

The Influence of Artificial Intelligence Technology on College Students' Learning Effectiveness from the Perspective of Constructivism — Taking ChatGPT as an Example

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Abstract. Based on the constructivism theory, this paper takes ChatGPT as an example to discuss how artificial intelligence technology affects the learning effectiveness of college students. Learning in constructivist classrooms is regarded as a proactive process, and the rise of artificial intelligence technology, especially ChatGPT, brings new possibilities to the field of education. In such a context, this paper analyzes the learning effect of students before and after using ChatGPT, paying special attention to a series of deep thinking caused by using ChatGPT. In this paper, 135 students from three different universities in Guangdong Province and Shaanxi Province are selected as the survey participants to investigate their perception toward effective learning before and after using ChatGPT from different angles. The survey results show that using ChatGPT can have a positive impact on their learning efficiency. Finally, this paper discusses the attitudes of different schools to students' use of ChatGPT and puts forward some suggestions to better integrate artificial intelligence technologies such as ChatGPT into higher education. Through in-depth research on the influence of ChatGPT on the learning effectiveness of college students under the constructivism theory, this paper aims to provide high-quality reference for college educators and contribute to the application of artificial intelligence technology in the field of education.

Keywords: ChatGPT, AI-facilitated education, constructivism, higher education.

1. Introduction

Modern education places a stronger emphasis on students as the initiative participants instead of the passive learners of teachers' instruction. However, the majority of teachers continue to teach using outdated and teacher-centred methods, even in the current age of digitalisation. In other words, most of the time, students' individual needs are ignored and the curriculum is still taught in a way that emphasizes changing soup rather than changing medicine. In order to achieve individualized instruction, teachers can apply artificial intelligence to conduct pertinent analyses based on the interests of their students. They can then use artificial intelligence to create lesson plans that are tailored to each student's needs. Additionally, teachers can use Internet technology to carry out individualized instruction and to accomplish online and offline, cross-time and space interaction.

In the teaching process, teachers can retrieve relevant teaching resources and adjust the teaching programme according to the degree of mastery of the students' learning situation, so as to achieve the maximum use of teaching resources and solve the problem of uneven distribution of teaching resources in China, which restricts the development of regional education [1]. With the rapid development of these technologies, the importance of constructivist educational theory comes to the fore. Constructivism emphasises the active role of the learner in knowledge construction and views learning as an active process, focusing on students' subjective experience and social interaction, which is very different from the traditional mode of knowledge transfer [2]. Chatbots and virtual assistants, such as ChatGPT, can offer students immediate feedback and question-and-answer sessions to enhance their comprehension of the course content. Students who do this not only perform better but also get more self-assurance and enthusiasm to learn. This poses a significant research question: can ChatGPT help students create their own knowledge and enhance their learning outcomes? Is it

consistent with the tenets of constructivist education in higher education? There are theoretical and practical ramifications to this subject. Theoretically, it advances our knowledge of how constructivist educational theories can be implemented in the digital age. From a pragmatic standpoint, it offers recommendations on how academic institutions and instructors might enhance student learning outcomes and knowledge production by making greater use of ChatGPT and other natural language processing technologies. The study can aid in understanding how this cutting-edge technology might be incorporated into higher education, hence fostering educational innovation, by employing ChatGPT as an example. In the realm of education, ChatGPT gives students the chance to fully express their subjectivity, can serve as a valuable learning ally and right-hand man, fosters the development of students' divergent, creative, and critical thinking, and offers a wide range of opportunities for students' cognitive growth. It is undeniable that ChatGPT can, to some extent, assist people in achieving high-quality educational development [3]. Educational decision-makers can benefit from insights regarding the best ways to incorporate ChatGPT and related technologies into the classroom, as this can enhance the standard of instruction and enhance student learning results. The study can be interpreted through a constructivist lens to reveal how students actively participate in the process of creating knowledge and how ChatGPT, an assistive technology, fits into this idea. This can offer useful advice for the development of constructivist education. In conclusion, the research on this selected topic will help to deepen the understanding of the application and impact of ChatGPT and constructivist educational theories in tertiary education and provide valuable insights for future educational innovation and academic research. A mixed quantitative study was used to investigate the impact of ChatGPT on students' learning outcomes. 135 questionnaires were used to analyse the use of ChatGPT by students in three universities in Guangzhou and Shaanxi Province. Data were analysed to compare the results of students who used and did not use ChatGPT to assess its impact on learning outcomes.

