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Metacognitive Strategies Used in Chat GPT among College Students

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Abstract: In March 2023, OpenAI released Chat GPT (GPT) version 4.0, which quickly set off a new wave of artificial intelligence around the world. Compared with the previous edition, GPT-4 is much stronger in terms of basic functions, imagination space, logic ability, and thinking ability. This study relates metacognitive concepts that have been developed for more than four decades to the use of GPT, trying to explore the association between metacognitive application level and GPT usage among college students in mainland China. In this study, MCQ-30 questionnaire was used, and the use method of 5 college students was explored by interview. Finally, the characteristics were analyzed by combining the score of the questionnaire with their use method. The study found that college students with higher metacognitive levels were able to clearly describe their goals and processes with GPT, and were able to critically adopt the answers given by GPT, while students with lower levels rely more on GPT than just using it as a tool.

Keywords: Chat GPT, metacognition, MCQ-30

1. Introduction

Metacognition is a new term in the field of cognition in the 1970s. In simple terms, metacognition is the cognition focused on "cognition" itself and is of great practical significance in the field of education [1].

Traditional psychological research has divided cognitive activities into categories such as perception, memory, thinking and speech, which to some extent cut off the internal relations between these phenomena. Metacognitive research, on the other hand, weakens this artificial separation by emphasizing the similarities between traditional cognitive categories rather than their differences, which helps to study the individual as a whole person [2].

In the development of metacognition research, different scholars have put forward many unique opinions. However, with the development of technology, in March 2023, the fourth generation of Chat GPT (GPT) came out. It is a newly launched artificial intelligence application, and metacognitive studies related to GPT are not yet abundant, especially among college students [3].

Therefore, the study will explore the link between the level of metacognitive application and the way college students use GPT. On this basis, the research will move on to explore the characteristics of usage of different levels. The following research questions are addressed: (1) What is the metacognitive application level of college students? (2) How do college students with

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high/medium/low application levels use Chat GPT? (3) How is the correlation between metacognitive strategies and the degree of problem solving?

2. Literature Review

As one of the research hotspots of educational psychology nowadays, metacognitive strategy was proposed by Flavell in 1976, which consists of three parts: "metacognitive cognition", "metacognitive experience" and "metacognitive monitoring" [2]. As early as 40 years ago, he predicted that metacognitive strategies would become a field of extraordinary research. According to Flavell, the strategy refers to the subject's knowledge and awareness of its own cognitive process. Brown, on the other hand, believe that metacognition is an individual's knowledge and control over the cognitive domain [4]. In Sternberg's work, Beyond IQ: A triarchic theory of human intelligence, he systematically elaborated the triarchic theory of intelligence, dividing human intelligence into three levels: the metacomponent, the performance component and the knowledge-acquisition component, in which the metacomponent is the core component and plays a key role [4]. In this sense, the metacomponent is equal to the metacognition, which is responsible for determining the strategy chosen by the individual to solve the problem [5]. Although in the nearly 40 years of research in this field, many scholars have put forward their own different views, but in general, metacognition is focused on the “cognitive” field, and is to treat the cognitive process of an individual as an organic whole rather than some separated parts [6].

The research direction in the field of metacognition focuses on the relationship between metacognition and the quality of thinking, the research in the multimedia environment and the relationship between metacognition and non-intelligence factors. As for the application direction of metacognition, the existing research mainly focuses on the cultivation and training of metacognition and its application in teaching and psychotherapy.

In March 2023, OpenAI released GPT-4. From a technical point of view, compared with the previous generation GPT-3, GPT 4.0 has made major breakthroughs in image understanding and information processing capabilities. It can understand pictures, recognize intent, accept and output longer text, and create content. Because of the creativity of GPT-4, it is also playing an increasingly significant role in pedagogy. Mehmet Firat argues that GPT-4 can be used in open education, especially for autodidactic learners, because it can provide personalized learning support, tailor appropriate learning programs, and provide timely feedback [7]. At the same time, college students are often self-learners who need to pace their learning according to their strengths and weaknesses and identify appropriate needs and goals. The open resources are often used by them to learn independently. As a result, Chat GPT 4.0 has become a tool for many college students to complete their learning tasks.

3. Methods

3.1. Participents

The subject of the questionnaire covered 131 college students in mainland China, and 5 of them accepted the interview later about their own methods of using GPT. There was no time limit in the questionnaire and interview process, and the respondents answered completely on their own.

