

Revolutionizing Education: Integrating Metaverse and the First AI Lecturers in Cross-Campus Higher Education

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(a)



(b)



(c)



(d)

Figure 1: AI lecturers, in forms of (a) video and (b) VR at one campus, (c) video and (d) VR at the other, teaching simultaneously.

Abstract

This paper presents the first global adaptation of Artificial Intelligence (AI) lecturers and the MetaClassroom, a virtual environment that operates with and without AI lecturers in higher education. The study involved two cross-campus postgraduate courses conducted over four consecutive semesters (N=18, 26, 20, 35) within the Thrust of Computational Media and Arts (CMA) at the Hong Kong University of Science and Technology (Guangzhou) (HKUST(GZ)) and the Division of Emerging Interdisciplinary Programs (EMIA) at the Hong Kong University of Science and Technology (HKUST).

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We provide a detailed description of the courses, methods, and pedagogical impact, as well as insights into practical implementation, including challenges and best practices. Additionally, we compare traditional, online, and VR classes, both with and without AI lecturers, based on our observations and interviews with 24 students. The paper also summarizes feedback collected from students and our teaching team, outlining future directions for integrating immersive technology and digital humans into educational practices.

CCS Concepts

• Applied computing → Education; • Human-centered computing → Virtual / mixed reality .

Keywords

Education, Virtual Reality, Digital Humans, EduTech, Immersion

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1 Introduction

The concept of the metaverse, including augmented reality (AR), virtual reality (VR), mixed reality (MR), extended reality (XR), and other immersive media, has expanded worldwide, influencing not only entertainment but also practical domains such as education and healthcare [Lanier 2017; Milgram and Kishino 1994; Pang et al. 2025]. This trend is further strengthened by the rise of AI generative content (AIGC), which is now highly mature in image and video generation [Cao et al. 2023; Elgammal et al. 2017]. Scholars predict that AIGC will transform the metaverse, especially in areas such as avatars and agent development, where virtual entities represent humans and technologies [Deary 2020; Wang et al. 2024].

Digital humans have emerged in various sectors, notably with virtual influencers [Jhawar et al. 2023; Lu et al. 2021]. By combining VR, motion capture, human animation, and video analysis, they are now used in decision-making, surgery, games, and simulations [Tang et al. 2024]. Educational research also explores digital humans and conversational agents in teaching and learning contexts [Lieb and Goel 2024; Manfredi et al. 2023; Tan et al. 2025; Ullrich et al. 2024]. Among these applications, digital teachers are increasingly relevant for their accessibility and scalability, offering a partial solution to the global shortage of 69 million educators and promoting affordable education [on Teachers for Education 2030 [n. d.]]. Since education underpins both individual and societal progress, teaching methods must evolve through rigorous experimentation and analysis [Darling-Hammond 1996].

Building on this context, two postgraduate courses at HKUST and HKUST(GZ) introduced the **MetaClassroom** and **AI lecturers**, marking a shift toward innovative pedagogy. Traditional settings often struggle to provide the interactivity and personalization required in the digital era [Garrison 2016]. The MetaClassroom, which is an immersive virtual space, connects students across campuses for collaborative learning [Chen et al. 2023], while AI digital teachers deliver scalable and consistent instruction tailored to individual learning styles.

Together, these projects redefine how higher education can integrate technology to improve engagement, learning outcomes, and inclusivity. This paper presents **(i) the application of digital teachers and MetaClassroom in teaching, (ii) feasible course arrangements with emerging technologies, (iii) limitations and improvements, (iv) comparisons of traditional, online, and VR classes with and without AI lecturers, and (v) future directions for more personalized learning.**

Beyond pedagogy, this work contributes to computer graphics through the the creation and rendering of AI lecturers and VR digital humans. Each VR digital teacher is built using 3D modeling, rigging, and animation blending optimized for teaching environments. Lip sync and gesture retargeting employ established computer graphics pipelines from film and interactive media. The MetaClassroom's

VR design, including spatial composition, and dynamic lighting, enhances user immersion and emotional engagement. These advances illustrate how computer graphics can drive new immersive paradigms for learning.

1.1 Background

Technology in higher education has progressed from basic online systems to immersive learning environments. Virtual and extended reality now support initiatives such as the Metaverse campus [Duan et al. 2021], immersive class activities [Hodgkinson 2015], and XR learning scenarios [Kamińska et al. 2023; Marks and Gil Parga 2023]. These developments signal a shift toward participatory and cross-campus modes of learning.

