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Game-type as Metaverse System for Problem Based Learning Classes

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Abstract

After COVID-19, various metaverse platforms for online lectures are being provided. Most of the classrooms are tiered type, and they are divided into intensive classrooms and open classrooms depending on the shape of the classrooms. Intensive classrooms provide a one-sided lecture format, so there are many difficulties in conducting communication-based classes that carry out team missions like PBL classes. In this study, we propose a metaverse classroom that applies the functions of a multiplayer online role-playing game (MMORPG), one of the game genres suitable for PBL classes. The proposed system provides various interaction techniques for PBL classes. We evaluated user satisfaction when this was applied to actual classes. As a result of the evaluation, it was found that users preferred text and voice chatting more than video chatting and solving missions like games was very helpful in online classes.

Keywords: *Metaverse, MMORPG, Open-Classroom, PBL*

1. Introduction

Since COVID-19, there have been many attempts to utilize metaverse in various industries[1]. In the field of education, which must be conducted in an untact environment, a method for using an online platform as a necessity has been suggested[2]. Various online education methods have been proposed from elementary school to university, but due to the nature of education field, it is difficult to cope perfectly in an untact condition so the method is used only as a temporary method. In particular, the one-way content delivery method of education caused many problems, and the learning effect of students was also sluggish[3]. In the early days, online video conferencing platforms such as Zoom, Cisco Webex, and Google Meet were widely used. As the metaverse platform gradually became popular, the educational environment has been developed in the direction of increasing realism and immersion with a model similar to an actual classroom in a three-dimensional space[3]. Most of the 3D-based classrooms used intensive tiered classrooms. In these classrooms, users had to go and sit down cumbersomely in order to use the attendance system, which caused most users to complain of inconvenience, and there is also a disadvantage that lectures cannot be conducted freely. In the

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case of Problem Based Learning(PBL) classes, team activities should be performed centrally, but intensive classrooms are fixed, so free teaching and learning cannot be achieved[4].

In this study, we propose a PBL-based open metaverse system (PBOMS). PBOMS applies the game elements of the existing Multiplayer Online Role-Playing Game (MMORPG) to allow role-based PBL classes to be conducted[5, 6]. Since PBL classes are taught by forming a team, discussion-based communication between team members is very important[7, 8]. In addition, accurate and detailed guides for the instructor's learning operation should be provided for learners to concentrate on classes without confusion[9]. In this study, the system was developed considering these functions.

The structure of this study is as follows: In Section 2, differences from the system proposed in this study is explained by comparing and analyzing various metaverse types; in Section 3, system design through comparative analysis for intensive classrooms and open classrooms is covered; in Section 4, results of applying the actual metaverse to class are introduced; and in Section 5, conclusions and future challenges are addressed.

2. Related Works

2.1. Metaverse for Online Education

Ifland provides an intuitive and easy UI on mobile platforms[10]. When the ifland app is launched, the home screen appears, and this home screen contains all the main functions of ifland. At the top of the application, the user's avatar profile appears, and at the bottom, a list of metaverse recommendations similar to the metaverse used by the user is displayed. If the user has registered interest in the room to be opened in advance, the user can receive a participation notification in advance to access without missing the timing. In addition, ifland is a metaverse specialized in broadcasting, character decoration, and social functions, as its main customer base is the MZ generation. For this reason, it is light and accessible, but there are shortcomings in delivering real-time lecture contents and operating teaching and learning such as team assignments.

Figure 1. Gather.town Metaverse

Gather Town is a metaverse platform that can conduct virtual offices and video conferences on the web platform[11]. The biggest feature of Gather Town is that video screens such as Zoom or Google Meet can be shared on the 2D game screen. Therefore, it is a platform that has been well-received in the COVID-19 era in

that it is possible to work without gathering offline while embodying the same location as the actual office. The three main functions are spatial audio, private space, and spotlight functions, and these are mainly focused on conversing with the other party in a specific situation. Mainly, when conducting business and meetings, blackboards and whiteboards are used to support more realistic meetings.

