Research on the Impact and Countermeasures of Artificial Intelligence Empowering Smart Classroom

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Abstract: Smart classroom is a new application of artificial intelligence in the field of education, and the rise and development of artificial intelligence technology has turned large-scale personalized education from an ideal to a reality. In order to promote the balance between artificial intelligence and humanistic care, and unleashing the irreplaceable nature of intelligent education, we use literature research method, based on inductive analysis of theoretical studies and technical practices of smart classroom, combined with the application of artificial intelligence in smart classroom, we propose the influence process of "artificial intelligence system - student learning process, teacher teaching process, and resource presentation process" directly or indirectly combined with each other. Then we analyze three major problems of the current smart classroom application: distorted classroom performance and abnormal teaching feedback; limited thinking ability and worrisome learning quality; data leakage and privacy protection concerns. Finally, we propose countermeasures for the application of AI-empowered smart classroom construction in three aspects: regulating the scope of application and adjusting the time of use; carrying out excellent case studies to ensure the quality of learning; relying on privacy protection technology and establishing relevant mechanisms.

Keywords: Smart Classroom, Artificial Intelligence, Intelligent Education, Humanistic Care, Application Countermeasures

1. Introduction

The Ten-Year Development Plan for Education Informatization (2011-2020) mentions that promoting the deep integration of information technology and education is a necessary way to achieve the modernization of education[1]. After "actively promoting the construction of education informatization" in 2021, the Ministry of Education proposed "implementing the strategic action of education digitization" in 2022, continuing to make education informatization a priority. In recent years, artificial intelligence, as the main driving force of the global fourth industrial revolution, has undergone profound changes in the development environment. Information technology represented by artificial intelligence has gradually entered the field of education and continues to be innovated, promoted and applied in education, promoting the personalization and contextualization of the teaching and learning environment. As a result, the modern classroom development model has been transformed and upgraded, and one of the new teaching environments combined with information technology - the smart classroom has emerged.

With the integrated development of Internet and artificial intelligence technologies and increased investment in education, research based on smart classrooms has become more and more active. How to achieve intelligent education in smart classroom is a new research topic, and scholars have conducted some studies in recent years, mainly focusing on several issues: One is to analyze the functions of smart classroom from the perspective of smart learning environment and system construction, such as RongHuai Huang[2] proposed the "SMART" conceptual model, which suggests that a smart classroom should have five characteristics: content presentation, environment management, resource access, timely interaction, and emotional perception. Then Fenghua Nie[3] proposed the "iSMART" model, which considers the smart classroom as a collection of classroom spaces, hardware and software facilities that provide intelligent services for teaching and learning. Secondly, the design and practice of smart classrooms are studied from various aspects such as technology application and system architecture. For example, Chunlin Xu[4] proposed the design of smart classrooms with the combined use of lecture

resources as the design orientation, and Huomu Xie[5] took classroom transformation as the guide to realize the core functions of smart classrooms in eight dimensions. Thirdly, they analyzed the application and practical exploration of smart classrooms in specific universities, such as Lunsheng Lv[6] took China University of Mining and Technology as an example to illustrate the design of the smart classroom and its impact on traditional teaching methods, and Zhiyong Jin[7] took Huazhong Normal University as an example to analyze the "three-in-one" model of the smart classroom. However, as the research on smart classrooms has just started, the existing domestic studies mainly stay on the conceptual definition, functional design and interaction studies of smart classroom [8], mostly focusing on the advanced and functional diversity of information technology equipment in smart classrooms, and there are at least the following deficiencies: first, they focus too much on the application of various new technologies in the construction of physical space, and the use and teaching effects after the construction are still in the exploratory stage; second, there is less research on aspects such as the teaching model of smart classroom, ignoring the connection between technology applications and students' portrait rights, privacy and willingness to use in the smart classroom environment, and less exploration of the application experience from multiple perspectives.

