

The influence of the usage intensity of generative AI tools by college students on their autonomous learning ability

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Abstract. With the prevalence of artificial intelligence, Generative Artificial Intelligence (GenAI) tools are playing an increasingly important role in higher education. This quantitative study uses a questionnaire survey to explore the relationship between college students' intensity of using Gen AI tools and their autonomous learning ability. This study used Zude Zhu's College Students' Autonomous Learning Ability Test Scale and the author's self-compiled College Students' Generative AI Tool Usage Intensity Scale. A total of 120 college students with an equal number of male and female students were selected through stratified sampling. According to data analysis, the final result is that the more intensively college students use Gen AI tools, the higher their autonomous learning ability.

1 Introduction

1.1 Background

With the development of technology, GenAI tools have attracted attention due to their powerful language generation capabilities and interactivity. GenAI tools have been used to solve complex problem-solving processes, such as writing assistance and personalized learning paths, especially in higher education [1]. Many countries, including the United States, the United Kingdom and China, have called for reforms in university education, emphasizing the key role of GenAI in higher education. Therefore, GenAI tools have been an important research direction in the educational field. ChatGPT, the typical representative of GenAI, which came out in 2022, has become a powerful assistant in college students' study life. ChatGPT can help college student accomplish their tasks more easily, including but not limited to understanding articles, generating new text content, and even providing personalized ideas and frameworks for writing. One of the consequences of this phenomenon is that many students no longer use their brains, laziness gradually sets in, and they gradually lack the ability to think independently. Through reading literature, the author found that previous studies have shown that GenAI tools have both positive and negative effects on college students. However, previous studies have not focused on the impact of the intensity of learning and using GenAI tools on college students' autonomous learning ability.

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Therefore, based on previous studies' outcomes and observation of some social phenomena, the study assumes that the more intensively college students use GenAI tools, the lower their autonomous learning ability will be.

1.2 Literature review

1.2.1 Autonomous learning& Autonomous learning ability

According to relevant literature, autonomous learning means that learners are “willing” and “able” to participate in the learning process throughout. The “willing” mentioned before comes from the learners' internal psychological factors such as learning motivation and learning attitude. The “ability” emphasizes that the learners have the ability to independently test and self-evaluate [2]. Autonomous learning ability includes the ability for individuals to independently determine their learning goals, choose a learning method that suits them, monitor the learning process, and finally evaluate their learning outcomes [3].

1.2.2 The impact of GenAI tools on college students

The author found that much research on GenAI tools in the past five years has been concerned with their impact on learners. Some past studies have shown that using GenAI tools can have an impact on college students. From a psychological perspective, ChatGPT's behavior of “feeding” well-generated content to college students may make them lazy and lead to the disappearance of their subjective initiative in the learning process [4]. As a consequence, students are no longer the subjects of the learning process, but rather accessories. Not only that, GenAI tools like ChatGPT will also harm students' ability to distinguish right from wrong [5]. Students no longer distinguish whether the answers given by artificial intelligence are right or wrong, but rely entirely on ChatGPT due to excessive reliance on AI. In addition, student's innovation thinking will be greatly reduced [6]. Moreover, under the guidance of this convenient technology, college students tend to focus more on solving immediate problems and neglect deep thinking about knowledge. This utilitarian value orientation can easily lead to rigid thinking and an inability to truly master knowledge [7].

Except for these negative influences, previous literature also mentioned that using GenAI tools can affect college students positively to some extent. Some scholars believe that GenAI tools can improve students' task motivation and help them better complete the tasks assigned by teachers [8]. Not only that, but some scholars have pointed out that the use of GenAI tools has a moderate positive impact on the academic performance of college students, which means that it can improve academic performance to a certain extent [9].

In summary, GenAI tools have both positive and negative effects on college students' learning abilities. Positive effects include but are not limited to improving grades and increasing task motivation. While negative effects include but are not limited to changes in learning subjects and weakening of innovative thinking.

