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Immersive Learning with Augmented and Virtual Reality: Hands-On Workshop with ARTutor and VR Environments

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Abstract. This hands-on workshop proposal aims to introduce participants to the exciting world of immersion technologies and to highlight their educational use. Through reference to virtual and augmented reality and the presentation of good practices, participants will become familiar with the applications of immersive technologies and their creative use in teaching and learning practices. The workshop will initially offer hands-on training in ARTutor, a free augmented reality software developed at the Advanced Educational Technologies and Mobile Applications (AETMA) Research Lab of the Democritus University of Thrace in Greece. ARTutor is freely available to educators of all educational levels to create teaching materials that address the needs of their students. It is globally available as its authoring tool has already been translated into 10 languages. The international workshop participants will have the opportunity to explore the potential of the technology in practice. Upon completion of the workshop, the participants will be invited to the IMT Virtual Reality Space to explore the affordances of immersive learning in Higher Education, interact with the immersive content, and discuss the usefulness of the technologies explored in alignment with their pedagogical implications.

Keywords: Augmented Reality, ARTutor, Educational Technology, Immersive Learning, Virtual Reality, IMT VR Space.

1 Introduction

The way we teach and learn is constantly evolving, and immersive technologies like Augmented Reality (AR) and Virtual Reality (VR) are opening up new possibilities in education. These technologies provide exciting ways to bring lessons to life, allowing students to engage with content in a more interactive and meaningful manner. Both AR and VR technologies have been applied to various knowledge domain in primary [1], secondary [2] and higher education [3], with several benefits. Furthermore, these technologies have the potential to revolutionize inclusive education by creating immersive and accessible learning environments for students with disabilities, advancing greater engagement and equal learning opportunities [4]. However, despite their potential, the adoption of AR and VR in educational settings remains limited due to challenges such as accessibility, technical complexity, and the lack of pedagogically sound implementation strategies.

A key challenge that the literature identifies is the need for accessible, free or low-cost, and easy-to-use tools [5] that may encourage educators, especially with no coding and programming skills [6] to invest time and effort in designing and developing immersive experiences with the intent to integrate them into their teaching practices. ARTutor [3], an open-source AR platform developed by the Advanced Educational Technologies and Mobile Applications (AETMA) Research Lab of the Democritus University of Thrace in Greece, was designed to fill this gap by providing a straightforward way for teachers to create and apply AR-enriched materials in educational settings. Since its release to public use, it has been leveraged by professionals and practitioners to address their diverse target audience needs, with good practices in education and training. As the authoring tool is available in 10 languages so far, examples of its usability are transnational projects to enhance multilingual and multicultural contextualization of content [8], enriched textbooks, case studies of STEM education, museums, treasure hunts, and escape room gamification due to the geolocation features and the AR experience editor that supports complex

scene building. Its wide use is further supported due to the compatibility of the application with Android and iOS devices.

Likewise, VR environments offer an additional layer of immersion, enabling students to take part in virtual simulations and field trips that enhance the learning experience. However, many educators are still unfamiliar with the best practices for using VR in education and may not be aware of the available tools that can support their implementation. The IMT VR space is the virtual educational space of the MSc in Immersive Technologies—Innovation in Education, Training, and Game Design [9]. It is an example of a multi-user virtual environment that was designed based on the instructional design principles for higher education, promoting transformational learning [10, 11]. Its rooms offer academic services, while it additionally serves as the repository of good practices designed, developed, and pilot-tested in microteaching sessions by the program students. Simulating the premises of an academic institution, the IMT VR space consists of a three-floor educational ecosystem with a reception hall, an amphitheater, a secretary office, the instructors and counseling rooms, a library, and microteaching and collaboration rooms. The upper floors host the laboratory applications and projects, while the outdoor space provides opportunities for socialization.

2 Best Practices and Case Studies

This section will present two representative best practices that have leveraged immersive technologies software applications, namely ARTutor, regarding Augmented Reality implementation cases, and Spatial.io regarding Virtual Reality multi-user educational spaces.

2.1 ARTutor Implementation

Currently, there are two primary methods for developing an Augmented Reality (AR) experience. The first involves using programming SDKs such as ARCore and ARKit. Google's ARCore SDK provides APIs for essential AR functionalities, including motion tracking, environmental understanding, and light estimation. Similarly, Apple's ARKit enables developers to integrate AR into iOS applications. While these SDKs offer flexibility and support a wide range of AR capabilities, they require advanced programming skills, making AR development inaccessible to many, particularly educators without programming skills.

To address this challenge, ARTutor provides a solution by enabling the easy creation of AR experiences without the need for programming expertise. Educators can effortlessly design and deploy AR content, which can be accessed through a mobile device, making AR technology available to all. Creating an immersive experience with ARTutor is a 3-step process. The first step is to create an augmented book where authors upload a pdf file and a cover image. The second step is to create an augmentation by choosing the appropriate trigger image into the uploaded pdf document and provide information about the augmentation (Fig. 1). The last step is to choose the augmentation type (image, video, 3D model, URL-HTML, audio, complex AR editor experience) and provide the digital information that will be placed over the real world trigger image.