The status and importance of smart classrooms in colleges and universities is becoming more and more prominent, and many colleges and universities in China are striving to build interactive, intelligent, open and diversified teaching environment to achieve two-way promotion of teaching space and teaching management. As the actual application of smart classrooms in colleges and universities increases year by year, the development of intelligent education in China is gradually changing to the design and practice of intelligent education platforms, resources and teaching modes[9]. However, it is still necessary for universities to explore how to reasonably use the new classrooms for future education in the context of the era of intelligent education. To this end, this paper proposes the influence process of AI-empowered smart classroom in which "artificial intelligence system - student learning process, teacher teaching process, and resource presentation process" are directly or indirectly combined with each other, analyzes the existing problems of smart classroom applications and proposes the application countermeasures for AI-empowered smart classroom privacy protection. By exploring these issues, on the one hand, we can comprehensively understand the performance and degree of interaction between human and technology in smart classroom and promote the deep integration of information technology and teaching, on the other hand, we can promote the balance between artificial intelligence and humanistic care, which is conducive to the development of intelligent education with "temperature" and promote the comprehensive, free and personalized development of students.

2. The Application of Artificial Intelligence in Smart Classrooms

At present, the application of artificial intelligence in the smart classroom contains three major systems: an intelligent monitoring system to achieve online monitoring and comprehensive management, an intelligent recording system to support teachers' teaching and students' learning, and an IT-based classroom teaching assessment system[10].

In terms of the core functions of the system, different systems have different positioning. In the intelligent monitoring system, after collecting video signals from the student area, the classroom monitoring cameras display descriptions of the actual number of students, classroom capture and head-up rate for each lesson based on face recognition and other technologies, then send the information to the system backend for quantitative analysis of the classroom teaching process; in the intelligent recording system, the camera is used to capture the blackboard and people by automatically switching between different speakers. When the classroom lecture is over, all videos will be automatically edited and a complete classroom video will be generated for teachers and students to play back; in the classroom teaching evaluation system, on the one hand, the system provides comprehensive and intelligent data support to evaluate students' learning characteristics and behavioral performance, and gives immediate feedback to teachers to form a more complete evaluation system; on the other hand, the effectiveness of teaching activities is evaluated based on the analysis reports of classroom teacher-student interaction and other learning conditions, which can be used as an assessment index to evaluate teachers' teaching quality.

3. The Impact of Artificial Intelligence Empowers Smart Classrooms

Human-centered thinking is the theoretical foundation of AI-empowered smart classroom. In this regard, we propose a multi-level influence process as shown in Figure 1 to form a connected network of smart learning through the connection of AI system, teachers, resources and students with each other, so

as to achieve the goal of collaborative education of industry-education integration and science-education integration.

3.1 Empowering the Process of Students' Learning and Optimizing Their Own Learning Strategies

For the student learning process, the AI system focuses on learning analytics and diverse classroom interactions to maximize students' intrinsic motivation to participate, giving them more freedom to learn and thus optimize their own learning strategies.
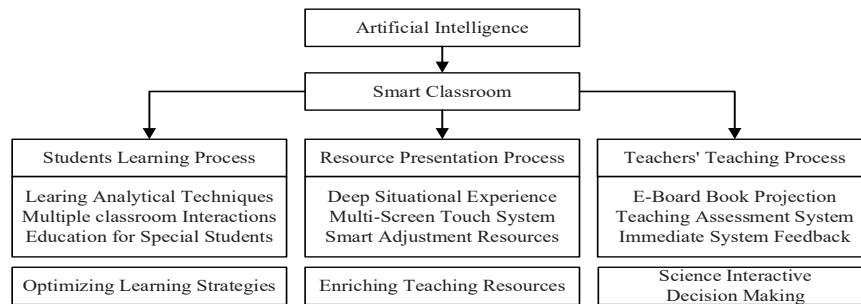

Figure 1: The impact process of AI-empowered smart classrooms.

Learning analytics is the technique of measuring, collecting, analyzing, and reporting data about students' learning behaviors and the learning environment to understand and optimize learning and the environment in which it occurs[11]. On the one hand, by mining classroom behavior data, the system is able to depict students' characteristics and learning process in detail, dynamically recommend and adjust the functional layout of the system interface, and recommend multiple hierarchical and differentiated learning paths and personalized learning resources for students' reference. On the other hand, the application of various new technologies makes student data collection more intelligent and comprehensive, such as the comprehensive recording of students' classroom learning behavior and process through the recording system, which provides students with dynamic analysis and visual feedback on their learning behavior performance, thus enabling them to accurately grasp their own learning progress and optimize their learning strategies.

