A Plan to Revitalize Virtual Space using Metaverse Zeb and ZEPETO App in Radiology Education

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ABSTRACT

Education in radiology involves a large portion of practical training, and it is difficult to conduct it through non-face-to-face online education. In this study, we utilized the Metaverse platform, which can replace hands-on education, to implement a practice room that is difficult to access through non-face-to-face classes into a virtual world, and then evaluated the satisfaction of learners after the practice class, the practicality of the Metaverse platform class, and the future orientation of the curriculum. I wanted to find out. Using the metaverse platforms ZEPETO (Build It) and ZEP (ZEP), the S University radiology department lab was implemented into a virtual world and used for students' classes. A total of 50 students were surveyed twice, divided into pre- and post-surveys, and all questions used a 5-point Likert scale. As a result of the study, satisfaction was low at 2.32 for education without using Metaverse virtual space, while education using virtual space was very high at 4.16. As a result of the analysis, the satisfaction level of the new education system and the practicality of the Metaverse platform classes are very high, and it is believed that it will be a more effective education platform when conducting additional education such as app explanations in the future.

Keywords: Metaverse Utilization Classes, Virtual Space, Non-Face-To-Face Activation, Practical Subjects, Radiological Education

I. INTRODUCTION

Due to the prolonged effects of COVID-19, we must adapt to the changing circumstances of our times, which differ from the past. As a result, almost all educational courses are now conducted remotely[1].

In particular, as universities conduct remote lessons online, not only are they unable to achieve the same satisfaction as traditional face-to-face classes, but various problems are also emerging.

According to an online survey on 'Perceptions, Usage, and Experience of Remote Learning' conducted by the Ministry of Education targeting faculty (2,881) and students (28,418) of four-year universities nationwide, students identified the main challenges of remote learning as 'lack of communication between professors and students' (59.2%) and 'decline in concentration' (54.3%). Professors identified 'course management according to subject characteristics' (45.7%) and 'motivating and encouraging student participation' (45.6%) as their top challenges. The results highlight issues of reduced communication between professors and students, friends, lack of interaction, and decreased motivation to participate in classes[2]. Furthermore, according to a study by Hong et al., the decreased satisfaction with major courses due to COVID-19 was the most significant factor causing academic stress among students[3]. Moreover, in courses requiring hands-on practice based on

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learned theories, problems such as reduced immersion and difficulties in applying theories arise due to remote learning. To address the issues of remote learning, stimulating student interest and fostering smooth communication between instructors and students is essential. Thus, we aim to utilize the metaverse as a new alternative to online remote classes offered through platforms like Zoom and Webex.

"Metaverse" is a compound word combining "Meta", meaning virtual or transcendent, and "Universe", indicating the cosmos or world. It refers to a world where social, economic, and cultural activities occur in a 3D virtual reality, creating value[4]. One of the most significant advantages and functional features of the metaverse is that it allows interactions similar to the real world in a virtual space, offering an expanded experience that merges reality with the virtual realm. By forming a space similar to the real world using their avatars in the metaverse, students can heighten their sense of presence and immersion, thereby elevating their interest[5,6]. The educational space's usability in the metaverse can lead to more efficient education. If applied to classes, the metaverse can facilitate interactions between instructors and learners similar to face-to-face classes and can enhance problem-solving abilities, creative thinking, and academic achievement. Additionally, by providing a changed learning environment, it can boost interest and concentration in studies[7,8].

Thus, in this research, we aim to implement radiology practical lessons in a virtual world using the metaverse platforms 'Zepeto (Build it)' and ZEP (Zep), to assess student satisfaction and the practicality of metaverse platform-based lessons.

II. PREVIOUS STUDIES

The metaverse is a 3D virtual world that enables societal and cultural activities similar to real life, resulting from the fusion of virtual and reality. Depending on how reality and the virtual world are integrated, the metaverse can be described in several forms, primarily categorized as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR)[9-10]. Virtual Reality (VR) is a computer-generated environment that allows people to have experiences akin to reality. VR is actively applied in various fields such as gaming, media, medicine, and education. Among the notable examples, ZEPETO, developed by Naver, combines augmented reality technology and virtual space. Using augmented reality technology, users can create their avatars and interact with others in a 3D virtual space, even playing games using these avatars. In particular, the platform's diversity, allowing users to create avatars resembling themselves and enjoy activities like shopping, performances, and exhibitions, has made it highly popular among users[11]. Augmented Reality (AR) combines dreams and imaginations with the real world, overlaying a 3D virtual image on a real background to create a single visual world. A representative example of AR is Pokémon GO, released in 2016, which created a sensation. It combines Google Maps with a location verification system (GPS) and augmented reality, allowing users to walk around in the real world while capturing Pokémon monsters appearing on their smartphones. Unlike conventional mobile games played in a confined space, Pokémon GO provided a unique experience, successfully drawing players out into the streets.