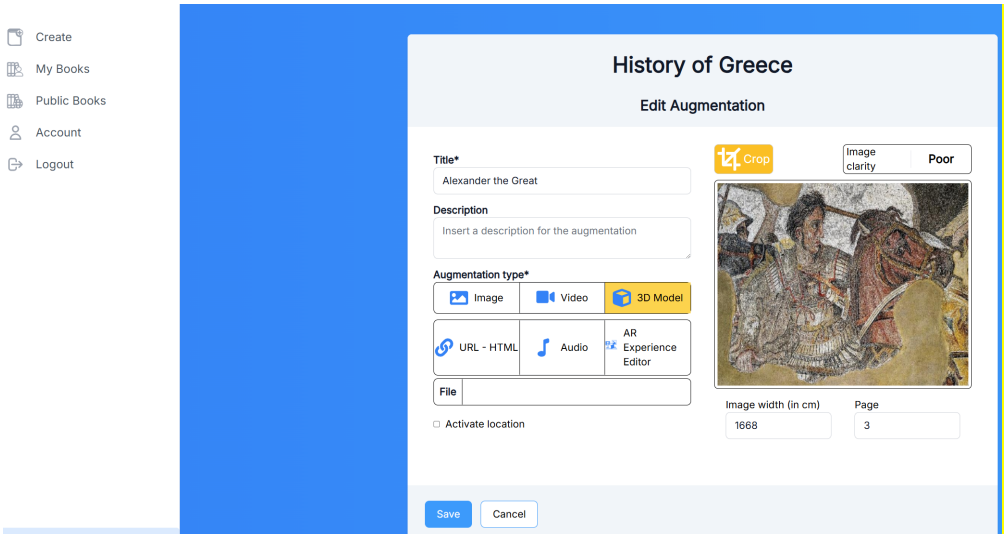

Fig. 1. Augmentation screen of ARTutor.

ARTutor enables end users to access augmented reality (AR) content seamlessly through their mobile devices, transforming traditional educational materials into interactive experiences. By scanning designated trigger images within augmented books or learning materials, users can view overlaid digital content, such as 3D models, videos, and interactive elements, directly on their screens. As ARTutor is compatible with both Android and iOS devices, it provides a user-friendly, mobile-first AR experience, allowing learners to explore augmented content anytime, anywhere, without requiring specialized equipment or technical expertise.

2.2 IMT VR Space

Spatial.io enables the development of multi-user, immersive VR environments for education and professional development, allowing instructional designers and 3D world developers to create interactive virtual spaces with or without programming expertise. Utilizing this platform, the AETMA Lab developed the IMT Metaverse, an advanced virtual learning environment supporting the international MSc program in "Immersive Technologies: Innovation in Education, Training, and Game Design" at Democritus University of Thrace, Greece. Designed from the ground up within Spatial, this VR space promotes global student interaction, offering an immersive educational space that integrates external media and supports distance learning.

Launching this initiative required interdisciplinary expertise, namely a well-designed plan that involved the collaboration among experts with backgrounds in graphics, 3D elements, and pedagogical knowledge to create an effective and engaging virtual space. The IMT Metaverse consists of a multilevel virtual world featuring eight specialized indoor spaces, each designed to support academic activities, social engagement, and recreation. The central reception area (Fig. 2) serves as an entry point, providing students and faculty with essential program information and access to virtual student-created spaces developed as part of their coursework. Through project-based learning, students contribute to the ecosystem by creating VR artifacts and integrating educational portals, thereby building a repository of best practices available to all the visitors of the IMT Metaverse.

Fig. 2. IMT Metaverse Reception Space**.**

The other spaces that are available are the lecture spaces (Fig.3) and microteaching areas, where professors can deliver their lectures and students can practice and refine their skills in teaching into a virtual environment; collaboration rooms where small student teams can virtually collaborate for their assignments; and virtual administrative and faculty offices where the students can virtually meet administrative personnel and faculty for guidance and support. To further enrich the learning experience, the metaverse integrates educational gamification elements and interactive portals, offering access to laboratory projects and external VR learning spaces, allowing exploration beyond the core curriculum.

