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Research on the Innovative Path of AIGC Enabling University Basic Course Teaching

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Abstract

The development of artificial intelligence-generated content (AIGC) technology brings new opportunities for the teaching reform of basic courses in colleges and universities. Based on the technology acceptance model, man-machine collaboration theory, and triple helix theory, this study adopts the mixed research method of questionnaire survey and interview to investigate 1247 students and 38 teachers. SPSS is used for descriptive statistics, difference analysis, and correlation analysis. This paper systematically discusses the current situation, dilemma, and innovation path of AIGC enabling college basic course teaching. The study found that AIGC was widely used in basic courses, with a 42.3% frequent utilization rate among students and a 76.3% attempt rate among teachers. However, the application level mainly stayed in information acquisition and assignment assistance, and the support for deep learning was insufficient. The application frequency of science and engineering students is significantly higher than that of humanities and social sciences, highest among sophomore students and lowest among senior students, and the application level of urban students is significantly higher than that of rural areas. The digital divide in the intelligent era deserves attention. AIGC has a dual effect on learning outcomes; 67.5% of students think it improves efficiency, but 49.6% of students admitted excessive dependence. The frequency of use and learning effect has an inverted U-shaped relationship; moderate use is the key. Teachers face three obstacles: technical anxiety, role confusion, and a lack of system. Based on the triple helix theory, this paper constructs a trinity innovation path of "technology empowerment-teaching reconstruction-ecological guarantee," which provides a reference for the intelligent transformation of basic courses in colleges and universities.

Keywords

AIGC, College Basic Courses, Teaching Innovation, Human-Machine

Collaboration

1. Introduction

1.1. Research Background

The rapid development of artificial intelligence technology is changing the way university education is conducted. Generation tools such as ChatGPT, Sora, and Wenxinyiyin can produce high-quality text, images, and videos. They also have the capability to act as learning partners and teaching tools. Educators around the world are beginning to study their applications in teaching, such as providing study suggestions, correcting homework, generating course content, and improving teaching interaction. Artificial intelligence has brought great changes to higher education. UNESCO mentioned in its 2019 report that artificial intelligence can help the sustainable development of education. Challenges were raised (Pedro et al., 2019), and five years on, these techniques have continued to mature, and the points made in the report have now become more important.

China is promoting education informatization. In 2024, the Ministry of Education proposed introducing artificial intelligence into teaching activities, and students need to master relevant application skills. Currently, basic courses in colleges and universities are in a transition stage. The “basic course” referred to in the research refers to compulsory general education courses for all undergraduates. The course content consists of college mathematics, college English, computer foundation, and ideological and political theory courses. These courses have a large number of students and consistent teaching schedule requirements, which are the foundation of talent training. Considering that these courses have a large number of students and unified teaching standards, and occupy an important position in talent training, it is of practical value for improving the quality of education to explore the use of generative artificial intelligence to improve classroom teaching methods.

There are many problems in the application of AI creation technology in basic courses of colleges and universities. The tool improves work efficiency, leading to the decline of students’ thinking ability and concerns about academic misconduct; the limited understanding of teachers regarding new technology, the slow updating of teaching methods, and the lack of management regulations in schools all limit the positive effect of technology. In the past, academia paid more attention to the use of AI in professional courses or technical training (Chen et al., 2024; Yang et al., 2020); there is insufficient in-depth research on the special environment of basic courses, and basic courses need to improve efficiency and adhere to the correct guidance direction.

Based on the above background, this study focuses on the innovative path of AIGC enabling college basic course teaching and attempts to answer the following three core questions:

1) What is the application status of AIGC in the teaching of basic courses in colleges and universities? It includes dimensions such as frequency of use, application scenarios, tool types, and the cognition of teachers and students.

2) What are the practical difficulties in the current application? How do these dilemmas manifest themselves in groups of teachers and students? Are there group differences?

3) How can an effective innovation path be built to achieve the unity of technological empowerment and educational goals? What levels need to be coordinated?

1.2. Research Significance

At the theoretical level, this study introduces the technology acceptance model and human-machine collaboration theory into the teaching of basic courses, establishes an analytical framework based on the triple helix theory, broadens the perspective of the application of artificial intelligence in the field of education, uses data to test theoretical hypotheses, and helps to understand the way of human-machine collaboration teaching in the university environment.

From the perspective of practice, based on large sample empirical data, this study identifies the key influencing factors and obstacle nodes of AIGC application, which can provide an empirical basis for colleges and universities to formulate relevant policies, optimize teaching design, and improve the digital literacy of teachers and students. The innovation path proposed by the research is operable and can provide a reference for front-line teachers and teaching managers.

2. Literature Review and Theoretical Basis

2.1. International Research Progress of AIGC Educational Applications

2.1.1. AIGC and Higher Education Reform

The impact of AIGC on higher education continues to attract research attention. Southworth et al. (2023) proposed the general course model of artificial intelligence, emphasizing that higher education needs to cultivate students' AI literacy from a systematic perspective. Students should not only regard AI as a single tool, but also establish an educational framework covering various disciplines in future universities. Each student should understand the principles, application scenarios, and ethical boundaries of AI, which changes the educational application of AIGC from the level of technical operation to the cultivation of literacy, and provides a reference for the reform of basic courses.

Katsamakas et al. (2024) used systems theory to analyze the changes brought by artificial intelligence to higher education institutions. The use of artificial intelligence involves the improvement of technology, as well as the overall transformation of organizational structure, teaching methods, and management means. In order to achieve the expected role brought by artificial intelligence, George & Wooden

(2023) analyzed from the perspective of strategic management that when promoting the application of artificial intelligence, universities need to maintain stability between innovation and standardization, efficiency and fairness, and establish a management system suitable for the actual situation.

