

## EXPLORING IMMERSIVE WEB ENVIRONMENTS IN AN EDUCATIONAL CONTEXT

EXPLORANDO AMBIENTES WEB IMERSIVOS NUM CONTEXTO EDUCATIVO

EXPLORANDO ENTORNOS WEB IMMERSIVOS EN UN CONTEXTO EDUCATIVO

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### Abstract

The projects presented in this article were developed in two training workshops on Immersive Web Environments (IWE) in an educational context. The workshops were carried out as part of a research project for a doctoral program in Multimedia in Education, which aims to study and understand the use of IWE in a teaching-learning context. The aim of the training was to provide teachers with key competences related to the use of IWE, leading them to explore the potential of Immersive Web Environments to be able to integrate them into their teaching practices. The data collected made it possible to select teachers from different disciplines to collaborate with the researchers. The article describes two of the Immersive Web Environments created during the training workshops held with primary and secondary school teachers. For this article, only those works whose IWE co-creation process involved primary school students were considered. The work carried out by the teachers during the training workshops shows that IWE have the potential to transform teaching and learning practices.

**Keywords:** Immersive Web Environments, teacher training, co-creation, personalization.

### Resumo

Os projectos apresentados neste artigo foram desenvolvidos em dois workshops de formação sobre Ambientes Web Imersivos (AWI) em contexto educativo. As oficinas foram realizadas no âmbito de um projeto de investigação de um programa de doutoramento em Multimédia na Educação, que visa estudar e compreender a utilização de AWI em contexto de ensino-aprendizagem. O objetivo da formação foi dotar os professores de competências-chave relacionadas com a utilização de AWI, levando-os a explorar as potencialidades dos Ambientes Web Imersivos para poderem integrá-los nas suas práticas pedagógicas. Os dados recolhidos permitiram selecionar professores de diferentes disciplinas para colaborar com os investigadores. O artigo descreve dois dos Ambientes Web Imersivos criados durante as oficinas de formação realizadas com professores do ensino básico e secundário. Para este artigo, apenas foram considerados os trabalhos cujo processo de co-criação de AWI envolveu alunos do ensino básico. O trabalho realizado pelos professores durante as oficinas de formação mostra que os AWI têm potencial para transformar as práticas de ensino e aprendizagem.

**Palavras-chave:** Ambientes Web Imersivos, formação de professores, co-criação, personalização.

## Resumen

Los proyectos presentados en este artículo se desarrollaron en dos talleres de formación sobre Entornos Web Inmersivos (EWI) en un contexto educativo. Los talleres se llevaron a cabo como parte de un proyecto de investigación para un programa de doctorado en Multimedia en la Educación, cuyo objetivo es estudiar y comprender el uso de EWI en un contexto de enseñanza-aprendizaje. El objetivo de la formación era dotar a los profesores de competencias clave relacionadas con el uso de los EWI, llevándoles a explorar el potencial de los Entornos Web Inmersivos para poder integrarlos en sus prácticas docentes. Los datos recogidos permitieron seleccionar a profesores de distintas disciplinas para colaborar con los investigadores. El artículo describe dos de los Entornos Web Inmersivos creados durante los talleres de formación celebrados con profesores de primaria y secundaria. Para este artículo, sólo se han tenido en cuenta los trabajos en cuyo proceso de cocreación de los EWI participaron alumnos de primaria. El trabajo realizado por los profesores durante los talleres de formación demuestra que los EWI tienen el potencial de transformar las prácticas de enseñanza y aprendizaje.

**Palabras-clave:** Entornos Web Inmersivos, formación de profesores, cocreación, personalización.

## INTRODUCTION

Immersive Web Environments, powered by WebXR technology, enable easy access to online content, that can also be experienced on devices with Virtual Reality and Augmented Reality skills (Rodríguez et al, 2021; MacIntyre & Smith, 2018), providing further levels of immersion and presence (Boel et al, 2021). This can have positive results on students' learning outcomes (Kavanagh et al, 2017). IWE provide a more attractive browsing experience on the internet, as they introduce more appealing visual elements and promote real-time interactions and collaboration. These features make the web more social and immersive, transforming static content into virtual worlds, that can be explored collaboratively, providing a sense of presence, and enabling spatial interactions that were not possible before (Kavanagh et al, 2017).