Traditional instructional models, including the 5E framework [Bybee and Landes 1990] and Problem-Based Learning (PBL) [Wood 2003], offer valuable pedagogical bases but provide limited personalization and scalability across remote contexts. AI-augmented approaches expand these models by offering adaptive feedback and consistent support. Within this trajectory, **MetaClassroom** and **AI digital teachers** aim to foster collaborative, inclusive, and self-paced learning experiences.

Artificial intelligence (AI) has rapidly become a catalyst for educational transformation. Studies show its impact on adaptive tutoring, automated assessment, and conversational learning assistants [Sajja et al. 2024]. Broader analyses emphasize AI's potential to support data-driven personalization while reinforcing the need for ethical and pedagogical oversight [Chakraborty 2024; Sajja et al. 2025]. These insights frame the integration of generative and embodied AI within higher-education contexts.

Building on these insights, our projects extend the discussion from short-term trials to sustained practice. By embedding AI lecturers within multi-semester MetaClassroom environments, we investigate how embodied digital humans enhance engagement and continuity in higher education. Combining pedagogical frameworks with computer-graphics techniques—such as real-time rendering, animation blending, and motion capture—this work demonstrates how digital humans can evolve from experimental tools into integral components of future learning ecosystems.

1.2 Sustainable Development Goals (SDGs)

The United Nations' 17 Sustainable Development Goals (SDGs) [Fund 2015] address global social, economic, and environmental challenges by 2030. Our project supports these goals via AI-driven avatars and VR-based learning environments that enhance accessibility, inclusivity, and collaboration. In particular, it advances **SDG 4: Quality Education** and contributes to broader sustainability efforts.

2 Courses Descriptions

The followings outline our approaches that have been implemented as part of two postgraduate courses successfully. A detailed description of the course arrangement and examples are also provided.

2.1 MetaClassroom

2.1.1 EMIA6500C - Metaverse Cross-disciplinary Design Thinking (Fall Semesters). This course runs within our self-developed extended reality (XR) environment, named MetaClassroom. Students simultaneously join the immersive virtual classroom remotely to learn problem solving and explore team collaboration. The course focuses on user-collaborative design methods for generating inclusive product solutions that integrate stakeholder and product functionality perspectives. Students create a designated product /process /policy /protocol /plan (5P) concept models using recursive user feedback engagement methods, experimental prototyping, and divergent and convergent ideation strategies. Featured topics include design thinking; stakeholder research; concept development, screening, and selection; and interaction design.



Figure 2: EMIA6500C at (a) a classroom, and (b) the other remote classroom in another campus simultaneously.

In the Fall semester of 2023 and 2024, 18 and 20 students from HKUST and HKUST(GZ) (see Figure 2) immersed themselves in the MetaClassroom, overcoming the limitations of physical restrictions, to learn design thinking and its application in metaverse education.

2.1.2 Preparation. Through our self-developed VR MetaClassroom using Unity¹, participants in a lecture, tutorial, and seminar – whether physically present at different location, or virtually – can communicate with one other. Avatars were used to represent online and other campus users. Apart from the classroom settings with sufficient space to walk around (see Figure 3a), we arranged fifteen VR headsets² at each campus (see Figure 3b). To provide a smooth teaching performance and deal with possible technical accidents, a technical supporting staff and three teaching assistants were arranged in each campus apart from the course instructors. Figure 3c depicts the virtual environment of the MetaClassroom.

2.1.3 Design and Features. Here we describe our design and features in two subsections: **(a) classroom settings** (see Figure 3) and **(b) the three main functions**.

In virtual classroom settings, there is a welcome area (see Figure 4 a) after selecting avatars (see Figure 4 b). In the classroom, there are grouped seating arrangements (see Figure 4c) that are conducive to group discussions, a main display (see Figure 4d) that ease the teacher's lecturing, and poster demonstration (see Figure 4e) for students' presentation.

¹<https://unity.com/>

²We used Meta Quest Pro in this course. Ten of these were for students and the others were for teaching team, battery charging, and backup.

