

Innovations in AI Education for Adolescents: Perspectives and Strategies from Global Experts

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Abstract. The pervasive influence of artificial intelligence (AI) on global society is prompting significant advancements and transformations in education. Amidst both opportunities and challenges, the application of AI in education has garnered considerable attention from the international community. Experts from both domestic and international backgrounds engaged in comprehensive discussions regarding the use and challenges of AI-generated content (AIGC), the international comparative research on information technology education, innovations in AI education within basic education, existing challenges, and the assessment of large models for human-machine collaborative teaching. They presented strategies to address the current challenges of effectively utilizing AI while fostering critical thinking, rather than succumbing to uncritical acceptance.

Keywords: artificial intelligence, teacher and student literacy enhancement, educational practices, ethical considerations, promoting fairness

1 Introduction

Artificial intelligence (AI), a key catalyst of the Fourth Industrial Revolution, is significantly transforming a variety of industries, driving social progress, and creating a profound social impact. The field of AI in education is concerned with development of Artificial Intelligence techniques for the study of human teaching and for the engineering of systems that facilitate human learning. (Lesgold, 1988^[1]) As a rapidly evolving disruptive technology, AI not only represents scientific progress but also fosters innovation across sectors, including education. There are clear indicators that the integration of "AI+education" will become the norm, inevitably reshaping the educational landscape through artificial intelligence. The "Beijing Consensus" and the "Guidance for Generative AI in Education and Research," published by UNESCO in 2019 and 2023 respectively, underscore the importance and benefits of applying AI within the educational system. These documents also highlight pressing global social issues that demand attention and urge nations to take appropriate action (Zhang Hui et al., 2019^[2]; Wang Wei et al., 2024^[3]). In this context, promoting AI literacy among youth is of utmost importance. However, there is ongoing debate about how to effectively understand and recognize artificial intelligence, including the specific aspects and strategies necessary to enhance young people's AI literacy.

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Education experts, administrators, and practitioners hold diverse views on the fundamental elements of cultivating AI literacy among youth. Some argue that the focus should be on equipping young individuals with a grasp of AI's core principles and technologies, such as algorithms and data structures. Others emphasize developing their capacity to utilize AI for practical problem-solving. There is a wide range of opinions regarding the methods of training and implementation pathways, with some advocating for improving teachers' AI literacy first to better guide students.

On July 29-30, 2024, the Forum on Enhancing Artificial Intelligence Literacy for Youth was held at Beijing Normal University. The conference convened experts, scholars, educators, administrators, and stakeholders from various fields, both domestically and internationally, who are invested in the development of AI in education. The discussions centered on responding to contemporary challenges, fostering educational reform and innovation, and cultivating the talent essential for today's world where AI is advancing rapidly. Attendees considered the roles and responsibilities of schools, families, and society in enhancing youth's AI literacy. Primary and secondary schools serve as the main educational implementers, while universities contribute through theoretical research and cutting-edge studies. Family involvement is crucial for supporting teachers' practices and personal development, alongside society's role in providing supportive policies and funding to bolster youth's AI literacy. This conference brought together experts from universities, school principals, leaders from the Education Commission and the Academy of Educational Sciences, as well as representatives from various sectors to address these differing roles and responsibilities.

2 Literature Review

China places significant emphasis on the advancement of artificial intelligence (AI), which necessitates the cultivation and supply of high-quality talent. In recent years, efforts during the basic education phase have primarily focused on the development of AI education, specifically concerning curriculum design, training objectives, faculty qualifications, and related aspects. Key documents outlining the framework for AI courses in primary and secondary schools include the "Development Standards for Ar-tificial Intelligence Courses in Primary and Secondary Schools," developed by the Information Technology Education Professional Committee of the Chinese Society of Education (2021)^[4], and the "Guidelines for Artificial Intelligence Courses in Primary and Secondary Schools," published by East China Normal University and the Shanghai AI Lab (2023)^[5].