Classroom teaching assessment system and intelligent interactive platform make classroom interaction more diversified. For example, the teaching software installed in the smart classroom and students' cell phones can be used together to carry out diversified classroom interactions such as random questions, quick quizzes and accompanying tests, which can comprehensively analyze students' classroom participation and instantly and accurately present feedback results in the system, prompting classroom interaction to change to personalized intelligent feedback, and this inquiry-based learning mode is conducive to mobilizing students' learning enthusiasm and cultivating their innovative spirit and thinking ability.

In addition, in the education of special students, the AI system follows the principles of intuition, convenience, flexibility and comfort, and provides intelligent interaction tools based on somatosensory, gesture and voice technologies through the cross-modal perception technology of AI to fully and timely understand the situation of students in the smart classroom, observe their emotional changes, educational needs and willingness to communicate, and recommend more effective learning content or better learning modes to them, thus contributing to helping students compensate for deficiencies and develop their potential.

3.2 Empowering the Process of Resource Presentation and Enriching Classroom Teaching Resources

The smart classroom environment provides a very convenient support for the development of college courses. The creation and development of artificial intelligence technologies such as augmented reality, virtual reality, and holograms as resource carriers have given the smart classroom environment a "static to dynamic" contextual experience, creating an immersive and interactive experience for students, thus fully engaging their senses and participating in the process of presenting classroom resources. For example, with the help of holographic projection technology and other information presentation technologies, the knowledge and information in geography learning do not just lie quietly on the books, but can be integrated into a realistic holographic map through artificial intelligence system to present a more imaginative and vivid presentation in the classroom, bringing students a more vivid and realistic

audiovisual experience. This can not only deepen students' understanding and absorption of knowledge, but also promote the balanced development of educational resources[12].

In addition, the multi-screen touch display system in the classroom can make presentation-based teaching more intuitive and rich, by allowing multiple screens to synchronize the same content or display different content, the way to present resources from "single resource sequential presentation" to "multiple resources associated presentation" transformation. At the same time, the touch screen replaces the traditional blackboard and provides teachers with a convenient interactive whiteboard to realize operations such as writing on the board, marking important and difficult points, reasoning and deduction. It also supports a variety of geometric shapes and functions such as zooming in and out of the page to achieve the effect and state of "writing anywhere, writing anytime" [13], which enables students to This enables students to understand and construct the knowledge system faster by comparing and connecting many resources [14].

Finally, based on an intelligent assessment of the student's status, the AI system can intelligently adjust the way resources are combined, presented and pushed to suit the dynamic needs of the student.

3.3 Empowering the Process of Teachers' Teaching and Implementing Scientific Interactive Decision Making

Artificial intelligence systems need to be used by teachers, which in turn empowers their teaching process, a process that should be based on scientific interactive decision-making. Interactive decision-making is a teaching behavior that determines the quality of classroom interaction; it is the process by which a teacher, guided by educational theory and with the help of artificial intelligence, selects the more satisfactory solution from multiple interaction options and puts it into practice to achieve the teaching goal[15]. According to Shavelson, teachers make interactive decisions every 2-6 minutes in the classroom [16].

First, certain traditional teaching methods have unique advantages in specific teaching processes. For example, when teaching a course involving equation derivation, the traditional board derivation process is superior to the direct presentation of electronic courseware. Therefore, the integration of the board derivation process into intelligent teaching equipment can provide hardware and software support for teachers to carry out rich and flexible teaching activities.

Second, the classroom teaching assessment system can assess students' learning characteristics and behavioral performance in a more comprehensive way. In the smart classroom environment, the interactive behaviors of teachers and students can be recorded and quantitatively analyzed by the AI system, enabling teachers to make more scientific and instructive decisions by considering multiple teaching factors, while the system provides optimized recommended strategies to assist in improving and adjusting teachers' teaching plans through comprehensive evaluation of their teaching process, ultimately realizing a two-way connection between teaching and learning.

