Applications of Generative Artificial Intelligence in Online Learning and Ethical Governance Framework

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Abstract: *By collecting and collating related literature, six application directions of generative AI in online learning are explored based on the ADDIE model, including personalized learning path design; generation and recommendation of learning resources; virtual assistants and chatbots; interaction between generative AI and instructors; visual presentation and interactive activities; online learning assessment and assignment correction. Both the advantages and limitations of generative AI in online learning are discussed by analyzing relevant cases. Meanwhile, educators need to pay attention to the ethical challenges that generative AI brings to the field of education, and this paper formulates an ethical governance framework for the application of AI in education to regulate the practice of AI in education and promote the development of AI for good.*

Keywords: *Generative Artificial Intelligence, Online Learning, Strengths and Limitations, Ethical Governance*

1. Introduction

1.1. Generative Artificial Intelligence

Since the launch of ChatGPT by OpenAI in 2022, this large language model of artificial intelligence for text generation has attracted about one million users in just five days and reached a staggering 100 million users in three months, setting a new high for the usage of generative AI technology.

ChatGPT is a free generative AI tool that provides humanized chat box responses in the form of text conversations based on users' input. Unlike traditional chatbots, ChatGPT combines various technologies such as Internet resources, artificial intelligence, natural language generation, and machine learning[1], with a deep learning architecture to generate contextually relevant and meaningful responses, which makes it stand out as the most advanced tool available for natural language tasks.Currently, big language modeling is gaining popularity and has been applied in many fields such as healthcare, banking, education, tourism, and marketing, with ChatGPT's application in education attracting a great deal of attention. Many educational researchers have conducted in-depth analyses of the potential impact of ChatGPT on teachers, learners, and government education policies, and have tried to systematically integrate it into educational activities.

However, as the technology continues to gain popularity, more and more discussions are festering about the ethical issues that ChatGPT may raise in the educational community. For example, its powerful writing capabilities are thought to potentially threaten the roles of teachers and creators, etc. Educators are divided over the use of the technology, and while many scholars are positive about the use of ChatGPT and its future impact on the education sector, there are still experts and organizations that are negatively opposed to it: the New York Department of Education has issued a policy banning the use of ChatGPT on devices and networks in all schools in the state. The New York Department of Education has issued a policy banning ChatGPT from all school devices and networks in the state[2], fearing that it could undermine current education.

1.2. Online Learning and Artificial Intelligence

Online learning refers to the use of instructional technology for teaching and learning activities. With the help of the Internet and other digital platforms, students can remotely access educational resources, participate in courses, and interact with teachers and classmates.

Online learning plays an indispensable and important role in today's digital era, but there are still some shortcomings, for example, online learning usually fails to provide real-time interaction and communication similar to traditional classrooms. Since students participate in the course asynchronously, they are unable to quickly feedback their learning difficulties to the teacher and get timely responses and answers. This greatly affects their motivation and efficiency of online learning, which is also one of the reasons for the low completion rate and poor results of current online learning courses.

In addition, online education still faces the challenge of meeting the individual needs of each student. Due to the large number of students participating in online learning, with varying basic learning levels and backgrounds, it is difficult for courses on online education platforms to adapt to the learning paces of different students and lack personalized learning assistance.

Therefore, the emergence of ChatGPT is expected to improve the current shortcomings of online learning and provide more intelligent, personalized as well as efficient learning management services for online learning scenarios with its powerful large-scale pre-trained language models. In this paper, I will discuss the current application status of ChatGPT in the field of online education, take the general model of online instructional design (ADDIE) as a framework, sort out the current application direction of generative artificial intelligence and summarize the main advantages and limitations of ChatGPT applied to online learning, to provide references for the following application research.

1.3. Research Question

Despite the promising application of generative AI in the field of online learning, current research on its application is not systematic or in-depth enough. Therefore, this study aims to comprehensively sort out the application of generative AI in the field of online learning by collecting and organizing the relevant literature, based on the ADDIE model, a general model of online instructional design, Furthermore, analyze in-depth including the direction of its application, advantages, limitations, and ethical issues, to provide references for the subsequent application research.

To solve this problem thoroughly, we refine it into the following sub-questions:

(1) Classification of application directions: What are the specific application directions of generative AI in online learning? How are these applications realized?

