International Journal of Education and Social Development
ISSN: 3078-9931 (Print), ISSN: 3078-2287 (Online) | Vol. 2, No. 3, 2025

Current Situation and Prospect of AI Education Application

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Abstract: This article reviews the current state of AI education applications and the challenges it faces. First, it introduces the research background and significance of AI education, and elaborates on the purpose and structure of the review. Next, by analyzing international application cases, it explores the practical situation of AI education in different countries, as well as the use of AI tools by teachers and students. Based on survey data, this article analyzes in detail teachers' understanding, use, and concerns about AI, while also statistically interpreting the situation of students participating in AI tools. The study finds that although AI education has shown great potential in personalized learning and teaching support, it still faces many challenges in terms of transparency, ethical considerations, and technology integration. In addition, the professional development needs of teachers are particularly prominent. Finally, this article summarizes the main findings, proposes future research directions and policy recommendations, emphasizing the importance of increasing transparency and strengthening teacher training to promote the healthy development of AI education.

Keywords: AI education, data-driven, teacher perspective, transparency and ethics.

1. Introduction

1.1. Research background and significance of AI education

With the rapid development of artificial intelligence (AI) technology, its application in the field of education has gradually become a research hotspot. AI Education (AIEd) not only provides teachers with more efficient tools to support teaching activities, but also creates a personalized and interactive learning environment for students. The research in this field is to explore how to use AI technology to optimize the allocation of educational resources, improve the quality of education, and to meet the many challenges faced by the traditional education model [1].

In recent years, many countries and regions have launched to explore the application of AI education. For example, in countries like Greece, Hungary, Latvia, Ireland and Armenia, a large survey involving 1,754 educators showed that most teachers have a more positive attitude towards AI technology and recognized its potential risk [1]. However, it is worth noting that despite the many opportunities brought by AI education, there are also some difficulties in its implementation. On the one hand, teachers are generally concerned about the impact of AI on students' critical thinking; on the other hand, they worry that the AI system may expose students to biased data, thus affecting the learning effect. In addition, the survey also revealed a strong demand for professional development, believing that training seminars, workshops and online courses can be better mastered in the use of AI tools, so as to promote the effective integration of AI education [1].

At the same time, transparency has also become one of the important issues that can not be ignored in the field of AI education. Although there are many AI ethics lists and frameworks that have been proposed, there are relatively few studies focusing on transparency in practical education scenarios. Rose Luckin In his paper, he proposed a framework called "Transparency Index", which emphasizes the importance of transparency throughout the AI development cycle and states that transparency helps achieve other ethical dimensions such as interpretability, accountability and security [2]. This suggests that, in order to ensure the fairness and reliability of the AI education system, transparency must be considered as a core design principle.

To sum up, AI education is not only the result of technological innovation, but also the embodiment of the needs of social progress. It can not only help us to solve various problems in the current education system, but also provide new ideas and development direction for the future reform of the education model. Therefore, it is of great significance to deeply study the application status of AI education and its challenges. The analysis of practice cases in different countries provides a clearer understanding of the trends of AI education globally and targeted recommendations based on existing findings to promote the healthy development of the field.

1.2. Review Purpose and structural arrangement

This paper aims to comprehensively explore the current situation of the application of AI education and its challenges, and reveal the potential and problems of AI in the field of education through the analysis of international application cases in different countries. Based on the survey data and practical application, the article will deeply discuss the teachers and students' understanding, use and doubts of AI tools, and summarize the key directions and policy suggestions for future development.

First, this paper will introduce the research background and significance of AI education. With the rapid development of artificial intelligence technology, the application of AI in the field of education has gradually become a research hotspot. AI can not only provide personalized learning experience, but also assist teachers in teaching design and evaluation, thus improving the quality and efficiency of education [3]. However, the promotion of AI education also faces many challenges, such as ethical considerations, technology

integration, and the professional development needs of teachers.