2.1.2. Teaching Mode and Curriculum Innovation

In terms of innovative teaching models, Yang et al. (2020) studied university practical teaching supported by artificial intelligence and found that technology helped theoretical teaching combine with practical training. They studied Chinese universities and proposed a four-stage model of AI-supported practice, which involved knowledge preparation, virtual training, real practice, and reflective improvement. Zhang (2025) studies the combination of artificial intelligence and innovation and entrepreneurship education, and believes that technology application improves teaching efficiency and helps students cultivate innovative thinking. According to empirical research results, artificial intelligence tools can assist students in breaking the inherent thinking mode and generating more innovative ideas. Tapalova & Zhiyenbayeva (2022) focused on personalized learning, demonstrating the value of artificial intelligence in developing automatically adjusted learning programs. They proposed a personalized learning framework for artificial intelligence education, emphasizing real-time adjustment of learning processes and accurate recommendation of learning resources.

In terms of curriculum design, Sangwa et al. (2025) proposed an AI-assisted curriculum design framework, which is divided into four stages: demand analysis, content generation, activity design, and result evaluation. They believed that AI could help teachers make teaching resources, improve curriculum arrangement, and improve the quality and speed of design.

2.1.3. AIGC and Learning Effect

Regarding the impact of AIGC on learning outcomes, researchers hold different views. Mutambik (2024), based on a study of universities in Saudi Arabia, found that AI-powered automation tools can significantly improve the student learning experience, especially in terms of personalized feedback and immediate support. The investigation of Bucea-Manea-Ţoniş et al. (2022) on universities in Romania and Serbia shows that AI technology indirectly improves students' learning effectiveness by enhancing the interactivity and adaptability of the learning environment. Takona (2024) observed that the application of intelligent technology in education may widen the digital gap between different student groups. Spivakovsky et al. (2023) studied the management policies of colleges and universities.

2.1.4. Teacher's Role and Professional Development

The application of artificial intelligence in teaching faces new challenges. Zhang et al. (2025) proposed a reform plan for artificial intelligence-assisted engineering teaching, which mainly includes finding problems, formulating strategies, and implementing methods. Teachers are faced with pressure caused by technical operation, role change, and ability improvement in the process of digitalization, and all parties need to improve the support system. Ge & Hu (2020) discussed the role of artificial intelligence in higher education management, artificial intelligence-supported classroom teaching, supporting teachers' professional development, using teaching data analysis to provide improvement suggestions, and recommending professional learning resources. The research of Murdan & Halkhoree (2024) on Mauritian universities showed that teachers' attitudes towards artificial intelligence determine the effect of technology use, and schools need to provide teacher training and support. Popescu et al. (2023) analyzed the impact of artificial intelligence on education and university projects from the perspective of public service innovation. Artificial intelligence helps teachers develop new teaching projects and improve teaching service methods, and schools need relevant systems to encourage them.

2.1.5. Ethical Dilemma and Governance Strategy

The ethical issues of generative artificial intelligence in education have attracted attention. Zeng et al. (2025) analyzed the difficulties faced by artificial intelligence in supporting vocational undergraduate ideological and political courses, which involve value objectives and security risks. They believed that technology application needs to support curriculum education objectives and take into account technical functions and value requirements. Allam et al. (2025) put forward the idea of sustainable innovation, advocating that the application of artificial intelligence should be combined with the long-term goals of education to avoid the disadvantages caused by short-term behaviors. They stated that ethical considerations should be integrated into all stages of the application of artificial intelligence in education, such as design, implementation, and evaluation. Solanki et al. (2024) outlined the key challenges of AI-driven innovation in higher education, including data privacy, algorithm bias, and accountability, and these studies also suggested future management directions.

2.2. Theoretical Basis

2.2.1. Technology Acceptance Model

The technology acceptance model is an important theory to explain and predict users' behaviors in using new technologies. In the study, TAM provides an analytical basis for analyzing the acceptance of AIGC by teachers and students. Considering the particularity of the educational environment, the study takes into account perceived risk and subjective norm. Perceived risk records the concerns of teachers and students about the decline of academic integrity and thinking ability, while subjective norm shows the influence of classmates, school, and social environment on individual use behavior.

2.2.2. Human-Machine Collaborative Education Theory

In the age of intelligence, human-machine collaboration becomes important. Aoun (2017) pointed out in his book Robot-Proof that the role of universities is to cultivate students' creativity, logical ability, and civic responsibility in collaboration with machines, and the focus of university teaching need not be limited to knowledge teaching. Man-machine collaboration in this study involves technical operations, including sharing cognitive tasks, confirming teaching value, and allocating related responsibilities. The personalized learning path proposed by Tapalova & Zhiyenbayeva (2022) shows a collaborative approach, in which AI programs are responsible for analyzing learning and recommending resources, students are responsible for setting goals and adjusting learning methods, and teachers are responsible for monitoring the process and timely intervention. In basic course teaching, clarifying the division of work between human and machine and realizing mutual complement are the main problems to be solved when establishing new teaching methods.

2.2.3. Triple Helix theory

Etzkowitz and Leydesdorff proposed the triple helix theory to analyze the connection between government, industry, and universities in the era of the knowledge economy. According to the theory, the three parties cooperate in the innovation process: the government makes supportive policies, the industry provides technical and market resources, and the university is responsible for cultivating talents and creating knowledge. In recent years, researchers have applied this theory to the field of educational technology.