Additionally, important documents detailing the training objectives for AI education include the "Framework for Artificial Intelligence Technology and Engineering Literacy in Primary and Secondary Schools," organized by the Central Electronic Education Museum (2021)^[6]. The curriculum standards are largely driven by the AI module integrated within the information technology courses, as reflected in the "Compulsory Education Information Technology Curriculum Standards (2022 Edition)," released by the Ministry of Education (2022)^[7]. For educators, the "Competency Standards for Artificial Intelligence Teachers in Primary and Secondary Schools (Trial)" published by the

Chinese Academy of Educational Sciences and Tencent Education (2022)^[8] provides relevant guidelines. Furthermore, the "2022 Blue Book on Artificial Intelligence Education,"^[9] released by East China Normal University and the China Academy of Education Sciences, serves as a comprehensive reference for AI education. These documents collectively furnish substantial guidance regarding curriculum, training objectives, AI modules in information technology courses, and qualifications for educators involved in AI education at the primary and secondary levels. However, a systematic policy framework for general AI education within basic education remains lacking.

A review of existing literature reveals several challenges in implementing AI education in China's primary and secondary schools. Key issues include insufficient class hours allocated for AI instruction, vague teaching objectives, the absence of supportive learning evaluations, overly complex teaching content that does not accommodate the diverse learning needs across different regions and student demographics, and a scarcity of qualified AI educators. A significant contributing factor to these challenges is the lack of structured guidance from high-level authorities. This observation underscores the importance of addressing various elements related to AI education in primary and secondary schools, including educational objectives, teaching content, evaluation methods, implementation strategies, and teacher qualifications.

Summarizing academic conferences serves essential purposes, values, and significance. The main goal is to systematically compile and integrate the most recent research findings, cutting-edge viewpoints, and innovative ideas shared at the conferences, thereby providing a valuable reference for researchers and practitioners. The value of such summaries lies in their ability to foster deeper academic exchanges, enabling readers to swiftly grasp trends and directions in the field while directing future research initiatives. Typically, the review process begins with the comprehensive collection of conference-related materials, such as agendas, speech transcripts, and discussion records. This data is then systematically categorized, key information is extracted, and core viewpoints are identified. The relationships and distinctions among various opinions, along with their significance in the context of academic progress, are subsequently analyzed.

In recent years, high-quality conference papers focusing on artificial intelligence education have been presented at international conferences, aiding the dissemination of new knowledge and developments. For instance, Lu Yu et al. (2024)^[10] offered a review of the 27th Global Chinese Conference on Computers in Education (GCCCE), where the authors analyzed prominent research directions and categorized them according to their sub-dimensions. They introduced and examined the main speeches and conference papers related to "artificial intelligence" across three dimensions: "educational applications and interaction mechanisms," "algorithm innovation and platform development," and "talent cultivation systems and curriculum resources," while elucidating the interconnections and underlying logic among these areas. Moreover, after reassessing the current research landscape and opportunities in this domain, the authors advocated for the promotion of a more profound integration and collaborative evolution of technology and education through interdisciplinary, front-line, and multi-party collaborations. The parallel conference on artificial intelligence and digital ethics at the 2024 World Digital Education Conference exemplifies this trend. The editorial team of "China Education Informatization" (2024)^[11] highlighted key areas discussed at the conference, summarizing them into five fundamental themes: upholding the principle of "digital goodness," fostering the mutual growth of intelligent technology and talent development, leveraging AI to enhance educational processes, addressing ethical risks associated with AI in education, and maintaining a people-centered governance approach in managing these risks. Beyond summarizing the application of AI in education, the authors emphasized the need for societal sectors to strengthen the implementation of existing policies, to focus on quality and equity issues in digital education, to respond to contemporary demands, to improve the literacy of both teachers and students, and to advance the evolution of knowledge production methods.

3 Research Design

3.1 Research Questions

This section addresses several specific issues:

1) Systematic Summary and Analysis: A comprehensive review of the key information, viewpoints, discussions, and outcomes from the meeting.

2) Holistic Perspective: An overarching understanding of the meeting's content, with insights into the current research landscape and developmental trends in related fields.

3.2 Data Collection

By examining relevant literature, speeches, presentation slides, and conference videos, we can achieve a thorough comprehension and analysis of the conference's theme, context, and discussion matters.

3.3 Research Methodology

We will employ a combination of systems analysis and content analysis to conduct a multidimensional, in-depth investigation of the conference:

1) Systematic Approach: Treating the conference as an integrated system, we will evaluate its goals, structural organization, functional execution, and the dynamic interactions among internal elements, ultimately establishing a comprehensive overview and logical framework for review.

2) Quantitative Content Analysis: Utilizing objective, structured, and quantitative descriptive methods to analyze the primary components of the conference communications, aiming to unveil the breadth, depth, developmental trajectories, and potential concerns within the conference themes at a social cognitive level.

