THE EDUCATIONAL USE OF MATH METAVERSE PLATFORMS FOR STUDENT ACTIVE LEARNING IN ONLINE CLASSES

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Abstract

Higher-educational institutions offer a variety of online courses because of advanced technology and remarkably improved students' and instructors' abilities to use educational applications. Instructors easily post or produce video lectures on their class websites and interact with students through Zoom or Microsoft Teams. However, students in online classes often have concerned that they could not keep up with their online classes. In addition, they do not expect interactions with their classmates and can't have instant feedback from instructors. Even if students can meet instructors through Zoom, students often shy to ask questions. Because of the limitations in online classes, students accept as a fact that they have to study alone while they are taking online classes. Even if students are in online classes, they can often meet their classmates and learn materials through a wide range of activities on a platform. Can instructors provide the educational environments and pedagogical instructions for students in online classes? The questions lead to the word "Metaverse" because the educational uses of virtual avatars could significantly improve students' engagement and meet students' high demands for new educational approaches utilizing innovative technologies. This presentation provides the definition of Metaverse, a list of educational Metaverse platforms, and an instructional strategy in online classes.

Introduction

The metaverse is a neologism that combines "meta," which means virtual and transcendent, and "universe," which means the world and the universe. The concept of the term was first used by Stephenson's 1992 vison of an immersive 3D virtual world. Acceleration Studies Foundation (ASF) states the term as virtually enhanced physical reality and physically persistent virtual space (Smart, 2007). In addition, ASF provides four categories in the Metaverse future: Virtual Worlds, Mirror Worlds, Augumented Reality, and Lifelogging. The four types of Metaverse are already used in recent years. For example, Head Up Display (HUD) in augmented reality, uploading work or study videos in lifelogging, online conferences or lectures using Zoom or Team in Mirror Worlds, and 3D multi-access online game in Virtual Worlds. The concept of Metaverse may be unfamiliar, but in fact, we already live in Metaverse. During the COVID-19 pandemic, math instructors provided remote classes through Zoom or Microsoft Teams, and uploaded videos and materials. Students attended remote classes anywhere and they could repeatedly review learned materials anytime through eLearning. During the pandemic, students have improved their abilities for using online educational materials and applications. According to increasing vaccination rates, math instructors have provided face-to-face lectures. However,

their pedagogical methods through live-video conferences or face-to-face classes have mainly used lecture-centered approaches instead of student-centered methods. Moreover, students became passive learners in online learning or live Zoom classes because of teacher-centered learning and limited activities. Even if I provided a lecture in face-to-face class, a similar phenomenon occurred because of limited time and places. Regardless of the types of online or face-to-face classes, how can math instructors promote students to be active learners, and to improve their engagement and conceptual understanding of mathematics materials? In addition, how can math instructors develop their pedagogical approaches using innovative technologies to meet improved students' e-learning abilities with advanced educational technologies?

Pedagogical Frame

- **Video lectures**: Students watch video lectures based on a class schedule.
- **Homework through MyMathLab or WebAssign**: after watching videos, students work on homework assignments through MyMathLab or WebAssign.
- **Activities on Metaverse platforms**: Students using their avatars do worksheets as group work or presentations on Metaverse platforms. A 50-minute meeting would be 8 times during a semester.

Metaverse Platforms			
	Equipment	**Advantages**	**Disadvantages**
Gather Town	PC, mobile	• Easy operation and build world maps • Open worlds • Fast accessibility	Up to 25 people free
ZEPETO	Android, Iphone, Tablets, PC	• Easy operation • Open worlds • 3D lively Avatar • Free accounts	Difficult construct world maps
Roblox	Android, Iphone, Tablets, PC	• Easy operation • A large number of users • Free accounts • 3D avatar	• Difficult construct world maps • Monotonous avatar
Minecraft	PC, mobile	• Easy operation • A large number of users • 3D avatar	• Low compatibility • No free accounts • Difficult construct world maps

Implications

According to the COVID-19 pandemic, social networking services (SNS), live-video conferences, and 3D Virtual Reality online games increased students' interests in interactive digital spaces. To meet students' improved digital learning abilities using advanced technologies, this project adopted two innovative approaches for students' success in learning math: 1) learning mathematics using Avarta or virtual characters in Augmented Reality (AR) worlds and 2) learning mathematics from experience in Metaverse instead of listening. The use of Avarta or virtual characters in AR worlds encouraged students to be interested in learning mathematics and promoted students to be active learners. Students can build their own Avartas and actively participate in problem solving or activities with low mental pressure. For example, students can present or share their work in front of their peers in AR worlds using 3D virtual tools. To increase students' conceptual understanding of new materials, some instructors adopt 3D graph calculator websites. However, students still have difficult to understand concepts because they still listen instructors' lectures and do not have many opportunities to explore their questions by themselves. Many math Augmented Reality worlds in this project enhanced students' interests to learning mathematics materials through virtualization, and encouraged students to learn new concepts from experience instead listing lectures. For example, students can go to 3D Golden Gate Bridge in Metaverse to learn characteristics of parabola functions and explore the characteristics of parabola functions through 3D Golden Gate Bridge in Augmented Reality worlds. After that, they can discuss or present their outcomes in Augmented Reality Worlds. Therefore, this math Metaverse project changed lecture-centered learning to student-centered learning using advanced 3D technologies. Students in this project improved their conceptual understanding of learning mathematics through virtualization and experience in Augmented Reality worlds. Implementing this project adopted new approaches for students as the following:

1) Promoting students to be active learners: The use of Avarta in Augmented Reality worlds enhanced students' interests in learning mathematics and students' engagement both inside and outside class.
2) Learning from experience in Augmented Reality worlds: A variety of Augmented Reality worlds with 3D graphs of functions provided opportunities for students to improve their conceptual understanding of mathematics from experience instead of listening lectures.
3) Adopting new innovative 3D technologies in education: Students learned how Metaverse is used in education.

Conclusions

Implementation of this project promoted student engagement utilizing students' Avatars in AR worlds because of students' high immersions through visualization. Students' virtual experiences in AR worlds encouraged students to be active learns, and to improve their conceptual understanding of mathematical content and critical thinking. The results of this project transformed lecture-centered learning to student-centered learning and stimulate students' interest in mathematics contents. Students can explore real-life places to solve application problems using their Avatars and 3D graphical tools. In addition, they can immediately share their solutions and ideas inside and outside class in Metaverse. Therefore, this project stimulated peer-tutoring and collaborative learning, and improved their achievements in 3D innovative virtual learning environments.