In the context of AIGC enabling higher education, the triple Helix theory provides an analytical framework for understanding the ecology of innovation. At the government level, it is necessary to improve standards and norms, provide financial support, and offer policy incentives. At the industry level, appropriate technical tools need to be developed to provide training and services. At the university level, it is necessary to promote instructional design and teacher development and establish application standards and quality assurance systems. Bucea-Manea-Țoniș et al. (2022) actually implied the idea of the triple helix and emphasized the importance of multi-party collaboration when they studied AI applications in universities in Romania and Serbia.

2.2.4. Integrated Analysis Framework of This Study

Integrating the above theoretical resources, this study constructs an integrated analysis framework as shown in **Figure 1**. The framework consists of three levels: the basic level is the technology acceptance model, which explains adoption behavior at the individual level, involving perceived usefulness, perceived ease of use, perceived risk, and subjective norm; the core layer is human-machine collaboration theory, which describes the interaction mechanism in the teaching process, including role division, cognitive collaboration, and value alignment. The guarantee layer is the triple helix theory, which describes the supporting effect of the institutional environment on innovation, covering three dimensions: government policy, industrial support, and university system. The three levels are interrelated and progressive, and together constitute the theoretical basis for analyzing the teaching innovation path of AIGC enabling basic courses.

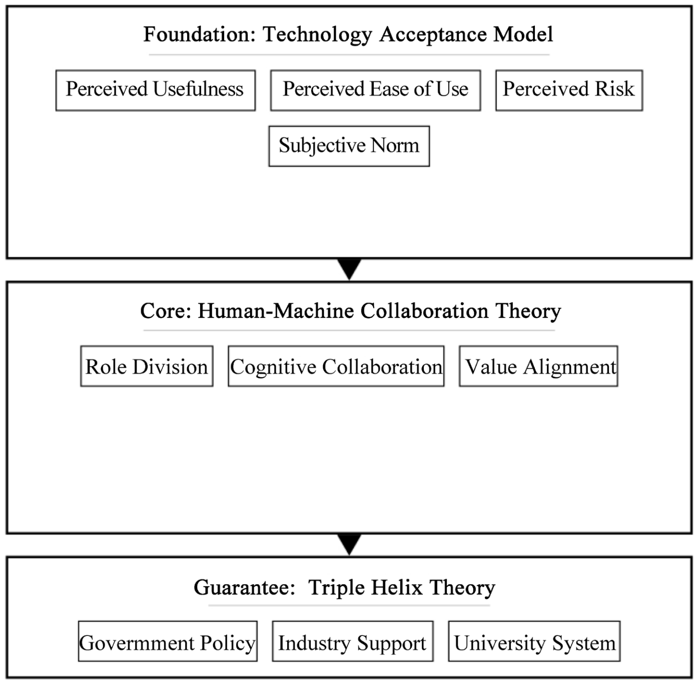

Figure 1. Analysis framework.

According to the above three theories, specific variables are transformed and connected to the research questions. The technology acceptance model directly determines how the questionnaire measures perceived usefulness, perceived ease of use, perceived risk, and subjective norm. For details, see Section 3.3, which shows the differences in the use situation and dilemma of different groups. It explains the inverted U-shaped relationship between frequency of use and learning effectiveness, as detailed in Section 4.3.2, which illustrates the differences in learning effectiveness among different groups. The triple helix theory illustrates the institutional barriers, such as lack of policies, training, and evaluation standards, to establish improvement paths, as detailed in Section 6.1, which illustrates the improvement of learning effectiveness. While quantitatively testing the variables of the technology acceptance model, the study uses human-machine collaboration and the triple helix to establish a qualitative framework for analysis and path selection, which is a deficiency of this study.

3. Research Design

3.1. Research Methods

The questionnaire is used to collect a large amount of data and analyze the usage status of intelligent content generation tools, population differences, and influencing factors. The interview focuses on understanding the feelings of teachers and students, cognitive difficulties, and suggestions for improvement, aiming to provide explanations for the data.

3.2. Respondents and Sampling

The research adopts the stratified convenience sampling method. First, six universities were purposively selected from the eastern, central, and western regions of China (two from each region) to ensure geographic diversity. Within each region, one comprehensive university, one science and engineering university, and one normal university were chosen based on institutional accessibility and willingness to participate. Second, within each selected university, course instructors of basic courses (mathematics, English, computer fundamentals, and ideological and political courses) were contacted to distribute student questionnaires during class sessions. Students were recruited based on their availability and consent on the day of distribution. For the teacher sample, all instructors teaching the identified basic courses in each university were invited to participate via email or in-person invitation.

Table 1. Distribution of survey samples.

Variable	Category	Student Sample (n = 1247)	Teacher Sample (n = 38)
Gender	Male	602 (48.3%)	21 (55.3%)
	Female	645 (51.7%)	17 (44.7%)
Grade	Freshman	389 (31.2%)	-
	Sophomore	372 (29.8%)	-
	Junior	301 (24.1%)	-
	Senior	185 (14.9%)	-
Discipline	Science & Engineering	515 (41.3%)	16 (42.1%)
	Humanities & Social Sciences	444 (35.6%)	14 (36.8%)
	Arts & Sports	151 (12.1%)	5 (13.2%)
	Others	137 (11.0%)	3 (7.9%)
Teaching Experience	<5 years	-	9 (23.7%)
	5 - 10 years	-	14 (36.8%)
	>10 years	-	15 (39.5%)

A total of 1300 student questionnaires were distributed, and 1247 valid questionnaires were returned, with an effective recovery rate of 95.9%. Forty-five teacher questionnaires were distributed, and 38 valid questionnaires were returned, with an effective recovery rate of 84.4%. Given the small teacher sample (n = 38), findings related to teachers should be interpreted as exploratory and not generalizable to all university instructors. Statistical comparisons involving teacher subgroups are not conducted due to limited statistical power. The sample distribution is shown in Table 1.

