

## The Future of Customized Education in Edutech through Digital Innovation

Koo Hyo-Jin<sup>1</sup> and Park Jin-Young<sup>2,\*</sup>

<sup>1</sup>*Rinascita College of Liberal Arts and Sciences, Shinhan University, Uijeongbu City 11644, Republic of Korea*

<sup>2,\*</sup>*Department of Software Convergence, Shinhan University, Uijeongbu City 11644, Republic of Korea*  
*allohamora2010@shinhan.ac.kr<sup>1</sup>, pcyksk@shinhan.ac.kr<sup>2,\*</sup>*

### Abstract

*Digital technologies such as Fifth-Generation Mobile Communications (5G), Virtual Reality (VR), and Augmented Reality (AR) are driving transformative innovations across various industries, with education being a particularly notable area of impact. These technological advancements are fostering the expansion of EduTech and digital big data, thereby enabling the provision of highly personalized and accessible learning experiences. By integrating Artificial Intelligence (AI), blockchain, and Extended Reality (XR) technologies, educational methodologies are becoming increasingly immersive, adaptive, and efficient. These innovations are redefining traditional learning paradigms, enhancing learner engagement, and broadening global access to education. Governments and institutions worldwide are making substantial investments in the digitalization of educational environments, utilizing state-of-the-art tools to optimize learning outcomes and prepare learners for the challenges of the future. We examine the profound implications of digital innovation on education, focusing on its role in shaping new paradigms of learning and exploring its broader socio-economic impacts.*

**Keywords:** *Artificial Intelligence (AI), 4th Industrial Revolution, Smart Education (Edutech), 5th Generation Mobile Communications (5G), Customized Learning*

### 1. Introduction

5th Generation Mobile Communications (5G) provides ultra-fast data transmission and low latency, enabling the transfer of large volumes of data almost in real-time. This significantly improves connectivity between devices and overcomes geographical limitations, greatly enhancing remote communication and interaction.

Technological advancements are positively transforming our lives and work environments, introducing new methods of collaboration and interaction that surpass traditional approaches. This drives innovation across various industries, including remote work and real-time production monitoring in manufacturing, telemedicine and remote surgery in healthcare, experiential learning in education, and immersive experiences in entertainment.

Virtual Reality (VR) and Augmented Reality (AR) technologies merge the real and virtual worlds to

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Corresponding Author: [pcyksk@shinhan.ac.kr](mailto:pcyksk@shinhan.ac.kr)

Tel:+82-031-870-3247

Department of Software Convergence, Shinhan University, Uijeongbu City 11644, Republic of Korea

provide immersive and realistic experiences, enabling users to engage in deeper learning and exploration through various scenarios and interactions. When combined with 5G, these experiences become even more vivid and instantaneous, allowing users to leverage technology in richer and more diverse ways. Virtual and augmented reality technologies enhance student immersion and strengthen hands-on education practices [1].

These technological advancements are expected to bring about groundbreaking changes across society, going beyond merely offering new experiences. The adoption of new technologies will enhance the efficiency of our lives and contribute to the creation of new economic ecosystems. This transformation and innovation positively reshape our lives and business environments, opening up new possibilities and opportunities.

Ultimately, the combination of 5G with VR and AR will reconstruct existing frameworks, revolutionize user interactions and collaboration, and create new business models that offer opportunities across the entire economy [2]. 5G technology, with its ultra-fast data transmission and low latency, is driving transformative changes in the field of education. These advancements enable remote learning and real-time interaction, enhancing the overall learning experience [3]. This demonstrates the potential of digital innovation to have a lasting impact on everyday life, both now and in the future, and to give rise to new industries.

## **2. Transformation of Learning Through AI and Digital Innovation**

The Fourth Industrial Revolution is characterized by innovations centered around digital technologies such as Artificial Intelligence (AI), big data, Internet of Things (IoT), and 5G. AI enhances efficiency and provides customized services across various fields, including healthcare, manufacturing, and education [4]. AI has been recognized as a transformative force across industries by advancing state-of-the-art solutions and fostering innovation in multiple domains, including education and healthcare [5]. In everyday life, AI is utilized in smartphone recommendation systems, autonomous vehicles, and smart cities. Edutech leverages AI to deliver customized education, with educational apps like Classing and I Am School recording high installation and user numbers. These technological advancements are expected to revolutionize educational methods and promote learner success.

The growth of edutech is clearly reflected in comprehensive social networking services. For instance, the Classing app, launched in 2012, experienced rapid growth during the COVID-19 pandemic, with approximately 2,895,000 installations by November 2020. This app provides AI learning services and classroom management functions and is currently used in over 20,000 schools domestically. Similarly, the I Am School app continues to maintain high installation and monthly active user (MAU) rates.

Additionally, the Highclass app has shown consistent growth even after COVID-19, with increasing installation and MAU figures. The Kanda and EBSi High School Lecture apps each record high MAU rates of over 80%, while the English education app Classcard records a 56.6% MAU rate. These educational apps go beyond merely providing educational materials or videos; they also offer services that recommend customized courses to learners by utilizing information and communication technology (ICT). The development of EduTech plays a vital role in improving the quality of education and increasing student engagement [6].

In 2022, the revival of face-to-face classes may cause a temporary slowdown in installations and MAU rates, but as the educational paradigm continues to evolve, these technology-based educational services are expected to seize new opportunities for growth. The innovation in the field of educational technology is anticipated to revolutionize traditional educational methods and play a significant role in further promoting the success of individual learners.