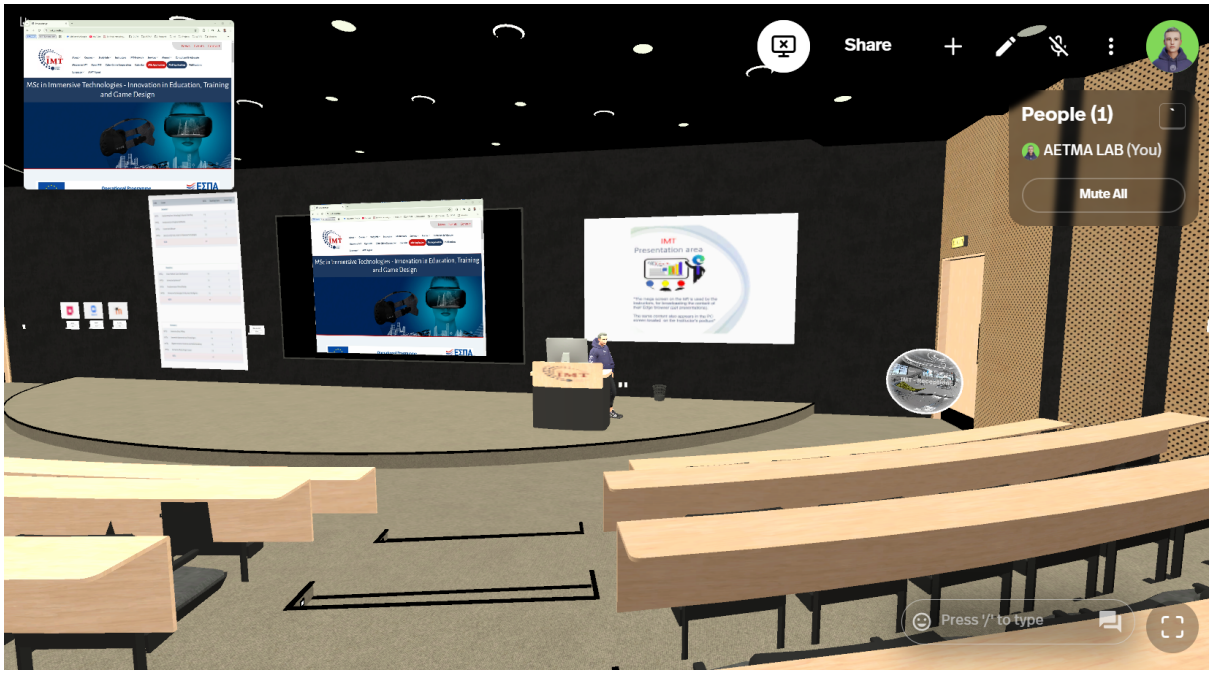

Fig. 3. IMT Metaverse Lecture Space.

3 Description of the Workshop Activities and Contribution to Inclusive Immersive Design

This workshop is designed for educators, instructional designers, and researchers interested in integrating Augmented Reality and Virtual Reality into their teaching and learning practices. It focuses on hands-on training with ARTutor, an open-source AR platform, providing participants with the necessary skills to design and implement immersive educational applications. Additionally, the workshop will introduce participants to the IMT VR Space and its repository of Virtual Reality environments, designed and created leveraging Spatial.io platform affordances, and demonstrate their educational applications.

Upon the end of the workshop participants will be able to

- Understand the fundamental principles and applications of immersive technologies in education.
- Gain hands-on experience in using AR for teaching and learning.
- Identify best practices for integrating AR and VR in the educational domain.
- Familiarize with open-source AR and VR software and apply them in practical scenarios.
- Engage in reflection and discussion on the pedagogical implications and inclusivity element of the design of immersive experiences.

Workshop Activities:

- Participants will create their first AR educational project using ARTutor.
- Hands-on exercises will guide attendees through the development and implementation of AR-enhanced learning materials.
- Case studies and best practices will be presented to highlight effective uses of AR and VR in various educational contexts.
- Participants will explore and interact with virtual reality environments designed for education.

A detailed presentation of the workshop activities, duration, and description is presented at Table1.

Table 1. Workshop activities, duration, and description.

Workshop Activity	Duration	Description
Introduction to immersive technologies in education	10’	Introducing workshop participants to the use of immersive technologies in education

AR case studies and best practices	10’	Presentation of case studies and best practices in a variety of educational and cultural fields
Demonstration of ARTutor	15’	Introducing workshop participants to ARTutor features and AR editor experience
Hands-on practice with the authoring tool	30’	Participants will register on the authoring tool which is available in 10 languages and get trained on creating their own AR experiences
Exploration of VR environments for education	15’	The workshop participants will explore immersive educational settings exhibiting xR artifacts
Reflection on the tool affordances	10’	An open discussion on the usefulness of tools and pedagogical implications on the design of inclusive, user-friendly immersive learning experiences

This workshop is an invitation to educators, instructional designers and researchers of all educational levels and diverse immersive technology expertise to hands-on experience in the design and implementation of pedagogically sound solutions leveraging the affordances of immersive applications that have been tested and verified for their effectiveness and contribution to inclusive immersive design. Its contribution to the iLRN community and especially the Immersive Learning Educators and Designers (iLEAD) lies in sharing insights on the usefulness of tools and inspire and urge the workshop participants to explore the pedagogical implications for the design of inclusive, user-friendly immersive learning experiences.

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