Learners' Acceptance of Chat GPT in Higher Education: A Comparison among Overseas and Chinese Undergraduates

Zhiyao Li [1] Ruohao Wang[2] and Yunfeng Zhang[3]

[1-2] Wenzhou University, Zhejiang, China
[3] Macao Polytechnic University, Macau, SAR, China
`81408819@qq.com`

Abstract. This study employs a mixed-methods approach to examine undergraduate students' acceptance of Chat GPT in higher education, specifically comparing views of Chinese students with those from other countries. The research uses the Technology Acceptance Model 2 (TAM2), questionnaires, and interviews to gather data. Notably, the results indicate significant differences in how Chat GPT is accepted by the two student groups, emphasizing the role of cultural context in AI tool adoption. The findings offer insights for stakeholders aiming to enhance AI integration in varied educational environments, and the paper also outlines recommendations for future studies and practical applications.

Keywords: Technology Acceptance Model 2,Chat GPT, higher education, cultural difference

1. Introduction

Chat GPT, an AI-powered chat bot released by Open AI, is equipped with a large language model that enables it to generate original text in response to prompts given by users. This technology, launched in November of last year, is available for free through an Open AI account (Open AI,2023) [1].Chat GPT using a large-scale language model based on GPT-3.5 architecture, can interact through learning and understanding human language. It can not only answer questions, provide information or participate in dialogues but also even complete email writing, copy writing, translation, code and other tasks, reaching millions of users in a short period of time. Unlike many Chat bots that generate text using predefined responses or rules, Chat GPT is trained to generate responses based on received input, resulting in more natural and diverse responses.

Artificial intelligence startup Open AI 3 unveiled the latest modelonOctober14generationofits AI language model, GPT-4.0. This model has higher performance and more advantages, can handle more complex language structure, more natural, smooth, emotional dialogue, but also uses more advanced privacy protection technology to protect users' privacy from leakage. Chat GPT is trained to provide detailed responses to instructions in a prompt. Chat GPT is based on the GPT-3.5seriesandisregularlyupdatedasmoreusersinteract with the tool and provide the system with their feedback [2].ThereleaseofChatGPT4.0 will bring users better quality service and experience, and also bring more convenience and innovation to people's life!

The integration of Artificial Intelligence (AI) into various sectors of society has become a prominent focal point of academic inquiry and application, with education standing out as a particularly noteworthy arena.H [3].According to the analysis of researchers,school education is one of the most likely scenarios to first apply Chat GPT, and it is full of development."Chat GPT +"education will certainly become the normal state of human education. According to the developer, Chat GPT has three core functions: First is to realize language interaction with human based on natural language processing system; the second is to complete general document processing, copy writing, code writing and other social work; the third is to support multiple input and output forms, with deep learning ability in the professional field. The acquisition of these new functions has opened the "Pandora's Box" of "robot +"education, provided unlimited creative space for school education, and becoming the redefinition of future school education [4].

2. Literature review

2.1. Role of AI and Chat bots in Higher Education

To explore the Chat GPT 's potential applications in higher education, different areas can be discussed as soft ware is producing fake citations,developing assignments,supporting essay writing (Crawfordetal, 2023),and encouraging critical reflection on AI's use in society.As universities weigh the implications of AI chats, some academic teachers have already incorporated it into their assignments to expose its limitations and challenge the technology. Universities are considering how Chat GPT may impact higher education teaching and learning in the future, as the possibilities of this technology are vast and potentially game-changing.One of the most popular AI technologies used to support teaching and learning activities is the Chat bot system. Chat bots are recognized as a

useful technology that promotes learning in an educational context. In this era of the Fourth Indus Experimental Revolution(4IR),educators can manage teaching through classroom platforms or through online platforms [1].

Chat GPT can be utilized for a diverse range of applications in academia [9].To begin with, it provides valuable support for writing reports, essays, and scientific articles. It can also proofread the provided text for structural, punctuation, and grammatical errors [5].Another useful application is acting as a virtual tutor; it can break down a complex concept into an easier-to-understand language [6]. For research projects, Chat GPT cannot only aid in literature review but can also generate innovative ideas in brain storming sessions [7]. In computer science, it can aid students by debugging their code and suggesting programming solutions [8].