To address this question, we will sort out the application cases of generative AI in online learning utilizing a literature review, select representative cases for dissection, and analyze their application modes as well as technical characteristics to reveal the diverse application directions.

(2) Exploration of advantages and limitations: What are the advantages of generative AI in online learning compared with traditional learning methods? What are the limitations or challenges at the same time?

(3) Discussion of ethical issues: What are the ethical issues involved in the application of generative AI in education?

1.4. Research Methods

This study mainly adopts the literature research method and case study method, combined with the ADDIE model, to deconstruct and analyze the application process of generative AI in online learning. In order to address the above three questions, this paper constructs the following research framework, which is shown in Table 1:

Table 1: Research Framework
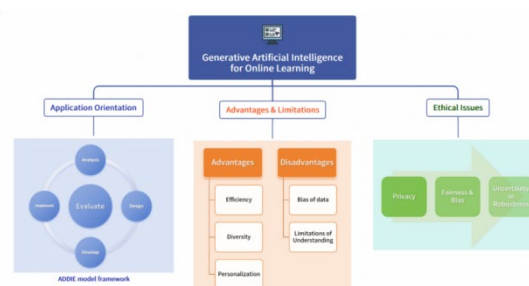
2. Generative Artificial Intelligence in Online Learning

2.1. Paper Collection and Organizing Framework

The keywords "Online learning", "Generative AI", "ChatGPT", "Online learning and Generative Artificial Intelligence" were searched in the four major thesis websites of IEEE, SEMANTIC SCHOLAR, CNKI, and Google Scholar, and filtered by applying the additional criteria, which required that each thesis was related to AI and online learning, and a total of 41 valid theses were obtained after filtering and 1 piece of information on the website of The Journal for some time of 2016 to 2024.

In terms of application scenarios, there are mainly six major scenarios in which generative AI is applied to online learning at home and abroad, namely: personalized learning path design; generation and recommendation of learning resources; virtual assistants and chatbots; interaction between generative AI and instructors; visual presentation and interactive activities; and online learning assessment and assignment correction. In the case sorting, this paper takes the ADDIE model as the basis to divide the current case application scenarios, and a total of three application dimensions are summarized, which are Analyse & Design Analysis & Design; Develop & Implement Development & Implementation; and Evaluate Evaluation. Table 2 shows the classification results and number statistics of specific cases: (there are single cases involving multiple application themes)

Table 2: Statistics on the use cases of generative artificial intelligence in online learning

Application Topics		Number	Percentage
Analyse & Design	Personalized Learning Path Design	10	23.81%
Develop & Implement	Generation and Recommendation of Learning Resources	11	26.19%
	Virtual Assistants and Chatbots	14	33.33%
	Interaction between Generative AI and Instructors	6	14.29%
	Visual Presentation and Interactive Activities	6	14.29%
Evaluate	Assignment Review and Learning Assessment	17	40.48%

Among the 42 papers, 17 papers mentioned the application of generative AI in the direction of "online Assignment Review and Learning Assessment", which is the largest number of papers. In the fields of "Interaction between Generative AI and Instructors" and "Visual Presentation and Interactive Activities", there were 6 papers mentioned respectively, which tied for the lowest number.

The number of specific application topics, from highest to lowest, is as follows:

1) Assignment Review and Learning Assessment(n=17, 40.48%)

2) Virtual Assistants and Chatbots(n=14, 33.33%)

3) Generation and Recommendation of Learning Resources(n=11, 26.19%)

4) Personalized Learning Path Design(n=10, 23.81%)

5) Interaction between Generative AI and Instructors(n=6, 14.29%)

6) Visual Presentation and Interactive Activities(n=6, 14.29%)

Table 3 displays the number of articles published per year. More than half of the articles were published in 2023, a percentage of 57.14%. This explosive growth is also indicative of the push for educational applications in 2023 with the emergence of generative AI such as Chat GPT.

Table 3: The number of articles per year

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024
Number	2	1	1	4	2	4	3	24	1
Percentage	4.76%	2.38%	2.38%	9.52%	2.38%	9.52%	7.14%	57.14%	2.38%

Among those 6 topics, personalized learning path design mainly refers to tailoring learning paths that are more suitable for learners according to their different learning levels, ability backgrounds, learning styles, needs, interests, etc., to promote personalized learning. The personalized learning plan provided by generative AI greatly facilitates the process of analyzing and understanding students' characteristics and current situation (Analyse) as well as organizing and designing knowledge points (Design) in instructional design.