Mixed Reality (MR) combines the virtual world with reality, where physical objects of the real world and virtual objects can interact. That is, it offers a rich experience through an environment where reality and the virtual world are seamlessly connected[12]. A prominent example is the Magic Leap whale video from the US, where wearing goggles displays one's regular space while augmented reality overlays it, providing a deep sense of immersion.

III. MATERIAL AND METHODS

1. Research Participants

The participants of this study were those who took part in major practical courses using the metaverse. The research was conducted among second-year students from the Radiology Department of S University. The project had 23 male students (46%) and 27 female students (54%), totaling 50 participants. The metaverse platforms ZEP and ZEPETO (Build It) were used twice each, making it a total of four sessions. The courses were conducted during actual class hours and were led by designated educators. 25 students (50%) participated in the first session on the ZEP platform, and another 25 students (50%) in the second session on the ZEPETO (Build It) platform, showing a high participation rate. After experiencing the platforms, a survey was administered to the students to gather their evaluations.

2. Research Method

In this study, virtual worlds were constructed using ZEP and ZEPETO, two metaverse platforms, as learning spaces for online classes. These platforms were used during class time, and surveys were conducted both before and after their use to understand the differences between traditional online classes and metaverse-enhanced classes, and to gauge student satisfaction. The pre-survey consisted of 12 questions about understanding of the metaverse, usage experience, and satisfaction with current remote classes. The post-survey had 14 questions evaluating program satisfaction, realism, novelty, utility, future orientation, and advantages and disadvantages.

3. Platform Selection

The metaverse platforms used in this research were ZEP and ZEPETO (Build It). These platforms were chosen because, in the era of the COVID-19 pandemic where remote education is prevalent, there was a focus on selecting platforms that were most suitable and helpful for educational environments. ZEPETO (Build It) offers excellent accessibility to participants, easy operation, and allows users to design their virtual spaces to resemble real-world structures closely. It also supports real-time voice and text chats for everyone on the same map, facilitating smooth classes for educators. It features image insertion, enabling the incorporation of actual site photos or drawings, which enhances the on-site feel compared to traditional online classes. On the other hand, ZEP offers similar accessibility and ease of use. Considering the registration aspect, it supports easy registration via email. While a similar platform, "Gather Town," has restrictions on the number of participants and many paid features, ZEP offers broader participant accommodation and numerous free features, making it a better choice for educational use. Although ZEP doesn't allow designing structures like ZEPETO, it facilitates easy sharing of videos, photos, and other class materials, and supports discussions among group members in designated spaces within the map. Therefore, it was deemed suitable for this study.

4. Platform Creation

4.1. ZEP

The metaverse platform ZEP is fundamentally comprised of pre-existing maps like beaches, classrooms, meeting rooms, and parks[13]. As show Fig.1, While users can choose from these standard maps, they can also select an empty space and customize it to create their desired map. Aiming to utilize the metaverse platform to represent a laboratory, we detailedly set up a general classroom, a lab, and a team meeting room. To begin map construction, one sets the desired width and height for their map. Following this, users can design the map using the floor, walls, objects, and tile effects. The floor can be arranged using the desired tiles to cover the required area. Walls essentially define impassable zones in the map, allowing users to divide and utilize areas based on their needs.

Objects primarily serve to decorate the map and help in establishing the desired theme. Creators can freely place objects anywhere, leveraging their creativity and imagination. Using this, we managed to replicate the ambiance of university classrooms, labs, and meeting rooms. Especially for the laboratory – a crucial space – we referenced lab photos to craft an environment reminiscent of a real lab. While we couldn't create a three-dimensional item like in ZEPETO (BuildIt), we incorporated actual device photos to enhance students' comprehension and learning. Secondarily, objects can also serve other functions. After placing an object, additional settings such as message input, image insertion, password configuration, website links, and embed settings can be employed. This allows users to convey messages, display images, or redirect to another website, promoting expansive learning and sharing.