Although Chat GPT can promote the development of higher education, it also brings many difficulties and challenges to higher education. The first challenge is the issue of accuracy. The accuracy of the system depends heavily on the quality, diversity, and complexity of the training data, as well as the quality of the input data provided by students. In previous research, Fuchs (2022) alluded to the importance of competence

development in higher education and discussed the need for students to acquire higher-order thinking skills (e.g., critical thinking or problem-solving) [10]. Another challenge is academic plagiarism. Chat GPT may become a student cheating tool, especially in paper writing, students can use robots like Chat GPT to generate and submit non-completed papers, bypassing most plagiarism detectors. In the undergraduate education tests of American universities, the Chat GPT was used to get the first grade [4]. The third challenge are technical limitations. Chat GPT and other large language models perform well in tasks such as natural language processing and computer vision, but their complex structure and training process lead to poor interpretability and lack of transparency in the model training process, which makes it difficult to explain the decision-making process of the model in specific tasks. Therefore, Chat GPT should be used as an auxiliary tool in higher education, and teachers should rely more on their own expertise, rather than regard it as the sole reliance on the teaching process.

2.2.Precedents and case studies for successful implementation of AI in higher education

With the deepening of the application of artificial intelligence in the field of higher education, traditional universities have gradually transformed into the form of "artificial intelligence +education". Artificial intelligence has become an auxiliary tool of higher education, which can help to enhance students interest, improve the teaching effect, and further promote the great reform of school education and teaching. Atypical example of the application of AI in higher education is the MOOC class first proposed by Canadian workers in 2008, enabling learners to access relevant course resources anytime and anywhere without paying fees. By the end of November 2015, the Courseraplatformhadoffered1,474 courses for free and had16.1million users. In 2013, Coursera entered China, and universities jointly launched many Chinese MOOC platforms, such as Chinese University MOOC, to provide free Chinese courses to foreign scholars, and the user group is increasingly large and diversified.

MOOC break through the traditional teaching materials and teacher-centered restrictions, have a complete teaching system and curriculum structure, fragmented knowledge, fine content and short time, and improve the effect of education and teaching. The effects of MOOC on higher education are: Promote equity in education. The use of MOOC can realize the sharing of global educational resources, break through the limitations of time and space, narrow the gap of educators, realize the education equality of the majority of people, and promote the balance of education. Improve students' ability of independent learning. MOOC use case-based teaching and problem-oriented teaching mode, which are student-centered and play the main role of students. Students can conduct personalized learning according to their own time and needs, interact with others on the platform, generate thinking sparks, significantly improve learning efficiency, improve their thinking ability and innovation ability.

Innovate teaching methods. There are many famous teachers with excellent quality in MOOC, which also brings great challenges to college teachers in traditional classrooms, and inspires traditional teachers to innovate teaching methods and improve teaching quality.

In the experimental teaching, the virtual simulation laboratory based on artificial intelligence technology can also simulate the experimental scene. For example, Tsinghua University uses the clinical teaching training of "artificial intelligence + real virtual", which can directly watch the anatomical details of the real human structure of patients in the virtual space, and can perform virtual surgery.

2.3.Existing Research on Technology Acceptance in Higher Education

In1989,American scholar Fred D.Davis (1989) studied Theory of Reasoned Action for user acceptance of information systems /computer technology, and proposed a decisive factor to explain and predict people's widespread acceptance of computers. The purpose is to find an effective behavior pattern that can explain the behavior of the user accepting in Information System and also analyze the factors that affect the user's acceptance.

The technology acceptance model (TAM) is used to investigate the acceptance of new technologies. TAM is a model that explains the process by which users accept and use information systems [11].