The generation and recommendation of learning resources mainly involves the use of generative AI to create and recommend learning resources for students, such as course materials, practice problems, etc. Virtual assistant and chatbot applications mainly refer to the AI that can provide real-time consulting services on questions posed by students, and humanized communication with learners through text or voice. Generative AI and teacher interaction refers to the fact that teachers can utilize generative AI to automatically generate teaching materials, assist in assessing student work, etc. Visual presentation and interaction activities involve the use of AI to automate the generation of rich images and videos related to an online course or to incorporate interactive features such as memory cards and discussion forums. These four types of application themes improve the efficiency and quality of instructional materials development (Develop) and hands-on implementation (Implement) in instructional design.

Finally, assignment review and learning assessment include the use of generative AI to assess students' online learning performance, such as monitoring students' learning progress, forming personalized feedback reports, etc., which improves the efficiency of Evaluate in instructional design.

2.2. Application Case Analysis

In the following paragraphs, I will select some typical application cases in different application directions for brief description and evaluation. (Note: several papers involve multiple AI application scenarios at the same time)

2.2.1. Design of Personalized Learning Paths and Assessment of Online Learning

Due to the increasing demand of students, the globalization process playing in that with the emergence of new technologies, the concept of personalized learning has undergone a landmark change from the traditional[3], one-way teacher output to a student-centered, multi-interactive, tailor-made learning model.

In this context, based on human-computer interaction (HITL), Zhang Rui[4] et al. deconstruct the mechanism of human-computer collaborative MOOC learning interaction and clarify the role that generative AI can play in it, thus constructing a model of human-computer collaborative MOOC learning interaction empowered by generative AI. The authors point out that generative AI can empower human-computer collaborative MOOC learning in the following three aspects:

①Sensing learners' needs in multiple ways and providing personalized learning suggestions

②Multiple rounds of human-computer dialog, dynamically recommending valuable knowledge content.

③Analyzing learners' multidimensional data to provide visualized outcome evaluation.

Intelligent Tutoring System (ITS) is also a major application of AI in the direction of personalized learning and is a highly developed form of personalized learning platform. ITS is designed to provide timely and customized feedback as well as assistance to learners, playing an important role in overcoming the growing gap between the increasing number of learners and the shortage of quality teachers[5]. Many schools in the U.S. are actively using ITS to compensate for the disadvantages of traditional school programs[6].

ITS includes assessing students' overall performance in core curriculum and skills, as well as monitoring students' implementation and compliance in learning pathways, etc. Zhou[7] et al. analyzed the role of "student data" in the ITS model, and concluded that there are four models that apply to different types of students, which further highlight the essential characteristics of ITS.

In the direction of learning evaluation, Laxmisha Rai[8] et al. studied in depth the evaluation class application of generative artificial intelligence (GenAI) tools in massive open online courses (MOOCs), and focused on testing the evaluation of GenAI tools for language courses. It was found that the types of assessment fully supported by generative AI at present are single-choice, multiple-choice, word

choice, and sequencing. As for drag-and-drop question types, group discussion, photo, audio, and video analysis, they cannot be effectively assessed and fed back.

Furthermore, Damien Raftery's experiment[9] also found that when using ChatGPT versions 3.5 and 4 supplemented with appropriate plugins to answer 12 online quizzes in a business course at an Irish university of science and technology, the accuracy of the AI's answers was quite high at around 78%. This finding challenges the use of online quizzes as a means of assessment but also provides an opportunity to redesign online course assessment strategies to better adapt them to the changes brought about by new technologies.

Supervised learning is one of the important applications of AI in the direction of learning assessment. Hasib[10] et al. proposed the LIME model for interpreting the results obtained by AI algorithms regarding the prediction of academic performance of secondary school students, where factors such as the student's prior grades, age, gender, and school-related and parent-related characteristics were included in the modeling.