Learners when working in immersive environments, which allow them the possibility to visualize virtual objects related to the task they are performing, can visualize virtual objects related to the tasks they are performing, which arouses greater interest and motivation for learning (Kavanagh et al, 2017), leading to a more attractive environment. This approach offers learners opportunities such as exploring distant places and going back in time (past) and scenarios impossible to experience in the real world (travelling inside the body, inside a machine, ...) (Kavanagh et al, 2017). As well as the possibility to practice safely and in a limited way (allows to repeat, pause, speed up, slow down). As well as allows them to receive immediate and always present feedback, including in visual and haptic form (Kavanagh et al, 2017).

For teachers IWEs enable innovative pedagogical methodologies and practices based on constructivism (learning by doing), collaborative learning, gamification and game-based learning. In addition, the use of these tools can lead to greater teacher motivation and satisfaction, as it allows the adoption of a more personalized and in-depth teaching approach for students (Kavanagh et al, 2017).

IWE represents a challenge to explore in the field of education and can be applied in any subject and level of education (Continua, 2023), allowing to explore its potential in teaching, not as a substitute, but as a complement to traditional approaches.

Schlemmer (2021) refers that digital technologies (DT) cannot be considered as a means, tool, resource or support in education, but as environmental forces that alter and expand human cognitive functions. DT are technologies of intelligence, modifying aspects such as memory, imagination, perception and reasoning (Pierre Levy, 1993; Schlemmer, 2021), they are not just a tool, they change the way we relate, perceive the world and interact with it (Floridi, 2015; Schlemmer (2021) and when appropriated by subjects, these technologies become processes to be developed, allowing their users to also become creators (Castels, 1999; Schlemmer, 2021).

DT should not be seen as external or unwanted elements in education and using them only as tools or applying them in the traditional way represents an underutilization of their potential (Schlemmer, 2021). The author argues that new methodologies and pedagogical practices should be explored that take advantage of the possibilities offered by DT, avoiding reproducing the old model of expository teaching in digital format.

## 1 CONTEXTUALISING

The two projects presented in this paper are the result of two teacher training workshops on Immersive Web Environments (IWE) in an educational context. The training workshops were designed and developed as part of a larger research project, which aims to investigate the use of Immersive Web Environments (IWE) to support pedagogical activities in formal contexts. This project, originated three distinct investigations: i) Research 1 – Evaluate the educational potential of immersive web environments in the educational practices of primary and secondary school teachers, ii) Research 2 – To analyze the interactions between teachers, students and objects in an immersive web environment, iii) Research 3 – Investigate the impact and appropriation that students make of immersive web environments when participating in activities co-created by them (Cleto et al., 2021). The main objectives of this meta-study relate to the design, promotion and integration of virtual environments suitable for learning contexts, as well as the search for the most appropriate pedagogical practices for their use (Cleto et al., 2021).

The training workshop was organized by the three researchers from the multimedia in education doctoral programme at the University of Aveiro, promoted by continUA – Centre for Lifelong Learning at the University of Aveiro and accredited by the Scientific-Pedagogical Council for Continuing Education (SPCCE). The aim of the training was to provide teachers with key competences related to the use of IWE, leading them to explore the potential of Immersive Web Environments so that they can integrate them into their teaching and learning practices. The data collected made it possible to select primary and secondary school teachers from different disciplines to collaborate in the research 3 (Cleto et al., 2021; Cleto et al., 2024).

With research project 3, the aim is to create and develop an educational experience in which students and teachers work together to co-create Immersive Web Environments and to explore how students and teachers can co-create and use these environments for learning contexts in different subjects (Cleto et al., 2021; Cleto et al., 2024). The selection of participants in this research was not defined in advance, but was carried out during the training workshops, where primary and secondary school teachers from different subject areas were invited to take part in the research 3 (Cleto et al., 2021; Cleto et al., 2024). Teachers who agree to take part are responsible for choosing the students who will co-create the virtual environments with them (convenience sampling) (Cleto et al., 2021; Cleto et al., 2024).

### 1.1 Overview of training

The proposal, drawn up for the SPCCE, states that the training workshop takes place online and aims to provide teachers with the acquisition of skills, that make it possible to incorporate the use of Immersive Web Environments, in their teaching practice. It is also intended that teachers have, at the end of the training, the knowledge that allows them to develop interdisciplinary and multidisciplinary projects, which aim to facilitate the interconnection of the various contents. Teachers (trainees) should develop skills and knowledge that allow them to plan teaching and learning tasks that integrate Immersive Web Environments.

The workshop sessions are theoretical-practical, where trainees can: i) learn how to build and customize IWE to teach didactic content, ii) design pedagogical activities to be carried out in these environments and iii) apply, individually and/or in groups, the knowledge to their own experiences and school contexts. During the thirty hours of training, several IWE are explored, such as Frame VR, Spoke by Mozilla Hubs, Mozilla Hubs and Spatial and the advantages and disadvantages are analyzed, in different subject areas and pedagogical strategies.