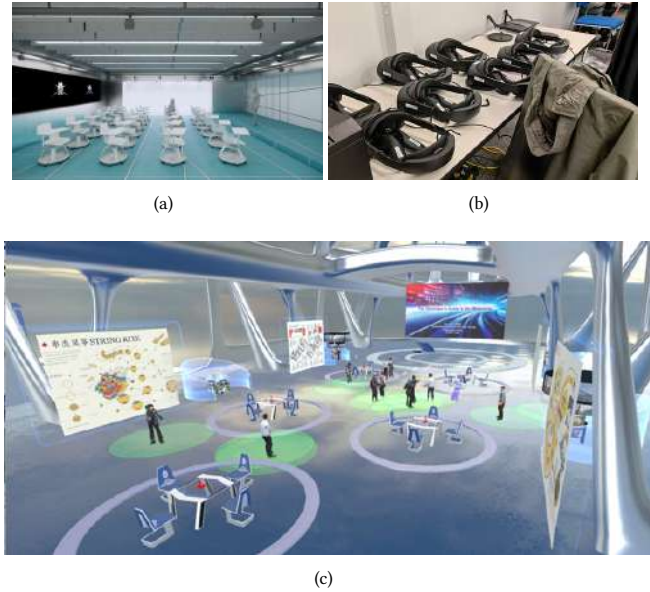


Figure 3: (a) Teaching area in physical classroom, (b) equipment and headsets, and (c) overview of our MetaClassroom.

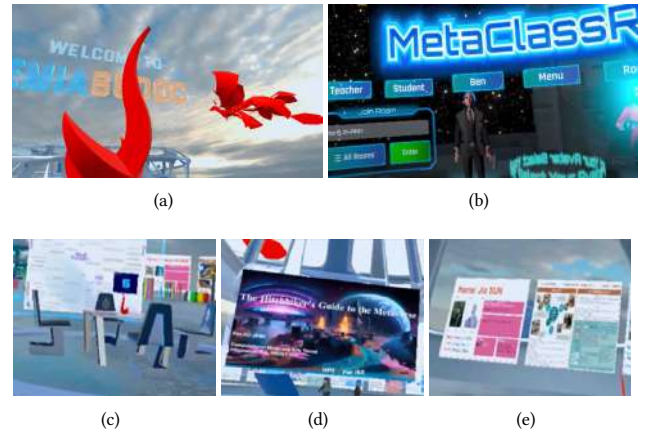


Figure 4: Captures of design and features in our MetaClassroom.

There are three major functions: **(i) presentation** that facilitates the lecturing and work demonstration, **(ii) whiteboard** that enables group discussion and sketching on idea, and **(iii) prototyping** for the class activities. Figure 6 showcases the functions.

2.2 AI Lecturers

2.2.1 EMIA6500F - Social Media for Creatives (Spring Semesters). This three-hour weekly postgraduate-level cross-campus course began in the Spring semester of 2024 and continue through 2025, accommodating 26 students in the first year and 35 students in the second year. This interdisciplinary course invites students to

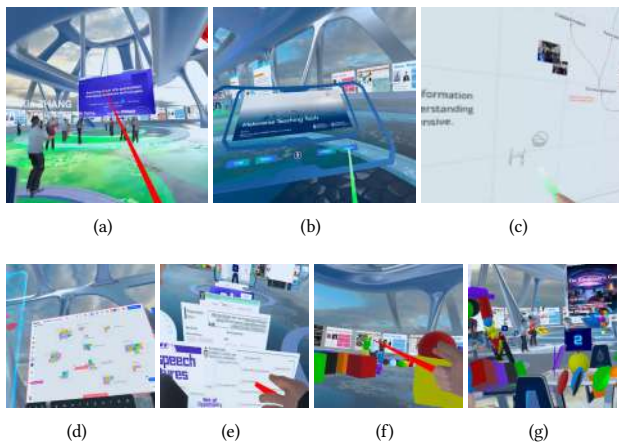


Figure 5: Functions in our MetaClassroom: (a) presentation from audience perspective, and (b) speaker console; (c) white-board editing, and (d) view tracking in whiteboard; (e) personalized curation from presenter perspective, (f) prototyping from user perspective, and (g) from side view perspective.

explore social media platforms, become familiar with content creation strategies, and how to use generative AI technologies while delving into digital storytelling, gamification, immersive technologies, social media theories, and relevant research skills. All these arrangements were finalized after consulting with the course leader, senior academic staff, and researchers about their feedback from an internal pilot study.

Approximately one-sixth of the lecture (roughly 30 minutes or one-fourth of the teaching materials, taught by AI lecturers) is devoted to explanations, discussing definitions and examples of social media terminology or phenomena. The remaining half of the lesson (roughly 60 minutes or 35% of the teaching materials) illustrates case studies and in-depth knowledge of the theories. Next comes the presentation of the assigned reading and in-class discussion, which lasts for approximately thirty minutes, and a hands-on tutorial session with teaching assistants for approximately thirty minutes. There are breaks, lasting anywhere between sessions, ranging from five to fifteen minutes each. These arrangements are finalized with all senior researchers and course instructors at our institution.