Lastly, tile effects, a sophisticated and multifaceted feature in ZEP, are the reason many choose ZEP for education, presentations, meetings, and promotions. Notable functions include portals, private space configurations, spotlights, web links, and web embeds. Portals let users transition from one map area to another designated space, overcoming limitations. Using this, during labs, additional spaces were designated where photo objects were placed. Virtual labs allowed students to explore these spaces and understand equipment and materials. Private space settings, as the name suggests, designate private communication zones within the map. This facilitated private conversations post-lab without external interference. Spotlight function allows an individual to broadcast their video, voice, or chat to the entire map, fostering self-led presentations. Web links connect to external sites, providing further exploration, and web embeds allow for real-time display of web content, ensuring all participating students can simultaneously view tutorials or information.

4.2. ZEPETO

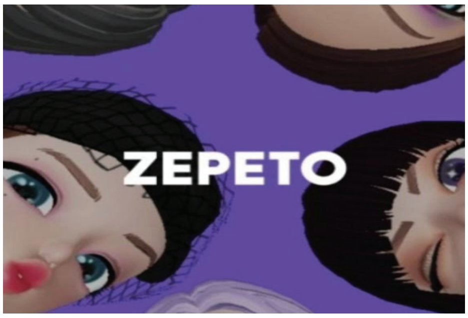
As show Fig.1, this metaverse platform, ZEPETO, allows users to select and use existing maps composed of areas like the House, Cafe, and School. However, by choosing the flat world, users can install structures directly to create their desired theme[14]. To initially set up the world, one can adjust the size of the floor they want from the explorer in the top left corner. After this, by using world terrain and sky settings, they can configure the base floor and sky of the world. To create a world that closely resembles an actual practice room, the appearance of a personally photographed practice room was referenced.

While there were pre-existing building objects within ZEPETO, it was deemed necessary to manually craft to achieve a structure that closely resembles a practice room. This was done by adjusting the X, Y, Z axes of the cube object to form the building walls, floors, and ceilings. While the X, Y, Z axes of the cube object can be manipulated by dragging with the mouse, to create objects of a certain size, the X, Y, Z values were entered and set directly. Subsequently, walls were installed to divide the shooting and preparation areas, replicating the structure of the practice room.

Given the limitations of the creation features in ZEPETO in representing objects, a photo insertion feature was utilized. This feature allows users to insert photos directly into custom objects. While there were frame and spherical custom objects, cubes were deemed most suitable for object creation. Therefore, by adjusting the X, Y, Z axes of the cube object, a framework for objects was created, and photographs of actual objects were then inserted to craft structures like the X-ray tube and bed.

Next, objects that students use in actual classes, such as chairs, grids, and cassettes, were created using the cube object, which is conducive for object crafting. The interaction feature in ZEPETO allows characters to use pre-set objects directly. Features like holding an umbrella or sitting exist, but the interaction feature cannot be granted to custom-crafted practice equipment. Thus, the "sitting" interaction was utilized, enabling users to fix their avatars in place to attend classes. The goal was to create structures in the world at a 1:1 ratio with the avatar's size to enhance realism. However, there was a concern about visibility on the user's screen.

(a) ZEP



(b) ZEPETO

Fig. 1. Metabus platform (a) ZEP (b) ZEPETO.

5. Research Procedure

Practical lessons were conducted non-face-to-face through online platforms using Metaverse platforms Zep and ZEPETO. These were divided across two classes, with each class receiving the training twice, making it a total of four sessions. The teaching content for students participating in the practical lessons on the Metaverse platforms Zep and ZEPETO is listed in Table 1. Before implementing this Metaverse platform, a team of four researchers and professors reviewed the students' practical environments and settings. For a smooth experience on Zep and ZEPETO, the instructor pre-studied the platform and guided the students about the practical lesson and its operation before the official first lesson. Essentially, students embarked on the practicals only after they were adequately familiarized with the controls.

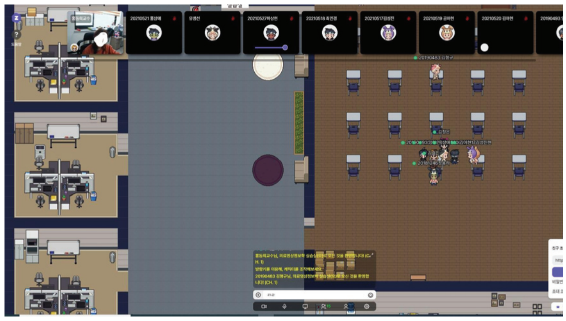
During lessons using ZEPETO, the instructor utilized the platform's structure to guide the participating students through the day's practical content. As show Fig. 2, students moved their characters within the ZEPETO platform and attended lessons that, as indicated in <a>, involved viewing virtual equipment and receiving instructions about camera equipment and focus setting methods. Furthermore, as shown in <b>, the appearance and use of MTF and experimental tools were explained using objects. Not only did they use the inherent voice chat in ZEPETO to interact, but the unique emotes in ZEPETO were also used to enhance the classroom atmosphere, encouraging students to stay engaged and interested. After the lesson, students were divided into teams within ZEPETO to discuss the lesson topic, and immediate feedback was provided to improve their learning efficiency.