MOIM is a representative metaverse platform that conducts cascading lectures[12]. Most of the interactions of the meeting are composed of UI, and all interactions in the form of general lectures including moving seats, expressing emotions, and raising hands are supported.

Figure 2. Tiered classroom in metaverse: MOIM

Gather Town and MOIM are metaverse spaces that are often used in online education. For Gather Town, the map composition is 2D, so the character's movement is visually seen in the top view. This top-view form has the advantage of being able to grasp the overall work status, interaction with others, and movement at a glance[13]. In particular, since it was created by modeling real-world business situations like offices and meeting rooms, even first-time users can easily identify the location and purpose. In the case of Gather Town, users can easily recognize the entire map with the top view function, but there are many inconveniences in moving to a certain point. Functions such as an automatic path movement that automatically moves to a specific location are not supported.

In addition, ZEPETO and oVoice are metaverse environments well known to the general public, but they are community-oriented and provide functions suitable for meeting and office environments[14, 15]. On the other hand, classroom functions that apply PBL-based game elements are not provided.

Table 1 shows the comparative analysis of the lecture function in the metaverse, which is widely used by the general public, and PBOMS, an open classroom metaverse system provided in this study.

Table 1. MAnalysis by metaverse function

Type / Function	zepeto	gather.town	ifland	oVoice	MOIM	PBOMS
Chat	O	O	O	O	O	O
Voice Chat	O	O	O	O	O	O
Customizing	O	O	O	O	O	O
Private Room	O	O	O	O	△	O
Free Movement	O	O	O	O	X	O
Point of View	O	X	O	X	O	O
Route System	X	X	X	X	X	O
Camera	O	O	O	O	O	O

2. PBOMS System

2.1. Intensive Classrooms and Open Classrooms

In this study, the suitability of PBL classes was judged by analyzing the existing metaverse classrooms. As a result of the analysis, it was classified into two types: an intensive classrooms, which is a method of gathering and taking classes like tiered classrooms in the university, and open classrooms, which is a form of taking classes freely in an open space without being constrained to a specific location[16].

Table 2. Analysis by metaverse function

	Advantages	Disadvantages
Intensive Classroom	1. Easy to focus on key concepts and principles. 2. Effective in conveying a large amount of knowledge or information in a short time. 3. Educators with excellent abilities and qualifications can provide high-quality lectures to many learners. 4. Provide a sense of stability to passive learners as the process is led by the educator. 5. Easy to control or identify learners.	1. Learner participation is limited since the educator unilaterally leads the lecture. 2. The role of learners is passive if there is no active participation such as questions or discussions by learners. 3. Difficult to grasp the learner's level of understanding or correct errors as the lecture is led by the educator.

Open Classroom	1. The learner's self-directed learning ability is improved. 2. Participation in learning increases. 3. Feedback between educators and learners can be easily achieved. 4. Classes are held in a freer atmosphere.	1. The concentration of the learner may be disturbed. 2. Difficult to control or identify the learner. 3. Difficult to convey a lot of knowledge and information in a short time.

An open classroom platform takes the form of a single room in a classroom. In other words, instead of entering the classroom through the lobby, a method of entering directly after creating an open classroom was adopted. The differentiating factor proposed in this study is that it is different from the existing form of creating a lobby and entering a room. Intensive classrooms include MOIM, oVoice, Pukyong National University and Dongshin University metaverse, and open classrooms include ZEPETO, Gather Town and ifland.

2.2. System Design

The PBOMS proposed in this study should provide various communication functions for the progress of PBL classes. Text and voice chatting services can be used by adding additional services in the game engine, but video conferencing using a camera must be implemented separately. In this study, a video conference was implemented by applying Agora which is provided as an open source. Text, voice, and video conference interactions were applied differently according to the number of concurrent users.