Ten of these weekly lectures were used for the study, which ran for thirty minutes per lecture or segment. Different digital teachers divided each portion into two groups, each lasting fifteen minutes. Following each segment, participants were asked to provide feedback using a Qualtrics form, which was modeled after the MUD card approach used in education. Each survey included a consent and notification section to guarantee its voluntary nature. For three to six minutes, each survey asked students about their preferences for and evaluations of digital teachers using a Likert scale, multiple choice, and short response questions. Students were asked to rate every digital teacher in the eleventh lecture and to participate in our voluntary in-depth interviews. Valid here only participation in the interview is entirely voluntary.

2.2.2 Preparation. Our pipeline consists of several steps, each leveraging advanced AI algorithm to create lifelike digital teachers. The teaching scripts of digital teachers are generated by AI tools with manual fine-tuning by teaching team. After that, we used state-of-the-art text to speech tool to generate the voice of the teacher. These voices are carefully crafted to convey tone, emotion, and clarity, to ensure an engaging learning experience. Next, we employed our proprietary AI algorithm to translate the generated voice into facial expression and body gesture. Figure 6 depicts the simplified workflow.

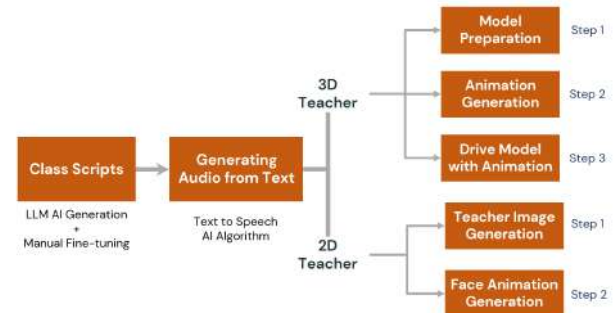


Figure 6: The pipeline shows how AI lecturers are generated.

2.2.3 Design and Features. The design and features of each digital teacher varied from settings, styles, verbal expression, non-verbal cues, realism, and format. Figure 7 portrays the ten pairs of AI lecturers, each with their own names and designs. Note that idol Aria and Einstein were in VR experience while others are in video format.

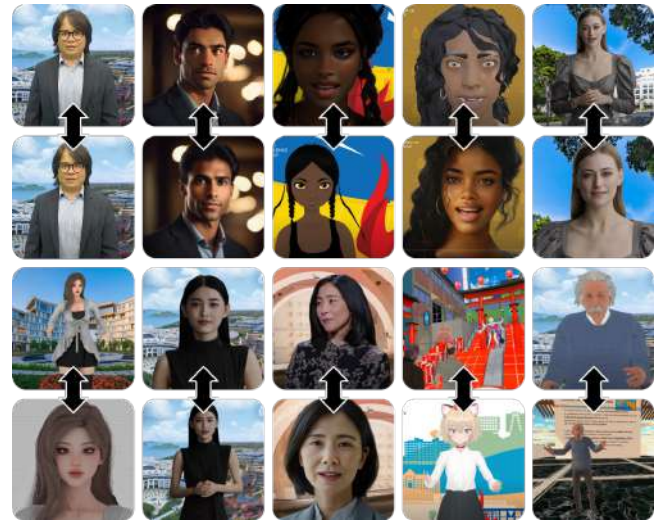


Figure 7: Ten pairs of digital teachers (from left to right): Digital Professor Ben, Albert, Betty, Camila, Diana, Eleanor, Fiona, Gabriela, Idol Aria, and Digital Einstein.

Specifically, we had introduced a storytelling session with the lecture exploring citizen journalism and fake news in social media.

The story takes place in the colorful fandom where the beloved idol Aria Neon lives in a state of transition between virtuality and reality. Admired by her followers for her charm and skill, she eventually reveals herself to be an AI composed of code and algorithms. This information, however, does not diminish the love for her among fans. Rather, it makes us reassess our definition of 'real.' Can a digital object elicit real feelings? Can a piece of code have a personality? What is authenticity in virtual world or digital age? Figure 8 captures the scenes and moments in the story.

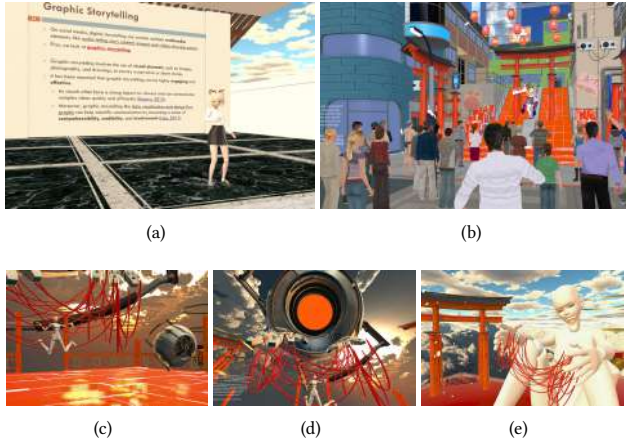


Figure 8: Captures of storytelling with AI lecturer, Idol Aria.