2. Literature Review

The theoretical origin of constructivism can be traced back to the early 20th century, among which Lev Vygotsky's theoretical framework is the most frequently mentioned constructivist thought [4]. Jonassen and Rohrer-Murphy emphasized that constructivism is a theoretical framework that can be used to design a constructivist learning environment [5]. According to constructivism, learners actively construct their understanding of the world through experience and interaction with the environment [6]. Under this theoretical viewpoint, learning is regarded as a self-regulating process, struggling with the conflict between the existing personal world model and different new ideas, and constructing new realistic representations and models with tools and symbols of cultural development [7]. Based on Vygotsky's theory, constructivism emphasizes the importance of cultural and social background, and individuals construct their own knowledge based on their understanding of the surrounding social environment [4]. In constructivism, learning is regarded as a process of constructing meaning, not just acquiring information. Learners construct new knowledge through active participation, exploration, and reflection [5]. In Vygotsky's theory, culture gives children the cognitive tools they need for development, and the nature and quality of these tools will affect the mode and speed of development [4]. A research based on constructivism methodology has launched a series of skills measurements in education by creating a practical classroom of artificial intelligence technology [8]. With the continuous development of science and technology, artificial intelligence technology has become one of the technical means in constructivist teaching classrooms.

Alan Turing's use of the term "machine intelligence" at the Dartmouth Conference in 1956 represented the emergence of the concept of "artificial intelligence" [9]. Since then, Bode, an expert in artificial intelligence, has used a concept similar to AI to explain human intelligence, indicating a view of human identity. Artificial intelligence's large-scale application has gradually changed how people process, store, and share information. One's destiny began to become constituted by technological means and calculations [10]. At the end of the last century, intelligent education

accompanied the wave of AI, and the concept of an Intelligent Tutoring System (ITS) was proposed in 1982, which became a typical application of AI technology in the area of teaching [11].

As time progresses, the convergence of AI and education has grown significantly. Researchers such as Anderson and Rainie emphasize the importance of AI in providing adaptive learning environments that meet the needs of individual students [12]. ChatGPT, with its conversational functionality, can be a powerful tool for creating personalised and interactive learning experiences. Despite the promising applications of ChatGPT in education, the creation of AI applications in higher education is a transformative journey [13]. Kasneci et al. point out issues related to data privacy, bias in AI-generated content, and over-reliance on AI [14].

Although the application of artificial intelligence technology in higher education has been widely and deeply discussed, there are still some research gaps in studying the influence of artificial intelligence technology such as ChatGPT on students' learning from the perspective of constructivism. At present, most research mainly focuses on the practical application of technology, such as the effect evaluation of ChatGPT in personalised learning, homework guidance, and question answering. However, few studies have explored the practical application and learning effect of ChatGPT in higher education from the perspective of knowledge construction and learning process based on constructivism. In addition, the research on how to combine this technology with constructivism learning theory to better promote students' knowledge construction and learning is still limited. In such a context, the purpose of this paper is to study the application of artificial intelligence technology in colleges taking ChatGPT as an example.

3. Methodology

3.1. Research Design

This study employed quantitative research methodology using questionnaires to delve deeper into the link between AI technology and student learning effectiveness. A Likert scale was used to design the questionnaire. The scale consisted of 30 entries in 5 level 1 dimensions. A 5-point scale was used, in which "strongly dissatisfied" scored one point, "dissatisfied" scored two points, "neutral" scored three points, "satisfied" scored four points, and "very satisfied" scored five points. The higher the score, the greater the effect on learning outcomes.

3.2. Data Collection

In this study, the snowball sampling method was used to select samples from students of different majors in three universities in Guangzhou and Shaanxi Province, and 163 questionnaires were distributed throughout the Internet. A total of 163 questionnaires were collected, of which 28 were invalid. When analyzing the data, it was found that 28 questionnaires were not filled in truthfully, so there were 135 valid questionnaires and 28 invalid questionnaires. Participants shared how they usually use ChatGPT and whether they think ChatGPT has a positive or negative impact on learning efficiency. In terms of the participant selection, it is observed that the number and frequency of college students using ChatGPT are increasing with the popularity of AI technology. This study can identify enough volunteers because of its enormous user base even though some colleges are still unsure whether to employ ChatGPT. After collecting students' questionnaires, the quantitative data are analyzed in a descriptive way.