3.3. Questionnaire Design and Measurement

The questionnaire design is adjusted according to the characteristics of basic courses in colleges and universities. The questionnaire is divided into five parts:

1) Basic information, including gender, grade, subject, and place of origin; 2) The use of AI-generated content, including frequency of use, application scenarios, and tool types; 3) Perceived usefulness and ease of use, with 4 questions for each item; 4) Perceived risks, including concerns about the decline of thinking ability and consideration of academic integrity, with 3 questions for each; 5) Self-evaluation of learning effect, including learning efficiency, level of understanding, and change of interest, with a total of 5 questions. The contents of the teacher questionnaire include: 1) basic information; 2) The application of artificial intelligence to generate content teaching, including frequency of use and application scenarios; 3) Technology acceptance, including perceived usefulness and perceived ease of use; 4) Application barriers were analyzed from three directions: technology, teacher's role, and rules and regulations; 5) Demand for support.

All the scales are scored on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The questionnaire was revised after a pre-test (n = 120 students, n = 10 teachers) to form a formal questionnaire. The reliability test shows that the Cronbach's α coefficient for each dimension of the student questionnaire is between 0.782 - 0.894, and that of the teacher questionnaire is between 0.756 - 0.867, indicating that the questionnaire has good internal consistency. The full questionnaires for students and teachers are provided in the Appendix.

3.4. Interview Implementation

Purposeful sampling was used to select 18 students and 12 teachers from the teachers and students who participated in the questionnaire for the interview. The students were chosen according to the principle of diversity; the selected individuals represented different grades, majors, and frequencies of use, while the teachers were selected based on teaching years, professional titles, and course types. The communication content involved the use experience of artificial intelligence, teaching applications, difficulties, and suggestions. The communication lasted 30 - 60 minutes, and all conversations were recorded and transcribed with my consent. A total of about 120,000 words of interview data were obtained.

3.5. Data Analysis Methods

The study uses SPSS 26.0 software to process quantitative data, and the method is relatively direct. Researchers used statistical description to explain the use of artificial intelligence, used independent sample t-tests and one-way analysis of variance to compare the differences of indicators in each group, and used Pearson correlation analysis to check the association between variables. When processing the qualitative data, the two researchers coded the interview records separately, and the coding was divided into three steps. 1) The researcher sorted out the basic items line by line, 2) the two researchers communicated, compared, and classified, and concluded after resolving the differences, 3) the research team checked the summary and the original data to determine the research theme, and the consistency of the coding evaluation reached 86%. The summarized themes were: a) relying on tools to reduce thinking, b) blurring the boundaries of academic integrity, c) the faculty expressed concerns about technology, d) unclear role orientation, and e) lack of institutional support. These themes explain the results of the survey. For example, 49.6 percent of the students stated that they rely on tools, which can be explained by the skip thinking session mentioned by the students. Among the difficulties mentioned by the teachers, 65.8% of them mastered the technology by self-study, which can also correspond to the interview content that lacks systematic training.

3.6. Ethics Statement

Before data collection, students and teachers were informed of the purpose of the study, the principle of voluntary participation, and the right to withdraw at any time. Participants signed written informed consent, and supplementary recording consent was required during the interview. The anonymity and privacy of participants were guaranteed. The recordings of the interviews were transcribed and stored on a computer with a password and viewed only by the researchers.

4. Research Results

4.1. Descriptive Analysis of AIGC Application Status

4.1.1. Usage of Students

Statistics illustrate (Table 2) that 42.3% of students use AI tools more than 3 times a week in basic courses, 35.8% use them 1 to 2 times a week, and 21.9% rarely or never use them. The scenarios in which students used these tools mainly focused on searching for information and answering questions, accounting for 86.4%; writing homework and revising sentences accounted for 67.2%; making study plans accounted for 43.5%; understanding concepts and giving examples accounted for 41.8%; and inspiring creative inspiration accounted for 32.6%. These situations reflect that artificial intelligence is currently used as a tool to find information and assist writing, and students are rarely using it in activities such as in-depth thinking and cultivating independent judgment ability. The intelligent tools commonly used by students are dialogue systems (92.1%), translation software (68.3%), writing assistance tools (52.7%), drawing software (23.6%), and code generation tools (18.9%). In terms of learning methods, 71.5% of students master them through self-study, and 23.8% of students are guided by teachers or have participated in relevant courses.

Table 2. Descriptive statistics of students' AIGC usage.