Finally, with the use of learning analytics in the smart classroom, artificial intelligence systems can alert students to weaknesses, learning status tips and risk identification of abnormal behavior based on the analysis results, so that teachers can make the right interventions and provide accurate feedback to the right people. For example, in the classroom teaching process, by statistically analyzing students' test scores of different question types and students' interaction data, teachers can roughly understand students' understanding and mastery of knowledge and make targeted feedback to each student so that they can plan to adjust teaching contents[17]. In addition, teachers can also supervise and manage students' learning status and interpret their learning performance based on the immediate feedback from the system, and when it is found through the analysis that there are students with withdrawn personalities and abnormal behaviors, teachers can provide timely scientific interventions to help students adjust their learning status so as to avoid the emergence of malignant and specific depressive behaviors.

4. Problems of Smart Classroom Applications

The application of the smart classroom can be very effective at the compulsory education level, and some of the disadvantages can be diluted and controlled through proper guidance. However, at the higher education level, as smart classrooms are gradually promoted and used on a large scale, teachers and students tend to have some concerns and worries due to the excessive attention of wisdom.

4.1 Distorted Classroom Performance and Abnormal Teaching Feedback

Although smart classrooms can bring certain benefits to teaching and learning, teachers and students interacting with AI systems under the monitoring of smart classrooms for a long time will inevitably develop a sense of discomfort of being spied on and monitored, which may lead to the opposite direction from good intentions.

For students, the student portraits provided by AI may overly magnify their own individual learning experiences, distorting their classroom performance and even creating a "performing personality" that is far from their real selves; teachers need to have a strong propensity and ability to reform their teaching in order to achieve classroom transformation in the use of smart classrooms. However, teaching under monitoring makes it difficult for teachers to fully let go of their autonomy, and they cannot get real feedback on teaching, which in the long run will reduce the teaching effect and deviate from the original purpose of education.

4.2 Limited Thinking Ability and Worrisome Learning Quality

In the smart classroom, artificial intelligence empowers a certain interesting process of learning, which seems to improve the fun of learning and reduce the learning burden of students. However, due to the huge amount of information in multimedia teaching in the smart classroom environment, the faster the information changes, the more likely students are overwhelmed and overly jumpy, which may affect their cognition and digestion of the learning content[18]. Faced with complex puzzles, students' higher-order thinking skills are often bred in the process of thinking, and to learn effectively they have to assume a certain load, and the more complex the knowledge is the higher the intrinsic load and the higher the concentration required. Therefore, excessive fun and multimedia may also reduce the actual quality of students' learning in certain subjects.

4.3 Data Leakage and Privacy Protection Concerns

The core of artificial intelligence-enabled smart classrooms includes data and algorithms, which means that the higher the level of artificial intelligence, the more data input and constant practice of algorithms are needed. Although smart classrooms have achieved "scientific", "digital" and "accurate" teaching management methods, they contain a large amount of personal and private data, and in the smart classroom monitoring system. While the smart classroom monitoring system collects and analyzes student behavior data and brings significant teaching benefits, improper regulation can easily break the balance between technical practicality and data privacy, while data leakage can cause incalculable consequences.

According to the relevant laws in China, schools can access various applications through students' use of local area networks, make a record of browsing URLs, and generate corresponding monitoring reports based on specific input conditions[19]. However, it is clear from the current situation of AI landing in China that the development of smart classrooms is still in its infancy, and there are still certain privacy leakage hazards behind it, such as the risk of misuse, theft, and abuse of students' personal confidential information, and the professional knowledge and skills to deal with cyberattacks within schools still need to be improved. Therefore, the data security of smart classrooms must be given high priority by the state and schools.

5. Countermeasures for Smart Classroom Applications

According to Murphy's Law, if some aspect of an intelligent classroom has the potential to be problematic, it will happen no matter how unlikely it is. The existence of individual problems is also the space and hope for progress. What we need to do is not to abandon this emerging educational technology, but to precisely balance the practicality of the technology and the learning experience and quality, privacy and the specific conditions of use to solve the problems that exist in it.

5.1 Regulating the Scope of Application and Adjusting the Time of Use

In order to ensure the quality of students' learning in different learning subjects, the use of smart classrooms also needs to be combined with specific subjects and appropriate teaching models for innovative talent training should be selected according to the characteristics, nature and direction of the subjects. In addition, in order to improve the efficiency of the use of smart classrooms and get real teaching feedback, the scope of application and time of use of smart classrooms should be standardized,

and the use of smart classrooms should be carried out by subjects and stages. For example, they can be used to maintain order and monitor examinations during examinations, or they can be used in flipped classrooms, seminar-style interactive teaching, and other teaching mode exploration courses based on teaching needs[20], or they can be used to share a lesson live after obtaining the consent of teachers and students to meet the purpose of sharing resources among schools, so as to closely focus on the "human-centered" approach to human resource development has been adopted to promote the development of smart classrooms.