3.3. Research Hypotheses

In accordance with Anderson and Rainie's theories about ChatGPT and its application in the educational sector, it is predicted that undergraduate students' classroom engagement, learning motivation, and confidence to explore novel domains will increase after using ChatGPT. It is possible that ChatGPT's personalised interactions and instant feedback would trigger more student engagement and increase motivation and ChatGPT can provide appropriate learning resources and

answers according to students' learning needs and comprehension abilities through dialogues with students, which promotes students' in-depth learning and understanding.

4. Results

The Cronbach for these data is 0.972, indicating high reliability. This study demonstrates that ChatGPT, as an educational aid, significantly improves students' learning engagement, efficiency, and satisfaction, among other aspects. After using ChatGPT, students showed significant increases in various learning-related variables, including interest in learning, learning efficiency, problem-solving speed, mastery of self-learning plans and goals, and motivation to participate in class discussions. Effect sizes ranged from moderate to large, and effect size analyses supported this finding.

During the analysis phase, the quantitative data collected were divided into four categories, including "interest and emotion" (Question 1, 2, 15, 16, 19, 20, 23-26), "learning outcome" (Question 3, 4, 11, 12, 27-30), "learning skills" (Question 5, 6, 9, 10, 13, 14, 17, 18), and "transferable skills" (Question 7, 8, 21, 22).

Table 1. How ChatGPT-facilitated learning changes students' interest and emotion

Interest & emotion	before	after	difference
1+2 My level of interest and engagement in learning	3.59	4.15	0.56
15+16 My level of confidence in solving complex problems or tasks is	3.18	4.23	1.05
19+20 My motivation for participating in class discussions and activities is	3.19	3.94	0.75
23+24 My feelings of motivation to learn or explore new knowledge outside of class is	3.39	4.09	0.7
25+26 I am satisfied with my overall performance in my studies	3.34	4.41	0.8

As shown in Table 1, there is little difference between before and after the use of ChatGPT in terms of its impact on students' interest and engagement in learning, but this method of learning multiplies students' confidence levels when dealing with complex problems. The reason for this problem may be that when students encounter complex problems they can use ChatGPT to give themselves some help and guidance on their ideas, whereas when they used ChatGPT before, they will not be able to carry the project through successfully because they do not have a clue, and sometimes they are even forced to give up because they are unable to solve the problem. Therefore, when students encounter difficulties in their studies without ideas or solutions, they can use ChatGPT to help them overcome the difficulties better.

Table 2. How ChatGPT-facilitated learning changes students' learning outcome

Learning outcome	before	after	difference
3+4 Academic efficiency	3.32	4.26	0.94
11+12 My rate of correctness in completing assignments and tasks is	3.37	4.16	0.79
27+28 I feel that my academic achievement is	3.31	3.9	0.59
29+30 My academic achievement grade is	3.45	4.07	0.62

It can be seen in Table 2, it is obvious from the data that ChatGPT has the greatest impact on students' learning efficiency, but in general, it has little impact on students' academic achievement levels. This is because ChatGPT is more helpful to students' learning ideas, and for students, exam-based grades account for more, while essay-based grades account for less. Hence, it does not have much impact on the test scores. ChatGPT also improves the correctness rate of students in completing homework and tasks, but the overall impact is not significant.

Table 3. How ChatGPT-facilitated learning changes students' learning skills

Learning skills	before	after	difference
5+6 My speed in solving learning problems	3.39	4.28	0.89
9+10 My ability to comprehend learning materials	3.25	4.14	0.89
13+14 My ability to solve problems and learning difficulties independently	3.33	4.04	0.71
17+18 My ability to remember and master the content of my studies	3.35	3.89	0.54

As shown in Table 3, ChatGPT has an impact on students' speed of problem-solving and their ability to understand the material. However, it has less impact on the ability to remember and master the content because ChatGPT can only provide effective help to students in understanding and solving problems, but not much help to students who need to remember and master the content through their own efforts. One possible reason is that it is only a method of learning, remembering and mastery that requires the students themselves to be enthusiastic and self-motivated.

Table 4. How ChatGPT-facilitated learning changes students' transferable skills

Transferable skills	before	after	difference
7+8 The mastery of my study plan and goals as	3.3	4.02	0.72
21+22 My effectiveness in working on team projects or cooperative tasks	3.38	4.2	0.82

It can be seen in Table 4, the impact of ChatGPT on mastery of learning plans and goals and the effectiveness of teamwork projects is more evenly balanced, with both increasing. However, the difference between the before and after values is not significant.