2.3 Mixed-Method Analysis

To complement the qualitative insights, basic quantitative measures were included to evaluate student engagement and perceived learning outcomes. End-of-semester surveys used five-point Likert-scale questions (1–5) on satisfaction, open-ended questions on comments, and areas for improvement. Participation was entirely voluntary, and students were assured that responses would not affect their grades or evaluation. Descriptive statistics (mean, standard deviation, and percentage agreement) were calculated and cross-checked with observation notes and interview transcripts to ensure triangulation.

Across four semesters, quantitative feedback showed consistently high satisfaction for both the MetaClassroom courses (2024: $M=4.81$; 2025: $M=4.92$) and the AI Lecturer courses (2024: $M=4.63$; 2025: $M=4.54$). Details can be found in Table 1. In particular, most students described the digital teachers as “novel,” “creative,” or “futuristic” in open-ended responses, while some ($N=20$) emphasized the **need for more interactive and responsive digital lecturers**, pointing toward future development directions. Together, these quantitative indicators reinforce the qualitative findings on engagement, revealing consistent patterns of positive learner motivation and satisfaction.

3 Pedagogical Impact

The subsequent sections first conclude the comparison and lesson learnt, then discuss how the advent of MetaClassroom and AI

Table 1: Summary of quantitative student feedback on course satisfaction across four semesters, based on 5-point Likert scales (1 = Strongly Disagree; 5 = Strongly Agree).

Course	Year	N	Mean (M)	SD
MetaClassroom	2024	18	4.81	0.40
	2025	15	4.92	0.34
AI Lecturer	2024	10	4.63	0.52
	2025	22	4.54	0.62

lecturers herald significant transformations in teaching methods, reshaping traditional pedagogical paradigms and fostering a more dynamic, interactive, and personalized learning environment.

3.1 Comparing the Learning Environments

In this section, feedback and interviews were collected from 24 students, labelled from S1 to S24, in Spring 2024 after the *EMIA6500F - Social Media for Creatives* course. Among these students, eight (S4, S5, S9, S13, S14, S18, S20, S21) had also taken the *EMIA6500C - Metaverse Cross-disciplinary Design Thinking* course in the Fall, giving them the opportunity to experience both projects.

3.1.1 Actual Classes. Actual classes are **traditional educational settings where real human instructors teach face-to-face**. In our study, we had our university professor and lecturer in the classroom for teaching (see Figure 9). This environment allows for direct communication, which is essential for effective learning. Students benefit from immediate interaction, allowing spontaneous discussions and clarifications.



Figure 9: Actual class with our human professor for lecturing.

The advantages of actual classes are noteworthy. One major benefit is **immediate feedback**. Instructors can assess students' understanding in real-time, allowing for quick clarification of doubts. S5, a student with experience in both traditional and alternative formats in our classes, stated, “*I still think I prefer actual classes the most because I love the discussions with my classmates. There's something about being in the same room that makes the conversation flow more naturally.*” He also acknowledges the potential of technology, suggesting that as the technology matures, other formats may replace actual classes, but now is not the time. Besides, compare to online education, actual classes highlight the importance of **social interaction**, as face-to-face engagement encourages collaboration and interpersonal skills.

However, actual classes have their disadvantages. A key limitation is the **variability in tone and accent** among instructors. When asked to recall their learning experiences from childhood to adulthood, S1 and S8 reported difficulties understanding teachers

from specific regions due to dialects. They found it challenging to follow lectures at times. S6 shared that her lower English proficiency made it harder to keep up with native speakers. She noted, “*When the lecturers (in previous courses) are native speakers who speak very fluently, I can hardly keep up... and that affects my learning experience.*” These experiences highlight **communication barriers in traditional classrooms**, which can hinder comprehension.

Several key factors are observed in offline classroom settings. First, group dynamics and peer support are stronger in face-to-face environments, fostering a sense of community among students. Second, there are concerns about customizing instruction, as one lecturer and a few teaching assistants typically manage large classes of ten to over one hundred students, limiting the ability to meet individual needs. Lastly, students often feel more accountable in a physical setting, as the presence of instructors and peers encourages active participation and engagement in learning.