5.2 Carrying Out Excellent Case Studies to Ensure the Quality of Learning

For university teachers and students, smart classroom is a new thing, and its application varies in different subjects. As teachers, they should try to use smart teaching methods to help students improve the learning quality, in addition to establishing moral education. Therefore, colleges and universities should pay more attention to the learning mode of smart classroom, actively organize excellent case study activities, guide teachers to conduct practical reflections and improve curriculum design through demonstrations, observations and seminars of excellent cases, and actively accept cutting-edge teaching concepts instead of simply introducing technology. At the same time, teachers can teach according to their abilities, select suitable teaching cases in their own classrooms through extensive study of excellent teaching cases, and adopt rich and diverse teaching modes and independent, cooperative and exploratory teaching methods to address the differences in the functions and approaches of different subjects in applying smart classrooms, so as to bring into play the advantages of smart education and ensure the quality of students' learning.

5.3 Relying on Privacy Protection Technology and Establishing Relevant Mechanisms

Data security needs to be protected by artificial intelligence technology; therefore, schools can give appropriate financial support to equip corresponding hardware facilities and intelligent teaching devices that meet the requirements of different courses, and apply new information technologies to smart classrooms as a way to ensure data security, promote data circulation, and provide a better data environment for innovative applications such as artificial intelligence[21].

In addition, to ensure the compliant use of personal information by the smart classroom system, it is important to increase the manual review mechanism and conduct independent tests on it, strictly protect biometric information, and disclose the collection, storage, and use of data information to students based on the principle of openness and transparency; actively organize relevant training, including the functions and limitations of the smart classroom system, to ensure the compliant use of the system, and to provide relevant school operation personnel to convey the concept of humanistic care and raise the importance of student privacy protection among instructional leaders, the teaching staff, and related personnel.

Finally, accountability reports should be prepared and monitored by legislative bodies to prevent the collected data from being used for illegal purposes by staff with authority within the school, resulting in sensitive information leakage and serious infringement incidents[22].

6. Conclusions

In this paper, through the application of artificial intelligence in the smart classroom, the influence process of "artificial intelligence system - student learning process, teacher teaching process, resource presentation process" directly or indirectly combined with each other is constructed, and three major problems of the current smart classroom application are proposed: distorted classroom performance and abnormal teaching feedback; limited thinking ability and worrisome learning quality; data leakage and privacy protection concerns. Finally, we propose countermeasures for the application of AI-empowered smart classroom construction in three aspects: regulating the scope of application and adjusting the time of use; carrying out excellent case studies to ensure the quality of learning; relying on privacy protection technology and establishing relevant mechanisms. In turn, the balance between artificial intelligence and humanistic care is promoted, and the irreplaceable nature of intelligent education is brought into play.

The essence of education, in the final analysis, is to help students grow up healthily; education cannot deviate from the right track, and the so-called educational innovation must also be based on respecting students' personality. In the case of ensuring that education does not deteriorate, uphold the idea of establishing a heart for education, seek a balance between personal privacy and the boundaries of the portrait, respect the privacy of students and avoid portrait stereotypes, in order to make the smart classroom on the right track of education further and further. If the artificial intelligence technology in the smart classroom is used in an uncontrolled and rigid manner, education will become soulless and emotionless.

Currently, smart classrooms are the product of innovation and reform in education, and are significant in improving teaching quality, enriching teaching formats and regulating student behavior. However, there is still considerable room for the development of smart classrooms, which will develop richer, deeper and more humane application function modules in the future and move forward with craftsmanship. In addition, the integration of offline and online data to carry out a comprehensive portrait of students and focus on the relationship between smart classrooms and privacy are also the direction of smart classroom construction efforts.

References

[1] Xuejiao Li, Key Shen, Binfeng Zhu. Exploring the application of learning analytics in smart classrooms [J]. Teaching Research,2021,44(04):24-31.