Next, this paper will analyze the practice of AI education in different countries in detail. Through a questionnaire survey of 1754 teachers in five countries of Greece, Hungary, Latvia, Ireland and Armenia, the study found that most teachers had a better understanding of AI and recognized its potential value. AI is mainly used to support teachers' teaching work and attract student participation. But at the same time, teachers also expressed concerns about AI impact critical thinking and exposure bias data [3]. In addition, the study showed that students mainly use AI tools to manage their academic burden and use it more for recreational [3] after class.

Then, this paper will count and interpret the students' participation in the AI tool. Based on Fermilab's K-12 education program experience, effective education programs need to make the most of opportunities to address challenges. By working with educators to design and run projects that meet their needs and interests. For example, Fermilab offers a variety of activities, including classroom presentations, experiential field trips, and high school visits, to enable students to experience the charm of science. In addition, projects QuarkNet and I2U2 provided real particle physics data for high school students for data analysis and experimental [4].

Finally, this paper will summarize the main findings and make future research directions and policy recommendations. Research shows that while AI has great potential for personalized learning and teaching support, further improvements in transparency, ethics and technology integration. In particular, teacher professional development is crucial in developing students' critical thinking and addressing potential misuse problems. To this end, more resources such as training seminars and online courses must be provided to help teachers master the use skills of AI tools to promote the healthy development of AI education [3].

2. The Application Status of AI Education

2.1. International Application case Analysis

In recent years, AI education has been increasingly widely used in the international scope, and countries are exploring how to integrate AI technology into the education system to improve the teaching quality and learning effect. The practice situation and achievements of different countries have provided rich experience and inspiration for the whole world.

In Africa, the AfricAIED 2024 workshop has focused on developing AI systems tailored to the unique African educational environment. Through the form of online AI Hackathon, the seminar encouraged participants to create open source AI tools to help prepare for Ghana's National Science and Mathematics Competition (NSMQ), thus narrowing the academic gap and enhancing the level of science and mathematics education [5] in Africa. This initiative not only promotes the equitable distribution of educational resources, but also demonstrates the great potential of AI in education. For example, the Brilla AI program provides resources that give students more access to learning opportunities and support, further driving the democratisation of education.

In Europe, Kaska Porayska-Pomsta presented a Declaration on Active and Responsible AI Education in its paper, highlighting key issues to be addressed in the field of AIED, such as interdisciplinary collaboration, understanding of human functional impact and the establishment of a human-centered educational innovation agenda, [6]. The declaration calls for revitalizing AIED by strengthening these efforts and making them an important force for the development of educational technology. The Porayska-Pomsta study points out the shortcomings of the current AIED field and points the way for future development.

In North America, a John Edwards study explored the perceptions and attitudes of university teachers towards generative AI. By conducting questionnaires and in-depth interviews with hundreds of educators, he found that although most teachers have positive views on AI language models, they still have many questions and concerns about their specific application [7]. Non-computer science teachers, in particular, are more cautious about complex technologies. Moreover, CS professional teachers, while showing higher confidence and technical understanding, were not better than teachers of other disciplines in identifying the content generated by AI. This suggests that all teachers need to receive more training and support on the use of AI tools, regardless of context.

The Asian region, particularly India, Karan Jani study explores the importance of international cooperation for maintaining space science programs. While this study focuses primarily on aerospace, it also indirectly reflects the role of technology cooperation in global education programs. Jani noted that international collaboration could help developing countries build ambitious space science research projects, while improving domestic infrastructure levels and development capacity in related areas [8]. However, he also mentioned the possible limitations of such collaboration, especially the relatively low returns in science education and national security.

To sum up, the above cases show the application status and effectiveness of AI education in different countries. It can be seen from these practices that AI education not only contributes to personalized learning and teaching support, but also plays an important role in promoting educational equity and improving teaching quality. However, issues such as transparency, ethical considerations and technology integration remain the key factors restricting their development. Therefore, the future AI education research should pay more attention to solve these problems, especially to strengthen the professional training of teachers, to ensure the healthy and sustainable development of AI education.