2.2.2. Generation and Visual Interactive Presentation of Learning Resources

Ivaylo Blagoev[11] et al. proposed a methodology for creating interactive online courses using generative AI and highlighted four basic steps: generating content based on AI; delineating knowledge nuggets; content Diversification; course visual presentation and interaction design (pop-up windows, flashcard instruction, hot discussions, etc.).

In addition, AI technology has shown great potential in the direction of learning videos. Daniel Leiker et al. used a mixed research method combining quantitative and qualitative approaches to explore the educational value of AI-generated synthetic videos in online education platforms[12]. The authors and their team members randomly divided adult learners into two groups to watch traditional teacher videos and AI-generated synthetic videos, and through the collection of pre-test and post-side assessment data, as well as participant feedback on the learning experience, the analysis found that learners improve significantly before and after learning, whether they watched a video generated using AI or a traditional teacher video; furthermore, learners' feedback and perceptions of the two types of videos did not differ significantly.

David Kennedy[13] proposed to apply AI to MOOC and utilized its powerful translation and transcription capabilities to translate the MOOC course into the language required by the learners, so as to overcome the language barriers in distance MOOC learning, and to make the excellent MOOC more widely disseminated and benefit more students.

2.2.3. Generative AI-teacher Interaction and Virtual Teaching Assistants

In the dimension of AI-teacher interaction, Sylvio Rüdian's team focused on the domain of language teaching[14], utilizing the GPT3.5 model and teaching prompts to generate learning content. Specifically, teachers need to provide information such as teaching topics, text inputs, etc., which are then combined by ChatGPT to form language learning units. In addition, the authors assessed the correctness and appropriateness of generating learning content and also explored the usefulness of the tool. The results show that the tool can generate mostly correct language learning materials, but further optimization is needed to accommodate a wider range of topics and language skills. Authors therefore suggest that while generative AI has great potential for the generation of language-based online courses, teachers still need to play an integral role to ensure the high quality of the learning content.

These results indicate that AI-generated synthetic learning videos have great potential for application in online education and can contribute to making high-quality educational content more accessible globally. However, although this study provides a valuable example of the application of AI in online education, we still need to further investigate its application and effectiveness in different subjects and environments to enhance its general applicability.

In addition, a French generative AI education technology company officially launched an OpenAI-based content generator called NOLEJ AI in March last year. NOLEJ automatically creates interactive course content based on static content (e.g.text, videos, URLs, etc.) uploaded by the instructor and incorporates a variety of learning formats, including memorization cards, quizzes, and transcripts. These forms are generated based on the materials uploaded by the instructor to form mini-learning resource packages. Students can flexibly use the course content according to their own learning needs and interests to improve learning outcomes.

At the level of development of virtual AI teaching assistants, Mahmoud M. Elmesalawy[15]

proposed an AI-based Laboratory Learning System (LLS) designed to support students' online laboratory experiments. It also utilized AI technology to provide virtual lab assistants and adaptive assessment processes in universities. Specifically, this chat-assistant-like robot will act as a teaching assistant in the students' real lab environment, it can answer some basic questions asked by the students while they are performing lab tasks. Besides, it can also monitor the students' behaviors and be automatically triggered when students encounter any difficulties.

3. Advantages and Limitations of ChatGPT for Online Learning

Although ChatGPT has been successfully applied to many areas of e-learning and has begun to play an increasingly important role, there are still potential difficulties and concerns about its use. Only by thoroughly analyzing and grasping its advantages and disadvantages which are summarized in Table 4 can we use this tool more safely and efficiently to promote the development of online learning in the digital age.

Table 4: Advantages and Limitations of ChatGPT for Online Learning
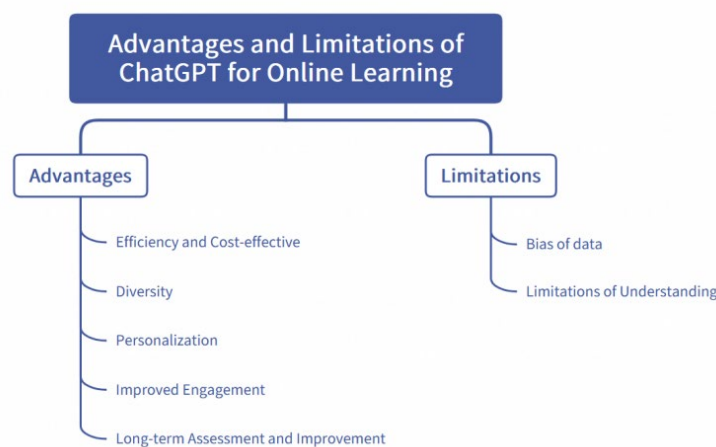
3.1. Advantages of Applying ChatGPT