3) Inductive and Deductive Reasoning: In crafting the review, we will employ induction to identify common characteristics and patterns within the conference, while using deduction to forecast future trends and suggest targeted improvement strategies, fostering a synthesis of theory and practical application.

4) Detailed Topic Analysis: Concentrating on critical issues and engaging discussions from the conference, we will explore inherent patterns and trends through both inductive and deductive reasoning, enriching the review with depth and insights.

5) Controversy Analysis: Addressing complex issues and controversial points raised during the conference, we will analyze their manifestations while tracing their origins, significance, and broader implications, offering a comprehensive and insightful analytical framework.

6) Comparative Evaluation of Perspectives: By meticulously comparing diverse viewpoints, programs, and research outcomes presented at the conference, we will assess their accuracy, objectivity, and feasibility, identifying prevailing trends, innovations, and existing disagreements, thereby establishing a multi-faceted evaluation system for the review.

3.4 Implementation Steps

1) Preparation Phase: Gather essential background information about the conference, including its theme and objectives, along with relevant literature and materials.

2) Data Organization: Systematically organize, classify, and filter the collected data to extract key insights and perspectives.

3. In-Depth Analysis: Employ the specified research methods to conduct a thorough analysis of the conference content, identifying patterns and trends in the findings.

4) Review Composition: Based on the analytical outcomes, prepare a detailed conference review that encompasses an introduction, an overview of the conference, discussion of main topics, highlights analysis, and a summary with outlook.

5) Review and Revision: Upon completion of the initial draft, undertake a meticulous review process followed by necessary revisions and enhancements.

4 Data Analysis

4.1 Perspectives and Concerns of Domestic Experts

The Use and Challenges of AIGC. Experts have provided a thorough overview of generative artificial intelligence (AIGC), detailing its principles and areas of application. The technology has shown significant promise in enhancing youth information technology education, with positive outcomes from its widespread use. However, it has been observed that some students may become overly reliant on AIGC, which can diminish their critical thinking and personal effort. A central concern raised is whether AIGC exacerbates disparities among learners. Students with stronger foundational knowledge and higher cognitive abilities tend to engage more actively with AIGC, potentially widening the gap with those who have less developed skills. While experts acknowledged the various challenges AIGC faces—including issues of data privacy, model accuracy, and reliability—they also recognized its potential positive influence

on future educational practices, advocating for an objective and optimistic approach to its integration.

International Comparative Research on Information Technology Education. Indepth analyses have been conducted by experts on the strategies, curriculum designs, teaching methodologies, and educational outcomes related to information technology education across different global contexts. The comparative research revealed that certain countries prioritize developing programming skills and innovative thinking among students from an early age, often embedding information technology education within other basic education subjects. This approach not only boosts students' information technology literacy but also enhances their ability to tackle real-world problems. These insights serve as valuable references for advancing information technology education in China, guiding improvements in curriculum design, teaching strategies, and overall educational effectiveness to meet the growing talent demands in the information age.

Innovation in Basic Education and Artificial Intelligence. Various regions in China have garnered significant and effective experience in fostering innovation in basic education and artificial intelligence (AI) education. This includes increased investment in educational resources and the provision of advanced teaching tools and software in schools. However, the issue of equity in access to these resources is a recurring concern. It is essential that the promotion of intelligent education extends beyond key schools to include routine schools, ensuring that relevant courses are available to a wider student population.

Current Challenges. 'Any sufficiently advanced technology is indistinguishable from magic,' wrote Arthur C. Clarke. And yes, magic it may seem. But it's not magic, and there has been a revolution in the way this new AI has arisen. (Jon Chun, Katherine elkins,2023^[12])

Experts domestically have identified several unresolved challenges within the artificial intelligence curriculum for primary and secondary education. First, the limited class hours hinder students from gaining a systematic and comprehensive understanding of the subject matter. Additionally, the curriculum often lacks variety, failing to provide the necessary depth and breadth, compounded by a scarcity of advanced equipment and technical support in schools. Furthermore, the impact of the curriculum is restricted, often falling short in engaging students' interests and unlocking their potential.

To address these challenges, an interdisciplinary integration model of "artificial intelligence + other subjects" is proposed as an ideal solution. AI general education courses should have a clear and defined purpose, encompassing diverse, up-to-date content that aligns with contemporary trends. Moreover, it is crucial to implement varied assessment methods that comprehensively evaluate students' learning outcomes and skill development. The forum also recommended offering comprehensive training for teachers to enhance their professional skills and teaching capabilities, developing highquality digital resources, and establishing a robust teaching platform to effectively tackle these challenges and support the holistic development of students.