2.2. Use of AI tools by teachers and students

The use of AI tools by teachers and students is a key link in AI education applications. According to Paraskevi Fragopoulou research, an online questionnaire survey of 1754 teachers in five countries, Greece, Hungary, Latvia, Ireland and Armenia, found that most of the teachers had some understanding of AI education (AIEd) and recognized its potential risks [9]. Teachers mainly used AI tools for teaching support and engaging student participation, but also expressed concerns about their impact on critical thinking and possibly exposing students to biased data.

Moreover, faculty generally believe that AI can help manage student academic burden, with students preferring to use AI tools for recreational purposes during extracurricular activities. This phenomenon reflects the differences in the application of AI in different scenarios, and also reveals that

students' cognition of the function of AI tools is not comprehensive yet in [9]. Notably, despite their cautious optimism about AI, they strongly call for improving their professional skills through training seminars, workshops, and online courses to better integrate AI tools into their daily teaching.

At the same time, Richard Brooker's research further explored the influencing factors of teachers' adoption of AI platforms. By analyzing data from 792 teachers in a large sample of a country, the study noted that teacher knowledge, confidence and product quality are important, but not the only or most important factor. The study also found that factors such as reducing additional workload, increasing teacher autonomy and trust, providing help mechanisms and support, and ensuring the minimization of ethical issues were critical to improving teacher engagement [10].

Yongsu Ahn The research focuses on teachers' views of insufficient social emotional ability of AI. Through a questionnaire survey of 100 primary school teachers in South Korea and in-depth interviews with 12 teachers, the study showed that teachers expect AI to supplement the work of human teachers with automated administrative tasks and personalized learning. However, the lack of socioemotional interaction capacity in AI presents both a challenge and is seen as an opportunity. This complex perception suggests that the application of AI needs to be tailored to the specific needs and preferences of teachers to achieve better complementary relationships [11].

Guanze Liao The research focuses on how stage K-12 teachers use the project-based learning (PBL) AI toolkit to integrate AI concepts into multidisciplinary teaching. Research shows that while teachers recognize that AI tools can promote the development of creativity and critical thinking, they are also concerned about the accuracy and credibility of AI-generated content. In addition, practical problems such as limited resources and uneven skills between teachers and students have also become obstacles to the popularization of AI tools, which suggests that us should develop more flexible and adaptable AI tools to meet the diverse educational needs of [12].

To sum up, the current use of AI tools by teachers and students is diversified. On the one hand, AI shows great potential in teaching support and personalized learning; on the other hand, transparency, ethical considerations and technology integration remain to be addressed. Future research should focus on optimizing the design of AI tools to make them more in line with the requirements of the actual teaching environment, while strengthening the professional development support for teachers, so as to promote the sustainable development of AI education.

3. Data-driven AI Education Practice

3.1. Teachers' perspective analysis based on the survey data

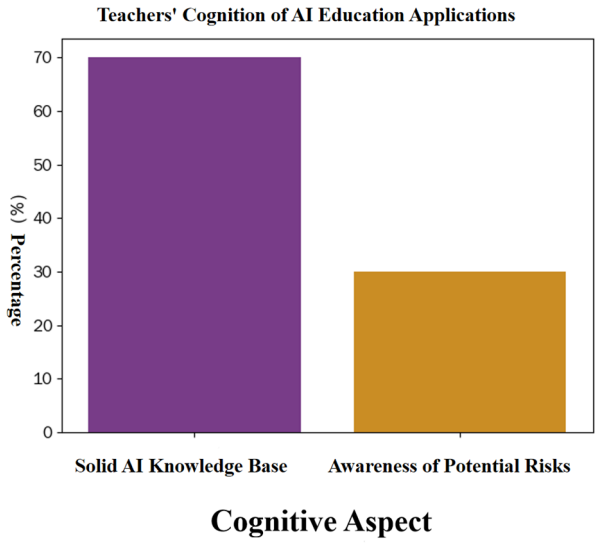
Educators play a crucial role in the application of AI education. To gain insight into teacher understanding, use, and doubts about AI education, Paraskevi Fragopoulou conducted a cross-country study covering 1,754 educators [13] in five countries: Greece, Hungary, Latvia, Ireland, and Armenia. The study explores three main research questions in the form of online questionnaires.