Variable	Category	N	Percentage
Usage Frequency	Frequently use	527	42.3%
	Occasionally use	447	35.8%
	Rarely/Never	273	21.9%
Application Scenarios	Information search & Q&A	1077	86.4%

Continued

(Multiple choice)	Assignment writing & polishing	838	67.2%
	Study planning	542	43.5%
	Concept understanding & examples	521	41.8%
	Idea stimulation	407	32.6%
	Others	89	7.1%
Frequently Used Tools	Conversational AI	1148	92.1%
(Multiple choice)	AI translation tools	852	68.3%
	AI writing assistants	657	52.7%
	AI drawing tools	294	23.6%
	Code generation tools	236	18.9%
	Others	124	9.9%
Learning Approach	Self-exploration	892	71.5%
(Multiple choice)	Peer communication	546	43.8%
	Course/Teacher guidance	297	23.8%
	Online tutorials	435	34.9%
	Others	68	5.5%

4.1.2. Application of Teachers

Table 3 shows that among the teachers, 76.3% have used AIGC tools in basic course teaching, which are mainly used for preparing course materials (84.2%), generating sample questions and exercises (63.2%), making courseware (55.3%), and preliminarily checking students' work (26.3%). Only 18.4% of the teachers used these tools to improve teaching design or to guide students to think, and 65.8% of the teachers mainly mastered relevant skills through self-study.

Table 3. Descriptive statistics of teachers' AIGC application.

Variable	Category	N	Percentage
Usage Frequency	Frequently use	12	31.6%
	Occasionally use	17	44.7%
	Rarely/Never	9	23.7%
Application Scenarios	Lesson preparation materials	32	84.2%
(Multiple choice)	Example & exercise generation	24	63.2%
	Courseware development assistance	21	55.3%
	Student assignment grading	10	26.3%
	Instructional design innovation	7	18.4%
	Guiding student use	5	13.2%
Skill Acquisition	Self-learning/exploration	25	65.8%
(Multiple choice)	Institutional training	13	34.2%
	Colleague exchange	19	50.0%
	Others	4	10.5%

4.2. Group Difference Analysis

4.2.1. Subject Differences

One-way analysis of variance in Table 4 showed that the frequency of using generative artificial intelligence was different among students from different disciplines (F = 8.47, $p < 0.001$). Post-hoc test (LSD) showed that the frequency of using generative artificial intelligence was higher among students from science and engineering (M = 3.76, SD = 0.92) than that of students from humanities and social sciences (M = 3.34, SD = 1.05). The use frequency of art and sports students (M = 3.52, SD = 0.98) is in the middle, and the usefulness perceived by science and engineering students is also better than that of humanities and social sciences students (M = 4.02 vs. M = 3.65, $p < 0.01$). The structure of subject knowledge content forms this difference, and science and engineering knowledge has strong logic and high certainty of answers. Generative artificial intelligence can provide effective content more easily. Humanities and social sciences involve value judgment and thinking, so students have reservations about the content provided by such tools and have low dependence on use.

Table 4. Comparison of AIGC usage differences among students from different disciplines.

Variable	Science & Engineering (n = 515)	Humanities & Social Sciences (n = 444)	Arts & Sports (n = 151)	Others (n = 137)	F-value	Post-hoc Comparison
Usage Frequency	3.76 (0.92)	3.34 (1.05)	3.52 (0.98)	3.41 (1.01)	8.47***	Sci-Eng > Hum-Soc
Perceived Usefulness	4.02 (0.76)	3.65 (0.84)	3.78 (0.79)	3.71 (0.82)	6.93**	Sci-Eng > Hum-Soc
Perceived Ease of Use	3.95 (0.81)	3.72 (0.88)	3.83 (0.84)	3.68 (0.91)	4.12*	Sci-Eng > Hum-Soc
Perceived Risk	3.12 (0.95)	3.58 (1.02)	3.31 (0.97)	3.43 (0.99)	5.26**	Hum-Soc > Sci-Eng

Note: $p < 0.05$, $p < 0.01$, $p < 0.001$; standard deviations in parentheses.

4.2.2. Grade Difference

There were differences in the frequency of use among students in different grades (F = 6.83, $p < 0.001$). Sophomore students had the highest frequency of use (M=3.82, SD = 0.88), followed by freshman students (M = 3.45, SD = 1.02), and junior students (M = 3.51, SD = 0.96). Senior students had the lowest frequency of use (M=3.18, SD = 1.12). Freshman students are in the adjustment period of admission and have fewer opportunities to use learning tools. Sophomore students have great academic pressure and increased demand for auxiliary tools; junior students have more professional courses and reduced demand for basic course tools; senior students are busy preparing for graduation or internship. With limited time devoted to basic courses, these data suggest that guidance should be adjusted differently for students in each grade. Seniors scored higher on perceived risk than other grades (M = 3.75 vs. M = 3.28 - 3.42), indicating that students who are close to graduation attach greater importance to academic integrity and independent thinking.

4.2.3. Urban-Rural Background Differences

Table 5 shows the data of students in cities, counties, towns, and rural areas, urban students use artificial intelligence tools more frequently than rural students (F = 5.21, $p < 0.01$), and there are differences in students' views on the role of these tools (F = 4.36, $p < 0.05$), which is worth noting. The technology gap has changed from hardware equipment to the ability to use smart technology, and without the necessary support, AI tools may lead to a widening gap in educational opportunities. One rural student said in an interview: "My urban classmates have used ChatGPT for a long time. I didn't hear about it from them until I was a sophomore. (S-12, sophomore)"

Table 5. Comparison of AIGC usage differences among students from different geographic backgrounds.

Variable	Urban (n = 468)	Town (n = 423)	Rural (n = 356)	F-value	Post-hoc Comparison
Usage Frequency	3.71 (0.94)	3.52 (1.01)	3.38 (1.08)	5.21**	Urban > Rural
Perceived Usefulness	3.94 (0.81)	3.76 (0.86)	3.61 (0.92)	4.36*	Urban > Rural
Perceived Ease of Use	3.85 (0.83)	3.74 (0.88)	3.65 (0.94)	2.45	-
Perceived Risk	3.42 (0.96)	3.38 (1.01)	3.45 (1.03)	0.38	-

Note: *$p < 0.05$, **$p < 0.01$; standard deviations in parentheses.