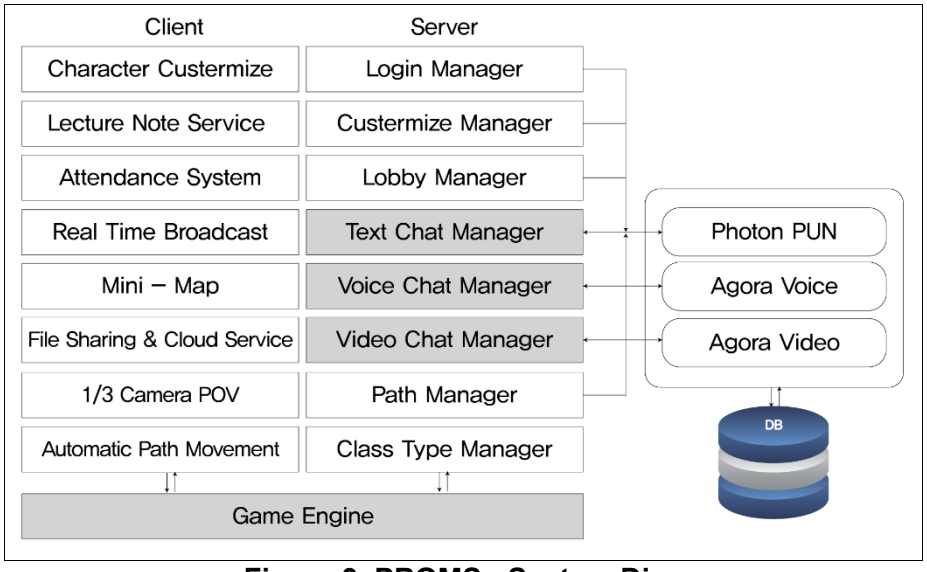

Figure 3. PBOMS : System Diagram

Figure 3 shows a diagram of the entire implemented system. Among the implementations of client technology, character customization is a system that allows users who enter the lobby to select and change their character. The lecture notes service enables visualization of lecture materials in a three-dimensional space in a cloud environment. The attendance system is a service for handling attendance of students participating

in open classes. Real-time broadcasting is a service in which instructors give lectures in a real-time virtual space. Through the mini-map, the instructor can give learners roles and monitor learners' situations when exploring. Lecture materials can be shared through file sharing and cloud services. First-person and third-person camera views are provided. In addition, an automatic path movement is applied to move students to the desired location in an open classroom.

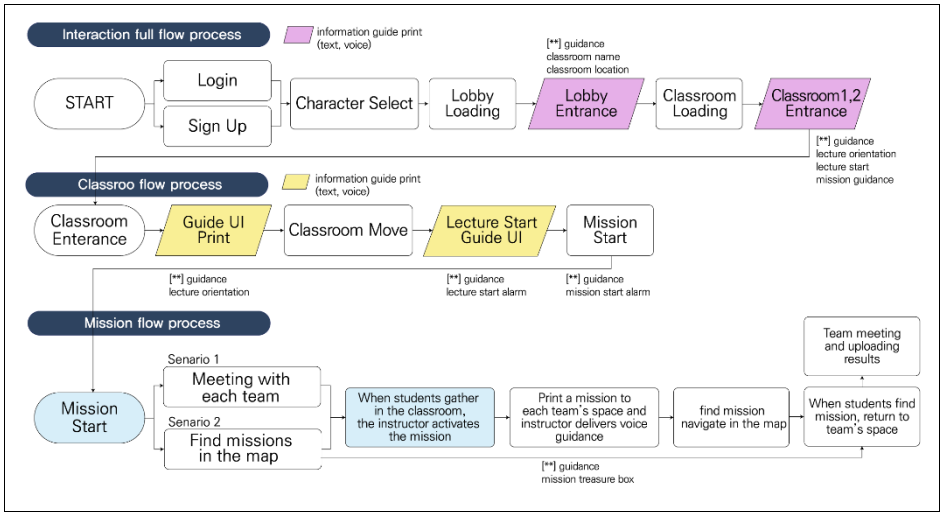

Figure 4. Interaction guidance of PBL lecture in metaverse

Figure 4 shows the guidance process of the system by dividing it into three stages: an open classroom process, a detailed process within the classroom, and a role process. Various interactions must be considered to conduct PBL classes in an open classroom environment. Unlike intensive classrooms where all lecture processes are focused on the instructor, in an open classroom, a variety of activities take place, so sufficient GUI design should be made.