3.2. Questionnaire

The study assessed the metacognition application level of the participants by a shortened version of the metacognitions questionnaire (MCQ), which was proposed in 2004 by scholars represented by Wells [8].

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MCQ-30 questionnaire is a measurement tool for anxiety disorders compiled by researchers represented by Wells from the perspective of cognitivism, based on the self-regulatory executive function model and the generalized anxiety cognitive model [9]. On the basis of the original MCQ questionnaire, the 65 questions are simplified into 30 questions, but the construct validity of the original questionnaire on five factors is still maintained, which are namely: (1) positive beliefs about worry (POS), (2) negative beliefs about uncontrollability and danger of worry (NEG), (3) cognitive confidence (CC), (4) need to control thoughts (NC), and (5) cognitive self-consciousness (CSC).

At the same time, Wenchao Fan and other scholars verified the reliability and validity of the MCQ-30 questionnaire in Chinese college students in their paper published in 2017. The results showed that there are significant differences among all the questions, and the Chinese version of MCQ-30 has good reliability and validity, which can be used to measure the metacognitive level of Chinese college students [10].

The questionnaire was distributed to college students in mainland China using the online questionnaire survey platform Wenjuanxing. In 6 days, 131 questionnaires were collected, among which 8 invalid questionnaires (all questions were answered with the same answer) were excluded, and finally, a total of 123 valid questionnaires were obtained, with an effective rate of 93.9%.

3.3. Interview

Five college juniors who participated in the questionnaire survey were selected for the interview. In the six questions of the interview, the research mainly focused on their methods of using GPT, including their expectations of the answer and if they will fully accept the answer given by GPT. The responses were classified and summarized for further analysis with regard to their questionnaire scores (listed according to five factors).

The interview was conducted in the form of an online voice conversation, and the researcher transcribed the answers into words through the recording after that. The following are the six questions from the interview:

Q1: What types of problems do you typically use Chat GPT for?

Q2: Before using Chat, did you have any expectations about the answers that Chat might give?

Q3: What's your process like with Chat GPT, from asking questions to solving them?

Q4: Are you always satisfied with the answers Chat gives? What don't you like?

Q5: Do you fully accept the answers given by Chat? Or will there be any changes?

Q6: What do you think are the advantages and disadvantages of Chat compared to your own answers to questions?

There was no time limit during the interview, and the interviewer did not give any guidance to the subjects.

4. Results

4.1. Questionnaire

Through SPSS analysis, the reliability (Cronbach α coefficient) of the 123 valid questionnaires collected was 0.924 (Table 1).

Table 1: Cronbach Reliability Analysis.

Number of terms	Sample size	Cronbach α coefficient
30	123	0.924

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Like the MCQ-30 scale analysis method proposed by Wells in 2004, the 30 questions in this study are also classified into five factors: cognitive confidence, positive beliefs, cognitive self-consciousness, uncontrollability and danger, and need to control thoughts. Each question in the questionnaire is provided with four options: strongly disagree (1 point), disagree (2 points), agree (3 points), and strongly agree (4 points) [10]. Since each factor contains six questions, the full score of each factor would be 24 points.

In Table 2, the questionnaire results are analyzed in a descriptive manner, presenting the mean, standard deviation, and median of each of the five factors and the total score (Table 2).

Table 2: Descriptive Analysis (Number of samples: 123).

	Full Score	Mean	Std. Deviation	Median
Cognitive Confidence	24	16.138	4.017	17.000
Positive Beliefs	24	16.431	3.957	17.000
Cognitive Self-consciousness	24	17.528	3.068	18.000
Uncontrollability and Danger	24	16.390	3.721	17.000
Need to Control Thoughts	24	15.715	4.098	16.000
Total Score	120	82.203	14.952	82.000

According to the data presented in Table 2, in the process of self-awareness monitoring, the subjects are more obviously aware of their own thinking process (average score 17.5). Compared with that, the results reflect that it is less necessary to control their thoughts (average score 15.7), while the other three factors have the scores around 16.

4.2. Interview

The six questions designed in the interview mainly explored the level of application level of metacognition when they use GPT. It started from three aspects: "pre-use expectation (Q1, Q2)", "evaluation of the answers given by GPT (Q4, Q5)" and "monitoring of the usage process (Q3, Q6)".