The role of the trainers is to stimulate reflection on the topics covered and guide the trainees in the tasks to be carried out. Monitoring and support is provided through discussion forums, chat and/or email. Specific documentation and bibliography are also made available (Continua, 2023).

In planning the training there was a concern to enable teachers to exploit and integrate IWE effectively and efficiently in the classroom context, using them to expand the way they teach and learn. The training was based on the TPACK model (Koehler et al, 2013), which made it possible to exploit the potential of immersive web environments, connecting technological, pedagogical and content knowledge.

## 1.2 TPACK Model

The Technological Pedagogical Content Knowledge – TPACK model presents a theoretical basis for integrating technology into the teaching and learning process (Koehler et al, 2013). This model consists of three main components of a teacher's knowledge: content, pedagogy and technology. One of the most significant advantages of TPACK is its emphasis on the interactions between the three components, enabling educators to understand diverse contexts and integrate educational technology effectively into classroom instruction (Koehler et al, 2013; Saito & Lee, 2023).

TPACK arises from the intersection of these three types of knowledge: Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK). Pedagogical Content Knowledge relates to how a teacher effectively teaches a particular content by adapting pedagogical strategies to make the content meaningful and accessible to learners. Technological Content Knowledge relates to how a teacher utilizes technologies appropriately and effectively to teach the specific content. This implies the understanding of the available technological tools, their functionalities and how they can be applied in a relevant way in the educational context. Finally, Pedagogical Technological Knowledge refers to the teacher's ability to integrate technology into their pedagogical practices. This implies knowing how to use technological tools to improve teaching strategies, promoting a more dynamic and engaging learning experience for students (Koehler et al, 2013).

## 1.3 Application of the TPACK model in the training workshop

The thirty hours of training workshops were divided as follows: fifteen hours of autonomous work and fifteen hours of synchronous work. The hours of synchronous work were distributed over seven sessions, organized as follows (Ferreira et al, 2024)

Session one: Presentation of the contents, objectives and methodology used. The concepts of XR/WebXR technologies (Virtual Reality, Augmented Reality and Mixed Reality), immersion, presence, identity and representation by avatars were also presented. Session two: Creating and personalizing avatars. An activity was carried out to set the scene and explore an IWE created by the trainers.

Session three: Creating and customizing an IWE. Teachers learnt how to incorporate multimedia elements, import 3D objects and implement interactivity in objects. use sound as an interactive element.

Session four: Presentation of the IWE (created to apply the content taught in the previous sessions). This session allowed for moments of discussion and sharing where it was also possible for the trainees to receive feedback from their colleagues and the trainers.

Session five: Using applications to create audio resources, images, 3D objects, as well as 360° videos and images.

Session six: Presentation of examples of planning pedagogical activities in IWE, followed by the proposal to conceptualize and plan a didactic-pedagogical activity in the scientific area of each trainee to be implemented in IWE.

Seventh session: Presentation of the IWEs created by the trainees, also describing the work carried out with the students.

It can therefore be concluded that the training was designed to include:

**Pedagogical knowledge:** trainees had to design activities for these environments, applying pedagogical principles to IWE.

**Technology:** they explored available tools and resources, familiarizing themselves with the platforms' functionalities and creating strategies to integrate these technologies into teaching practice

**Integration:** they selected tools and adapted the activities to the learning objectives, integrating the dimensions of content, pedagogy and technology.

**Reflective Practice:** the presentation sessions allowed for continuous reflection on the various dimensions, as well as being a space for collaboration and sharing of ideas between the participants.

## 2 IWE CARRIED OUT AT TRAINING WORKSHOPS

This section presents two of the projects carried out during the Immersive Web Environments in Educational Context' training course. These works were chosen because they best suited research 3, as they are spaces co-created with primary school teachers and students, where the students actively participated in designing the online space, and because there have been few studies with students in this age group.

These two environments combine the co-creation of immersive web environments, various applications (collaborative applications, Virtual Reality, Artificial Intelligence and programming and robotics, among others), involving primary school students (3rd and 4th grade).

### 2.1 IWE "ANIMALS OF AFRICA"

The teacher began to apply the knowledge acquired during the training in her classes, exploring it with her students. The IWE "Animals of Africa" was conceived in a process of co-creation between teacher and students. The students who developed the IWE are 4th graders. IWE is an integral part of the "Animals of the World" project, a project that involves all of the school's classes and follows an approach guided by methodologies such as Project Based Learning; Inquiry and Flipped Classroom. The aim is for students to investigate the specific characteristics of animals, relating them to the geographical aspects of their regions of origin, where each class directs its research to a specific area of the globe or habitat. In addition, to provide active learning experiences for students and for them to use new digital tools.