First of all, regarding teachers' understanding of AI education, research has found that most teachers have a solid AI knowledge base and recognize the potential risks of AI technology. For example, reduced teacher workload and enhanced AI tools are widely used to enhance student engagement in teaching support and student engagement. However, teachers expressed concerns about the question of whether AI could promote the development of critical thinking and whether there was data bias. This suggests that although teachers generally recognize the potential of AI in education, they are also aware of the possible negative impact of the [13].

Secondly, from the teacher's perspective, students use AI tools differently in and after class. On campus, students mainly use AI tools to manage academic tasks, such as homework and exam preparation; off campus, AI tools are used more for recreational purposes. This difference reflects the limited cognition and application of AI tools, but also suggests that educators need to guide students to more fully understand and use AI technologies. Moreover, teachers believe that the potential of AI in personalized learning is particularly prominent, but also emphasizes the importance of transparency and ethical considerations [13].

Finally, teachers are generally cautiously optimistic in the face of future challenges. They expect AI to play a bigger role in improving the quality of teaching, especially the personalized learning experience. However, teachers also expressed deep concern about developing critical thinking skills and preventing technology abuse. To address these challenges, many faculty members have called for enhanced professional development training, including participation in seminars, workshops, and online courses, to better integrate AI into teaching practice. Research has shown that effective professional development can not only improve teachers' technical literacy, but also enhance their confidence in AI tools and application ability [13].

To sum up, teachers' understanding and use of AI education show diversified characteristics. While AI has shown great potential in enabling personalized learning and supporting teaching, there are still many challenges in transparency, ethical considerations, and technology integration. Therefore, future research should focus on how to improve the transparency of AI systems and provide teachers with the necessary professional development opportunities to ensure the healthy development of AI education.



3.2. Data statistics and interpretation of students' participation in AI tools

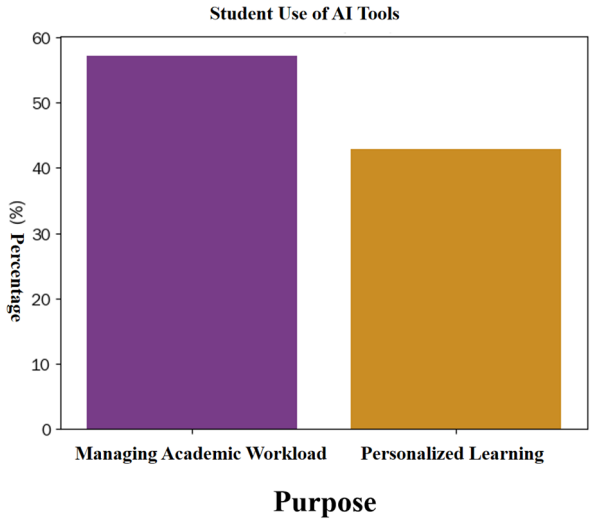
Student participation in AI tools is an important aspect when exploring the current situation of the application of AI education. By conducting surveys and data collection with students in different countries and regions, the researchers received a large amount of information on how students use AI tools. According to Fragopoulou, more than half of the 1,754 teachers in Greece, Hungary, Latvia, Ireland, and Armenia, say that students mainly use AI tools to manage academic workload, while outside schools, they are more used for recreational activities [14]. This suggests that students do begin to try using AI tools during the learning process, but their use is still limited, especially in extracurricular activities.

Further analysis revealed that students' interest in AI tools was not limited to simple task management. Angela Guercio The study found that AI tools showed significant results in improving students' learning habits, time management and feedback mechanisms. Specifically, AI tools supporting personalized learning, adaptive test adjustment, and real-time classroom analysis are widely welcomed by students. The results showed that while students reduced their study time, their grade point average (GPA) improved, showing a positive impact of AI tools on student academic performance [15]. However, at the same time, some students expressed concerns about their over-reliance on AI tools, and pointed out the importance of combining AI with traditional teaching methods.