With the deepening of the application of TAM in information technology, it is found that the TAM model itself still has shortcomings. For example, it does not take into account the influence of subjective norms on the behavior intention of the system users. Davis and Venkatesh (2000) combined with the research conclusions of his scholars, appropriately extended the TAM model, deleted the use attitude, introduced variables such as subjective norms (social impact) and cognitive tools into the TAM model, and expanded into the technical acceptance model 2 (TAM 2). The social impact process includes three variables: subjective norm, image and voluntary, and the cognitive tool process includes four variables: work relevance, output quality, result presentation and perceived ease of use. Figure 1 below illustrates the idea of TAM 2.
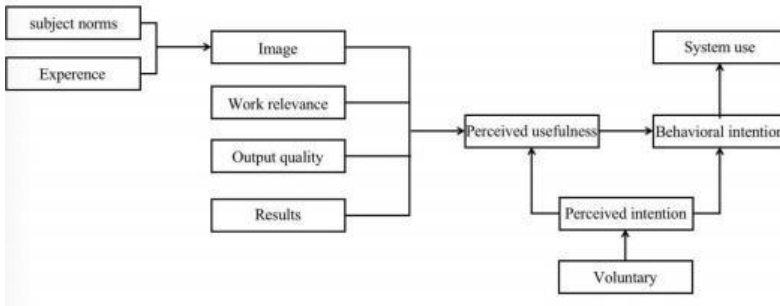

Fig.1. Technical Acceptance Model 2 (TAM 2)

Based on the theoretical research results of predecessors, the variable of cultural difference is selected, and the theoretical model of this study is finally constructed as follows:
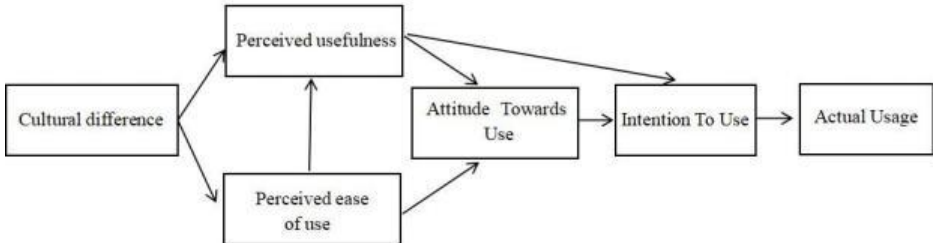

Fig.2. Technical Acceptance Model (TAM)

In China, the research of technology acceptance model mainly focuses on the variable topics of electronic commerce and electronic technology acceptance. Each model starts from exploring the core variables and external variables that affect the user acceptance behavior, and studies the technical acceptance behavior of the system users from the perspective of the user behavior intention influencing the system use behavior. When applying TAM theory, scholars mainly focus on the four core variables of perceived usefulness, perceived ease of use, behavioral intention and use behavior. In empirical studies, Likert five-point scale is generally used to prepare a questionnaire, for each question (for example, "very much agree", "agree", "uncertain", "disagree", "very much disagree"). After the data based on questionnaire are collected, both reliability and validity are calibrated, and different methods are used to validate the model. The majority of the existing research on the acceptance of AI in higher education does not distinguish between different student populations, such as undergraduate and post

graduate students, or students from different regions or with different cultural backgrounds. While some studies have examined the acceptance of technology in higher education in general, fewer have focused on the acceptance of AI or on Chat GPT. There is a significant gap in the literature regarding the comparison of technology acceptance between Chinese and overseas students, particularly in relation to AI applications like Chat GPT. Understanding these differences could provide valuable insights for the design and implementation of AI tools in higher education.

3. Method

This study employs a mixed-methods research design, combining quantitative and qualitative data to explore students' acceptance of Chat GPT in higher education. Research questions that will be addressed include:

（1）Do different cultural backgrounds affect students' acceptance of Chat GPT?

（2）How to determine that cultural background factors rather than other factors affect the use of Chat GPT?