2 Method

2.1 Research subjects

The research subjects of this study are college students. Participants must be college students, generally between 18-23 years old, with no restrictions on specific grades, genders, or majors,

and must have a certain foundation in independent learning. Moreover, research subjects need to be willing to participate in this questionnaire survey.

2.2 Questionnaire design

The study designed a questionnaire for college students' use intensity of GenAI tools and their autonomous learning ability. The questionnaire includes the college students' autonomous learning scale compiled by Zhu Zude et al [10] and the college students' GenAI tool use intensity scale compiled by the author. The questionnaire includes three categories, 3 questions on personal information, 9 questions on college students' use intensity of generative AI tools and 69 questions on college students' autonomous learning ability, a total of 81 questions.

2.2.1 Generative AI tool usage intensity scale for college students

In order to measure the intensity of college students' use of generative AI tools, the author compiled a scale that evaluates students' use intensity of generative AI tools through two dimensions: frequency of use and duration of use.

Table 1. Reliability analysis of the generative AI tool usage intensity scale for college students

Dimensions	Cronbach reliability analysis		
	Number of items	Sample size	Cronbach's alpha coefficient
Frequency of use of GenAI tools	5	120	0.878
usage time of GenAI tools	4	120	0.825

Table 1 presents the Cronbach's Alpha results for each dimension of this scale. The Cronbach's Alpha values for each dimension established in this study are 0.878 and 0.825, respectively. These values exceed the threshold of 0.7, suggesting that the internal consistency of each dimension of the GenAI tool usage intensity scale is satisfactory. The results of this survey demonstrate a high level of reliability.

2.2.2 College students' autonomous learning scale

The study uses the college students' autonomous learning scale to assess the autonomous learning ability of the college students surveyed. The scale has 69 questions and is divided into two dimensions, namely the motivation subscale and the strategy subscale. The students surveyed were asked to rate each question on a 6-point scale (1= "completely inconsistent" and 6= " completely consistent"). The total score of the autonomous learning ability of the college students tested is obtained by adding up the scores of each question. The higher the score, the higher the autonomous learning ability. The overall Cronbach's α coefficients of the two subscales of this scale are 0.8 and 0.9, respectively, which shows that the overall reliability of the scale is very high. The correlation coefficients of the motivation and strategy subscales with the total scale are very high (over 0.9), which shows that this scale has high validity.

2.3 Questionnaire distribution and sample description

The study collected data through online questionnaires, which were distributed through some online apps. Before distributing the questionnaire, the researcher conducted a specific sampling of students in each grade and ensured that students in each grade and gender group could receive the questionnaire link. Data collection lasted for 1 week, during which data cleaning was performed and incomplete questionnaires were removed to ensure the diversity and representativeness of the sample. The samples of this study are from college students, and stratified sampling is used for selection. This study plans to select 30 samples (15 males and 15 females) from each grade (freshman, sophomore, junior, and senior) to ensure a balanced gender ratio and representativeness of each grade. The final sample size is expected to be 120 valid questionnaires.

2.4 Data analysis method

The study used SPSS 25.0 software to conduct statistical analysis on the collected data, mainly including frequency analysis, reliability analysis, difference analysis, correlation analysis and regression analysis.

Firstly, the study conducted a frequency analysis of the sample’s gender and grade to understand the basic distribution of the sample. Secondly, the study used a difference analysis to examine the impact of gender and grade on the intensity of GenAI tool usage and college students’ autonomous learning ability. Finally, we conducted a correlation analysis. Suppose the test finds that the intensity of college students’ generative AI tool usage is related to their autonomous learning ability. In that case, the study will use regression analysis to detect the specific relationship.

