The Sustainable Innovation Impact of AI and Immersive Technology in Information System Management on Education Development

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Abstract
Abstract This paper describes the development of artificial intelligence and immersive technology in the field of education. The background of the research was introduced, including the analysis of its application in education from relevant international and domestic research. There are also application status, such as the data processing advantages of AI in education and the role of the squirrel Ai large model, as well as the pilot application of immersive technology in some fields and the improvement of the management of educational information systems. Then, the data generated by the integration of the two in the educational information system and the use of analysis are explained. It also highlights the sustainable innovations that this integration brings, such as optimizing resource allocation, improving educational effectiveness, reducing costs, and promoting educational equity. At the same time, it pointed out the challenges faced by technology convergence and proposed countermeasures to address these challenges.

1. Introduction

With the progress of society and the rapid development of science and technology, China's various industries are transforming towards informatization, digitalization and intelligence, and the field of education is standing at the crossroads of change and is facing unprecedented opportunities and challenges. Among them, the industrial integration of AI (artificial intelligence) and immersive technology (AR and VR) is a hot spot in education development, which interacts with each other in information system management and has a far-reaching and sustainable impact on education development [丁云霏.].

With the help of an intelligent data analysis platform and powerful data analysis capabilities, the application of AI technology deeply analyzes the development of students' personalities, formulates diversified development models for students, promotes students' personality development, and greatly improves the efficiency and quality of education. The deep integration of AI and immersive technologies (virtual reality (VR) and augmented reality (AR)) creates unique learning scenarios for students, making teaching more intuitive and vivid. This immersive learning experience breaks the space and time constraints of traditional education, greatly frees students from the rejection of the classroom, improves students' interest in learning, improves

learning efficiency, and makes education more interesting and effective [Roslinda Murad, M. S. Sulong, S.]. Information systems management plays a crucial role in this process. It organically integrates AI and immersive technology into all aspects of education. From the allocation and scheduling of resources to ensuring the stable operation of technology; From the secure storage and management of data, to the collaborative work between different education platforms, information system management ensures the smooth operation of the entire education ecosystem. The application of these technologies in the field of education has gradually improved the development of education. Not only for students but also for teachers. At the same time, these technologies have great potential to promote the allocation of educational resources, educational equity, and innovative educational integration [陈王兴, & 祁芸.].

The sustainable impact of AI and immersive technology on education development under information system management is of immeasurable significance for us to grasp the direction of education development and build a better, fairer, and more dynamic education system [Krishna Kashyap].

1.1 Literature Review

The use of artificial intelligence (AI) and immersive technologies (e.g., virtual reality (VR) and augmented reality (AR) in education is rapidly evolving, dramatically improving learning outcomes and student engagement by providing immersive, interactive learning experiences.

Research background

In the context of the development of a new generation of technology, the integration of AI and immersive technology empowers the education industry to become a hot topic. Published in December 2023, Advances in Educational Technology and Psychology: This article provides a detailed analysis of the application of AI and virtual reality (VR) technologies in collaborative learning in primary and secondary schools, shows how to design and implement AI and VR-based learning environments, and proposes corresponding solutions and best practice recommendations. Released in January this year, Diving Deeper into Digital: How AI is Elevating Immersive Learning Experiences explores the potential of AI to enhance immersive learning experiences in digital education, detailing the application of VR, AR, and other multi-sensory tools in modern immersive learning environments.

In China, the "2024 Artificial Intelligence + Education Industry Development Research Report" released by iResearch in August 2024 (iResearch is a leading brand in the field of China's new economy and industrial digital insight research and consulting services): The report points out that education is essentially a manpower-intensive industry, and human factors limit the two-way development of education scale and personalization, while the powerful data processing and learning capabilities of AI technology can provide students with support in refined tutoring and personalized learning path planning. It can also assist teachers in their work. These technologies provide customized learning resources and feedback based on students' learning progress and ability level, resulting in more efficient and motivated learning. The January 2024 paper, "2024 Research on the Application and Development Prospects of Virtual Reality Technology in Education," points out that immersive technology enables students to engage in learning by creating realistic virtual environments. Extended reality (XR) technologies include virtual reality (VR), augmented reality (AR), and mixed reality (MR), which bring new modes of experience to users through the integration of digital information with the real environment with varying degrees. The application of XR technology in education has the characteristics of humanism, intelligence, interactivity, ecology and generation, which can provide learners with intelligent education product design, optimize gamified learning, and create a smart learning environment.

