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Communication

A Study on AR Education Application That Applies Social Functions

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Abstract: As outside gatherings were banned after Corona, online education remotely conducted at home instead of at school or academy has become commonplace. This study examined the current state of the education industry post-COVID-19, prior research on augmented reality applications, and education case studies using Edutech. Through this research, the necessity of designing and developing customized explanation applications using the metaverse was established, and an AR education application was proposed using application design elements. The discussions of this study are as follows. First, an application is proposed based on the current status of the edutech market, a case analysis of the metaverse platform in education, and a design element analysis. The metaverse education-related market is revitalizing, but the related research is insufficient.Second, by proposing a metaverse AR education application, it can be used as content in the education industry. This application can overcome the limitations of practical subjects taught in school classes. Third, if educational AR application is developed, launched, and used in classrooms, positive changes in teaching can be expected. Fourth, the application should enable multilateral experiences. Multilateral experience means that several people share an experience while pursuing the same objective and achieving their goals. This is intuitive because the explanation process can be viewed in detail from various angles using AR technology, and is significant because it can communicate with users through social functions.

Keywords: Education; Application; Social Functions, Edutech; VR; AR; Metaverse

1. Introduction

As public gatherings were banned after COVID-19, online education conducted remotely at home instead of at school became commonplace. Amid this trend, Edutech, which combines ICT such as artificial intelligence, virtual reality, augmented reality, blockchain, and big data, garnered attention. The Edutech-related market is expected to grow significantly from $127.1 billion (about 169 trillion Won) in 2018 to $404 billion (about 538 trillion Won) in 2025 [1].

Using artificial intelligence and big data, Edutech can analyze individual students' learning abilities and knowledge levels to provide the most appropriate level of instruction, learning goals, and study methods for each student. Immersion in learning can also be increased through experiential learning using virtual reality (VR) and augmented reality

(AR) [2]. The original educational content should be the basis of understanding the personalized and customized learning direction of students who receive education from the perspective that the students are the core of the education. The possibility of Edutech growing indefinitely to present future educational models and advocate for educational directions continuously is high. Due to the COVID-19 pandemic, which has changed the paradigm of education, Edutech not only attracts offline class spaces online but also aims for online and offline interactive communication [3, 4]. Additionally, it is necessary to find a way to integrate and manage online and offline resources and learning information at universities using various Edutech services and to attempt to provide higher-quality education by converting learners' environments to digital environments [5]. Therefore, this study examined the concept of Edutech, domestic and foreign Edutech education trends, the use of metaverse platforms in the field of education, and the precedent cases of Edutech. Thus, the necessity of designing and developing a customized explanation application using a metaverse was confirmed, and an AR-customized explanation app was proposed using the application design elements. The AR application designed in this study helps students review and learn parts that are not understood in class several times in practical subjects such as development, design, and experimentation. Additionally, it provides an explanatory video in page format using AR, and an educational function that allows learning without dropouts through communication between users.

The research questions of this study are as follows:

<Research Question 1> How can educational AR applications be developed for practical subjects?

<Research Question 2> How are design elements incorporated into AR applications?

2. Theoretical Background and Prior Research

2.1. Concepts of Edutech

Edutech is a compound word for Education and Technology that refers to a technology used to improve existing services or provide new services by incorporating ICT technology into education or to improve educational services or provide new values [6]. Recently, artificial intelligence (AI) and AR/VR have attracted attention as technologies that innovate existing education. Concepts similar to those of Edutech include e-learning and smart learning. E-learning emerged with the rapid spread of the Internet in the late 1990s and was mainly focused on digital textbooks and online learning. As smartphones and tablets spread in earnest around 2010, smart learning to improve educational outcomes through smart devices received attention from industry and academia. In the case of e-learning and smart learning, the main conceptual focus was on the means of learning (Internet and desktop, smartphone, tablet, etc.) through which education was conducted [7]. Another aspect that focuses on Edutech beyond e-learning and smart learning is the activation of remote education because of the spread of COVID-19. Educational sites worldwide have begun to realize the importance of Edutech in the stable implementation of education. Under these circumstances, devices such as smartphones and tablet PCs and AI, VR, and AR technologies have begun to be incorporated into existing educational services, resulting in the rapid expansion of the Edutech market [8].

