

The Impact of Generative Artificial Intelligence Dependency on the Mental Health of College Students: The Mediating Role of Cognitive Load

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Abstract: To explore the impact mechanism of generative AI dependence on the mental health of college students, this study collected data using a questionnaire survey, constructed a relationship model between generative AI dependence, cognitive load, and mental health, and conducted empirical testing using structural equation modeling. The results show that generative AI dependence has a significant negative impact on the mental health of college students; generative AI dependence significantly increases cognitive load; and cognitive load plays a significant mediating role in the impact of generative AI dependence on the mental health of college students. Based on this, universities should guide students to use generative AI tools rationally to improve their information processing capabilities, reduce cognitive load during the learning process, and improve mental health education and support mechanisms to promote the coordinated development of generative AI applications and the mental health of college students.

Keywords: Generative Artificial Intelligence Dependency; College Students; Mental Health; Cognitive Load

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1. Introduction

With the rapid development of generative artificial intelligence technology, intelligent tools such as ChatGPT, Wenxin Yiyan, and Tongyi Qianwen have gradually been integrated into the learning and life of college students. They have been widely used in knowledge acquisition, homework assistance, information retrieval and content creation, providing new technical support for the transformation of learning methods. At the same time, some students have gradually developed a tendency to rely on intelligent tools in the process of long-term and high-frequency use of generative artificial intelligence, which may weaken their ability to think independently and solve problems independently, and increase the cognitive burden in the process of information screening, judgment and integration, thus having a potential impact on mental health. Existing research mainly focuses on the educational application effect, learning behavior and technology acceptance of generative artificial intelligence, and pays relatively little attention to the psychological consequences of generative artificial intelligence dependence and its internal mechanism, especially lacking empirical testing from the perspective of cognitive load^[1]. Cognitive load reflects the cognitive resources consumed by individuals in the process of information processing and is an important variable connecting technology use behavior and psychological state. Based on this, this paper takes college students as the research object, explores the impact of generative artificial intelligence dependence on mental health, and

examines the mediating role of cognitive load, in order to enrich the relevant research on generative artificial intelligence usage behavior and provide a reference for college students to use generative artificial intelligence tools rationally and for mental health education.

2. Theoretical Analysis and Research Hypotheses

2.1 Dependence on Generative Artificial Intelligence and the Mental Health of College Students

Generative artificial intelligence can quickly provide services such as information retrieval, text generation and learning assistance. While improving learning efficiency, it also changes the way college students acquire knowledge and complete learning tasks. When students rely on generative artificial intelligence to complete learning activities for a long time, it is easy to reduce their enthusiasm for independent thinking and problem-solving, and form a path dependence on intelligent tools^[2]. Once they leave the relevant tools, individuals may experience negative emotions such as anxiety and tension due to insufficient learning confidence and increased pressure to complete tasks. At the same time, excessive reliance on generative artificial intelligence may also reduce students' opportunities for active exploration and deep learning, which is not conducive to the improvement of psychological adaptability and has a negative impact on mental health. Based on this, the following hypothesis is proposed:

H1: Generative AI dependency has a significant negative impact on the mental health of college students.

2.2 Dependence on Generative Artificial Intelligence and Cognitive Load

Cognitive load refers to the cognitive resources that individuals occupy when completing learning tasks or processing information. Generative artificial intelligence can quickly output a large amount of content, but the generated results still need to be identified, filtered, verified and integrated by users. As the frequency of use of generative artificial intelligence continues to increase, students need to continuously invest more cognitive resources to judge the authenticity, applicability and logical consistency of information, and the information processing pressure increases accordingly^[3]. At the same time, in the face of diverse generated results, individuals need to constantly compare and make decisions, which will further increase the level of cognitive load. Therefore, the higher the degree of dependence on generative artificial intelligence, the easier it is to increase cognitive load. Based on this, the following hypothesis is proposed:

H2: Generative AI dependency has a significant positive impact on cognitive load.

2.3 The Mediating Role of Cognitive Load

Cognitive resources are limited. When individuals are under high cognitive load for a long time, they are prone to cognitive fatigue, decreased attention and weakened emotional regulation, which in turn affect their mental health^[4]. For college students, the continuous information processing demand brought about by generative artificial intelligence dependence will increase the consumption of cognitive resources. When cognitive resources are under high load for a long time, individuals are more likely to experience learning pressure, anxiety and psychological fatigue, thereby reducing their mental health. It can be seen that generative artificial intelligence dependence may not only directly affect the mental health of college students, but may also indirectly affect them by increasing cognitive load. Based on this, the following hypothesis is proposed:

H3: Cognitive load plays a mediating role between generative AI dependence and mental health of college students.

