Balancing Technology and Humanity: How to Prevent Over-Reliance on Generative AI in Student Independent Learning

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Abstract: With the rapid iteration and penetration of generative AI tools (e.g., ChatGPT, DeepSeek) in education, they have become versatile aids for students' independent learning, enabling instant information retrieval and efficient task optimization to enhance learning efficiency. However, students' growing over-reliance has triggered prominent dilemmas, such as eroded independent thinking, pervasive loss of creative expression, and impaired cognitive construction, challenging the balance between technological empowerment and humanistic cultivation. This study explores the formation mechanism of such over-reliance and constructs a targeted prevention strategy system via a mixed method: a questionnaire survey of 500 students from 18 schools, semi-structured interviews with 30 typical students and 15 teachers, and 3-month case studies. Results show over-reliance is driven by individual (instrumental motivation, low self-efficacy), teacher (insufficient guidance), and environmental (tool usability, unclear norms) factors. A three-dimensional strategy for students, teachers, and management departments is proposed, enriching relevant theories and providing practical references for rational AI application in education. This study enriches the theoretical system of the integration of generative AI and education, particularly deepening research on the negative effects of generative AI in students' independent learning and its regulatory mechanisms. Practically, the proposed three-dimensional prevention strategy provides specific and operable reference schemes for schools, teachers, and educational management departments to address students' over-reliance on AI. It is anticipated to guide the rational application of generative AI in education, give full play to its auxiliary role in promoting learning, and simultaneously safeguard the core status of students' cognitive development and humanistic quality cultivation, thereby advancing the healthy, sustainable, and humanistic development of AI-assisted education.

1. Introduction

In the digital era, generative AI represented by ChatGPT has reshaped education with powerful content generation and interaction capabilities. Widely used in all educational levels, it provides personalized support like real-time knowledge explanation and academic writing assistance, boosting students' independent learning and breaking traditional time-space limitations.

However, students' over-reliance on generative AI has raised widespread concerns. Many directly copy AI answers, rely on it for full-process writing, or replace personal judgment with AI results, weakening independent thinking, logical reasoning, and creativity—conflicting with the goal of cultivating independent individuals, making it urgent to balance AI's auxiliary role and humanistic education.

This study has theoretical and practical significance: it enriches interdisciplinary research on educational technology and AI ethics, and provides operable guidance for standardizing AI use. Focusing on three core questions—over-reliance characteristics, driving factors, and prevention strategies—the paper is structured as literature review, methodology, results, discussion, and conclusion.

2. Literature Review

Student independent learning, a long-standing research focus, refers to students independently planning, monitoring, and evaluating their learning activities [1]; its development is affected by internal factors (learning motivation, self-efficacy) and external factors (teacher

guidance, resources). Zimmerman [2] noted that self-efficacy directly affects learning strategy selection, while scientific teacher guidance effectively stimulates independent learning motivation. Current evaluation systems lack targeted indicators for AI-era independent learning [1].

Technology dependence theory indicates that excessive use of autonomous tools may cause psychological dependence and ability weakening [3]; existing research on technology over-reliance mainly focuses on traditional tools, with limited systematic empirical studies on generative AI. Its strong autonomy and interactivity exert more complex impacts on independent learning, and there is a lack of in-depth research on its formation mechanism and targeted strategies [4], which is the core gap this study addresses.

In terms of the application of generative AI in education, existing studies have shown that generative AI has a wide range of application scenarios in teaching and learning. In terms of learning support, generative AI can act as an intelligent tutor, providing students with personalized knowledge explanation, learning plan formulation, and task feedback, helping students solve learning difficulties in a timely manner and improving learning efficiency [5]. In terms of academic writing, tools such as ChatGPT can assist students in topic selection, outline design, language polishing, and citation formatting, reducing the threshold of academic writing and improving the quality of writing [6]. In addition, generative AI can also be applied to creative education, such as assisting students in creating literary works, designing art works, and simulating scientific experiments, stimulating students' creative potential. However, while affirming the positive value of generative AI, scholars also point out potential risks, such as the homogenization of learning results, the decline of students' independent thinking ability, and the hidden danger of academic misconduct [7,8], which have become the main controversies in its educational application.

Student independent learning, as the core object of this study, has been a key research direction in the field of education for a long time. Scholars generally believe that independent learning refers to the learning process in which students independently plan, monitor, adjust, and evaluate their own learning activities according to their own learning goals and characteristics

[1]. The formation and development of independent learning ability are affected by multiple factors, including individual internal factors and external environmental factors. From the perspective of individual internal factors, learning motivation, self-efficacy, cognitive level, and learning strategies are the key determinants: students with strong intrinsic motivation and high self-efficacy are more likely to take the initiative to carry out independent learning and actively solve learning problems [2]. From the perspective of external environmental factors, teacher guidance, family education, and learning resources play an important role in promoting students' independent learning. Among them, teacher guidance is particularly critical. Teachers' reasonable task design, timely feedback, and scientific guidance can effectively stimulate students' independent learning motivation and improve their independent learning ability. In terms of the evaluation of independent learning ability, existing evaluation systems mainly focus on learning results, learning processes, and learning strategies, but there is still a lack of targeted evaluation indicators for independent learning in the AI era.