3.1.Participants and Sampling

The participants of the sample were selected through a combination of purposive and convenience sampling, aiming to ensure a diverse representation of students. Out of 150questionnaires distributed, 150 responded and completed the questionnaires with no further amendments, and the sampling group can answer all the required questions. Combined with the answer time, the participant whose answer time less than 100 seconds was regarded as invalid. A total of 141 valid questionnaires were obtained, the effective rate was 94%.The sample include100 undergraduate Chinese students and 41foreign students. The questionnaire comprised of six components formulated to assess each of the theory's major constructs: perceived usefulness, perceived usefulness, subjective norms, and intention to use AI.

3.2. Data Collection

Participants were asked to complete a questionnaire designed based on the Technology Acceptance Model (TAM). This allowed us to quantify students' perceived usefulness and ease of use of Chat GPT, their attitudes towards using it, and their intention to use it.The questionnaire survey is divided into two parts: the basic personal information; cognitive measurement scale of Chat GPT. To ensure the accuracy of this study, the 5-point Likert scale was used to measure the variables.This questionnaire is distributed among Chinese and foreign undergraduate students. A total of 200 questionnaires were distributed, out of 194 were valid with an effective rate of 97%. To complement the questionnaire data, semi-structured interviews were conducted with a subset of participants. These interviews allowed for a deeper exploration of students' experiences and perceptions of using Chat GPT.

3.3. Data Analysis

The data obtained from the questionnaires were analyzed using descriptive and inferential statistics to compare the acceptance of Chat GPT among Chinese and overseas undergraduate students. The interview data were transcribed and coded using thematic analysis to identify common themes and patterns in students' perceptions of Chat GPT.

Descriptive statistical analysis. This is divided into three parts: basic information of respondents statistics; Basic information about respondents' use of e-learning tools; The respondents' basic condition and feelings about using Chat GPT. In the sample of Chinese students, men accounted for 34% and female accounted for 66%, while in the sample of foreign students, male accounted for 36.59% and female accounted for 63.41%,therefore in these two samples, the radio of men to women is basically the same. In terms of grade distribution, all Chinese students are undergraduates, while 57. 14% foreign students are undergraduates, and 26. 19% foreign students are graduate students. Among the frequency of using various digital learning tools, the frequency of Chinese students using social tools was the highest which is 96%,the frequency of foreign students using social tools was the highest too which is 96%. Forty-three percent of Chinese students had used Chat GPT, while only 39% of foreign students had used Chat GPT.

Analysis of reliability and validity. By calculating the α coefficient (Cronbach's Alpha) to measure the reliability of the data, it overcomes the disadvantage of method. Set the equation for the measurement x and the truth τ：

$$x= \alpha \tau+e \quad （1）$$

where e is the error, let the mean of the error is zero and is not associated with the true value, i.e.

$$E(e) = 0; \; cov\,(\tau, e) = 0,$$

for two measurements xi and xj, let their e_i and ej are not associated ,the same true value:

$$\tau_i = \tau_j; \; cov\,(e_i, e_j) = 0, \text{ then:}$$

i) when $\alpha_i = \alpha_j$ and var (e_i)=var (e_j), x_i and x_j are parallel measurements.
ii) if and only if $\alpha_i = \alpha_j = 1$, x_i and x_j are equivalent measurements. And
iii) if $\alpha_i = \alpha_j$, var (e_i) =var (e_i) ,it is a similar measurement.

As required, select n questionnaires to calculate their overall variance, and then find the sum of the n questionnaires in each question, its α calculation formula go thus:

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum S_i^2}{S_x^2}\right), \; i=1,2,\dots\dots n$$

where α is the reliability coefficient; K is the number of questions; Si is the standard deviation of the subject on each question; and Sx is the overall standard deviation of the subject. The larger, the value of α, the higher, the internal consistency between the items, and the higher, the reliability of the questionnaire. Generally, the questionnaire reliability is good when α > 0.8and acceptable when α>0.7.