Efficiency and Cost-effective: First of all, the application of generative AI can perform many teaching and tutoring tasks in online learning more efficiently, such as the generation of learning materials, correction, and evaluation of students' answers[16], etc. It shortens the time and energy spent by teachers involved in the courses improving the teaching efficiency of online courses. Generative AI is also cheaper to use than traditional teaching methods, which can help schools save more money that can be invested in planning other educational resources.

Diversity: Based on a huge database, generative AI can not only generate various forms of teaching content, including text, images, audio, and video, based on unified knowledge points but also design various online interactive activities, which greatly enriches online teaching mode and satisfies the increasingly diversified learning needs of students as well.

Personalization: The application of generative AI in teaching assistant robots and personalized learning path design can effectively solve the problem of "online learning is too rigid and patterned to meet students' pursuit of personalized learning", making online learning flexible and oriented to learners with different backgrounds, formulating online learning courses with a higher degree of self-adaptation. The course will be more adaptive and oriented to learners from different backgrounds.

Improved Engagement: Generative AI can create more interesting, engaging content that improves the student learning experience, for example, VR, AR, flashcard instruction, and other interactive formats, which can significantly increase student motivation, enthusiasm, and engagement.

Long-term Assessment and Improvement: Assessment is an integral part of online education and is a long-term activity. Assessment should focus on four aspects: knowledge, skills, attitudes, and learning outcomes that students have learned. Generative AI can continuously record student learning performance[17], questions asked, learning status, etc. in different periods with the support of big data, create a tailor-made assessment and feedback mechanisms according to the different needs of each

student, and carry out continuous tracking and refinement based on the assessment results to fundamentally solve the problems arising from students.

3.2. Discussion of Limitations

The bias of data: since ChatGPT is trained from a large amount of linguistic data, in terms of educational applications, it will be inevitably extracted from the educational big data on the Internet with real-world social characteristics and attributes[18]. As a result, its output is likely to be discriminatory. These negatively biased data are gradually augmented by users' continuous collection and feedback and ultimately are likely to cause algorithmic discrimination jeopardizing online education.

Limitations of Understanding: ChatGPT ultimately can not fully mimic the human brain to understand and think about problems, so it may generate unreasonable or unnatural content in conversations, increasing the learner's confusion and burden of understanding. Timely manual review, correction, and optimization are still required to ensure that the content is accurate and rigorous.

4. Ethical Issues and Proposed Governance Framework for the Application of Artificial Intelligence in Education

4.1. Privacy

One of the biggest ethical issues in applying AI technology in online learning is the privacy of students and teachers. Students are prone to overexpose their personal information due to a lack of security awareness when using AI on online platforms, and unknowingly agree to share their privacy. Despite laws protecting users' sensitive data, many tech companies continue to have breaches in data access and security. The risk of privacy breaches is exacerbated by the fact that student's personal information is often shared across multiple platforms and systems for different pedagogical purposes[19].

At the same time, the surveillance and tracking functions of AI systems on students also jeopardize student privacy. The system collects detailed data on students' and teachers' behaviors and preferences, not only for monitoring the present but also for predicting future behaviors. While this is partly necessary for pedagogical analysis, it also violates privacy and limits users' learning participation as well as freedom of expression. Constant surveillance by AI may also cause stress and anxiety to students, affecting their self-esteem and not being conducive to learning progress.

4.2. Fairness and Bias

As mentioned above, current generative AI algorithms are still biased, which can lead to problems such as students being exposed to harmful information, or being mistreated by AI systems. [20]Biased decision-making algorithms are manifesting themselves in areas such as personalized learning and automated assessments, which may exacerbate the problem of educational inequality.