Application status

The application of AI in the field of education is based on its powerful data analysis, pattern recognition, and intelligent decision-making capabilities. It can process massive amounts of educational data and mine students' learning behavior patterns. For example, Squirrel Ai's intelligent adaptive education model: Squirrel Ai is a leading enterprise in the field of Chinese artificial intelligent education, and its intelligent adaptive education

model was officially released at the AIAED Intelligent Adaptive Education Large Model Academic Seminar on January 8, 2024. The model can cover multiple scenarios such as preview, review, test preparation, and homework help, and give students more accurate responses and incentives in terms of social-emotional and interpersonal interactions. The intelligent adaptation model of Squirrel Ai provides strong technical support for personalized education and improves students' learning efficiency and interest. VR and AR in immersive technologies provide students with a more realistic and vivid learning experience by creating a virtual 3D environment or overlaying virtual elements on top of the real environment. VR and AR technologies are already being piloted in some areas of education, such as Medical and Surgical Training 2022: Adams's and St Thomas' NHS Foundation Trust hosted a VR training event for trainees to practise knee replacements and other surgical procedures in a simulated operating room. The use of immersive technology in education not only increases student motivation and engagement, but also provides a safe, controlled, and highly realistic learning environment that significantly improves learning outcomes and knowledge retention.

There are many problems in the management of educational information systems. Traditional education information systems often have scattered data, information is not updated in a timely manner, and data flow between various departments is not smooth, resulting in inefficient allocation of educational resources. The introduction of AI and immersive technology can effectively solve these problems. AI can integrate scattered data and realize the dynamic allocation of educational resources through intelligent algorithms. Immersive technology can break the limitations of traditional educational information systems in the form of presentation, and display two-dimensional information in three-dimensional form to enhance students' learning participation [刘怡萱, 陶奕芹, 贾雪彬, & 王运武.].

Integration of information management systems and education

In educational information systems, the use of AI and immersive technologies generates a wealth of valuable data. For example, in a virtual learning environment, the system can record students' operation tracks, stay time in different learning modules, and the number of interactions with virtual elements. At the same time, it can also collect data such as the types of questions asked by students when using the intelligent tutoring function, feedback on answers, etc. For example, in the virtual learning environment, each student's actions are recorded in detail [junjiesong.]. The system can accurately capture the trajectory of students' movements, such as whether they quickly skip certain chapters or watch specific content repeatedly when browsing course materials. The length of stay in different learning modules is also accurately counted, for example, half an hour in the English listening and speaking module, and only 10 minutes in the grammar module; The number of times students interact with virtual elements is even clearer, such as clicking on virtual teaching aids and participating in virtual group discussions. At the same time, when students use the intelligent tutoring function, the types of questions asked, such as whether they ask more questions about the application of mathematical formulas, or whether they have more questions about the ideas of Chinese composition, and their feedback on the answers, whether they continue to ask in-depth questions after understanding, or whether they are still confused and ask for further explanation, these data are collected one by one.

For this massive and complex data, we can use a series of mature data science methods to conduct in-depth mining and analysis [Brum, Y. K.]. For example, the online learning system of Beijing No. 4 International High School uses a cluster analysis algorithm to divide students with similar learning patterns into different groups by taking into account multi-dimensional learning behavior data such as students' login time, learning frequency, homework completion, and performance on different difficulty topics. For example, there is a group of students who always study intensively in the evenings and are highly engaged in science experiment courses, but have a low quality of reading assignments in humanities and history. Based on the results of this analysis, the teacher developed a targeted teaching strategy for this group of students to arrange more interactive science course learning guidance in the evening, and at the same time increase the interesting guidance and supervision mechanism of humanities and history courses. In addition, regression models in machine learning can be used to predict students' performance on specific learning tasks based on data such as past test scores, daily homework completion, and performance in mock exams. For example, in anticipation of the possibility

that some students may not perform well in the upcoming physical mechanics unit test, the school pushed additional learning materials for these students in advance and arranged online tutoring sessions, so as to reasonably adjust the allocation of teaching resources. At the level of educational decision-making, this processed data provides a guarantee for personalized learning path planning. In the online education platform of Xueersi Online School, the analysis found that a certain student always made operational errors in the virtual experiment of chemistry and performed poorly, but the accuracy of answering questions in the theoretical knowledge learning part was very high. Therefore, the system recommended more targeted experimental operation demonstration videos and virtual experimental practice courses for the student, and appropriately reduced the proportion of theoretical learning time, increased the practical learning time, and helped the student improve his comprehensive ability.

Sustainable innovation embodiment

In terms of educational development, this convergence of technologies has led to significant sustainable innovations. From the perspective of resource allocation, through the intelligent management of information systems, geographical restrictions can be broken, so that high-quality educational resources can be more widely disseminated. Students in remote areas can have the same experimental course experience as students in developed areas through a virtual learning environment, thereby reducing the impact of uneven distribution of educational resources [朱龙, 李何婷, & 孔祥钰.][张毅.].

From the perspective of improving the effectiveness of education, immersive technology makes learning more vivid and interesting. When students learn about historical events in 3D virtual scenes, they feel as if they are in history, and can have a deeper understanding of the historical background and the development process of events. This kind of fun enhancement can stimulate students' enthusiasm for learning, and in the long run, it will effectively improve the quality of education [董翠翠, 杨丽华, & 杨欣怡.].