Table.1.Reliability analysis of Chinese students

latent variable	Item number	The Cronbach's Alpha based on the standard term
The questionnaire as a whole	28	0.915
Learning the software usage degree	6	0.952
Expected degree of use of ChatGPT	2	0.967
Chat GPT Effectiveness of the answers	5	0.742
Chat GPT Freeability	4	0.966
The way of accepting	4	0.869
Importance and correlation degree accuracy	5	0.781
	2	0.709

Table.2.Reliability analysis of foreign students

latent variable	Itemnumber	The Cronbach's Alpha based on the standard term

5

The questionnaire as a whole	28	0.945
Learning the software usage degree	6	0.915
Expected degree of use of ChatGPT	2	0.962
Chat GPT's effectiveness of the answers	5	0.916
The degree of ChatGPT difficulty	4	0.907
The way of accepting	4	0.832
Importance and correlation degree	5	0.809
accuracy	2	0.796

According to Table 1 and 2, the α value of the questionnaire based on standardized items was greater than 0.9. In the reliability analysis of the potential variables of the questionnaire, the α coefficient of each variable was greater than 0.7, indicating that the credibility of the questionnaire was within the acceptable range. The exploratory factor analysis (EFA) was used to assess the validity of the questionnaire, and the KMO and Batley spherical tests were used as predictors before the factor analysis. Generally, the sample data are suitable for factor analysis when the KMO> 0.8 and the KMO test passes.

Table 3.KMO and Batley spherical tests

KMO	The Batley spherical test	
	Approximate Chi square variance significance	
0.874	2924.4197	0.00

With KMO value being 0.874, this is expressed to the standard for factor analysis. The Batley spherical test approximated a chi-square value p-value of 0. 000,less than 0.001, passing the significance test with a   significance level at 0.1%. In conclusion, EFA can be performed based on the sample data obtained from this questionnaire.

After the reliability and validity analysis, the current data were fitted into the theoretical model and the results thus obtained are shown in Table 4. Table 5 shows the path test results.

Table 4. Simulated fit

Fit Index	R-squared	Reference value	Fitting results
CMIN/DF	1.928	<3	satisfactory
RMR	0.039	<0.05	satisfactory
NFI	0.874	>0.8	acceptable
IFI	0.958	>0.9	satisfactory
TLI	0.912	>0.9	satisfactory
CFI	0.931	>0.9	satisfactory
RMSEA	0.072	<0.08	satisfactory

As can be seen from the analysis results, the total variance interpretation of the "expectation" of the dependent variable in the model is reasonable, and the interpretation effect is relatively ideal. According to the fitting results of the structural equation model, the usage and usage expectation have a great influence

on the usefulness; the usefulness, ease o use, effectiveness and precision have a significant positive effect on the user attitude; the modified path test is given in Table 5.

Table 5.The corrected pathway test results

| path	Normalized path coefficient(β)	S.E.	C.R.	P
Using expectations→Usage	0.187	0.075	2.438	**
Effectiveness→Using expectations	0.273	0.086	3.749	***
Difficulty→Using expectations	0.512	0.091	5.937	***
Way of receiving→Usage	0.339	0.106	2.937	**
Importance andrelevance→U sage	0.198	0.068	3.982	*
Accuracy→Usage	0.308	0.077	4.892	***
Accuracy→Importance and relevance	0.312	0.072	3.826	*
Difficulty→Usage	0.179	0.064	2.846	*
Effectiveness→Importance and relevance	0.254	0.072	3.175	**
Using expectations→Way of receiving	0.398	0.089	6.037	***
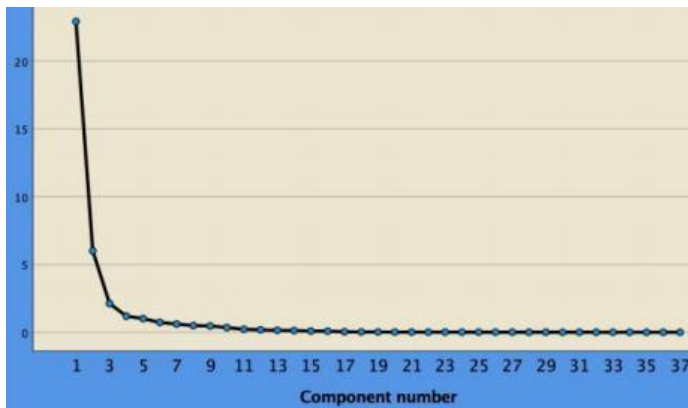
Fig.3. Questionnaire Scree plot

From the Scree plot in Figure 2, it can be observed that when the number of components exceeds 9, their characteristic values tend to stabilize. As the scree plot illustrates, the first two factors are very obvious. This shows that the design rationality and effectiveness of the survey questionnaire are significant.