4.3. Uncertainty in Robustness

Currently, the robustness of generative AI systems is questionable. Algorithms may perform well on one dataset but poorly on another, leading to situations where models fabricate absurd or false information. Junaid suggests that when ChatGPT was quizzed on the veracity of its answers, it was found to have several factual errors about events, books, articles, and people that were fabricated or confused and obfuscated factual errors. This also proves that generative AI still has a lot of room for improvement in terms of stability and truthfulness.

In addition, deepfake technology is also a huge danger to the application of AI technology in education. Deepfake is a hybrid of "deep learning" and "fake media" that uses the powerful learning capabilities of generative AI to create highly realistic multimedia content[21] such as text, images, audio, and video, which can lead to the dissemination of misinformation and false teaching content. This can not only seriously affect students' views and behavior, but also provide opportunities for unscrupulous individuals who conspire to indoctrinate young students with misconceptions or manipulate their attitudes. Based on this, the uncertainty of robustness and the violation of deepfake technology can pose a potential threat to the application of AI in online learning, thus affecting the normal learning of

students and compromising the fairness and objectivity of education.

4.4. Governance Framework

In response to the multiple ethical issues presented in the application of generative AI in education, this paper proposes an integrated and comprehensive governance defense framework, as shown in Figure 1. The framework consists of four major elements, which comprehensively articulate effective actions to prevent the continuous fermentation of ethical issues from four aspects, namely, technical level, cross-platform strategies, user-centered, policies, and regulations, respectively.
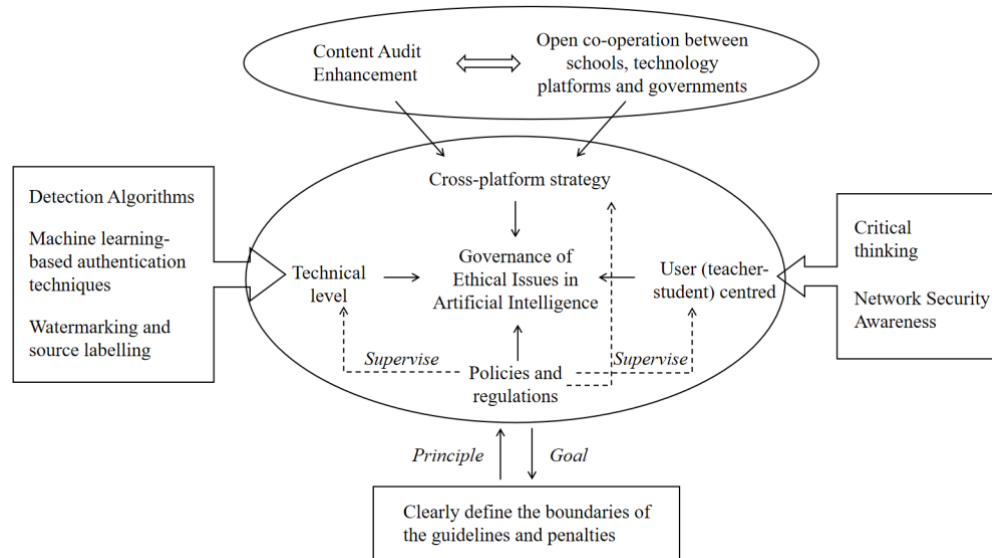

Figure 1: Governance Framework for Ethical Issues in Artificial Intelligence

4.4.1. Technical Level

Detecting content authenticity is the first line of defense to prevent AI from generating fake content and spreading it. Since machine learning can generate fake information, the same can be used to identify and combat them. Using more advanced detection algorithms with machine models that recognize false information, it is possible to detect signs of alteration in video frames at the pixel level[22] or spot irregularities in background noise in the audio, thus detecting the authenticity of learning materials. In addition, when AI provides students with appropriate learning materials, it is advisable to mark the websites or literature that are mainly cited for that knowledge point, embedded in the content as a digital watermark[23], which can be used to confirm authenticity.

4.4.2. Cross-platform Strategy

Maintaining an ethical environment for the use of AI in education requires open collaboration across platforms, which mainly includes platforms that provide AI technology, schools and educational institutions that use AI technology, and governments. The three collaborated to develop standardized protocols to ensure AI-generated content is vetted and screened to guarantee that it is healthy, authentic, and correctly oriented. In terms of teacher and student privacy, there needs to be a privacy protection agreement between the education sector and the technology platforms to eliminate the risk of personal information being leaked and monitored by the government.