Furthermore, the Angela He study focuses on the question of student engagement in self-directed learning. She explored the barriers students encounter in anatomy education games and their impact on learning performance through a mixed methods case study. The study found that negative game cognition, mismatched target groups, difficulty mismatch, and price factors were the main reasons hindering student participation. Nonetheless, the pathway analysis results suggest that the relationship between engagement and academic performance is not obvious, meaning that game participation may not be a key factor in improving academic performance. This reminds us that when designing and promoting AI education tools, we must fully consider the actual needs and preferences of students to ensure the effectiveness and attractiveness of the tools [16].

To provide a more comprehensive understanding of student engagement with AI tools, the Yiming Zhang study introduced eye-tracking techniques to assess the impact of personalized learning on student engagement. This study shows that in immersive and intelligent virtual classrooms, personalized learning can better understand students' attention allocation by analyzing their eye movement patterns, thus providing valuable feedback information to teachers. Research has found that personalized learning not only enhances students' sense of engagement, but also promotes their motivation and academic performance. Therefore, eye-tracking technology, as a novel evaluation method, can help to reveal the real experience and behavior patterns of students in the AI-assisted learning environment [17].

Considering the above research, we can see that although AI tools show great potential in improving students' learning efficiency and performance, they still face many challenges in practical application. For example, how to balance the relationship between the function of AI tools and traditional teaching methods, and how to solve the problems of students' negative cognition and use disorders of AI tools, all need to be further explored. Future research should continue to focus on these issues and find effective solutions to maximize the strengths of AI education.



4. The Key Problems and Challenges of AI Education

4.1. Transparency and ethical considerations

Transparency and ethical considerations are the key issues that cannot be ignored in AI education. To ensure that the application of AI systems in education is both effective and responsible, both transparency and ethical issues must be addressed. Rose Luckin In its research, it proposed a "transparency index" framework, which is designed with educators, educational technology experts and AI practitioners, to improve the transparency of AI education system [18]. Luckin The research highlights that transparency is not limited to the data collection phase, but should continue throughout the AI development process, from model training to final deployment and iterative improvement. Increased transparency helps to enhance the implementation of other ethical dimensions such as interpretability, accountability, and safety in the education field.

Aniket Deroy Exploring the importance of user-centered interpretability AI (HCXAI) in education. He noted that as AI is increasingly integrated into educational environments, it is critical to ensure that these systems are understandable and trustworthy. Deroy emphasizes that transparency and interpretability are not only about technical issues, but also about the interaction between society and technology. Therefore, HCXAI systems that can meet different user needs need to be developed to ensure that teachers and students can effectively interact with these technologies. Furthermore, he recommends that educators, developers and policy makers work together to create more effective, inclusive and ethically responsible AI solutions to support the diverse learning experience [19].

Niladri Sett The study reveals the complex operation of AI in modern education and its potential biases. His research shows that while AI can bring great potential for change in education, its complexity also makes understanding and solving problems more difficult. Especially regarding the

impact of parental income on their children's education, Sett found that biases in AI decision-making may exacerbate educational inequalities. This highlights the importance of developing AI solutions that are more reliable, accountable, and beneficial to everyone. To achieve this, the complexity of AI operations must be explored in depth and steps taken to reduce bias and ensure transparency and equal opportunity [20].

Wenbin Zhang The review further explores the importance of algorithm fairness in the application of educational AI. He noted that while AI has the great potential to provide personalized learning experiences, its inherent bias may inadvertently perpetuate discrimination against specific groups of people. Zhang detailed various forms of bias including data correlation, algorithms and user interaction, and proposed technical approaches to mitigate these biases such as diverse data collection and algorithmic equity interventions. He stressed that to ensure the fair use of AI in education, the ethical factors and the legal framework must be considered comprehensively to create a more just educational environment [21].