At the economic level, in the long run, this innovative model can reduce the cost of education compared with traditional education. The construction of traditional educational resources often requires a large amount of material and human input, such as the construction of laboratories and the purchase of experimental equipment. Virtual learning environments can replace these physical resources to a certain extent, reducing construction and maintenance costs. At the societal level, improving educational equity is one of the important significance. More people, regardless of their location or family economic conditions, have access to high-quality education and promote the harmonious development of society [李攀, & 邱小健.].

2. Research Methods
2.1 Complexity of technology integration

Hardware and software compatibility issues: The application of AI and immersive technologies requires a variety of hardware devices (such as high-performance servers, VR headsets, sensors, etc.) and software (AI algorithm libraries, virtual environment development software, etc.) to work together. There may be compatibility issues between hardware and software from different manufacturers, which can affect the stable operation of the system. For example, VR devices are not compatible with the graphics rendering engine in the education information system, resulting in picture stuttering and delay, reducing the immersive experience.

Data interaction challenges: AI systems and immersive environments generate and rely on a variety of data types, including student learning behavior data, virtual scene interaction data, etc. It is a major challenge to realize the effective interaction and integration of these data in the information system, such as inconsistent data formats and delayed data transmission, which may lead to inaccurate analysis of students' learning status by AI and the inability to adjust immersive teaching content in time.

2.2 Educators' ability and concept

Lack of technology application capabilities: Educators need to master new technological tools and platforms to effectively use AI and immersive technology for teaching, but many educators lack relevant training and experience, and are not familiar with how to design teaching content and operate AI-assisted teaching systems in immersive environments.

Constraints of traditional concepts: Some educators are accustomed to the traditional education model, are skeptical of the application of new technologies in education, believe that traditional methods are sufficient, and are reluctant to try new teaching methods, which hinders the promotion and application of AI and immersive technologies in the management of educational information systems [董赟, & 孙晓玲.].

2.3 Cost and resource constraints

High hardware costs: Implementing AI and immersive technologies requires the purchase and maintenance of expensive equipment, such as high-end servers to run AI algorithms, VR devices for students, etc. This is an unaffordable expense for many educational institutions, especially those with limited resources, limiting the mass adoption of these technologies.

High demand for content development resources: Creating high-quality immersive educational content and training effective AI models require a lot of human, material, and time resources.

Privacy and data security concerns: When using AI and information technology systems, students' personal information and facial biometrics may be collected, raising concerns about privacy and data security. Ensuring that these systems are fair and unbiased is also a major challenge.

2.4 Students' adaptability and potential negative impacts

Over-dependence and risk of social deficit: Long-term immersion in virtual environments may lead students to become overly dependent on technology, reduce real-world social interactions, and may be unable to distinguish between virtual and reality, affecting their mental health and the development of normal social skills [13].

3. Results and Discussion
3.1 Technology R&D and standardization

Strengthen technology convergence research: Encourage scientific research institutions and enterprises to cooperate to carry out research on the integration of AI and immersive technologies in the field of education, and improve the compatibility of hardware and software. Develop relevant standards for the application of AI and immersive technologies in the education industry, including hardware device parameters, software function specifications, data formats, etc., to promote the interoperability and compatibility of products in the market.

3.2 Educator training and support

Carry out professional training programs: Provide teachers with systematic training courses, including basic knowledge of AI, immersive technology operation, and methods of designing teaching content in a virtual environment, etc., to improve educators' ability to apply new technologies.

3.3 Cost control and resource sharing

Finding a cost-effective solution: Educational institutions can choose cost-effective hardware and software platforms, such as cloud-based AI services and lightweight VR devices.

3.4 Pay attention to student development and guidance

Personalized adaptation plan: Design personalized learning paths in the information system, and adjust the intensity and method of immersion teaching according to the individual differences of students, such as providing more rest prompts and visual adjustment functions for students who are prone to vertigo. Cultivating digital literacy and social competence: In the educational process, focus on cultivating students' digital literacy, so that they understand the difference between virtual and reality, and use technology appropriately .

4. Conclusions

The convergence of AI and immersive technologies under information system management has brought unprecedented opportunities for education development, showing great potential and positive impact. Through intelligent data analysis and immersive learning experience, it can improve the efficiency, quality and fairness of education, promote the personalized development of students, and reduce the cost of education at the economic level. In this development process, there are also many challenges. The hardware and software compatibility problems and data interaction problems in technology integration, the limitations of educators' abilities and concepts, the limitations of cost and resources, and the adaptability and potential negative impact of students may restrict the further application and development of these technologies in the field of education. In order to fully realize the sustainable and innovative role of AI and immersive technologies in education, a series of response strategies are needed. Only by overcoming these challenges can we make better use of these technologies to build a better, equitable and vibrant education system, promote the sustainable development of education in the direction of informatization, digitization and intelligence, and achieve profound changes and long-term progress in the field of education.

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