4.4.3. User (teacher-student) Centred

Launching a programme on cybersecurity and digital literacy development to educate the teaching staff and students involved in digital media, popularise the risks of AI usage as well as cultivate cybersecurity awareness, reminding them not to disclose their personal privacy at will. At the same time, develop critical thinking. Encourage them to question the answers and help they receive, and acquire the ability of independent thinking as well as human-computer collaboration.

4.4.4. Policies and Regulations

The government needs to develop new laws and regulations from the top down to clarify the guidelines and boundaries of AI use, as well as the penalties for non-compliance. Policy and law

continue to influence those three directions in this framework and play an important role in regulating the implementation of the first three strategies.

5. Future Research Directions for Artificial Intelligence Applications in Education

5.1. Ethical and Privacy Issues

Based on the previously discussed ethical issues regarding AI applications, it is crucial to develop ethical AI algorithms for education. How to avoid algorithmic bias and protect privacy when collecting, analyzing, and providing feedback on student-supplied data is a pressing issue for future generative AI development. Related professionals have already made attempts and efforts in this area, Akgun et al[24]. proposed a series of solutions to the ethical issues and social drawbacks brought by AI systems in the K-12 education environment in the hope that stakeholders can responsibly use AI and benefit from it. Meanwhile, the U.S. NIST also released the "Artificial Intelligence Risk Management Framework 1.0" in January last year, aiming to provide a reference for organizations designing, developing, deploying, and applying AI systems to enable them to control diversity, promoting the development of safe and trustworthy AI systems.

5.2. The Importance of Prior Knowledge and Ability to Ask Critically

Generative AI does not always consistently provide the same answer to a question: the answer it generates depends on the context in which the chat is taking place. The same question placed in different questioning situations may get completely different answers. Therefore, the framing of the question and the context of the ongoing discussion becomes significant.

The effectiveness of any resource or tool is limited by an individual's existing knowledge and background[25], which means that a person can only use it effectively and truly benefit from it if he or she has a comprehensive and in-depth understanding of the available resources. In the case of generative AI, only people with knowledge of a domain and strong critical thinking are capable of recognizing and filtering inaccurate information, extracting the truly useful essence from the answers provided by ChatGPT.

This requires users (including teachers, students, and course designers) to be more intelligent in critical thinking and skillful in asking questions. The saying "the quality of the answer depends on the quality of the question[26]" also applies to generative AI technologies. In the future, prompt engineering will be a worthy subject of study. Teaching users the art of communicating with AI, and critically refining the answers and knowledge that are truly useful in the exchange, is also a way of developing the survival skills that students will need to enter society in the future.

5.3. Sentiment Analysis in Education

Sentiment analysis enables teachers and administrators to better understand students' learning behaviors, analyzing students' experiences and feedback. In e-learning, by analyzing students' sentiments, we can more accurately understand students' feelings, feedback, and experiences in the course, to predict student performance trends. That can be used to further improve personalized learning tools, increase student enthusiasm and performance, and take remedial measures to improve e-learning effectiveness as well as increase completion rates when necessary.

5.4. Personalized Learning

Generative artificial intelligence technology has been proven to be very effective in the domain of customized teaching, which can provide more flexible, diverse learning resources and learning paths according to students' learning characteristics and needs. Meanwhile, intelligent tutoring system is another important application field of generative AI in online learning, which can provide real-time learning feedback and tutoring for students to improve learning efficiency. The practice cases proposed and analyzed in the paper provide a good reference experience for establishing advanced generative AI education models in the future.

6. Conclusion

In today's high-speed digital world, generative artificial intelligence has become an irreplaceable and important tool in the field of online learning. Based on ADDIE, this paper introduces and analyzes the six application directions of generative AI in the field of online learning respectively, and combs through the relevant application cases and literature. Finally, based on the analysis, it summarizes the advantages and limitations of the current application of generative AI. In the future, with the continuous development and improvement of technology, it is expected that AI will play a greater role in promoting a better learning experience for online learners. At the same time, educators also need to pay continuous attention to the trends and challenges of generative AI and take effective measures to overcome these obstacles to achieve healthy and sustainable development in the field of online education.

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