on the Impact of artificial intelligence generated content on college students' innovation ability and autonomous learning. *Education and Information Technologies*, 2024, 30(8): 1-20. DOI: 10.1007/S10639-024-13209-6.
- [8] Wei L, Du S, Zhu Z. A Survey Study on College Students' Autonomous English Learning Ability in the Context of Artificial Intelligence. *Journal of Sociology and Education*, 2025, 1(12). DOI: 10.63887/JSE.2025.1.12.16.
- [9] Zhang Y. Relationships among College Students' Learning Motivation, Self-Directed Learning Ability, and Satisfaction with Academic Achievement. *Chinese Journal of School Doctor*, 2021-06-20.
- [10] Xiao YG, Li Xiang B, Liu W. Research on Cultivating College Students' Self-Directed Learning Ability Based on Enhancing Employability Competitiveness. *Henan Education (Higher Education)*, 2024-06-20.
- [11] Wei Y, Dang C, Zhan Y. Development of a Self-Assessment Scale for College Students' Self-Directed Learning Ability and AI Applications—A Case Study of Tsinghua University's Exploration. *Jiangsu Higher Education*, 2026-01-05.
- [12] Ping M, Di Y. Literature Review on Developmental Teacher Evaluation. *Journal of Intelligence and Knowledge Engineering*, 2023, 1(4). DOI: 10.62517/JIKE.202304404.
- [13] Li C, Yu G. The Impact of College Students' Self-Directed Learning Ability on Creativity in the AI Era. *Journal of Multimedia and Network Teaching and Learning (First Ten-Day)*, 2025-12-01.
- [14] Ji R, Xu Z, Liu X. A Study on the Cultivation Mechanism of College Students' Self-Directed Learning Ability in the AI Era—Using Undergraduate Capstone Design in Engineering Majors as a Practice-Based Carrier for Education. *China University Teaching*, 2025-11-15.
- [15] Song C, Luo L, Zhang K, et al. Enhancing College Students' Self-Directed Learning Ability with Technical Support from Generative AI Tools—A Case Study of the Financial Accounting Major. *Internet Weekly*, 2024-01-05.