3 Result

3.1 Sample basic information

Table 2. Frequency analysis of survey samples

Frequency analysis results			
Name	Options	Frequency	Percentage (%)
Gender	Male	35	29.17
	Female	85	70.83
Grade	Freshman	30	25
	Sophomore	30	25
	Junior	30	25
	Senior	30	25

Table 2 shows that in terms of gender distribution, the proportion of females in this survey sample is higher than that of males. Specifically, there are 85 female participants, accounting for 70.83%; while there are 35 male participants, accounting for 29.17%. In terms of grade distribution, this survey covers four grades from freshman to senior year, with 30 participants in each grade, accounting for 25%. This shows that the sample has a good balance in grade distribution and can better reflect the situation of students in different grades.

3.2 Difference analysis

Table 3. The impact of gender on the intensity of generative AI tool usage and autonomous learning ability

Index	Results of t-test analysis			
	Male(n=35)	Female(n=85)	t	p
Intensity of use of GenAI tools	3.42±1.10	3.32±0.81	0.476	0.636
College students' autonomous learning ability	4.05±0.64	3.90±0.62	1.208	0.23
* p<0.05 ** p<0.01				

Table 3 shows that male GenAI tool use intensity averages 3.42 and females' 3.32, with standard deviations of 1.10 and 0.81. T - test gives $t = 0.476$, $p = 0.636 > 0.05$. So, gender has no significant impact on usage intensity, meaning no notable male - female disparity, likely due to tool applicability and ease - of - use.

For autonomous learning ability, the males' average is 4.05 and the females' is 3.90, with standard deviations of 0.64 and 0.62, respectively. T-test gives $t = 1.208$, $p = 0.23 > 0.05$, meaning gender has no significant impact on autonomous learning ability, and there's no notable male-female disparity in it.

Table 4. The impact of grade on the intensity of generative AI tool usage and autonomous learning ability

Index	Anova result					F	p
	Freshman (n=30)	Sopho- more (n=30)	Junior (n=30)	Senior (n=30)			
Intensity of use of GenAI tools	3.26±0.77	3.31±0.94	3.38±0.92	3.44±0.99	0.237	0.871	
College stu- dents' auto- nomous learning ability	3.97±0.54	3.94±0.56	3.80±0.74	4.06±0.64	0.855	0.467	
* p<0.05 ** p<0.01							

Table 4 shows that in terms of the intensity of AI tool use, the average values of the four grades are: freshman 3.26, sophomore 3.31, junior 3.38, and senior 3.44, and the standard deviation is between 0.77 and 0.99. The variance analysis results indicate an F value of 0.237 and a p-value of 0.871, significantly exceeding the threshold of 0.05. This indicates that there is no notable variation in the intensity of AI tool usage across different grades.

In terms of autonomous learning ability, the average values of the four grades are: freshman 3.97, sophomore 3.94, junior 3.80, and senior 4.06, and the standard deviation is between 0.54 and 0.74. The results of variance analysis show that the F value is 0.855 and the p-value is 0.467, which is also greater than 0.05. This shows that there is no significant difference in autonomous learning ability between different grades.

3.3 Correlation analysis

Table 5. Correlation analysis between the intensity of generative AI tool usage and autonomous learning ability

Pearson correlation

	Intensity of use of genera- tive AI tools	College students' autono- mous learning ability
Intensity of use of genera- tive AI tools	1	
College students' autono- mous learning ability	0.351**	1
* p<0.05 ** p<0.01		

Table 5 illustrates the application of correlation analysis, which is used to examine the relationship between the intensity of GenAI tool usage and autonomous learning capability. The Pearson correlation coefficient serves as a measure of the correlation's strength. A detailed examination reveals that the correlation coefficient between the intensity of GenAI tool use and autonomous learning ability is 0.351, with a significance level of 0.01. This indicates a significant positive correlation between these two variables.

3.4 Regression analysis

Table 6. Linear regression analysis of generative AI tool usage intensity on autonomous learning ability

	Linear regression analysis results (n=120)				
	Unstandardized coef- ficients		Standardized coefficient	t	p
	B	Standard error	Beta		
constant	3.13	0.207	-	15.129	0.000**
Intensity of use of GenAI tools	0.243	0.06	0.351	4.071	0.000**
R 2			0.123		
Adjust R2			0.116		
F	F=16.576,p=0.000				
Dependent variable: College students' autonomous learning ability					
* p<0.05 ** p<0.01					

The intensity of generative AI tool usage serves as the independent variable, while the autonomous learning ability functions as the dependent variable in the linear regression analysis.