Table 1. Edutech education policies for major countries

States	Key Policy	Key Contents
US	National Edutech Plan (2017)	- Establishment of National Edutech Policy and Vision divided into five areas (Learning, Teaching, Leadership, Evaluation, Infrastructure)
UK	Edutech Framework (2019)	- Step 1: Establishing a vision in the areas of administration, evaluation, instruction, and continuous career development for the use of Edutech - Step 2: Establishment of digital infrastructure, capability/technology development and effective procurement, and policy trends in digital security promotion areas - Step 3: Step 1 and Step 2 Based Execution, Integration, Repeat, and Pursue Innovation

EU	Digital Education Action Plan (2017)	- Improve digital capabilities and innovation of all educational institutions and open up the education system - Search for policy measures in teaching and learning, digital capabilities and technology development, and data analysis area
China	Education Information 2.0 Action Plan (2018)	- Active Efforts to Combine ICT Technology and Education - Establishment of 10 or more 'Wisdom Education Teacher Zones,' a smart learning space - Application of learning methods using blockchain and big data in all higher curriculums
Japan	3rd Basic Plan for the Promotion of Education (2018)	- Establishment of information utilization ability, ICT utilization in subject maps, ICT utilization in school affairs, and promotion of ICT environment improvement as four detailed goals for ICT utilization
Korea	Edutech Promotion Act (2023)	- Promote the combination of technology and content by establishing data standards and expanding public data opening - Establishment of a Hazard Check System - Establishment of 'digital education norms' in the AI era

2.2. Trends in Edutech Education at Home and Abroad

Edutech education is a global trend. Many countries worldwide are investing in large-scale budgets for Edutech and setting specific roadmaps to promote it. Korea aims to revitalize its K-Edutech exports by establishing a national-level educational support system. Edutech is indispensable for students to lead the world [9]. Edutech education policies for each major country are as follows [10].

2.3. Metaverse Platforms in Education

Like the real world, the metaverse refers to a three-dimensional virtual world where social, economic, and cultural activities occur, and are characterized by the possibility of an experience similar to the real world. Since the spread of COVID-19, non-face-to-face culture, such as online education, has been spreading, and extended reality technology, which implements an environment similar to reality, has been expanding.

Against this background, various metaverse platforms are emerging rapidly, and services using these platforms are increasing, especially in the field of education. The second is the main platform used in the current educational environment. 'Mozila Hubs' is an open-source platform that allows users to create and customize virtual spaces for meetings, events, and education. It supports functions such as spatial audio, customizable avatars, and 3D content integration. Therefore, it is suitable for immersive educational experiences. 'AltspaceVR' is a social VR platform that enables users to meet, interact with, and participate in virtual spaces. It is also used for virtual conferences, workshops, and educational sessions to provide opportunities for joint learning and participation. 'Engage' is a VR education platform that provides functions such as virtual classrooms, interactive presentations, and collaborative projects. It supports a multi-user environment and customized content; therefore, it is suitable for a variety of educational purposes. 'Rec Room' is a social VR platform that provides a variety of multiplayer games, activities, and creative tools. Although it mainly focuses on games, it is also used for educational purposes such as virtual field trips, language learning, and coding workshops. 'Spatial' is a mixed-reality collaboration platform that allows users to meet and work together in virtual spaces using AR and VR devices. It is used for virtual meetings, educational sessions, and workshops, allowing participants to interact with 3D content and simulations [11]. In this study, we propose a customized explanation platform that combines AR technology for students who have difficulties in practical subjects, such as development, design, and experimentation, because they are not understood in class.

2.4. Prior Research on Edutech

Interest in Edutech has increased during the pandemic, and studies on the application, scope, and effects of the technology base are increasing as well.

Lim Cheol-in et al. (2023) derived the Edutech classification system by reviewing prior literature on teaching and learning and conducting a comprehensive analysis of the use of Edutech by the Future Education Center, a teacher training institution, suggesting the necessity of developing and sharing a specialized teaching and learning model for each university, and argued the importance of a direction for co-evolution [6]. Another study developed and applied future education programs linked to the curriculum, confirmed the effectiveness of future education programs using Edutech in inventions highly related to creativity and creation, and suggested that it is important to set UCC, work activities, and future education class modules in four stages, depending on whether Edutech devices are needed. They also argued that future educational programs that secure connectivity with the regular school curriculum could be an effective and efficient way of approaching students' future competencies [12]. In addition, in a study on the development and application of elementary convergence education programs using Edutech, creative science, career, SW, and AI education were fused using Edutech's VR, AR, and AI and consisted of experience- and practice-oriented programs, suggesting that the Edutech convergence education program can increase students' learning outcomes and class participation [13].

3. Research Design

3.1. AR Application Design Elements

This study reviewed prior research to propose a explanation application using AR technology. The identified design elements are shown in Table 2.

Table 2. Metaverse application design

Name	Contents
Lee et al. (2019)	- Integration with existing portal accounts, allowing users to log in without the need for registration. - Users should be able to conduct live broadcasts through their device's camera. - During live viewing, there should be an option for easy payments to support the performers.
Na and Hwang (2022)	- Avatars should serve as replacements for users in the gaming context and allow personalization. - Users should be able to produce and sell content in addition to being content consumers. - Integration with entertainment services to include elements of fun. - Users should be able to form communities based on their interests.