In terms of the application of generative AI in education, existing studies have shown that generative AI has a wide range of application scenarios in teaching and learning. In terms of learning support, generative AI can act as an intelligent tutor, providing students with personalized knowledge explanation, learning plan formulation, and task feedback, helping students solve learning difficulties in a timely manner and improving learning efficiency. Zhang et al. found that 62% of college students use generative AI for daily learning assistance, with 41% regarding it as an indispensable tool. In terms of academic writing, tools such as ChatGPT can assist students in topic selection, outline design, language polishing, and citation formatting, reducing the threshold of academic writing and improving the quality of writing. Li & Wang pointed out that generative AI's strong autonomy increases the risk of students' over-reliance, as it can provide "one-stop" solutions for writing tasks. In addition, generative AI can also be applied to creative education, such as assisting students in creating literary works, designing art works, and simulating scientific experiments, stimulating students' creative potential. However, while affirming the positive value of generative AI, scholars also point out

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3. Research Methodology

This study adopts a mixed research method integrating quantitative and qualitative approaches to ensure comprehensive, in-depth, and reliable results. Quantitative research investigates the general characteristics, influencing factors, and manifestations of over-reliance through objective data; qualitative research explores the internal mechanism via in-depth interviews and case studies, complementing the limitations of single quantitative research.

Research objects include 500 students from 18 schools in northern, eastern, and central China, 30 typical over-reliant students, and 15 frontline teachers. Stratified and purposeful sampling ensures sample representativeness across regions and school types.

Research tools include a reliable questionnaire (Cronbach's $\alpha=0.87$, KMO=0.82), semi-structured interview outlines (focusing on motivation and guidance difficulties), and 3-month case tracking tables.

Data includes 500 valid questionnaires (96.15% recovery rate), 80,000-word interview transcripts, and 3-month case records. SPSS 26.0 analyzes quantitative data, while thematic analysis and triangulation verify qualitative results for reliability [9].

Correlation analysis ($p<0.01$) shows significant links between instrumental motivation, self-efficacy, teacher guidance, and over-reliance (Figure 1).

The selection of research objects follows the principles of random sampling and purposeful sampling. For the 500 surveyed students, stratified random sampling is adopted to ensure the representativeness of the sample in terms of region, school type, grade, and discipline.
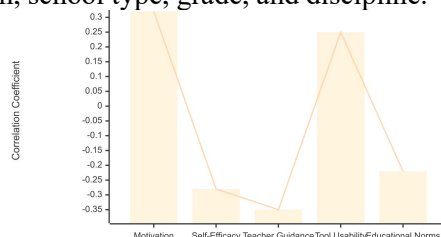

Figure 1. Correlation Coefficient

4. Results and Analysis

Based on questionnaire, interview, and case data, this study explores the manifestations, influencing factors, and harms of over-reliance, with the following results:

Over-reliance manifests in three aspects: knowledge acquisition (direct AI answer-seeking for learning difficulties, even simple memory questions), content creation (AI-generated homework/essays with minor modifications, homogenized works), and problem-solving (over-reliance on AI for plans and processes, weakened logical thinking) [8, 10].

Group differences in over-reliance manifestations are significant. Among 500 surveyed students, 45.6% show over-reliance in knowledge acquisition, 38.9% in content creation, and 29.3% in problem-solving. Specifically, 48.5% of middle school students rely on AI for knowledge acquisition, higher than college students' 43.7%; while college students have a higher proportion of over-reliance in content creation compared to middle school students, due to varying learning tasks and cognitive levels.

Over-reliance is driven by three interrelated factors: individual, teacher, and environmental. Individually, instrumental motivation (pursuing short-term high scores) and low self-efficacy promote over-reliance; students with low digital literacy face a higher risk of blind trust in AI [11]. For teachers, 73.3% lack sufficient understanding of generative AI, 66.7% adopt result-oriented evaluation, and simple prohibition of AI use leads to students' secret reliance. Environmentally, AI's high usability lowers over-reliance costs; unclear usage norms and inadequate supervision exacerbate the problem [12]. Over-reliance harms students' cognitive development, weakens independent learning ability, and increases AI-related academic misconduct. Case tracking shows core ability declines, such as creative expression, independent problem-solving, and academic integrity awareness. Table 1 shows core ability changes in case students.

Table 1. Core Ability Changes in Case Students

Core Abilities	Before Over-Reliance	After Over-Reliance	Change Range
Logical Reasoning	82.3	71.5	-13.1%
Creative Expression	78.6	69.2	-11.9%

Independent Problem-Solving	80.1	68.9	-13.9%
Academic Integrity Awareness	85.7	76.3	-10.9%

Note: Full score=100.