Finally, Gouri Ginde highlights the importance of identifying and extracting software ethical requirements by conducting a systematic literature review of user reviews. She pointed out that as machine learning and AI are widely used in decision-making, user security, privacy, and trust issues have become key considerations in software development. By analyzing user reviews, researchers can better understand user needs and develop more reliable software solutions. For the education field, this means focusing not only on the technical performance, but also on the ethical concerns of users, thus promoting the healthy development of educational technology [22].

4.2. Technology integration and teacher's professional development needs

The successful implementation of AI education depends not only on the advancement of the technology itself, but also on its effective integration in the actual teaching environment. According to Paraskevi Fragopoulou research, a survey of 1754 educators in Greece, Hungary, Latvia, Ireland and Armenia found that although most teachers have some knowledge of AI and recognize their potential value, they still face many challenges in integrating AI tools into their daily teaching [23]. Specifically, many faculty members expressed concerns about the possibility that AI may influence the development of students' critical thinking, especially when dealing with biased data. In addition, how to ensure that AI tools can truly help rather than replace teacher work is also an important issue.

To better address these challenges, teachers generally believe that more professional development opportunities are needed, including attending training seminars, workshops, and online courses. This need reflects the desire for teachers to receive more comprehensive support to enhance their ability and confidence to use AI tools. Research shows that by providing targeted professional development activities, teachers can not only enhance their technical literacy, but also promote their more effective application of AI technology [23] in the classroom. For example, in a professional development program for teachers, participants learned how to use AI tools to design personalized learning pathways, thus improving student learning outcomes.

Rose Luckin The importance of transparency for AI education is further emphasized in its research. She proposed a transparency index framework designed to ensure that AI systems are always highly transparent during their development and application in education. This framework can not only help to solve ethical and technical issues, but also provide clear operational guidelines for teachers to feel more comfortable with the AI tool [24]. The improvement of transparency can also enhance teachers' trust in the use of student data, thus promoting the smooth progress of AI education.

In addition to technology and transparency issues, teacher professional development needs to take into account differences between countries and regions. Oguzhan Atabek The study showed that 117 experts selected by the Turkish Ministry of Education identified the lack of in-service and pre-service training as one of the main barriers to technology integration. Moreover, this problem is exacerbated by inadequate content support and incentives. The study also points out that the imperfect physical and technical infrastructure is also a factor that cannot be ignored. It is worth noting that the difference between the old and the new technologies is not the main obstacle, but the more experienced in-service teachers are more likely to feel the problem caused by the lack of resources [25].

In short, in order to realize the effective integration of AI education, we must pay attention to the professional development needs of teachers. This includes not only providing the necessary technical training and support, but also ensuring the transparency and reliability of the AI system. Through multi-party cooperation and jointly formulating relevant policies and measures, teachers can create an environment conducive to the healthy development of AI education. Future research should continue to focus on how to better meet the needs of teachers, especially in terms of personalized learning and ethical considerations, to promote the wide application and development of AI education worldwide.

5. Conclusion and Future Prospects

5.1. Summary of studies and main findings

By reviewing the current situation of AI education applications and its challenges, this paper reveals key issues in current research and practice. First, the research background section clarified the importance of AI education in improving teaching efficiency, personalized learning and resource allocation. With the progress of technology, AI tools are gradually integrated into the education system, providing new means of support for teachers and students. However, this process has not been smooth sailing and involves many complex issues.

By analyzing the international application cases, this study explores the practice of AI education in different countries. A cross-country survey covered 1754 educators [26] in Greece, Hungary, Latvia, Ireland and Armenia. The results showed that most teachers had a better understanding of AI and recognized its potential risks. The AI tools were mainly used to support faculty teaching efforts and enhance student engagement, but faculty members also expressed concerns about their impact on critical thinking and exposure to biased data. In addition, students primarily use AI tools to manage their academic burden, and more than extracurricular use for recreational activities. These findings suggest that despite the significant advantages of AI in education, there are some

urgent issues to be addressed.