3. Research Design

3.1 Variable Measurement

This study used a mature scale to measure each variable and made appropriate adjustments to some of the statements in combination with the application scenarios of generative artificial intelligence. All items were scored using the Likert five-point scoring method, with 1 indicating "strongly disagree" and 5 indicating "strongly agree". The higher the score, the higher the level of the corresponding variable^[5].

Table 1 Variable Measurement

Variable type	Variable name	Measurement content
Independent variable	Generative AI Dependence	Students' dependence on generative artificial intelligence tools is measured by factors such as frequency of use, degree of dependence, and tendency to substitute learning.

Variable type	Variable name	Measurement content
Mediator variables	Cognitive load	The cognitive load level of students using generative artificial intelligence is measured in terms of information processing pressure, comprehension difficulty, and cognitive resource consumption.
Dependent variable	mental health	The mental health status of students is measured from aspects such as emotional state, psychological stress, and psychological adaptation.
control variables	Gender, Grade	To reduce the impact of individual differences on the research results, gender and grade were included as control variables in the model.

3.2 Data Sources

This study surveyed students at a university, using a questionnaire survey method to collect data. The questionnaire was designed to cover topics such as dependence on generative artificial intelligence, cognitive load, and mental health, and was distributed online. The survey covered students from different grades and majors. A total of 591 questionnaires were distributed, and 579 were returned. After checking the completeness and logical consistency of the returned questionnaires, invalid questionnaires with missing answers, repetitive answers, or obvious contradictions were removed, resulting in 562 valid questionnaires, with an effective response rate of 97.06%.

4. Empirical Results Analysis

4.1 Descriptive Statistics

Descriptive statistical analysis was conducted on variables such as generative AI dependence, cognitive load, and mental health. The results are shown in Table 1. From the means, college students' generative AI dependence and cognitive load are both at a moderately high level, and their overall mental health is relatively good. The standard deviation of each variable is less than 1.

Table 2 Descriptive statistics of key variables

variable	mean	Standard deviation	Minimum value	Maximum value
Generative AI Dependence	3.46	0.72	1.33	4.92
Cognitive load	3.38	0.68	1.40	4.80
mental health	3.74	0.63	1.83	5.00

4.2 Reliability and Validity Testing

To ensure the reliability and validity of the scale's measurement results, Cronbach's α coefficient was used to test the scale's reliability, and the KMO test and Bartlett's test of sphericity were used to evaluate the construct validity of the data. The results showed that the Cronbach's α coefficients for all variables were above 0.80, indicating good internal consistency of the scale; the KMO value was 0.889, greater than 0.80, and the Bartlett's test of sphericity reached a significant level ($p < 0.001$), indicating that the sample data was suitable for factor analysis and the scale had good construct validity.

Table 3 Reliability and validity test results

Inspection items	Test results
Generative artificial intelligence relies on Cronbach's alpha	0.873
Cognitive load Cronbach's α	0.856
Cronbach's Alpha	0.891
Cronbach's Alpha Scale	0.901
KMO value	0.889
Bartlett's test for sphericity χ^2	3685.472
Degrees of freedom (df)	136
Sig.	<0.001

Further exploratory factor analysis was used to examine the scale structure. The results showed that three common factors were extracted, corresponding to the three theoretical dimensions of generative AI dependence, cognitive load, and mental health. The loadings of each item on its respective factor were all above 0.60, and no significant cross-loadings were observed, indicating that the scale has good convergent and discriminant validity. The cumulative variance explained by the three rotated common factors reached 72.48%, and each factor was able to explain the information of its corresponding variable well, indicating that the scale has good structural stability.

4.3 Empirical Results

After completing the reliability and validity tests, structural equation modeling was used to perform an overall fit test on the research model to verify the degree of fit between the model and the sample data. The model fit results are shown in Table 4.

Table 4. Fitting results of structural equation model

Fit index	Standard value	actual value	Fitting results
χ^2/df	<3.000	2.184	good
GFI	>0.900	0.931	good
AGFI	>0.900	0.912	good
NFI	>0.900	0.927	good
CFI	>0.900	0.951	good
TLI	>0.900	0.944	good
RMSEA	<0.080	0.046	good
SRMR	<0.080	0.041	good

Table 4 shows that all model fit indices meet the recommended standards. Specifically, χ^2/df is 2.184, less than 3; GFI, AGFI, NFI, CFI, and TLI are all above 0.90; RMSEA and SRMR are both below 0.08, indicating that the theoretical model fits the sample data well, and the overall model has high adaptability. The model can effectively reflect the relationship between generative AI dependence, cognitive load, and mental health, providing a reliable foundation for subsequent path analysis and mediation effect testing.