In the “pre-use expectation” part, respondents used GPT mostly for open-ended tasks (such as writing articles and collecting materials for presentations) or mechanical tasks (such as translating articles ang integrating data). Besides, four out of five respondents have some expectations about the answers GPT might give. For example, when interviewee Liu uses GPT to plan travel routes, she wants to get information about locations, recommended routes, surrounding facilities, etc., and she often has some ideas about the framework of the answers. Only one of the respondents said she doesn’t anticipate the answers GPT might give.

After receiving the answers given by GPT, all respondents don’t adopt them completely, but make some modifications. All of them are aware of the rigidity of the answers given by GPT, some of which are too technical and lack logic. It is worth mentioning that respondent Wang pointed out that every time she received GPT's answer, she would be skeptical, because she found that GPT often made mistakes and did not take the initiative to correct mistakes.

Respondents also generally monitor their use process to varying degrees. They were able to clearly explain the advantages and disadvantages of using Chat compared to solving the questions themselves. Three out of five of the interviewees said that GPT saves time but the answers are not so satisfying. In this section, there was little difference between the responses given by different people.

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5. Discussion

After the questionnaire survey and online interviews, the scores of the MCQ-30 questionnaire of the five respondents (Table 3) and their interview responses are combined to study the association between metacognitive application level and GPT usage among college students in mainland China.

Table 3: Scores of Interviewees on Five Factors.

Interviewees	Meng	Wang	Lu	Hu	Liu
Cognitive Confidence	12	16	8	19	10
Positive Beliefs about Worry	6	22	22	17	14
Cognitive Self-consciousness	8	22	16	15	14
Negative Beliefs about Uncontrollability and Danger of Worry	6	11	13	16	18
Need to Control Thoughts	8	16	14	14	12
Average score	8	17.4	14.6	16.2	13.6

According to the scores of the interviewees, they can be divided into three levels according to their metacognitive level: high (Wang, Liu), medium (Lu, Hu) and low level (Meng) to discuss their characteristics in the use of GPT.

At high metacognitive level, interviewees can give more detailed descriptions of the usage scenarios of GPT, such as the phrase "open-ended questions" mentioned by interviewee Wang. This means that people with high level of metacognition are more aware of what types of tasks GPT is better suited for as a tool. They also have in common that they are not always satisfied with the answers given by GPT and do not fully adopt them. Wang pointed out that since there had been cases in which GPT gave wrong answers and she had to ask it to correct them, she always “keeps skeptical" about the answers. This also shows that in the process of using GPT, people of high level can more clearly use prior experience to help themselves use the tool.

In the answers of the medium level respondents, it’s not difficult to find that both of them don’t have specific requirements for the answers that GPT may give. Hu said, "if the answer (given by GPT) can be used, it’s fine. If not, (I’ll) just change the keywords and search again." In response to the answers given by GPT, they all said that they were "basically satisfied", although GPT had some cases of indistinct and even made-up answers, but their overall attitude was positive.

As for the respondents with low metacognitive level, interviewee Meng admitted that she didn’t anticipate the answers GPT might give before using it, which is completely different from the other four interviewees. She was mostly satisfied with the answers she was given, but changed the overly rigid parts to be more flexible.

In general, college students with higher metacognitive levels are able to maintain a higher level of self-monitoring throughout the use of GPT, including accurate anticipation of the required answers,

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flexible use of their prior knowledge, and critical adoption of the answers they received. In contrast, students with lower levels of metacognition tend to have a vaguer understanding of the task, make fewer revisions after receiving the answers given by GPT, and are more satisfied with them.

6. Conclusion

The Chinese version of MCQ-30 can better adapt to the cultural background of the country, so it can effectively measure the metacognitive level of the subjects in this study. After combining the questionnaire results with the analysis of the interview results, the research has analyzed the characteristics of college students with high/medium/low metacognitive levels when using GPT, that is, the correlation degree between the two factors. The study has found that students with higher metacognitive levels tend to use GPT as a tool to assist them in their work or study, and always do more planning and reflection in this process, while students with lower levels have a higher dependence on GPT.

Although the authoritative MCQ-30 questionnaire was adopted in the study, the questions set in the interview process are not fully matched with the questionnaire scores, so the analysis of the interview results also needs to be improved.

In recent decades, the researches on metacognition have been continuously deepened by scholars from various countries, and its influence on other fields such as education and psychology has also been expanding. As an emerging artificial intelligence, GPT may have epoch-making significance for the development of metacognition. Therefore, research related to GPT may become the direction of further research.

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