This group of students chose to investigate the animals of the African continent, using digital tools and artificial intelligence. Each student had to choose an animal to research, carrying out research on that animal and its habitat. The students also had to select the digital tools they wanted to use. To share the project with the educational community, the students proposed creating a virtual exhibition, to which end they built the IWE "Animals of Africa", using Frame VR. In IWE, each student was assigned a space where they placed images, some taken from search engines and others generated by AI tools, from text to image, where they also included 3D models of the animals (Figure 1).

**Figure 1**

*Screenshot of the IWE "Animals of Africa" (3D models)*



*Note.* The IWE was created on the FrameVR platform, with the students using one of the templates provided by the platform and simply customizing the space, including 3D objects, videos, images and text.

The information collected was processed with the help of chatGPT. The students also created posters and presentations using AI tools such as Slide GPT (Figure 2).

**Figure 2**

*Screenshot of the IWE “Animals of Africa” (posters and presentations using AI tools)*



It's also possible to see photographs of the students next to the animals in the different areas of the immersive room using AR tools such as ARLoopa (Figure 3).

**Figure 3**

*Screenshot of the IWE “Animals of Africa” (using AR tools)*



## 2.2 IWE “OUR CLASSROOM ONLINE”

The development of this IWE involved 3rd and 4th year primary school students. Teacher and students co-created a collaborative space that can be used for informal meetings and leisure activities and/or for collaborative learning activities for the subject of 'Beginning Programming'. The space, monitored by the teacher, with active access notifications, is a meeting point for 3rd and 4th year students from the various schools in the cluster, where students have access to various resources, indicated by them. It is used by students outside of class time, autonomously, usually via their tablets, since the school's computers don't support Frame VR platform (Cleto et al, 2024a). The students began by choosing the Frame VR template, then created a sketch of the online space, drawing it using scenery paper. Finally, they presented their work. The space was then personalized by the teacher with the resources suggested by the students and using the options offered by the platform (Cleto et al, 2024a). Although all the planning took place in the classroom, the personalization in the classroom was done by the teacher and at home by the students, due to difficulties with internet access and problems with the school's computer equipment (Cleto et al, 2024a).

The aim was to understand the students' participation in customizing an immersive web environment and how this participation influences their appropriation of this space.

The space is divided into two rooms (Video 1), the 3rd grade room and the 4th grade room, with resources specific to each grade but accessible to all students (Cleto et al, 2024a).

## Vídeo 1

### IWE "OUR CLASSROOM ONLINE"



Note. <https://drive.google.com/file/d/1U5CHY1yd7XyfbhRGEwj0rurSXZN4oVzR/view?usp=sharing>

The common areas include links to SeguraNet games and 'Home Study' posters, as well as access to online radio stations (Cleto et al, 2024a).

## FINAL CONSIDERATIONS

The training workshop aimed to provide teachers to use immersive web environments in their teaching practices, as a complement to traditional teaching, to stimulate collaboration between students and teachers. The training workshop also allowed to identify and choose which teachers will participate in the research 3, where they will have the opportunity to participate in the co-design and development of the immersive classroom, making it more suitable and personalized to their learning needs.

Teachers have already completed 30 hours of training. It is therefore intended that teachers who continue to integrate IWE in the classroom and want to collaborate in research project 3 will take part in a 4-hour workshop with their students to (re)familiarize themselves with the platform (registration, choosing and controlling the avatar, movement). The students will be given the opportunity to learn some concepts about building worlds. The teacher will be given complete freedom to decide how to integrate and explore IWE with their students (Yeh & Lan, 2018), as well as to develop the environments that suit the content they want to teach. Students can explore and experiment with the different possibilities for developing the environment they want to create. When creating teams and conceptualizing various models, before starting their 3D modelling to turn a technological experience into a pedagogical experience, this phase should be supervised by the teacher to ensure that all the concepts you want to convey are incorporated. In a later session, the students can develop their spaces and finally test the "room" that best suits what they want to teach. Afterwards, a teacher (who may have decided not to go ahead with the project in their class) will be invited to have a few lessons in the environment co-created by the students. The students will be able to describe what they have done to their classmates and will have the opportunity to teach a particular piece of content to the class(es).

The researchers will not attend the lessons, they will only have access to the data provided by the teacher. The researchers will interview the teacher, but the questionnaires given to the students will be given to the teachers, who will in turn give them to the students.

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