## **3. Modern Educational Innovation and Future Directions Utilizing Digital Big Data**

In the past, education was primarily conducted in classrooms, centered around textbooks and guided by

teachers. However, in the modern era, digital big data and an information-rich environment are revolutionizing educational methods. Students can now learn through various content types beyond textbooks, such as online resources, video lectures, and interactive applications. This plays a crucial role in offering diverse and customized learning opportunities.

Teachers use digital big data to collect and analyze students' learning data, enabling them to understand learners' progress, achievements, and learning patterns, and provide tailored education based on these insights. The integration of artificial intelligence and big data is increasingly used to design personalized learning pathways in education [7]. E-learning systems designed with the support of digital big data have demonstrated their effectiveness in enhancing the teaching-learning process, particularly in technical education settings [8]. Such data analysis improves the quality of education, enhances the potential for learner success, and contributes to more engaging and effective learning experiences.

Digital innovation is transforming educational environments, serving as a key element in delivering personalized learning experiences [9]. Digital big data significantly increases the accessibility and diversity of education, helping learners experience customized learning tailored to their learning styles [10]. Through data analysis, teachers can choose educational methods that meet students' needs and optimize learning processes, playing a critical role in increasing learner engagement and achievement. These changes go beyond the limitations of traditional education, contribute to setting new directions for future education, and enhance the potential for learner success.

#### **4. Innovation and National Approaches to Future Education Using Edutech and Big Data**

Following COVID-19, the transition to a future education system has accelerated, highlighting the importance of big data and edutech. Edutech is a concept that integrates Information and Communication Technology (ICT) technology into education to improve existing educational services or provide new educational services. Similar to e-learning and smart learning, edutech focuses on data and software to provide customized education to learners, enriching interactions between educators and learners. It contributes to innovation in educational environments and enhances learner performance.

Countries worldwide are actively digitizing education through edutech. Australia is improving digital infrastructure and promoting the fusion of education and technology through the "Smart Classroom Project" to enhance learning environments. The United States focuses on customized education, utilizing data-driven learning models to provide educational content tailored to learners' needs. Finland and Japan are innovating curricula and diversifying learning methods through the "Inno School" and "Dream School" projects, respectively.

Singapore aims to enhance learners' capabilities and continuously improve educational environments through edutech, establishing modern and advanced educational methods to help learners become competitive in the future. Edutech strengthens learners' creativity and problem-solving skills and advances learning environments through various technologies. These efforts support learners in successfully adapting to and thriving in the global market.

In South Korea, smart education and edutech are also actively developing. Advanced technologies such as AI, AR, and VR are utilized to provide customized educational content tailored to individual learning styles. Various online platforms and learning management systems innovate educational experiences. These national approaches focus on different aspects of educational content, methods, and environments, allowing for the identification of national differences and characteristics in edutech utilization.

## **5. Innovation in Smart Education Through Digital Big Data and Edutech**

Digital big data technology is at the core of smart education. It collects and analyzes data from schools, teachers, students, families, and educational institutions to optimize educational processes and learning methods. This enhances learning outcomes, enables customized education, and improves interactions between teachers and students.

AI ethics emphasize data transparency, privacy protection, and fairness, providing a foundation for the appropriate and ethical use of AI in education. COVID-19 and the Fourth Industrial Revolution have accelerated technology application in education. In the contactless era, students attend real-time classes in virtual classrooms and interact with teachers through online platforms.

Blockchain and XR technologies enrich learning experiences and innovate educational methods. Mobile learning offers an accessible educational environment anytime, anywhere. Learners can easily access lectures, content, quizzes, and assignments via mobile devices.

Mobile learning promotes interaction and helps form communities. Blockchain securely stores learning records, and XR technology provides immersive learning experiences. VR, AR, and MR enhance learning outcomes through realistic experiences.

XR technology provides an ethical training environment and allows experimentation with various scenarios, presenting new possibilities and innovations in the education field. AI-based edutech continues to develop, considering mobile learning environments, offering learners the flexibility to learn anytime, anywhere. AI provides customized learning by understanding learners' styles and levels.

The international Edutech market is rapidly growing. In 2021, the market size was approximately 25 billion USD, experiencing rapid growth due to increased online education and remote learning following COVID-19. The United States and Canada are making significant investments in Edutech. The global Edutech market is expected to grow at a compound annual growth rate of 18.1%, reaching 285.23 billion USD by 2027.

## **6. Conclusion**

Advancements in digital technologies such as 5G, VR, and AR are driving innovation across various industries, including education. These technologies enhance remote communication and interaction, transforming traditional educational methods and providing learners with customized learning experiences. In particular, edutech and digital big data expand the accessibility and diversity of education, supporting learners in receiving education tailored to their individual learning styles.

Countries worldwide are focusing on digitalizing education, improving learning environments, and maximizing student performance through edutech. Australia, the United States, Finland, Japan, and Singapore are enhancing the quality of education and innovating educational processes and methods through edutech. These efforts by various countries focus on building a new paradigm for the future of education.

Digital big data and AI, the core of smart education, analyze learner data to provide customized education and optimize educational processes. Blockchain and XR technologies make learning experiences more immersive and effective while considering the ethical aspects of education. Digital innovation thus introduces new directions for education and will play a crucial role in the future of education.

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