3.1.2 Online Classes. Online classes are courses delivered via the internet, allowing students to learn remotely without being physically present in a classroom. This approach gained popularity during the COVID-19 pandemic, leading to the rise of many MOOCs³ and online tutorials on social media platforms. Our course is a cross-campus course, spanning two different locations, with classes taught in one of the classrooms alternating each week, while the other classroom was left without an instructor (see Figure 12).

The advantages of online classes are notable. First, they offer **flexibility in scheduling and pacing**. Students can choose when and how quickly they learn. This is particularly beneficial for non-traditional learners, such as working professionals. S9, a part-time postgraduate student, shares, “*I need to take classes after work, and online classes make that possible for me.*” This flexibility allows students to balance their studies with their personal and professional lives.

However, online classes also have disadvantages. One major issue is **the potential for lower engagement and motivation without face-to-face interaction**. S5 notes, “*I find it harder to stay motivated in online classes compared to in-person ones.*” Additionally, there are challenges in building a sense of community and collaboration among students. Many students expressed a **need for more interactive online activities**. S1, S2, S14, S16, and S19 mentioned that online discussion forums were helpful as they allowed them to connect with groupmates and share ideas.

We found that online classes can be effective, but **engagement strategies** are crucial. While students appreciate the convenience of online learning, they may miss the social interactions found in traditional classrooms.

3.1.3 Online Classes with AI Lecturers. Online classes with AI lecturers feature courses where AI-driven instructors deliver lectures through videos with various avatars. In our course, these avatars differ in appearance, gender, age, ethnicity, accent, and character settings, including formats like anime, cartoon, realistic, hyper-realistic, historical, or fictional representations. Students learn by watching these videos.

The advantages of online classes with AI lecturers are notable. First, scalability allows many students to participate simultaneously.

³Massive open online courses

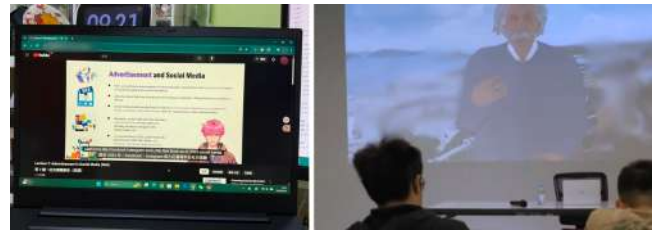


Figure 10: Online classes with our AI lecturers, remotely outside (left) and inside (inside) the classroom.

Second, students have 24/7 access to learning materials and AI-generated videos, enabling flexible study schedules. The variety of avatars also keeps students engaged; many expressed excitement about the different AI instructors and looked forward to each new class.

Our observations show that students appreciate the potential of AI lecturers. Many (N=24) believe that AI can enhance learning when used alongside traditional methods. However, continuous monitoring and improvement of AI-driven videos are necessary to ensure effectiveness and meet diverse student needs.



Figure 11: Students attending collaborative MetaClassroom VR session.

3.1.4 Classes Using VR. Classes that utilize VR (VR) create immersive learning experiences, allowing students to participate in simulations and interactive environments. In the EMIA6500C course, teachers and students wore head-mounted displays (HMDs) in the MetaClassroom.

The advantages of VR classes are significant. First, immersive experiences greatly enhance student engagement. Students (S1, S10, S13, S19) reported that learning in the imaginative virtual spacecraft of the MetaClassroom provided a unique and enjoyable experience. Second, VR promotes collaboration among students from different locations in a shared space, benefiting cross-institutional learning and aligning with Sustainable Development Goals (SDGs). Third, VR fosters positive attitudes toward learning and emerging technologies.

However, there are challenges with VR classes. One major concern is the high cost of VR technology and equipment. Implementing VR also requires substantial effort from teaching staff for course preparation and support. For instance, we initially arranged two teaching assistants for classes of ten students, later increasing this to five for classes of thirty-five to help newcomers adapt to the VR environment. Technical issues, such as flashes in VR, network

problems, and crashes can disrupt learning. For example, S21 mentioned distractions like a red bird flying, while S24 found it amusing when classmates appeared to float without chairs. Such distractions can detract from the educational experience. Networking issues, like a dropped connection, can halt classes and affect learning flow. Additionally, cognitive load becomes a concern when students and teachers wear HMDs for over 40 minutes.

Overall, our findings suggest that VR can significantly boost student engagement and motivation. However, adequate training and preparation are essential to maximize its benefits and minimize potential drawbacks.



Figure 12: Classes using VR with AI lecturers.