As show Fig. 3, for lessons using Zep, similar to ZEPETO, the class was based on a virtual lab. The instructor shared a link for students to access the platform. Unlike ZEPETO, Zep allowed direct access without any installation, saving time. The instructor guided the students about the day's practical content. Before the lesson began, students had time, as in <a>, to personally check their practical environment, including inspecting the mobile setting. During the primary lesson, students moved their characters within the Zep platform, experiencing the virtual lab. The instructor was able to explain shooting sequences, conditions, and the usage of experimental tools easily, as shown in <b>, using lab photos within Zep. After the lesson, teams were formed to collaborate within designated spaces in Zep.

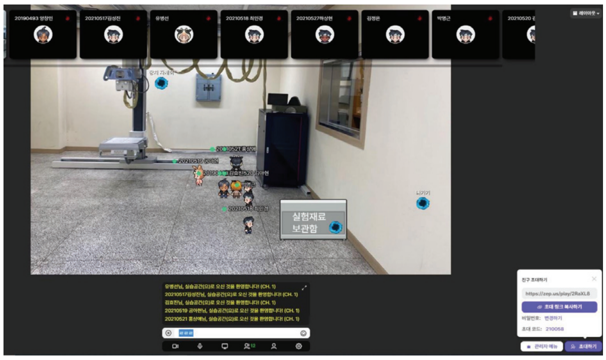
(a)

(b)

Fig. 2. (a), (b) Image of practice using ZEPETO



(a)



(b)

Fig. 3. (a), (b) ZEP.

Table 1. Teaching and learning contents

Class	Contents	Teaching and learning content
1	Instructions on how to operate	Zeb/Zepetto basic guide and usage instructions Zeb/Zepetto operation practice Zeb/Zepetto voice and chat practice
2	Class practice	- ZEPETO's practical classes Practical class content: Learning how to use filming equipment, MTF, and experiment tools
		- Jeb My Hands-on Class Practical class content: Learning shooting sequence, how to use experiment tools, and how to set shooting conditions

6. Satisfaction Survey

To analyze satisfaction levels of the lessons using the Metaverse platforms, satisfaction surveys were conducted before and after operating the non-face-to-face lessons using Zep and ZEPETO. Participating students took both multiple-choice and descriptive surveys. The pre-operation survey consisted of seven multiple-choice questions on current non-face-to-face satisfaction levels, understanding of the Metaverse platform, and suggestions for improvement. The post-operation survey included nine multiple-choice questions about the satisfaction level of Metaverse lesson operations, preference between Zep and ZEPETO, and reasons for preference, along with two descriptive questions on improvements. All multiple-choice questions were rated on a Likert scale of 1 (strongly disagree) to 5 (strongly agree). The before-lesson survey focused on satisfaction, understanding, concentration, communication frequency, and understanding of the Metaverse platform. The after-lesson survey touched on topics of satisfaction, preference, difficulty, and understanding.

7. Data Analysis

Analysis was performed using an independent samples T test using the IBM SPSS program (version 22.0, SPSS, Chicago, IL, USA). The significance probability (p) of 0.05 or less was considered significant. Firstly, a frequency analysis was conducted to understand the demographic characteristics of the participants. Subsequently, the average and standard deviation for each variable were calculated. Both pre and post-surveys were uniformly administered and then analyzed.

IV. RESULTS

1. Satisfaction Before the Implementation of Online Classes

From the survey, the results of the current online class satisfaction survey conducted before the Metaverse platform class operation for 50 second-year Radiology students of S University are as shown in Table 2. Observing the averages of the four items, scores ranged between 2.62~3.04 points, indicating a relatively low satisfaction level with the current online classes. To verify the satisfaction for each item, the response ratio was analyzed. The agreement ('Strongly Agree', 'Agree') rate for the statement "satisfied with online classes" was 26.0%, with an average score of 3.04. Although the average score is above 2, the low agreement rate suggests many students are not satisfied with online practical lessons. The agreement rate for understanding online practical lessons was 62.0%, with an overall average score of 2.32, indicating that students generally had a low understanding of online practical lessons. The agreement rate for concentration in online classes was 46.0%, with an average score of 2.60, indicating that many students had difficulty concentrating. Lastly, the agreement rate on communication between professors and students was 48.0%, but the average score was 2.62, suggesting room for improvement. The highest average score was 2.96 for the first item, but considering the overall average scores and response rates, it is evident that there's a low satisfaction rate for the current online practical lessons.