PBOMS proposed in this study utilizes two maps: an urban map where classes are held in the city and a medieval map focused on exploration in the middle ages.

Figure 5. (a) Both Middle Ages Map & (b)City Map in PBOMS

Figure 5(a) shows the entry screen of the Middle Ages Map and Figure 5(b) shows the entry screen of the City Map. These two maps are optimized for the game-type.

4. Experiments and Results

Classes were conducted in the metaverse environment for 1 hour a week for 3 times for first year students in the Department of IT Engineering. Figure 6 shows students taking PBL classes in the actual metaverse environment, and figure 7 shows the avatars of students who access the metaverse.

Figure 6. Apply to lecture (The first year of university)

Figure 6 shows the results of students participating in the game-type metaverse for PBL during actural classs time.

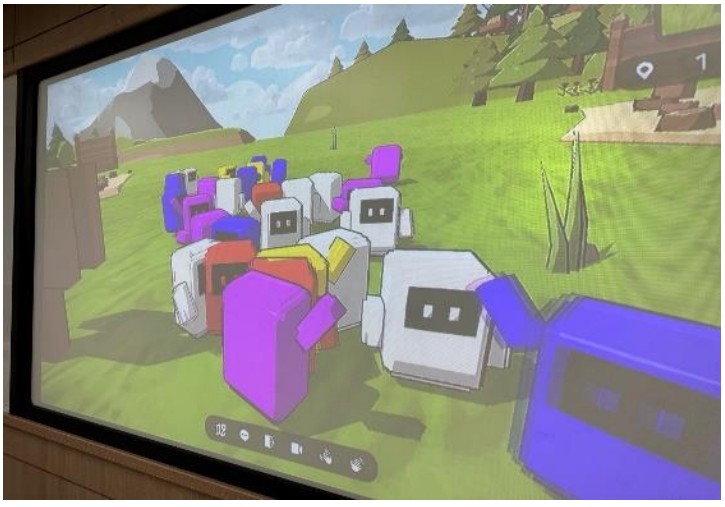

Figure 7. Lessons in the metaverse environment

Figure 3 shows characters in the PBOMS that students directly manipulate. After the 3-week class was over, a questionnaire was conducted. The contents of the questionnaire are shown in Table 3. Functional investigation of PBOMS, PBL class satisfaction, GUI environment, and important communication in PBL class were investigated[17].

Table 3. PBL class survey contents

Function	Contents of Questionnaire
Text Chat Voice Chat Video Chat Real Time Broadcasting Lecture Material Sharing Quiz (Role) Route System	Was the function performed properly?
	When the untact class is conducted with the corresponding function, does the level of interest and fun of the user increase?
	Does the function facilitate communication with other players?
	Do you think that this function is helpful for the user's lectures?
	Did you have any difficulties using this function?
PBL Class	Was the PBL lecture helpful in understanding the contents of the class compared to the existing lecture?
	Was communication with classmates smoother during the PBL lecture than in the existing lecture?
GUI	Is the structure of the UI intuitively easy to understand?
	Do you like the appearance of the main character?
	Are the colors of the main characters varied?
Communication	Approximately how many times did you use text chat while playing?
	Approximately how many times did you use voice chat while playing?

