MetaClassroom:
A WebXR-based Hybrid Virtual Reality Classroom

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***Abstract*—The primary objective of this study is to design and implement a virtual reality classroom that incorporates the OMO (Online Merge Offline) concept. Utilizing WebXR technology, a virtual reality classroom environment is created, enabling teachers and students to interact within this immersive space via various devices, including mobile phones, tablets, laptops, and VR devices. Currently, the system has established two virtual reality scenes in both classroom and discussion room settings to provide students and teachers with a highly realistic virtual reality classroom experience. It is worth mentioning that these virtual reality scenes have been tested by university students and instructors and received positive feedback.**

Keywords—Virtual Reality, Virtual Classroom, WebXR

I. INTRODUCTION

The COVID-19 pandemic has led many countries to transition from traditional face-to-face education to online distance learning in an effort to mitigate the spread of the virus, posing significant challenges for the education community [1]. While distance learning offers a solution for students unable to attend school in person, it presents new difficulties, such as decreased academic performance for some students [2, 3].

In traditional classrooms, teachers can assess students' understanding and progress through real-time interactions and discussions [2, 3]. However, distance learning lacks a physical classroom environment and offers reduced opportunities for language, gesture, and eye contact, hindering teachers' ability to gauge students' comprehension [4, 5]. Consequently, many teachers report students struggling with online learning [2]-[4].

Existing literature on distance learning focuses on challenges and limitations during the pandemic, but few studies explore innovative solutions integrating virtual reality (VR) technology to address these issues [6]-[8]. In response, our study develops and evaluates a hybrid virtual reality classroom, Meta Classroom, which enhances multi-person distance learning by blending physical and virtual environments for a more engaging and interactive learning experience.

Meta Classroom utilizes VR technology to transport students into a simulated and immersive classroom environment, enabling real-time interactions with teachers. This approach overcomes traditional online education challenges such as reduced language, gesture, and eye contact. Meta Classroom permits students to participate in virtual classes from anywhere using various devices and provides access to tools and resources that enhance their learning experience. The VR classroom environment fosters real-time interaction between teachers and students, addressing conventional distance learning limitations. By offering an innovative solution, Meta Classroom holds the potential to revolutionize the way students learn and interact with their teachers.

II. IMPLEMENTATIONS AND APPLICATIONS

The Meta Classroom is an innovative multi-person distance learning platform that integrates WebXR technology to overcome the limitations of traditional video conferencing. This cutting-edge system provides immersive virtual classrooms and discussion rooms for teachers and students, facilitating real-time, face-to-face communication and interaction across various devices, thereby simulating a physical classroom experience (Fig. 1).

Aiming to achieve virtual reality hybrid teaching, the Meta Classroom incorporates OMO (Online Merge Offline) to blend online and offline technologies seamlessly. This accessible platform enables teachers and students to enter the virtual reality classroom environment through mobile devices, laptops, or VR devices for an even more immersive experience. The platform consists of two distinct scenes: a classroom and a discussion room, both furnished with projection walls and TV screens for screen sharing.

In the virtual environment, students can freely move, change their posture, or raise their hands to indicate their learning status (Fig. 2). Teachers can efficiently organize group discussions by assigning students to different discussion rooms and providing guidance as needed. Features such as multi-voice synchronized instant messaging, screen sharing, and multi-person video systems not only remove communication barriers but also

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enhance instructional methods and student engagement in group discussions (Fig. 3). Furthermore, the system's adaptability allows for the integration of customized tools and resources to cater to individual learning needs, fostering a more effective and immersive educational experience overall.

Fig. 1. VR Experience Screen

Fig. 2. VR Classroom Scene

Fig. 3. VR Discussion Room Scene

III. Discussion and Conclusion

In conclusion, this study aimed to develop, evaluate, and test the Meta Classroom platform as a novel solution to address the limitations and challenges posed by traditional distance learning. By leveraging virtual reality technology, the platform provides students with a highly immersive and interactive learning experience, blending the advantages of both physical and virtual environments. The main findings, obtained through initial testing in diverse settings such as universities and elementary schools, indicate that the platform has garnered positive feedback from both teachers and students alike.

This study contributes to the field of distance learning by introducing the innovative Meta Classroom platform, which demonstrates a promising solution to the challenges inherent in traditional distance learning. Incorporating the novel concept of OMO (Online Merge Offline), it seamlessly integrates online and offline technologies, offering a unique and effective solution for the education community. This groundbreaking approach has the potential to revolutionize the way students learn and interact with their teachers.

Our experiments assessed the platform's immersive and interactive features, as well as its ability to seamlessly integrate online and offline technologies through the innovative concept of OMO (Online Merge Offline). The results demonstrated the platform's potential to transform the educational landscape by providing a unique and effective solution for the education community.

Based on these findings, we recommend that practitioners consider adopting the Meta Classroom platform to enhance distance learning experiences. Furthermore, the development of user-friendly VR scene editors for teachers and educators could facilitate the customization and creation of tailored virtual learning environments, promoting more engaging and effective educational experiences for students.

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