In terms of the harms of over-reliance, the research results show that over-reliance on generative AI has a negative impact on students' cognitive development, learning ability, and academic integrity. In terms of cognitive development, over-reliance leads to the weakening of students' independent thinking and logical reasoning abilities. The case study shows that after a 3-month tracking, the scores of the case students in logical reasoning and critical thinking tests have changed significantly, which is consistent with the research conclusion of Brown & Knight [13] that over-reliance on generative AI will reduce students' cognitive flexibility. In terms of learning ability, over-reliance hinders the improvement of students' independent learning ability and learning strategies. Students who are over-reliant on AI are unable to independently formulate learning plans, monitor learning processes, and evaluate learning results, and their ability to solve complex problems independently is significantly lower than that of students who use AI rationally. Zimmerman [2] emphasized that independent learning ability is formed through repeated practice and reflection, and the intervention of generative AI will break this formation process.

5. Discussion

This study's results align with preliminary research and show uniqueness. Generative AI's strong autonomy and interactivity lead to "one-stop" support, increasing over-reliance risk, Notably, teacher guidance is the core influencing factor, differing from previous individual-focused research. Cross-group differences in over-reliance manifestations enrich heterogeneity research [14].

Balancing technology and humanity requires leveraging AI's advantages while upholding humanistic education. Teachers can use AI for auxiliary tasks and focus on cultivating critical thinking in core links. A optimized three-dimensional strategy system is proposed:

An optimized three-dimensional strategy is proposed: Students should strengthen critical thinking and digital literacy, establish intrinsic motivation; Teachers need AI training, inquiry-based task design, and process-oriented

evaluation [15]; Management departments should improve norms, develop education-friendly AI tools, and build school-family-society joint governance [16].

This study has limitations: unrepresentative samples (lacking western China and primary students), 3-month short-term tracking, and potential subjective bias. Future research should expand samples, conduct long-term tracking, and explore dynamic early warning mechanisms and cross-cultural comparisons [17].

The interpretation of research results shows that the manifestations of students' over-reliance on generative AI are closely related to the characteristics of generative AI itself. Compared with traditional intelligent tools, generative AI has stronger content generation ability and interactivity, which can provide students with "one-stop" learning support from knowledge acquisition to content creation, thus making students more likely to form over-reliance. At the same time, the research finds that the key influencing factors of over-reliance involve multiple levels. Different from existing studies, this study finds that teacher guidance is the core link affecting students' AI usage: effective teacher guidance can significantly reduce the risk of over-reliance, while the absence of teacher guidance will directly exacerbate over-reliance. This finding highlights the important role of teachers in the integration of generative AI and education, and provides a new perspective for solving the problem of over-reliance, which is different from the previous research that focused more on individual factors.

The balance between technology and humanity is the core issue to be solved in this study. In the AI era, the essence of educational balance is to give full play to the auxiliary role of technology while adhering to the humanistic nature of education, and realize the coordinated development of technological empowerment and humanistic cultivation. Specifically, on the one hand, we should recognize the positive value of generative AI in promoting independent learning, and encourage students to use AI tools rationally to improve learning efficiency and expand learning boundaries; on the other hand, we should firmly safeguard the core status of students' cognitive development and humanistic quality cultivation, and avoid the substitution of technology for human thinking and creation. To achieve this balance, it is necessary to break the one-sided view of "technology omnipotence"

and "technology rejection", establish a correct view of AI education, and integrate generative AI into the educational process in a scientific and reasonable way. For example, teachers can use generative AI to design hierarchical learning tasks, guide students to use AI to complete auxiliary tasks such as information sorting and preliminary analysis, and focus on cultivating students' critical thinking and creative expression in the core links of thinking and creation.

6. Conclusion

This study uses mixed methods to explore students' over-reliance on generative AI and construct a three-dimensional prevention strategy. Core findings: over-reliance manifests in three aspects, driven by individual, teacher, and environmental factors, harming cognitive development and academic integrity; the strategy balances technological empowerment and humanism.

Practical implications: Students use AI as an auxiliary tool; teachers master AI-assisted teaching; management improves norms. Future AI-education integration must focus on over-reliance, adhere to humanistic education, and promote healthy development.

The research results of this study have important practical implications for students, teachers, and educational management departments. For students, they should establish a correct view of AI usage, recognize the auxiliary role and limitations of generative AI, actively cultivate their critical thinking and digital literacy, transform learning motivation, and improve their independent learning ability. Students should use AI tools as a helper for independent learning, not a substitute, and maintain their initiative and independence in the learning process. For teachers, they should strengthen the learning and application of generative AI, master the relevant skills and methods of AI-assisted teaching, and give full play to the guiding role in students' AI usage. Teachers should optimize teaching design and evaluation methods, design learning tasks that are conducive to cultivating students' independent thinking and creative expression, and establish a process-oriented evaluation system to guide students to use AI rationally. For educational management departments, they should speed up the formulation and improvement of relevant educational norms and standards, clarify the boundaries and requirements of students' use of generative AI, and establish a dynamic supervision and management mechanism. At the same time, they should strengthen the professional training of teachers on generative AI, promote the research and development and application of educational AI tools, and form a joint governance force to promote the healthy development of AI-assisted education.

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