2. Satisfaction After the Class Operation

Based on the preliminary survey, after conducting the program for 50 second-year Radiology students at S University, the response rates for program satisfaction are shown in Table 3. The questions are based on user experiences like the difficulty of using the platform and differences after the program. Looking at the average scores of the items, they ranged from the high 3s to 4s, indicating high satisfaction. The agreement rate for overall class satisfaction was 84.0% with an average score of 4.16. The agreement rate for the sense of realism compared to an actual lab was 78.0%, with an average score of 3.98. The differentiation between regular online classes and Metaverse platform online classes had an agreement rate of 86.0% and an average score of 4.24. The fourth and fifth items regarding the ease of use of the platform had average scores of 3.84 and 3.52 respectively, indicating some students found it challenging. 42.0% of students responded negatively to the difficulty item. For understanding how to use it, 80.0% agreed, while 20.0% responded negatively, suggesting that there might not have been enough instruction time. In comparison between remote classes and program classes, 82.0% agreed that the program classes were more engaging than previous ones. The average score for improved concentration and communication was 3.74, with an agreement rate of 60.0%, which was noticeably lower than other items. 74.0% agreed, with an average score of 4.0, that there's potential for this to be a future educational system. The agreement rate for the willingness to participate in the Metaverse platform class was 80.0%, with an average score of 4.10, indicating many students hope to continue participating.

As a result of an independent samples t-test, there was a statistically significant difference in satisfaction before and after using Metaverse (t=-2.910, p>0.05, Table 4).

Table 2. Current class status survey average and response rate (N=50)

Question	Average	It really is	Yes	Is average	No	Not very
I am satisfied with non-face-to-face classes	2.96	4 (8.0%)	9 (18.0%)	20 (40.0%)	15 (30.0%)	2 (4.0%)
The level of understanding of practice is high	2.32	7 (14.0%)	24 (48.0%)	15 (30.0%)	4 (8.0%)	0 (0.0%)
Class concentration is high	2.60	6 (12.0%)	17 (34.0%)	19 (38.0%)	7 (14.0%)	1 (2.0%)
Mutual communication is smooth.	2.62	6 (12.0%)	18 (36.0%)	17 (34.0%)	7 (14.0%)	2 (4.0%)

(It really is=5, Yes=4, Is average=3, No=2, not very=1)

Table 3. Program satisfaction average and response rate (N=50)

Question		Average	It really is	Yes	Is average	No	Not very
User experience	Are you satisfied with the class?	4.16	16 (32.0%)	26 (52.0%)	8 (16.0%)	0 (0.0%)	0 (0.0%)
	Did you create a sense of reality?	3.98	10 (20.0%)	29 (58.0%)	11 (22.0%)	0 (0.0%)	0 (0.0%)
	Is there differentiation and originality?	4.24	19 (38.0%)	24 (48.0%)	7 (14.0%)	0 (0.0%)	0 (0.0%)
	Was it easy to attend class?	3.84	8 (16.0%)	26 (52.0%)	16 (32.0%)	0 (0.0%)	0 (0.0%)
	Was the difficulty level easy?	3.52	5 (10.0%)	24 (28.0%)	14 (28.0%)	6 (12.0%)	1 (2.0%)
	Do you understand how to use it?	3.94	9 (18.0%)	31 (62.0%)	8 (16.0%)	2 (4.0%)	0 (0.0%)
Difference	Was it more interesting than a non-face-to-face class?	4.08	16 (32.0%)	25 (50.0%)	6 (12.0%)	3 (6.0%)	0 (0.0%)
	Has concentration and communication improved?	3.74	10 (20.0%)	20 (40.0%)	17 (34.0%)	3 (6.0%)	0 (0.0%)
	Is there potential for educational use?	4.0	15 (30.0%)	22 (44.0%)	11 (22.0%)	2 (4.0%)	0 (0.0%)
	Are you willing to continue taking classes?	4.10	15 (30.0%)	25 (50.0%)	10 (20.0%)	0 (0.0%)	0 (0.0%)