3.4. Ethical Considerations

All participants were informed of the purpose of the study, and their informed consent was obtained. Participants' anonymity and confidentiality were assured, and the data was handled incompliance with relevant data protection regulations.

4.Results

According to Table 1 and 2, the overall questionnaire is based on standardized terms α, the values are all greater than 0.9. When conducting reliability analysis on potential variables in the questionnaire, the α, the coefficients are all greater than 0.7, indicating that the credibility of the questionnaire is within an acceptable range. Using EFA to assess the validity of the questionnaire, KMO and Bartley's spherical test were selected as predictive indicators before factor analysis. Generally, when KMO>0.8 and the significance test of Bartley's spherical test is passed, the sample data is suitable for factor analysis.

From the questionnaire data, it can be tentatively inferred that student gender and student education were not largely associated with the use of Chat GPT.3.5 percent of Chinese students said they would use Chat GPT if they were allowed, while 20 percent of foreign students said they would use Chat GPT if they were allowed. We know that Chat GPT is prohibited in China, while most foreign countries are allowed to use Chat GPT, so   it is known that students' willingness to use Chat GPT is unrelated to the national policy on Chat GPT. Among Chinese students, 4.75% think Chat GPT is convenient to use, and 5% think Chat GPT is useful for their study / work. While 41.46% of foreign students thought that Chat GPT is very convenient to use, and 19.5% of foreign students thought that using Chat GPT can help them with their study and work. Only 6.9 percent of Chinese students who have used Chat GPT volunteered for Chat GPT, which increased to 23.01 percent among foreign students. In the number of students who have used Chat GPT, only 9% of Chinese students think the output quality of Chat GPT is high, but this proportion has increased to 17% of foreign students.

4.1. Results of the TAM questionnaire

Based on the results of the questionnaire survey, it can be inferred that: Perceived usefulness and perceived ease of use will positively affect students 'attitude towards Chat GPT; Students' attitude will positively affect students 'willingness to use; Students' willingness will positively affect the probability of students actually using Chat GPT.; Because students' gender, grade and English level were the same in both sample groups of Chinese students and foreign students and from the questionnaire results, we preliminarily concluded that the policy factors did not affect the use of Chat GPT. So we can focus on the one variable of cultural difference. The cultural background of two sample groups is different, and we

know that we stern culture, relative to the eastern culture ,is more open, more easy to accept new things. The emergence of the Chat GPT, we can also be influenced by the cultural factors, led to two sample groups for the use of Chat GPT attitude differences.

4.2. Thematic Analysis of Interview Data

After analyzing the reliability and validity of the data, the data was substituted into the theoretical model.   According to the fitting results of the structural equation model(SEM), the following conclusions can be drawn: perceived ease of use and social impact have a significant impact on perceived usefulness; Expectation of use,   answer validity, difficulty, and accuracy have a significant positive impact on usage. Foreign students use Chat   GPT more frequently and with higher recognition than that of Chinese students, because the importance and relevance of using expectations and answering information are lower than those of foreign students.

5.Discussion

Chinese students tend to use Chat GPT for tasks assigned by teachers, while foreign students tend to use Chat GPT more flexibly. The questions in the questionnaire are highly targeted, and designed from different perspectives on the same aspect to reduce randomness. At the same time, questions were set around the topic to improve comprehensiveness.

This study has a slightly higher acceptance than previous surveys, in some way reflecting the novelty, pertinence, and comprehensiveness. The research results are highly consistent with the TAM2 and in line with the current basic situation.