Another study suggests that transparency is a key factor in the development of AI education systems. Rose Luckin presents a transparency index framework highlighting the importance of transparency in ensuring the interpretation, accountability and security of AI systems [27]. Transparency not only runs throughout the AI development process, from data collection to system deployment, but also promotes the implementation of other ethical dimensions. This provides a new perspective for future research on how to build transparent AI systems in practical education scenarios to enhance user trust and reduce misunderstandings.

In addition, the development of artificial intelligence education (AIED) in Africa also provides valuable experience for the world. AfricAIED 2024 The seminar focuses on developing AI systems suitable for Africa's unique educational environment, and aims to improve science and mathematics education through activities such as online AI hackathons. The event not only demonstrated the latest technological advances, but also promotes collaboration and innovation in the African educational community, providing other regions with [28].

Aiming at the professional development needs of teachers, the study found that teachers generally believe that more training and support are needed to effectively integrate AI tools. Specifically, teachers want to receive professional guidance on AI operational skills, ethical issues, and technology applications. By attending seminars, workshops, and online courses, teachers can better adapt to the changes brought about by new technologies, thus driving the development of AI education [26].

Finally, this paper summarizes the main findings and provides future research directions and policy recommendations. While AI education has shown great potential in personalized learning and teaching support, it still faces many challenges in transparency, ethical considerations, and technology integration. To address these challenges, teacher training, transparency, and policies to standardize the application and development of AI education. Through these measures, we can better promote the healthy development of AI education, and finally realize the overall improvement of education quality.

5.2. Future research directions and policy suggestions

Future research directions and policy recommendations aim to provide guidance and support for the healthy development of AI education and ensure that technology can better serve educational needs. First, in terms of research, further exploration on how to improve the transparency and interpretability of AI systems is needed in the future. Transparent AI systems not only help teachers and students understand how they work, but also enhance trust in AI tools. For example, when exploring Human-Centric eXplainable AI (HCXAI), Aniket Deroy noted that by introducing large language models (LLMs), more transparent and understandable AI systems can be built, thus promoting trust and interactive [29] in the educational environment.

Second, research should focus on how to reduce bias in AI systems to ensure fairness and inclusion. Niladri Sett The study shows that the application of AI in education may be affected by data bias, leading to unfair results. This not only affects the quality of the learning experience, but may also exacerbate social inequality. Therefore, the future AI system design must consider the diversity and fairness, and avoid the bias of [30] arising from the data source or the algorithm design.

In addition, with the development of AI technology, the professional development of teachers is particularly important. Daniel Leiker In his white paper on Generative Education (GenEd) Framework, teachers need new skills and knowledge in the era of AI to better use these technologies to improve teaching results. Specifically, teachers need to be trained in AI operations, data analysis, and ethical considerations. At the same time, policy makers should actively promote the implementation of relevant training programs to ensure that teachers can remain competitive in the changing technology environment [31].

In response to the policy recommendations, educational institutions should issue guidelines for the use of AI applicable to their own schools as soon as possible to clarify the application scope of AI tools and the potential risks they bring. Anca Marginean It pointed out that each university should formulate specific AI policies, on the one hand to improve teachers and students' awareness of AI tools, on the other hand to reduce the risk of AI in education. For example, regular training activities and publicity campaigns can be conducted to help teachers and students understand the advantages and limitations of AI and learn to use these tools correctly [32].

Finally, in order to promote the healthy development of AI education, cross-sectoral cooperation is indispensable. Ian Goodfellow When discussing the safety of antagonistic samples, I mentioned that AI security is not only a technical issue, but also involves laws, regulations and social ethics. Therefore, the government, scientific research institutions, enterprises and all sectors of society need to work together to form a synergy to jointly meet the various challenges encountered in the development of AI education. Through the establishment of multi-department collaboration mechanism, technological innovation can ensure that it is in the interests of the society, and promote AI education to develop in a more positive direction [33].

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