Therefore, it can be inferred that the promotion of ChatGPT in higher education can help to improve the quality of education and student learning outcomes, suggesting that the use of ChatGPT has a significant positive impact on the student learning experience. Current higher education is faced with the challenge of how to utilise emerging technologies to enhance learning outcomes. The results of this study suggest that AI tools such as ChatGPT can play an important role in this regard. Through conversational interactions, ChatGPT may help students better understand complex concepts, and increase students' self-confidence, especially when solving complex problems and tasks.

5. Discussion

Personalised learning is the primary way in which ChatGPT's impact on university students' learning effectiveness is demonstrated in this study. Natural language processing technology, the foundation of ChatGPT, allows it to communicate with, intelligently evaluate, and provide feedback based on students' responses. This customised learning approach can enhance learning outcomes and better address the diverse learning needs of pupils. Furthermore, from the standpoint of multimodal learning, ChatGPT is not just restricted to text input and output; it can also engage with other multimedia resources and autonomously learn and recognize various linguistic patterns, all of which are crucial for advancing multimodal learning. Lastly, ChatGPT allows multiple students to study and communicate online in one location while also making it convenient to share instructional materials. According to constructivism, students' internal incentive to engage in learning activities is known as their learning motivation. By providing prompt feedback and encouragement, ChatGPT, an artificial intelligence tool, can increase students' willingness to learn. ChatGPT can provide instant feedback to assist students in problem-solving and conceptual understanding. When students receive rapid feedback, it can boost their motivation to learn and pique their interest in what they are learning. Secondly, it can also create a conducive learning atmosphere. Students can study in an open, stress-free environment and individually based on their own needs and interests by interacting with ChatGPT. Students' motivation and focus for studying are enhanced by this supportive learning environment. Lastly, it deals with the use of multimedia, including images and video. ChatGPT is not just for text communication. Instead, it can output other multimedia content, such as images and

informative films. This approach to learning through multimedia can improve the quality of the curriculum and boost students' enthusiasm and drive to study. Although the artificial intelligence education products based on ChatGPT are gaining increasing attention and applied in the domestic and foreign education markets, there are also some problems. First of all, the educational application of artificial intelligence technologies such as ChatGPT is still in the early stage of development, and the performance and quality of technologies and products are still improving, which requires more practice and verification. Secondly, artificial intelligence education products should not replace traditional education methods, but should be combined with traditional education to jointly build a more comprehensive and diverse learning model.

Therefore, many universities around the globe prohibit students from using ChatGPT, and encourage students to think independently, rather than relying on artificial intelligence. Tutors in diverse universities, considering their different stances in AI-facilitated education, either restrict the use of ChatGPT in the classroom or students' homework. Therefore, the author has the following suggestions: firstly, researchers should strengthen the research and development of artificial intelligence technology to improve the quality and performance of technology and products. Secondly, we should deeply understand students' learning needs and characteristics, and design a more personalised and accurate education system to achieve better learning results. It is hoped that the school can establish a diversified evaluation mechanism, not only paying attention to students' achievements, but also paying attention to students' learning process and learning state, and constantly improving and optimizing artificial intelligence education products. Finally, it is needed to strengthen the integration of artificial intelligence technology and traditional education and teaching methods so as to build a more diverse, comprehensive and efficient education model to meet the learning needs of different students and improve learning efficiency.

6. Conclusion

This study, which employs a constructivist methodology, examines how the latest artificial intelligence technology such as ChatGPT affects college students' ability to learn. Through the questionnaire survey, the potential value of students' learning before and after using ChatGPT is analyzed from different angles, and we draw a series of conclusions on education, which provides some suggestions for integrating artificial intelligence technology in higher education in the future. First of all, ChatGPT has a positive impact on students' learning effectiveness. After using ChatGPT, students perform better in knowledge mastery, problem-solving and critical thinking in colleges and universities. At the same time, we put forward a series of suggestions to promote the better application of artificial intelligence technologies such as ChatGPT in higher education. Schools and educational institutions should provide training and support for educators, make better use of artificial intelligence technology and promote the development of innovative teaching methods. Generally speaking, this paper puts forward some in-depth opinions for the future development of education by deeply studying the application of ChatGPT in higher education. This research not only contributes to college educators but also gives full play to the potential of artificial intelligence technology to promote the innovation and progress of education.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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