6.Conclusion

The current study illuminates a path for future research in several ways. Firstly, further exploration of cultural influences on AI acceptance, as shown by the observed differences between Chinese and overseas undergraduates, could be beneficial. Next extending the scope to other demographic groups, like post graduate or high school students, and other AI tools beyond Chat GPT, can offer a wider view of technology acceptance. Longitudinal studies may reveal how acceptance changes over time.

What's more the findings underscore the importance of considering cultural and demographic differences when implementing AI tools like Chat GPT in higher education. Institutions should provide comprehensive training to students, tailored their specific needs and backgrounds, to enhance perceived usefulness and ease of use. Additionally, promoting positive attitudes toward AI by highlighting its potential benefits and capabilities can increase acceptance. For educators, incorporating Chat GPT into pedagogical practices in a way that meets students' learning preferences, possibly through a blend of traditional and AI-supported methods, may foster better engagement. It's vital that feedback channels are established to continuously refine AI implementation strategies.

Conflict of interests

The authors declare no financial or personal conflicts of interest that could potentially influence the research reported in this paper.

References

1. Author,Strzelecki,Artur:'To use Or Not to use Chat GPT in Higher Education? A Study of Students' Acceptance and use of Technology',Interactive Learning Environments,vol. ahead-of-print/no. ahead-of-print,(2023),pp.1-14.
2. Author,Open AI:Introducing Chat GPT,San Francisco, CA,USA,2022.
3. Author,Strzelecki,Artur.'Students' Acceptance of Chat GPT in Higher Education: An Extended Unified Theory of Acceptance and use of Technology', Innovative Higher Education, vol. 49/no. 2,(023),pp.223-245.
4. Author,Wang Hongcai,Long Baoxin,Mao Ju,etc:Chat GPT Challenges and opportunities brought to education(pen club)[J]. Journal of Soochow University (Educational Science Edition), 2023.
5. Author,Kohnke.L.,Moorhouse,B.L.,etc:Chat   GPT   for   language   teaching   and learning,2023.
6. Author,Hodges,C.B:How Teaching Happens: Seminal Works in Teaching and Teacher Effectiveness and What They Mean in Practice, 2022.
7. Author,Huang,Tan:The role of Chat GPT in scientific communication: Writing better scientific review articles,2023.
8. Author,Surameery,N.M.S.;Shakor,M.Y:Use Chat GPT to Solve Programming Bugs, 2023.
9. Author,Heaven,W.D:Open AI's New Language Generator GPT-3 Is Shockingly Good— And Completely Mindless,2020.
10. Author,Fuchs,K(Fuchs,Kevin):Exploring the opportunities and challenges of NLP models in higher education:is Chat GPT a blessing or a curse,2023.
11. Author,Tamori,H.,Yamashina,H.,Mukai,M.,Morii,Y.,Suzuki,T.&Ogasawara,K:"Acceptance of the Use of Artificial Intelligence in Medicine Among Japan's Doctors and the Public:A Questionnaire Survey", JMIR human factors, vol. 9,no.1,pp. e24680-e24680
12. Author,Singh,Harpreet,Mohammad-Hassan,Tayarani-Najaran,Muhammad Yaqoob: 'Exploring Computer Science Students' Perception of Chat GPT in Higher Education: A Descriptive and Correlation Study', Education Sciences, vol. 13/no. 9, (2023), pp. 924.
13. Author,Zhong Binglin, Shang Junjie,Wang Jianhua,Han Yunbo,Liu Jin,Zou Hongjun, Wang Zhenglu:Chat GPT Challenge to education (written talk) [J]. Higher Education Research in Chongqing, 2023, 11 (03): 3-25.
14. Author,Cui Yuhong,Bai Fan,Zhang Ruixin:Chat GPT Application, risks and responses in higher education[J]. Journal of Chongqing University of Technology (Social Sciences), 2023,37 (05): 16-25.
15. Author,Li Mi, Han Man, Ju Di,& Huang Wenhua:Impact and challenges of MOOCS on higher education [J]. Education and Teaching Forum, 2018 (47): 206-207.
16. Author,Akbar, F:What affects students' acceptance and use of technology?