4.3. Effect and Influencing Factors of AIGC Application

4.3.1. Perceived Evaluation of Learning Effect

Table 6. Students' perceptions of AIGC learning effects.

Item	Strongly Agree	Somewhat Agree	Uncertain	Somewhat Disagree	Strongly Disagree	Mean	SD
Improved learning efficiency	28.5%	39.0%	18.2%	9.6%	4.7%	3.77	1.08
Helped to understand complex concepts.	19.8%	34.4%	22.6%	15.3%	7.9%	3.43	1.18
Broadened knowledge horizons	16.2%	26.9%	28.4%	18.5%	10.0%	3.21	1.21
Sometimes, people overly rely on AI and are unwilling to think independently.	18.5%	31.1%	24.3%	16.8%	9.3%	3.33	1.20
Directly used AI-generated content for assignments without reflection.	10.2%	21.6%	25.4%	26.8%	16.0%	2.83	1.22

Table 6 shows the students' evaluation of their learning results, artificial intelligence has a different impact on learning effect. 67.5% of the students said that artificial intelligence has improved learning efficiency, 54.2% of the students thought that artificial intelligence has helped them understand complex concepts, and 43.1% of the students thought that artificial intelligence has broadened the scope of knowledge. 49.6 percent of the students said they sometimes did not want to think for themselves because they relied too much on AI, and 31.8 percent admitted to directly submitting AI-generated content with little reflection.

4.3.2. Correlation Analysis

In order to analyze the relationship among variables, the researchers conducted a Pearson correlation analysis on students' use frequency, perceived usefulness, perceived ease of use, perceived risk, and learning effect, and the results are shown in Table 7. There was also a positive correlation between perceived ease of use and learning effect ($r = 0.32$, $p < 0.05$), and an inverted U-shaped relationship between frequency of use and learning effect.

Through hierarchical regression analysis, the researchers investigated whether there was a curvilinear relationship between the frequency of use and the learning effect. Model 1 took gender, grade, discipline, and hometown as control variables; model 2 added the linear term of the frequency of use, and model 3 added the square term of the frequency. The results showed that the coefficient of the square term was −0.18, p less than 0.01, and the coefficient of the linear term was 0.32, with p less than 0.001. The data show that there is a curvilinear relationship, and the R-squared value from model 2 to model 3 changes to 0.03, with p less than 0.01. Statistics show that users who use 1 - 3 times per week have the highest learning satisfaction, and use more than 5 times per week is associated with a decrease in learning effectiveness. This analysis does not consider the impact of perceived usefulness, perceived ease of use, and perceived risk, in order to clarify the real results brought by the frequency of use.

The square term of frequency of use was significantly negatively correlated with learning effect ($\beta = -0.18$, $p < 0.01$). Moderate user satisfaction was the highest, while excessive user satisfaction decreased. This result reflects the boundary of technology use; moderate use can support learning, while excessive dependence may damage cognitive ability. Perceived risk and learning effect are significantly negatively correlated ($r = -0.29$, $p < 0.05$). Students' concerns about academic integrity and thinking ability affect their judgment of AIGC value.

Table 7. Correlation coefficient matrix among variables.

Variable	1	2	3	4	5
1. Usage Frequency	1				
2. Perceived Usefulness	0.52**	1			
3. Perceived Ease of Use	0.46**	0.58**	1		
4. Perceived Risk	−0.18*	−0.24**	−0.21*	1	
5. Learning Effect	0.23*	0.47**	0.32*	−0.29*	1

Note: *$p < 0.05$, **$p < 0.01$.

4.4. Supplement to Qualitative Findings

The qualitative analysis, conducted by two researchers as described in Section 3.5, revealed several details not fully captured by the statistical data. In the interview, I found some details different from statistical data. When discussing the problems that students did not like to think about, some students mentioned that they used to find solutions by themselves when they encountered difficulties, but now they tend to consult artificial intelligence first and give up the process of exploring the reasons after getting the answers (S-09, junior year). Such problems need to be paid attention to. Educational psychology has proved that learning knowledge requires a thinking process, which is the basis for deep learning. Long-term reliance on tools will weaken students' thinking ability, and students seem to have the answer, but actually they do not really master these contents.

The current review system cannot judge whether students' work is generated by AI, and it is difficult to distinguish students' own thinking (T-06, associate professor). Some schools try to formulate standards for use, and the implementation process is very difficult. A teaching administrator said, the school has issued a policy prohibiting direct copying of AI content, but there is no answer to the question of defining the methods and detection methods of direct copying (T-11, director of educational affairs).

When teachers encounter difficulties in using technology, they often feel great work pressure, unclear responsibilities, and imperfect management systems. A teacher who has been teaching for 15 years said that technology is upgrading so fast that when you learn to use ChatGPT and new tools come along, you feel like you are constantly playing catch-up (T-03, Prof). A young teacher mentioned that he wanted to try to use artificial intelligence to improve teaching effectiveness, but the school's attitude towards this kind of innovation is not clear enough, and the existing assessment system does not involve these works (T-07, lecturer).