In this study, we propose an application that uses fun elements among the snow crab elements of Jiyoung Na and Yongjun Hwang, social studies, and AR, the core technology of this study [14].

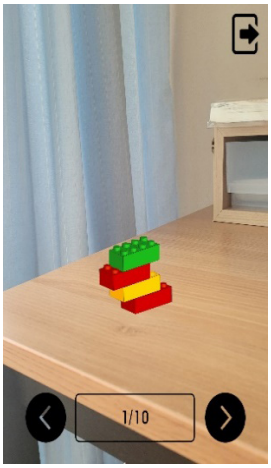
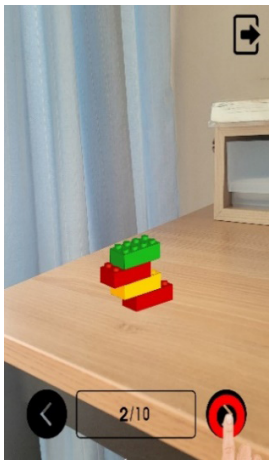
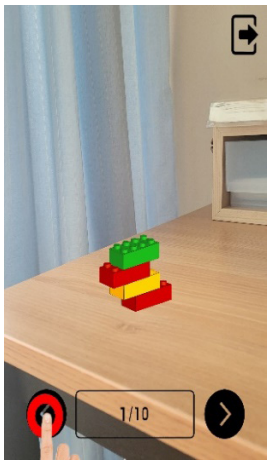
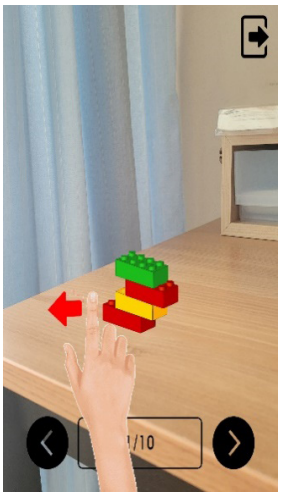
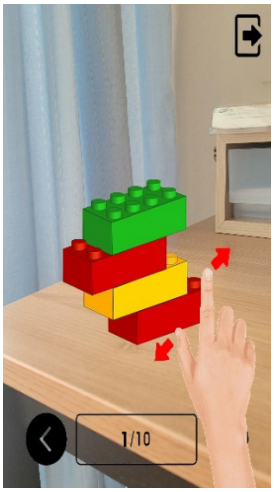
3.2. Overview

The application developed in this study operates by producing and uploading explanatory videos when a user who has difficulty with practical subjects, such as development, design, and experimentation, requests a platform. When a user who requested help utilized the answer of the user who produced the video, the user received points for using the paid content in the app. Popular videos help developers to use AR technology to understand the explanation process in more detail and vividly from various angles [15].

3.3. Main Page Configuration

Developers can implement the most popular video in real-time or video with more than 5,000 views among the videos uploaded to the application in AR. The manager reviews and determines whether the video meets the purpose of the application, and then creates an AR explanation video. AR images can only be uploaded by the manager, and the assembly process is divided into details and organized sequentially, as shown in Table 3.

Table 3. Composition of an AR videos screen

		
1. Place the exit button on the top right of the screen and the forward and backward buttons on the bottom of the page.	2. on the bottom right If you press the “Go Forward” button. The page moves forward to page 1.	3. If you press the ‘Go Back’ button on the bottom left, the page will be displayed Move back page 1.
		
4. When you drag the screen with one finger, the object rotates in the direction you dragged.	5. If you touch the screen with two fingers and open it in a different direction, the object is magnified.	6. If you touch the screen with two fingers, and then put both fingers in one place, the object shrinks.

A scene divided by organizing the explanation process is defined as a ‘page.’ In the video, the explanation process can be moved as if turning a page by adding forward or backward buttons. When switching to the previous page, it shows how it has been decomposed, in which the user can see an explanation that is difficult to understand. On the AR video screen, the user can rotate and zoom in on the object by dragging the screen with their finger, allowing the user to understand the explanation method in more detail. In addition, adding a function to display drawings on a screen can

help users understand the drawings in various ways.

The produced video was uploaded directly to the video page by an administrator. When the video is uploaded, an upload notification is sent to all users. The composition of the main page is shown in **Figure 1**.