3.1.5 Classes Using VR with AI Lecturers. Classes that use VR (VR) with AI lecturers blend immersive environments with AI-driven instructors to offer personalized learning experiences. This approach enhances traditional education by providing interactive simulations that cater to different learning styles.

The benefits of using VR with AI lecturers are significant. This format combines immersive learning with personalized instruction, allowing scalable and engaging experiences. Students can interact with material in ways that match their individual preferences. AI avatars act as non-player characters (NPCs) in VR storytelling and gamification, enhancing engagement through interactive simulations, making learning enjoyable and effective. Moreover, AI lecturers help avoid issues faced with human instructors, such as connection drops that interrupt classes. Since AI is pre-generated, it delivers lessons consistently without being affected by network problems.

However, there are challenges to consider. Integrating AI and VR technologies can be complex and may require more preparation time for instructors to ensure smooth operation. Additionally, distractions in the VR environment may go unnoticed, as teachers cannot see students' facial expressions or focus areas, making it harder to provide personalized support. Currently, the AI lecturing in VR could benefit from more customized content, such as immersive journalism in case studies.

Our observations suggest that combining VR and AI can create engaging and effective learning environments, showing great potential for future educational applications. Continuous evaluation and refinement of both technologies are essential to maximize learning outcomes and ensure students receive the best educational experience possible.

3.2 Changes in Pedagogical Practices

These technologies apparently change pedagogical practices and teaching methods in enhancing accessibility and equity, thereby facilitating the asynchronous, massive, and personalized learning experience.

3.2.1 Accessibility and Equity. Traditional education models often face limitations in reaching geographically dispersed or underserved populations. MetaClassroom, by creating immersive virtual environments, allow students from different locations to participate in the same educational experiences without the need for physical presence. This capability is particularly beneficial for students in rural or remote areas who may not have access to quality educational institutions. For example, a student in a remote village can attend a virtual class hosted by a prestigious university, gaining access to the same resources and instruction as their peers in urban centers.

Moreover, AI digital teachers can provide continuous access to learning resources and support, breaking down time constraints associated with traditional classroom settings. Students with varying schedules, such as working professionals or those with care-giving responsibilities, can engage with educational content at their convenience. This flexibility ensures that education is more accessible to non-traditional learners, promoting lifelong learning and professional development.

The scalability and consistency offered by AI digital teachers contribute to promoting equity in educational outcomes. In traditional settings, disparities in the quality of instruction can arise due to variations in teacher expertise, class sizes, and resource availability. AI digital teachers can deliver consistent, high-quality instruction to all students, regardless of their geographical location or socioeconomic background. This consistency helps level the playing field, ensuring that every student has access to the same educational opportunities and resources.

3.2.2 Asynchronous, Massive, and Personalized Education. AI lecturers and MetaClassrooms excel in providing massive, asynchronous classes like MOOCs due to their scalability, flexibility, and personalized learning capabilities. These technologies can accommodate a vast number of learners simultaneously, overcoming the limitations of physical classrooms and enabling access to education on a global scale. By leveraging AI-driven instructors, MOOC platforms can deliver personalized content tailored to each learner's pace, preferences, and knowledge gaps, enhancing engagement and knowledge retention.

The immersive nature of MetaClassrooms offers a dynamic and interactive learning environment where students can engage with course materials, collaborate with peers, and participate in hands-on activities at their own convenience. This flexibility allows learners to access educational content anytime, anywhere, breaking down barriers to traditional education and empowering individuals to pursue lifelong learning opportunities. In summary, AI lecturers and MetaClassrooms are instrumental in providing massive, asynchronous classes like MOOCs by offering scalable, personalized, and engaging learning experiences that cater to the diverse needs of online learners.

3.3 Redefining the Role of Educators

Rather than focusing solely on content delivery, educators can take on more facilitative and mentorship roles, or as our instructor called himself in post-class interview of ‘**curator**’, guiding students through personalized learning pathways and supporting their development of higher-order thinking skills. Educators can leverage the data and insights provided by AI lecturers to offer more targeted and meaningful interventions, enhancing their ability to address individual student needs. This shift allows educators to focus on organizing class activities that foster critical thinking, creativity, and problem-solving skills, which are increasingly important in the 21st-century educational landscape.

4 Practical Implementation

Here outlines challenges and best practices from these case studies.