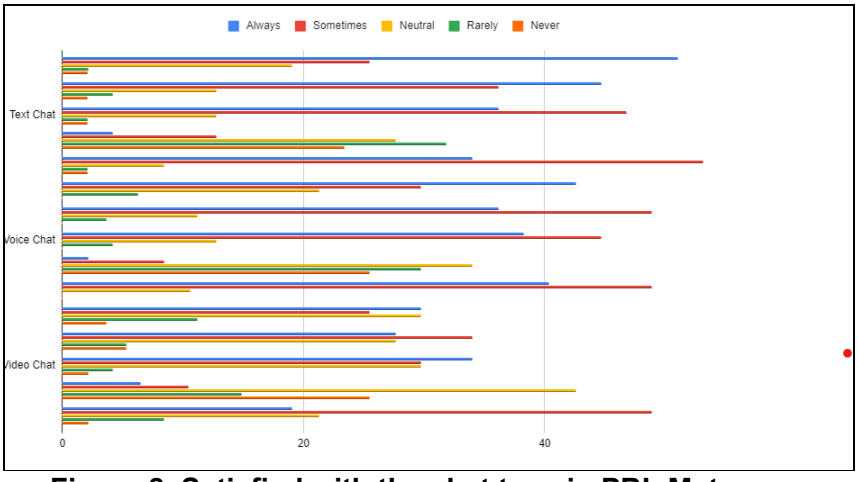

Figure 8. Satisfied with the chat type in PBL Metaverse

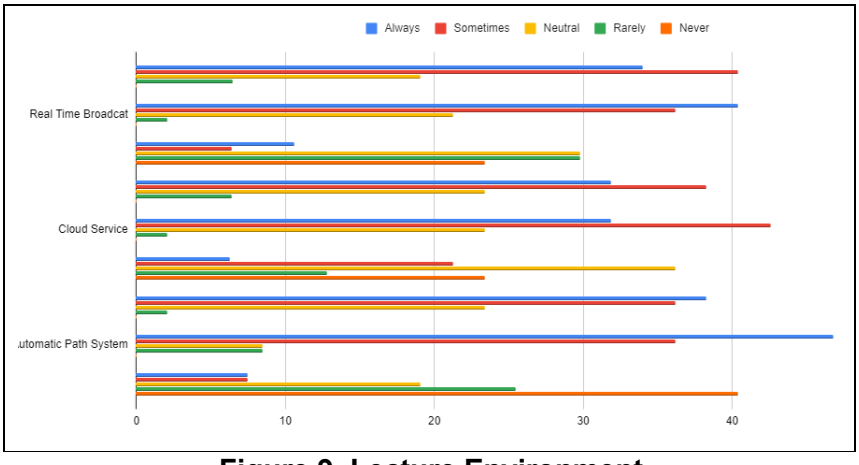

Figure 9. Lecture Environment

Figure 8 shows the overall satisfaction survey results for text, voice, and video chatting. From the results that users generally prefer text chatting and voice chatting to video chatting, it can be inferred that texting is more convenient than voice chatting. Figure 9 shows the function investigation results for the instructor's real-time lecture broadcast, lecture materials through the cloud, and the file sharing system.

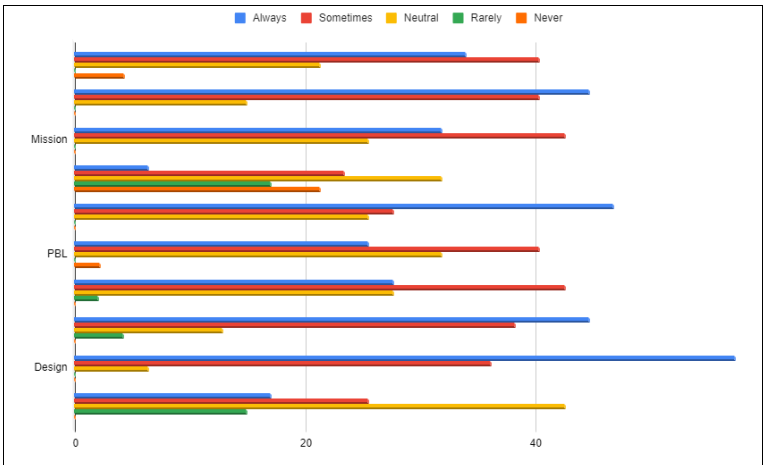

Figure 10. Lecture Environment in PBL Metaverse

A general automatic path movement from the metaverse to the classroom was investigated. In general, users' satisfaction was higher when the instructor gave a lecture in real time rather than showing a video lecture. Utilizing lecture materials through the cloud in the metaverse was not very satisfactory. Lastly, automatic path movement had a very high level of satisfaction, which can be seen as a necessary function in the attendance system. Figure 10 shows the results of the survey on PBL classes and UI. In fact, satisfaction in the process of solving missions was average, but users pointed out the need to conduct PBL classes in the metaverse. Since it is a first grader, preference for cute characters was high in UI design.