[2] Ronghuai Huang, Yongbin Hu, Junfeng Yang, Guangde Xiao. The concept and characteristics of smart classroom [J]. Open Education Research,2012,18(02):22-27.

[3] Fenghua Nie, Xiaoliu Zhong, Shuqiang Song. Smart classroom: conceptual features, system model and construction cases [J]. Modern Educational Technology,2013,(7):5-8.

[4] Chunlin Xu. A kind of intelligent classroom design for colleges and universities based on "Internet+"[J]. Journal of Huaihai University of Technology (Natural Science Edition), 2016, 25(04):21-24.

[5] Huomu Xie, Chuanyao Liu, Lichun Liu. Construction of intelligent classrooms in colleges and universities oriented to classroom teaching transformation[J]. Modern Educational Technology, 2018, 28(10): 76-80.

[6] Lensheng Lv, Zaiming Yang, Kai Zhang. Smart classroom design and its impact on traditional teaching methods--a case study of China University of Mining and Technology[J]. Modern Educational Technology, 2019, 29(09):86-92.

[7] Zhiyong Jin, Lilong Zhang. The construction and practical exploration of the "trinity" model of smart classroom: the case of Huazhong Normal University[J]. Modern Educational Technology, 2019, 29(04): 75-81.

[8] Yazhen Zhang, Baohui Zhang, Yunxia Han. Review and prospect of domestic and international smart classroom research [J]. Open Education Research, 2014, 20(01):81-91. DOI: 10. 13966/ j. cnki. kfjyyj. 2014. 01.005.

[9] Mixue Wang, Liguo Zhang. Analysis of research hotspots and development trend in the field of intelligent education in China--based on word frequency analysis method, co-word clustering method and multi-dimensional scale analysis method [J]. Modern Educational Technology, 2017,(3):41-48.

[10] Xiaohai Deng. Research on the application of smart classroom and classroom intelligent teaching assessment [D]. Hangzhou University of Electronic Science and Technology, 2020.

[11] Xiaoqing Gu, Jinliang Zhang, Huiying Cai. Learning analytics: data technology in the making [J]. Journal of Distance Education, 2012, 30(1):18-25.

[12] Ke Zhu, Ying Zhang, Ruili Li. Holographic classroom: a new exploration of visualized three-dimensional learning space based on digital twin [J]. Journal of Distance Education, 2020, 38(04):38-47.DOI:10.15881/j.cnki.cn33-1304/g4.2020.04.004.

[13] Kai Zhang, Zaiming Yang, Lensheng Lv, Shi Qiuyi. Exploring the construction and practice of dual-screen smart classroom [J]. China Education Informatization, 2021(05):91-96.

[14] Zhaoli Zhang, Yang Li, Hai Liu. Teaching innovation and change under the support of multi-screen multi-touch teaching system [J]. Electrochemical education research, 2018, (3):82-89.

[15] Deqing Wang. Modern educational management techniques [M]. Chongqing: Chongqing University Press, 2004: 430.

[16] Richard J. Shavelson. Review of Research on Teachers' Pedagogical Judgments, Plans, and Decisions [J]. The Elementary School Journal, 1983, 83(4): 392-413.

[17] Tao Liu. Research on learning models in smart classrooms in the context of core literacy--a review of Research and Practice of Teaching and Learning in Smart Classrooms [J]. China Grease, 2022, 47(02): 158.

[18] Ronghuai Huang. Smart learning environments: Effectively supporting the transformation of learning and teaching styles [DB/OL].https://wenku.baidu.com/view/19cac6df852458fb770b56aa.html.

[19] Yi Chen. Remodeling the ethical relationship between teachers and students in the smart classroom [J]. Basic Education Reference, 2021(01): 7-10.

[20] Guoqiang Hu, Jianping Chen, Sujian Han. Cold thinking in the "smart classroom" fever [J]. Laboratory Research and Exploration, 2019, 38(02):259-262.

[21] Shen Chunlei. Relay Intelligence releases upgraded privacy protection platform [N]. China Science News, 2021-09-23(003).

[22] Xiong Zeng, Zheng Liang, Hui Zhang. International experience and Chinese strategy of face recognition governance [J]. E-Government, 2021(09):105-116.