(It really is=5, Yes=4, Is average=3, No=2, not very=1)

Table 4. Independent sample t test based on satisfaction

Question	N	M ± SD	t	p
Satisfaction before using Metaverse	50	2.96 ± 0.98	-2.910	0.005
Satisfaction after using Metaverse		4.16 ± 0.68		

V. DISCUSSION

All educational institutions that educate radiology must not only improve the quality of non-face-to-face classes, which is inevitable due to the COVID-19 situation, but also visit the hospital to practice equipment that cannot be practiced at school due to problems such as cost, size, and lack of equipment. If this is implemented using a bus platform, it will be of great help in providing indirect experience with devices that cannot be practiced in schools. Students would have to visit hospitals directly for practical training on unavailable equipment[15,16]. However, if we implement this using a metaverse platform, it appears to be a significant aid in providing an indirect experience with equipment that cannot be used in schools. Additionally, even if the COVID-19 situation eases and onsite training is conducted, it has been confirmed that the platform can be used as an auxiliary teaching material to supplement the lack of practical experience for students who cannot participate in training due to COVID-19 infection, health, or personal circumstances[17]. So far, we have introduced the concept of the metaverse, the implementation of labs using the metaverse platforms Zep and Zepeto, an educational program and experience analysis targeting students, and lastly, the limitations of this research and the educational potentials identified through it. The use of metaverse platforms has expanded in various ways post-COVID than before. This study anticipates that the practical classes utilized in this research, along with regular lectures, club activities, and festivals in universities, will communicate and share information without temporal or spatial constraints and will further develop in more advanced dimensions, providing assistance in educational aspects. The metaverse's main advantage, where we can realize the things hard to achieve in reality without any temporal or spatial constraints and can greatly broaden the range of experiences, needs in-depth research. Radiology education also has limitations due to dose risk and the difficulty of training human subjects for actual education. Implementation of the Metaverse platform for these limitations is expected to be very helpful. Future research should clarify the causes of the problems mentioned above, and if research on the improvements and strategies for each platform progresses, significant results that move beyond the traditional educational system and apply to a new environment are expected.

VI. CONCLUSION

This study used the metaverse platforms ZEP and Zepeto (Build It) to implement practical lessons in a virtual world in situations where face-to-face classes were difficult due to COVID-19. We applied these directly in student classes and analyzed the satisfaction, practicality, originality, and reality of online classes through a survey of students. The research results confirmed both the positive and negative aspects of the metaverse platform and its future orientation. Practical lessons, where learned theories are applied in real life, require significant interaction between professors and students, as well as among students. However, such lessons can be insufficient for acquiring knowledge or skills and can hinder smooth interaction between team members. Thus, the current remote practical lessons can be seen as increasing the difficulty level for students, decreasing understanding and concentration. In contrast, it was confirmed that practical lessons using the metaverse program could provide high satisfaction for college trainees.

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방사선학 교육에서 메타버스 젭과 제페토 앱을 활용한 가상공간 활성화 방안

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요 약

방사선학의 교육은 실습이 많은 비중을 차지하며 비대면 온라인 교육으로 진행되기 어려운 실정이다. 본 연구에서는 실습교육을 대체할 수 있는 메타버스 플랫폼을 활용하여 비대면 수업으로 접하기 어려운 실습실을 가상 세계로 구현 후 실습수업 이후 학습자들의 만족도 및 메타버스 플랫폼 수업의 실용성과 교육과정의 미래 지향성을 알아보고자 하였다. 메타버스 플랫폼인 제페토(빌드잇)와 ZEP(젭) 을 활용하여 S대 방사선학과 실습실을 가상 세계로 구현하여 학생들의 수업에 활용하였다. 총 50명의 학생이 각각 사전, 사후 조사로 나누어 총 2회 설문조사를 실시하였고, 모든 문항은 리커트 5점 척도가 사용되었다. 연구결과 메타버스 가상공간 이용하지 않은 교육은 2.32로 만족도가 낮은 반면 가상공간 활용을 통한 교육은 4.16으로 매우 높게 나왔다. 분석 결과, 새로운 교육 시스템의 만족도와 메타버스 플랫폼 수업의 실용성은 매우 높으며 추후 앱설명 등 추가 교육 진행 시 더욱 효과적인 교육 플랫폼이 될 것으로 사료된다.

중심단어: 메타버스 활용 수업, 가상공간, 비대면 활성화, 실습 과목, 방사선학 교육

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