4.4 Path Analysis and Hypothesis Testing

Based on the fact that the structural equation model fits the requirements, the path relationships between the variables are tested, and the results are shown in Table 5.

Table 5. Results of Path Analysis and Hypothesis Testing

Assumption	Path Relationship	Standardized path coefficient (β)	CR value	p-value	Test results
H1	Generative AI Dependence $\rightarrow$ Mental Health	-0.312	-4.873	<0.001	support
H2	Generative AI Dependence $\rightarrow$ Cognitive Load	0.541	8.926	<0.001	support
H3	Cognitive load $\rightarrow$ Mental health	-0.387	-6.245	<0.001	support

Table 5 shows that generative AI dependence has a significant negative impact on the mental health of college students ($\beta = -0.312$, $P < 0.001$), indicating that the level of students' mental health declines with increasing dependence on generative AI, thus validating hypothesis H1. To further examine the mediating role of cognitive load in the relationship between generative AI dependence and the mental health of college students, the Bootstrap method was used to test the mediation effect, with 5,000 repeated samplings and a 95% confidence interval as the criterion. The test results are shown in Table 6.

Table 6. Results of Bootstrap Mediation Effect Test

Effect type	Effect value	Boot SE	95% confidence interval	Test results
Total effect	-0.521	0.062	[-0.643, -0.399]	Significant
direct effects	-0.312	0.064	[-0.438, -0.187]	Significant
Indirect effects	-0.209	0.041	[-0.292, -0.131]	Significant

Table 6 shows that both the total and direct effects of generative AI dependence on the mental health of college students are significant, and the 95% confidence interval for the indirect effect does not include 0, indicating that cognitive load plays a significant mediating role between generative AI dependence and the mental health of college students. Hypothesis H3 is validated, demonstrating that generative AI dependence not only directly affects the mental health of college students but also further influences their mental health level by increasing cognitive load.

5. Relevant Recommendations

Generative artificial intelligence has become an important learning aid for college students, and its application value is undeniable. However, over-reliance on it may have adverse effects on mental health. Based on the findings of this study, the following suggestions are proposed.

Guiding students to use generative AI tools appropriately. Universities should strengthen education on the proper use of generative AI, guiding students to use it as a learning aid rather than a substitute for independent thinking and self-directed learning. Teachers can design open-ended and inquiry-based tasks in their courses to encourage students to combine independent thinking with AI tools, thereby improving learning quality and reducing reliance on generative AI.

Reducing Cognitive Load in Students' Learning Process. Research shows that cognitive load plays a mediating role in the impact of generative AI dependence on mental health. Universities should strengthen information literacy education to help students master methods for identifying, filtering, and integrating the output content of generative AI, thereby improving information processing efficiency and reducing the consumption of cognitive resources caused by ineffective information. Simultaneously, the continuous information processing pressure on students can be reduced by optimizing course task design and rationally arranging the learning pace.

Improve the support mechanism for the mental health of college students. Colleges and universities should include the use of generative artificial intelligence in the scope of students' mental health education and daily management, and promptly understand changes in students' usage behavior and mental state. Relying on psychological counseling, psychological testing, and mental health education, colleges and universities should strengthen psychological support for students who are overly reliant on generative artificial intelligence, guide them to form scientific and rational technology usage habits, and promote the coordinated development of generative artificial intelligence and students' mental health.

6. Conclusion

This study investigates the impact of generative AI dependency on mental health among university students and examines the mediating role of cognitive load. The results show that generative AI dependency has a significant negative impact on the mental health of university students, further affecting their mental health by increasing cognitive load. Therefore, in promoting the application of generative AI in education, it is crucial not only to focus on the improved learning efficiency brought about by the technology but also to pay attention to the potential cognitive stress and mental health risks it may cause. Universities should strengthen guidance for students' scientific use of generative AI, optimize learning support and mental health services, and promote the coordination between technology application and students' all-round development. Due to limitations in sample size and research conditions, this study still has certain shortcomings. Future research could further expand the sample source and incorporate longitudinal data to enhance the generalizability and explanatory power of the findings.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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