Evaluation of Large Models in Human-Computer Collaborative Teaching. In the examination of large model evaluations for human-computer collaborative teaching, experts shared valuable insights drawn from their teaching experiences, focusing on optimizing instructional design and enhancing teaching efficiency. The evaluation results highlighted both the strengths and weaknesses of large models in educational settings, pointing out their remarkable effectiveness in certain specific areas as well as their limitations in more complex scenarios. To address the identified issues and gaps, we carefully explored strategies to further optimize the use of large models in collaborative teaching. Our recommendations include bolstering technology research and development, improving data management practices, and enhancing teacher training programs to support the ongoing advancement and refinement of human-computer collaborative teaching.

4.2 Perspectives and Concerns of Foreign Experts

Emphasizing Moral Development Alongside Technological Advancement. Foreign experts at the conference praised AI for its remarkable transformative potential, believing it can fundamentally alter the education system and reshape our understanding of educational goals. The integration of AI in education has dramatically changed traditional methods of knowledge delivery and acquisition. The once-clear roles within the teacher-student dynamic are increasingly blurred, shifting towards a more interactive and collaborative relationship. However, it's crucial to note that an overreliance on emerging technologies can lead to the neglect of essential values like fairness and ethics. Therefore, in advancing technological development, moral considerations must be prioritized. We should commit to humanistic approaches in educational practices, respecting fundamental human values and sustainable development objectives. Additionally, enhancing AI literacy through education and training empowers individuals to utilize AI responsibly, fostering an inclusive and high-quality learning environment that benefits all, while promoting educational equity and sustainable progress.

Using AI Responsibly: Encouraging Thoughtful Engagement Rather than Blind Compliance. According to experts, AI is an inherently complex subject that encompasses a broad spectrum of knowledge and technology across multiple disciplines. Consequently, conducting thorough and comprehensive research often proves challenging for individuals or small teams. Within education, AI serves a dual purpose: it advances educational innovation by providing new teaching methods and tools and enhances efficiency and quality in the learning process. Yet, as AI technology becomes more prevalent in education, it is vital that users do not settle for a superficial understanding of its functions but instead maintain critical thinking. This involves rigorously evaluating whether the questions posed are relevant and whether the answers obtained are reliable

and precise. By doing so, we can avoid mindlessly following technological trends, ensuring that AI contributes positively to education and fosters meaningful progress.

Establishing Robust Laws, Regulations, and Ethical Guidelines. Experts elaborated on the newly launched International Olympic Artificial Intelligence Competition. This platform encourages young innovators to delve into cutting-edge technologies and AI applications, stimulating their creative thinking and practical skills. However, they also cautioned that AI functions as a double-edged sword. While it offers unprecedented opportunities and conveniences that drive social development, a lack of reasonable regulation can result in issues such as data breaches and algorithmic bias. The impact of AI development is significantly shaped by the attitudes and actions of both developers and users. To ensure that AI technology yields a positive influence globally, it is essential to establish comprehensive laws, regulations, and ethical standards that govern its development, distribution, and application, thereby preventing misuse and safeguarding against potential harm.

4.3 Roundtable Discussion

Cultivating Artificial Intelligence Literacy in Basic Education Students. The first roundtable discussion at the forum focused on fostering artificial intelligence literacy among basic education students. Six participants examined the theme from various angles:

1) Course Structure: Participants suggested that a general artificial intelligence course should not replace core information technology classes as an independent discipline. Instead, they proposed an interdisciplinary thematic lesson model consisting of basic modules, empowerment modules, and modules that instill a sense of responsibility. It was recommended that the basic and responsibility modules share a unified outline tailored to their specific characteristics to ensure effective teaching.

2) Regional Practices: Examples from schools in Fengtai District were highlighted to showcase their initiatives in promoting balanced artificial intelligence education and enhancing educational quality. The discussion detailed their curriculum structure and teaching methodologies. Fengtai is actively improving teacher quality, increasing teaching effectiveness, and boosting student engagement while conducting theoretical research on AI education. They contribute to the "Guidelines for Artificial Intelligence General Education." In Shanghai's Baoshan District, new standards for youth core literacy relevant to the age of intelligence were introduced, alongside phased implementation suggestions for interdisciplinary AI literacy training. Chongqing reported substantial progress through a synergistic approach involving national guidance, local responsiveness, and practical implementation.