5. Discussion

5.1. Tension of AIGC Empowerment

The study found that intelligent auxiliary tools can improve learning efficiency, while frequent use may reduce students' cognitive ability. The tool has a positive impact on learning, and the degree of impact depends on the method and frequency of use. When this commitment is completely replaced, learners will reduce the key thinking process, and it is difficult to achieve the effect of in-depth learning. The teaching of basic courses faces challenges. The task of basic courses is to teach knowledge, build thinking models, and cultivate core abilities. The goal of ideological and political theory courses is to help students establish reasonable values and worldviews. Once students use such tools too much to complete writing or thinking tasks, the educational goal may not be achieved.

Human-machine collaboration should be complementary. Tapalova & Zhiyenbayeva (2022) show this kind of collaboration. AI performs data analysis and resource recommendation, while students and teachers are responsible for goal setting, method selection, and value judgment. Teachers need to design human-computer collaborative tasks to guide students to have a dialogue with AI, question, and think comprehensively.

5.2. Deep Implications of Subject Differences

It was found that there are significant disciplinary differences in AIGC application, with science and engineering being used more frequently than the humanities and social sciences. The superficial reason for this difference is the different degree of knowledge structure, and the deeper reason involves the distinction between the knowledge production mode and the cognitive paradigm. Science and engineering knowledge has highly formal characteristics and is easily represented and generated by algorithms. The knowledge of humanities and social sciences is rich in context, value, and criticality, and its essence is difficult to be "generated" and needs to be "grown" in historical and realistic contexts. This finding confirms the view of Southworth et al. (2023) that improving AI literacy should be combined with the teaching of various disciplines, and there are differences in teaching content and methods between disciplines. Science and engineering courses use generative AI to simulate problems, assist experiments, and verify reasoning, which is helpful in cultivating students' algorithmic thinking and engineering practice ability. Humanities and social science courses focus on guiding students to analyze the content generated by AI, identify the value position of the content, and consider the scope of knowledge. These methods can cultivate students' humanistic spirit and thinking ability. These paths have different focuses, and the goal is to let students master the technology and keep them active in its use.

5.3. Lag of Institutional Supply

The institutional problems mentioned by the teachers in the research reflect a contradiction in the application of AIGC in colleges and universities. The speed of technology dissemination exceeds the progress of system construction. According to the innovation communication theory, AIGC has entered the stage of majority use at present, and the school has not established relevant norms, evaluation methods, and incentive mechanisms, which brings restrictions to the application of technology.

The concrete manifestation of this contradiction is manifold. At the level of teaching management, there is a lack of clear standards for the use of AIGC, and teachers and students are wandering between "available" and "unavailable", "fair use" and "academic misconduct"; at the level of teacher development, there is a lack of systematic training and capacity building support, and teachers' technology application remains in spontaneous exploration; at the level of evaluation mechanism, the existing teaching evaluation standards are difficult to adapt to the new form of human-computer collaboration, and teachers' innovation faces the dilemma of "not being evaluated".

6. Conclusions and Prospects

6.1. Research Conclusions

The research investigated 1247 students and 38 teachers from 6 universities, recorded the interview data, analyzed the current situation, difficulties, and improvement methods of artificial intelligence-generated content in the teaching of basic courses in colleges and universities, and reached the following conclusions.

The content generation technology of artificial intelligence is being adopted in the teaching of basic courses in colleges and universities. 42.3% of the students often use these tools, and 76.3% of the teachers have tried these tools. At present, the above applications are mainly used to complete basic tasks such as data queries and assignment modification. The school lacks systematic teaching guidance, the use by teachers mainly focuses on lesson preparation, and the degree of innovation in classroom teaching is insufficient.

Second, there are significant group differences in AIGC application. The subject difference is that the frequency and perceived usefulness of science and engineering are higher than those of the humanities and social sciences, which is related to the degree of knowledge structure. The grade difference shows that sophomore students use the highest frequency, and senior students use the lowest frequency. The difference between urban and rural backgrounds reveals that the application level of urban students is significantly higher than that of rural students, and the digital divide in the intelligent era deserves attention.

Third, students use artificial intelligence tools to learn, and everyone's situation is different. Most students think that these tools can improve learning speed and help them understand complex content. About 50% of students report that they are beginning to develop a sense of dependence, and about 30% of students reduce their active thinking when looking at learning materials. Too much or too little use of tools will affect the final results, and it is important to control the frequency of use to ensure the learning effect.

Fourthly, teachers' application is faced with three obstacles: technical anxiety, role confusion, and system lack. The rapid updating of technology, not knowing how to integrate into the curriculum, fearing that the value of teachers will be weakened, and the absence of a college system are intertwined, which restricts the enthusiasm of teachers to innovate. This reflects the deep contradiction between the speed of technology diffusion and the pace of institutional evolution.

Fifth, based on the triple helix theory, this paper studies and constructs a trinity innovation path of "technology empowerment-teaching reconstruction-ecological guarantee." Technology empowerment emphasizes the development of discipline adaptation tools and the strengthening of literacy training; Teaching reconstruction promotes the innovation of teaching design of human-machine collaboration; Ecological protection requires the government, industry, and universities to cooperate to improve the institutional environment. Only through the joint efforts of the three parties can the paradigm shift from tool empowerment to ecosystem construction be realized.