Table 6 shows that the model formula is: autonomous learning ability = 3.130 + 0.243*intensity of AI tool use, and the model R-square value is 0.123, which means that the intensity of generative AI tool use can explain 12.3% of the change in autonomous learning ability. When the model is tested by F, it is found that the model passes the F test (F=16.576, p=0.000<0.05), which means that the intensity of AI tool use will have an impact on autonomous learning ability.

The conclusive analysis indicates that the regression coefficient for the intensity of generative AI tool use is 0.243 (t=4.071, p=0.000<0.01). This suggests that increased intensity of generative AI tool use correlates positively with autonomous learning ability; specifically, a higher intensity of use is associated with a stronger capacity for autonomous learning.

4 Discussion

The results of the questionnaire survey show that the more college students use GenAI tools, the stronger their autonomous learning ability will be, which is inconsistent with the initial assumptions of the study. The main reasons are as follows.

4.1 The conversational interaction function of GenAI tools can cultivate students' autonomous learning ability

The biggest feature of GenAI tools is that they can communicate with users like humans and impart knowledge to users during the conversation. Some scholars pointed out that the conversational interactive characteristics of GenAI tools can encourage students to think deeply and adjust their own learning process based on feedback. Moreover, the characteristics are conducive to cultivating students' autonomous learning ability [11].

Moreover, the ability of GenAI tools to quickly retrieve information and generate content can provide students with timely and personalized feedback and guidance. As a consequence, it can improve students' autonomous learning efficiency. Therefore, from the perspective of the conversational interaction it provides, college students' autonomous learning ability can be improved.

4.2 GenAI tools have the function of assisting in learning

The study's initial prediction that GenAI tools would have a negative impact on autonomous learning ability was based on the assumption that it might replace traditional ways of thinking. However, the questionnaire did not investigate how college students use generative AI tools, so it overlooked the fact that they may serve as an auxiliary tool in the learning process of college students, rather than directly replacing students' independent thinking. The information provided by GenAI tools can not only help college students understand and solve problems in a faster way, but also inspire students to explore more learning resources and thinking angles. Therefore, the motivation for the independent learning of college students can be stimulated. So from this perspective, generative AI tools may have a positive impact on college students' independent learning ability.

5 Conclusion

Through a questionnaire survey and analysis, the results of this study show that the intensity of college students' use of GenAI tools has a positive impact on their autonomous learning ability. In other words, this shows that the more intensively college students use GenAI tools, the stronger their autonomous learning ability.

5.1 Study limitations

The study has provided some innovations and new research ideas for the field of education to some extent. However, the study still has many limitations.

Firstly, the variables are too single. The study found that there is a significant positive correlation between the intensity of GenAI tools use and autonomous learning ability, but there may be other variables that affect it, such as learning environment, personal interests, etc.

Secondly, the study also has a certain degree of depth problems. Our questionnaire data is mainly collected through scales, lacking open-ended questions or semi-structured interviews. The method can not deeply understand the specific context of each experimental sample using GenAI tools, such as whether the sample directly uses GenAI tools to complete

tasks, or uses it as an auxiliary tool to check for deficiencies in their own results. This may also have a certain impact on the research.

5.2 Study prospects

The study provides new research perspectives and current support for the application of GenAI tools in the field of education. In terms of practice, the results of this study can also provide a reference for colleges on how to guide college students to use GenAI tools and promote the integration of educational technology and teaching. In the future, the study can be gradually optimized by deepening the question. Not only that, the study can also use the dynamic pursuit method to observe the changes in the intensity of students' use of GenAI tools and the development trajectory of their autonomous learning ability over a period of time, in order to explore the dynamic relationship between the two.

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