4.1 Challenges

4.1.1 Technical Issues. Specifically, the deployment of MetaClassrooms requires robust technical infrastructure. Issues such as connectivity disruptions, hardware malfunctions, and software glitches can significantly impede the learning experience. Ensuring a seamless technological environment is essential but often challenging due to varying levels of internet bandwidth and device capabilities among students. We recruited three teaching assistants at each campus yet might not be able to completely resolve the sudden technical issues. Thus, the human force arrangement is crucial.

4.1.2 Possible Distraction in Engagement and Concentration. Traditional classroom cues and interactions are less effective in a Metaverse setting. Reported by several students (N=4), the immersive nature of the Metaverse can lead to distractions, making it crucial for lecturers to develop strategies that keep them actively involved. Some may find the VR setting (*in terms of background music and scenery*) and digital teacher’s avatar pose distractions.

4.1.3 Potential High Cost in Course Preparation. One of the significant challenges of implementing AI lecturers and the VR MetaClassroom is the high cost associated with course preparation. Acquiring VR headsets and related technology can be a substantial financial investment, often limiting accessibility for some institutions. Additionally, developing engaging and effective course content for a virtual environment requires considerable time and resources. This includes training faculty to utilize the technology effectively and creating immersive learning experiences that leverage the unique capabilities of VR. These factors can create barriers to widespread adoption, making it essential to find cost-effective solutions that ensure equitable access to innovative educational tools.

4.2 Best Practices

4.2.1 Sufficient Training Time. Providing comprehensive training for both lecturers and students is crucial. This training should cover the technical aspects of using Metaverse tools as well as pedagogical strategies for effective virtual teaching and learning. Ongoing professional development opportunities should be made available to keep pace with technological advancements. We suggest reserving at least one hour testing and training time per lesson according

to our experience. Besides, s should be provided to students, facilitating their self-learning to get familiar with the system.

4.2.2 Constant Feedback. Regularly collecting and acting on student feedback can help improve the Metaverse learning experience. This feedback can provide insights into what works well and what needs improvement, allowing for continuous refinement of teaching methods and virtual environments. While we collected compulsory weekly and post-course feedback which might be demanding as reflected, we propose voluntary nature in the feedback submission to ensure the class maintenance.

5 Envision the Future: Education For All

From our observation, the integration of AI lecturers and Meta-Classroom can democratize education by providing global access high-quality learning experiences to students worldwide. Virtual environments can bring expert educators into the homes of students in remote or under-served areas, bridging the gap between urban and rural education standards. As such, they support a lifelong learning opportunity by offering virtual courses and certifications across various fields with less human force and more personalized experience. With an upcoming interactive and responsive digital teacher in development among our team, we believe that AI can analyze individual learning patterns and adapt content to meet the specific needs of each student. Personalized learning paths can be developed to cater to different learning speeds, styles, and preferences, ensuring that every student receives the attention and resources they need to succeed.

Furthermore, AI-powered digital teachers can handle large numbers of students simultaneously, making it possible to scale educational programs without compromising on quality. This scalability can be particularly beneficial in regions with a shortage of qualified educators. Incorporating gamification elements into the Metaverse can make learning more engaging and enjoyable. Reward systems, virtual challenges, and interactive storytelling can motivate students and enhance their learning experience.

While the concept of AI education at universities presents exciting possibilities, the human dimension of education remains irreplaceable. AI can efficiently manage large-scale teaching, personalize learning, and support data-driven decisions, but it cannot replicate the empathy, mentorship, and ethical judgment that define effective human educators. In the future, AI-led universities may integrate AI systems to enhance curriculum design, assessment, and feedback under human guidance; AI-first universities might prioritize AI-driven tools within a human-centered framework; and even in AI-only models, human oversight should ensure fairness, creativity, and emotional connection remain central to learning. Therefore, the most sustainable educational future will likely emerge not from replacing teachers with technology, but from designing a symbiotic model where humans and AI collaborate to advance inclusive, ethical, and lifelong learning for all.

6 Limitations

This study is limited by the scale and duration of its classroom deployments, focusing on a small number of postgraduate courses within a single institution. Results may not be fully generalizable due to factors such as infrastructure, instructor experience, and

evolving AI models. We also recognize potential bias from relying mainly on qualitative findings. Future work will broaden the scope across disciplines and longer teaching periods.

7 Conclusion

The future of education lies in harnessing the potential of AI and Metaverse technologies to create inclusive, personalized, and engaging learning environments. By addressing current challenges and embracing innovative practices, the vision of "Teachers for All" can become a reality, ensuring that every learner has access to the resources and support they need to succeed in an increasingly complex and dynamic world. This study, as the first implementation in higher education, targets to provide inspirations, potential future directions and insights to our educator and research community. We are looking forward to more relevant application in our field.

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