6.2. Future Outlook

The future research direction mainly includes the following aspects: carry out long-term follow-up surveys, observe the long-term impact of students using various kinds of artificial intelligence to generate learning content, focus on the change in students' thinking ability, use experimental methods, design different teaching means, verify the real effect of human-machine collaboration cooperative teaching mode, go deep into the basic courses of specific disciplines, and look for the combination of disciplines. Develop teaching models in line with the characteristics of the subject, pay attention to the equity issues in the application of AI in education, study the methods to narrow the digital gap, ensure that all students can get help from technology, improve the management system to provide reference for universities to formulate AI management policies, pay attention to the changes brought about by technological updates, and study the application value of different forms of tools such as video generation in education.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix: Survey Questionnaires

AIGC Application in Foundational University Courses

Part I: Basic Information

Gender: □ Male □ Female

Grade: □ Freshman □ Sophomore □ Junior □ Senior

Discipline: □ Science & Engineering □ Humanities & Social Sciences □ Arts & Sports □ Others

Hometown: □ Urban □ Town □ Rural

Part II: AIGC Usage Behavior

How often do you use AIGC tools in your foundational course studies?

□ Frequently use (more than 3 times per week)

□ Occasionally use (1-2 times per week)

□ Rarely/Never use

In which scenarios do you use AIGC tools? (Multiple choices)

□ Information search and knowledge Q&A

□ Assignment writing and polishing

□ Study planning

□ Concept understanding and example generation

□ Idea stimulation

□ Others (please specify: _________)

Which AIGC tools do you frequently use? (Multiple choices)

□ Conversational AI (ChatGPT, Ernie Bot, etc.)

□ AI translation tools

□ AI writing assistants

□ AI drawing tools

□ Code generation tools

□ Others (please specify: _________)

How did you learn to use AIGC tools? (Multiple choices)

□ Self-exploration

□ Peer communication

□ Course/Teacher guidance

□ Online tutorials

□ Others (please specify: _________)

Part III: Perceptions of AIGC

Please indicate your level of agreement with the following statements (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

Item	1	2	3	4	5
Perceived Usefulness					
PU1: AIGC tools help me complete learning tasks more efficiently.	□	□	□	□	□
PU2: AIGC tools help me to better understand complex concepts.	□	□	□	□	□

Continued

PU3: AIGC tools broaden my knowledge horizons.	□	□	□	□	□
PU4: Overall, I find AIGC tools useful for my learning.	□	□	□	□	□
Perceived Ease of Use					
PEU1: Learning to use AIGC tools is easy for me.	□	□	□	□	□
PEU2: It is easy to get AIGC tools to do what I want them to do.	□	□	□	□	□
PEU3: My interaction with AIGC tools is clear and understandable.	□	□	□	□	□
PEU4: Overall, I find AIGC tools easy to use.	□	□	□	□	□
Perceived Risk					
PR1: I worry that relying on AIGC may weaken my independent thinking ability.	□	□	□	□	□
PR2: I worry that using AIGC for assignments may violate academic integrity.	□	□	□	□	□
PR3: I am concerned about the accuracy and reliability of AI-generated content.	□	□	□	□	□

Part IV: Learning Effect Self-Assessment

Please indicate your level of agreement (1 = Strongly Disagree, 5 = Strongly Agree).

Item	1	2	3	4	5
LE1: AIGC tools have improved my learning efficiency.	□	□	□	□	□
LE2: AIGC tools have helped me to understand complex concepts.	□	□	□	□	□
LE3: AIGC tools have broadened my knowledge horizons.	□	□	□	□	□
LE4: Sometimes I overly rely on AI and am unwilling to think independently.	□	□	□	□	□
LE5: I have directly used AI-generated content for assignments without reflection.	□	□	□	□	□

End of Student Questionnaire

Questionnaire for Teachers: AIGC Application in Foundational University Courses

Part I: Basic Information

Gender: □ Male □ Female

Teaching Experience: □ Less than 5 years □ 5 - 10 years □ More than 10 years

Discipline of Courses Taught: □ Science & Engineering □ Humanities & Social Sciences □ Arts & Sports □ Others

Part II: AIGC Application Status

How often do you use AIGC tools in your teaching?

□ Frequently use □ Occasionally use □ Rarely/Never use

In which scenarios do you use AIGC tools? (Multiple choices)

□ Lesson preparation materials

□ Example and exercise generation

□ Courseware development assistance

□ Student assignment grading

□ Instructional design innovation

□ Guiding student use

□ Others (please specify: _________)

How did you acquire skills in using AIGC tools? (Multiple choices)

□ Self-learning/exploration

□ Institutional training

□ Colleague exchange

□ Others (please specify: _________)

Part III: Perceptions and Obstacles

Please indicate your level of agreement with the following statements (1 = Strongly Disagree, 5 = Strongly Agree).

Item	1	2	3	4	5
Technology Acceptance					
TA1: AIGC tools are useful for my teaching.	□	□	□	□	□
TA2: AIGC tools make my teaching more efficient.	□	□	□	□	□
TA3: AIGC tools are easy to use.	□	□	□	□	□
Application Obstacles					
AO1: I am not very familiar with AIGC technologies.	□	□	□	□	□
AO2: I want to use AIGC but do not know how to integrate it into my courses.	□	□	□	□	□
AO3: I worry that AI may weaken the value of teachers.	□	□	□	□	□
AO4: I am confused about how teachers' roles should be redefined.	□	□	□	□	□
AO5: My institution has no clear guidelines for AIGC use.	□	□	□	□	□
AO6: There is a lack of evaluation criteria for AI-integrated teaching.	□	□	□	□	□

Part IV: Support Needs

What kind of support do you need to better integrate AIGC into your teaching? (Multiple choices)

□ Technical training and workshops

□ Clear institutional policies and guidelines

□ Sharing of best practices and cases

□ Technical support and resources

□ Reform of teaching evaluation systems

□ Others (please specify: _________)

Do you have any suggestions for promoting AIGC application in foundational course teaching?

End of Teacher Questionnaire

Thank you for your participation!