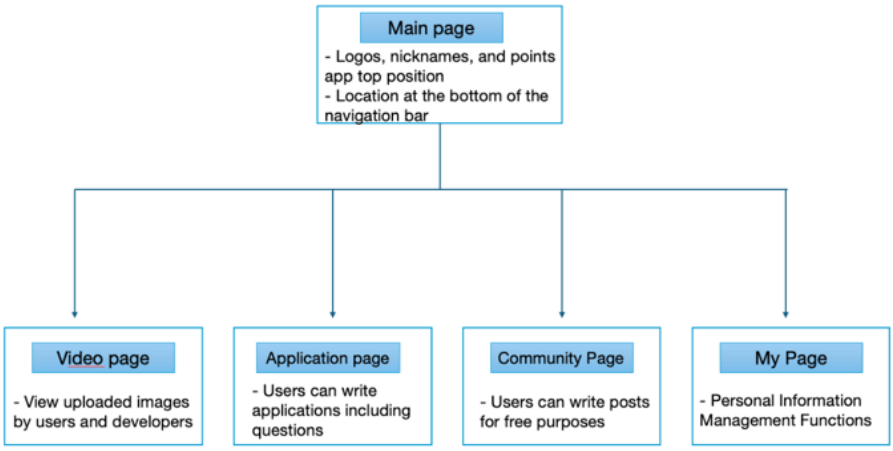


Figure 1. Composition of the Main Page of the Application

3.4. Community Page

Users can write free posts on a community page. In addition, the comment function within the post enables communication between users, which can be effectively used to increase application retention even when questions and answers are not asked.

3.5. Analysis of AR Application Design Elements

3.5.1. AR Elements

When a user requests an explanatory video of the desired content through the application page, other users can view the article and upload the video, while the manager produces a popular video in AR. If an AR image exceeds a specific number of views, it becomes a paid feature. On the AR image screen created by the manager, users can rotate and zoom in on the object by dragging it. Additionally, the page can be moved forward or backward by adding buttons to the AR image.

3.5.2. An Element of Fun

If you ask questions in a practical subject, you can receive real-time feedback through community pages and videos. Rather than in a one-way class, one can experience fun through interactions with questions and answers. Respondents earned points as a reward when their videos are adopted. You can also post questions, watch AR videos, and spend a certain amount of money in connection with real life.

3.5.3. Social

Users can write free posts on a community page. In addition, the comment function within the posts enables communication between users, which can effectively increase application retention even in the absence of direct questions and answers.

4. Discussion

The discussions of this study are as follows. First, an application is proposed based on the current status of the edutech market, a case analysis of the metaverse platform in education, and a design element analysis. The metaverse education-related market is revitalizing, but the related research is insufficient. In this study, the elements required for application design were defined as fun, social, and AR through prior research, and a customized explanation application was designed based on these elements. Currently, the education-related market is increasingly being digitized after COVID-19, and if the metaverse market is activated in the education industry in the future, the results of this study can be used as basic or reference data for metaverse education applications.

Second, by proposing a metaverse AR education application, it can be used as content in the education industry. This application can overcome the limitations of practical subjects taught in school classes. Not all students understand the instructor's explanation, and academic achievement is bound to differ because there are differences in levels between learners. In particular, in the case of practical subjects, once an explanation is missed, it is very difficult to follow the content afterwards. This study is more intuitive than textbooks because the practical process of using AR technology can be viewed in detail from various angles, and it is significant because it can communicate with users through social functions.

Third, if educational AR application is developed, launched, and used in classrooms, positive changes in teaching can be expected. There is a research case that utilized "Our Body's Shape AR Content," a collaboration between KERIS and ETRI in Korea, which demonstrated that classes incorporating AR showed significant results in all areas compared to traditional classes. Both students and teachers who learned through immersive content integrated with AR technology responded positively. In addition, it can also be used for self-directed learning after class. According to a study on teachers' perceptions of immersive content usage, teachers found that immersive content stimulates students' interest and curiosity about the lessons, enabling active participation and making it convenient.

Fourth, the application should enable multilateral experiences. Multilateral experience means that several people share an experience while pursuing the same objective and achieving their goals. Through this AR application, participants can converse freely in a relaxed atmosphere, revealing what they have "already" understood and what they "still" do not grasp, thereby making their learning more accurate and solid. In addition, they can experience learning by openly adjusting and re-evaluating their thoughts. Since interaction with peers is essential during the learning process, it is possible to enable multilateral experiences by using the AR application together while learning practical subjects.

There were also clear limitations to this study. As an AR application for use in schools, there is room for students to develop their research content through user evaluations while using this app in the future. In addition, it is necessary to expand content, such as discussions and team activities, for interaction in class, and not just through questions and answers.

5. Conclusion

Post-COVID-19, a digital transformation has occurred in the education industry due to increasing interest in edutech. Amid the growing interest in and expectations for the use of edutech in the education field, this study proposes a customized learning explanation application that incorporates AR technology for students who have difficulty in learning practical subjects. The application, which allows students to share and watch the explanation process as an AR video, helps them review and learn parts that are not understood in class.

This is intuitive because the explanation process can be viewed in detail from various angles using AR technology, and is significant because it can communicate with users through social functions. Future studies should address these

limitations.

Author Contributions

JYN performed the research and authored the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest

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