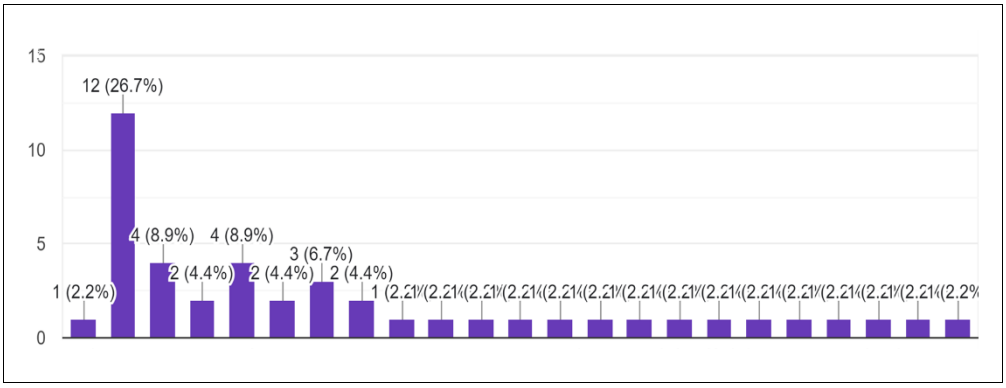

Figure 11. How many times text chat while playing

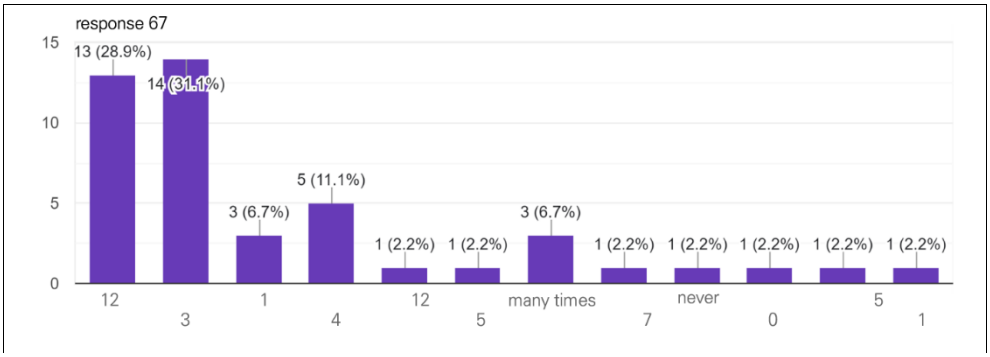

Figure 12. How many times voice chat while playing

5. Conclusion

In this study, a system that can obtain efficient educational effects in conducting PBL-based classes in the metaverse is proposed. In general, when lectures are conducted in the current metaverse, intensive classrooms are used. The intensive classroom is inefficient in that it is inconvenient to move around and the concentration of students decreases during lectures for a long time. In particular, PBL classes in which various discussions take place cannot be conducted in an intensive classroom. In order to solve these problems and facilitate PBL classes, we developed a metaverse system based on open classrooms.

PBOMS is the system proposed in this study and includes various functions for PBL classes. It is characterized by supporting text, voice, and video chatting for team activities. Instructors provide problems in real time, and learners have to produce results through virtual collaboration in time. Classes are conducted in such a way that the games are actually played. In this study, actual classes were conducted with first-year university students for three weeks, and a survey was conducted afterwards. Open classrooms were superior to intensive classrooms, and a communication system for various activities was found to be essential. Lastly, rather than conducting classes only offline, a combination of online and offline classes was required.

In the future study, we plan to increase class satisfaction through research on applying various functions of online games to PBL classes.

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