3) Technical Support: Some participants noted the role of educational robotics companies in fostering AI literacy among the next generation by developing effective teaching platforms and promoting AI education. Initiatives discussed included building online learning platforms leveraging technology, offering free AI knowledge sharing, partnering with schools and research institutions for competitions, workshops, and camps, and providing technical resources to nurture young talents. They also emphasized creating immersive learning environments using AI tools to engage students emotionally, stimulating their innovative thinking and leadership skills—often requiring robust technical support.

Developing an Artificial Intelligence Curriculum System for Basic Education. During the second roundtable, six participants representing educational institutions and enterprises discussed several key points regarding the establishment of an AI curriculum system:

1) Challenges and Course Design Concepts: Experts highlighted issues in the current AI course designs, including the propensity for direct copying and inappropriate difficulty levels. They stressed that the goal of AI education is to cultivate a proper understanding and concepts, rather than to train children to become programming experts or practitioners.

2) Regional Development and Curriculum Design: The forum shared experiences from Shenzhen in advancing AI education, emphasizing that curriculum design should reflect students' cognitive levels and be aligned with educational objectives, promoting diversity to offer practical teaching suggestions applicable in other regions.

3) Integration of Science and Technology Innovation with Curriculum: Some participants stressed the importance of aligning science and technology innovation with educational practices. They advocated for promoting AI education through hands-on activities, developing innovative technology teachers, establishing demonstration labs, and introducing professional platforms to aid in curriculum construction.

Innovations in Basic Education, Artificial Intelligence Education, and Teaching. In the third roundtable discussion, six attendees engaged in diverse dialogues on various aspects:

1) School Practices and Innovations: Educators shared current practices and advancements in applying artificial intelligence in their schools, aligning with the broader trends of "artificial intelligence" integration into education. Schools are adopting technologies across various subjects to enable personalized and precise teaching. Efforts have been made to enhance teacher proficiency in integrating AI into their curricula at all educational levels, supported by national initiatives.

2) Local Education Development: The success of Hailin City, Heilongjiang Province, was cited as a valuable case for integrating artificial intelligence into education through innovative curriculum designs rooted in local resources. This initiative has sparked student interest in AI, significantly boosting their learning efficiency and enthusiasm.

3) City-Wide Promotion and Innovation: Qingdao's innovative model for promoting artificial intelligence focuses on building a comprehensive curriculum framework, upgrading basic software and hardware facilities, and developing evaluation metrics. The experiences shared received high marks in AI educational innovation in basic education. 4) Product Functionality and Applicability: Participants from the enterprise sector highlighted the extensive capabilities of AI-enhanced educational tools, including lesson planning, lecture notes, PPT generation, homework assessments, and knowledge Q&A. Technologies that integrate AI with education, administration, and evaluation have matured, offering broad applicability in education and continuously driving educational innovation.

5 Conclusion

This conference served as a practical forum aimed at examining the role of artificial intelligence in education, considering various documents and policies, including the Beijing Consensus from UNESCO and the Chinese government. It not only reviewed past experiences and identified current challenges but also fostered communication and collaboration among stakeholders, thereby accelerating the effective integration of artificial intelligence in educational settings.

Educational institutions must evolve with the times, actively engaging with policy initiatives and implementing artificial intelligence in a thoughtful and effective manner. This will provide students with more accessible, intelligent, and efficient learning environments. Additionally, individuals should take full advantage of the learning opportunities offered by artificial intelligence to enhance their AI literacy and develop their overall skills and professional capabilities.

During the conference, experts and scholars reiterated the importance of leveraging artificial intelligence in education, echoing sentiments from previous meetings. The rapid advancement of technology and breakthroughs in AI present both challenges and opportunities for the education sector, urging all stakeholders—including educators and policymakers—to adapt and innovate. Insights from teachers and principals who are pioneering the integration of AI into their classrooms reveal that significant progress has been made in this area. Innovative approaches such as the "AI + local characteristics" teaching model and the "teacher-machine-student" collaborative teaching tasks represent not only valuable educational practices but also the latest advancements in AI technology within the education sector.

This meeting built upon the analysis of existing issues from earlier forums, facilitating deeper discussions on these topics. In addition to enhancing AI literacy among educators and students and refining educational and assessment systems, the forum highlighted the importance of advancing AI initiatives in Africa and other regions. It underscored that issues of equity must remain a priority, ensuring that the benefits of digitalization are accessible to all.

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