DOI: https://doi.org/10.56198/qcke5820

# Educational Virtual Tours: Creating Immersive and Interactive Tours to Support the Teaching and Learning Process

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**Abstract**. This iLEAD study presents a design and development methodology for creating virtual tours with the aim of supporting the teaching and learning process of undergraduate students at our university. These tours are created to foster interactivity and immersion, enriching educational experiences across diverse fields such as medicine, music production, and engineering. We propose a seven-stage design process for developing tours, which includes stages such as project evaluation, production, and final documentation, ensuring the tours meet specific educational objectives. During the production stage, some tours are created using simple navigation and interaction tools commercially available, effectively meeting basic needs. Driven by the demand for more personalized interactions, we developed a proprietary solution that incorporates audiovisual elements, interactive quizzes, structured navigation, student's evaluation and feedback, and the use of VR. Furthermore, we integrated immersion dimension analysis, considering system, narrative, and challenge aspects, with the intention of optimizing the effectiveness of the tours in supporting the teacher's learning objectives.

**Keywords:** Virtual Tours, Immersive Education, Interactive Tools, Immersive Environments.

## 1 Introduction

Virtual tours have become increasingly popular due to their versatility and ability to provide accessible immersive experiences in several fields, such as real estate, tourism, industry, and more. In the educational field, they open up new possibilities for exploring historical sites, laboratories, and academic facilities. A promising area also lies in their use for remote training, visits to hard-to-access locations, and studying the operation of complex equipment. A very common solution for creating virtual tours is provided by the Matterport technology suite [1]. The general workflow of using this technology involves the following steps: capturing images of the real environment; generating a 3D model and a package of images of the space; and creating the virtual tour available at a Matterport domain, which may include interactive points (mattertags). The software tools supporting this production are comprehensive and intuitive, allowing for the quick creation of tours. Typically, Matterport's native tools are sufficient for creating most educational tours intended for use on browsers, tablets, and smartphones.

An important feature of educational tours is the possibility to use Virtual Reality (VR). One limitation of the Matterport technology suite is that interactions (mattertags) do not function in VR headsets. Motivated by this limitation and the need to establish a structured development process for virtual tours, we developed our own design and development methodology, structured in seven stages, ranging from project evaluation (feasibility) to production and final documentation. Additionally, we created our proprietary solution for building tours, which was developed using the Unreal engine [2] and incorporates the image assets generated by Matterport. This solution, fully functional in VR headsets, enhances immersion and learning through interactive features. All projects follow our seven-stage methodology, and based on the project's characteristics assessed during evaluation and planning, we develop tours using either the Matterport technology set or our proprietary solution. This article focuses on presenting our methodology for designing and developing virtual tours, along with our immersion analysis strategy. While future studies are planned to empirically assess learning outcomes, the current focus is on the framework and its implementation in real educational settings.

To this end, we have structured this work as follows: in Section 2, we present our design and development methodology through the tours we created, showcasing new interactive features. In Section 3, we provide a discussion on the tour development process, the effectiveness of different interaction types, and immersion strategies. Section 4 is dedicated to our conclusions and reflections on the future of virtual tours.

## 2 Design and Development

In our development center [3] we are specialized in creating immersive experiences like virtual tours, digital games, interactive films and documentaries, simulators, training software, and many other educational applications. The design and development of our virtual tours for educational purposes follows a structured process in seven stages (Fig. 1). The **Evaluation (1)** stage analyzes the project's feasibility, including obtaining permissions for image capture and assessing the impact on learning. During this stage, we also evaluate whether to use the Matterport technology set or our proprietary solution based on the project's requirements. In the **Briefing (2)** stage, the scope of the tour is defined, points of interest are listed, and the didactic content, developed by the requester teacher, is organized. The **Planning (3)** stage involves a meeting with the team to align development details, such as who will be responsible for each task. **Pre-Production (4)** handles image capture and creates a prototype, if needed. During the **Production (5)** stage, the tour is developed and tested. **Post-Production (6)** makes final adjustments based on feedback, fixing bugs or issues. Finally, in the **Final Documentation (7)** stage, an official software registration is made, and the content is approved. The seven-stage methodology was designed to ensure pedagogical alignment, iterative refinement, and seamless integration of technical and educational elements. Each stage addresses specific needs in the development process — from feasibility analysis to post-production adjustments based on student feedback.

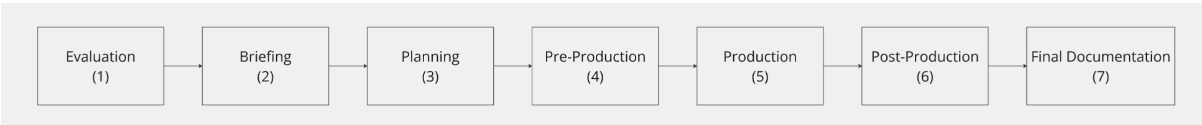


**Fig. 1.** Virtual Tour Development Stages.

During the Production stage, the development approach varies based on the tour's complexity. For simple interactions—such as exploring spaces, reading, listening to audio, or viewing images and videos—we use Matterport's native tools. However, for scenarios requiring complex decisions, alternative paths, or interactive assessments, we employ our proprietary solution. In both cases, image capture and 3D model generation are done using Matterport.

### 2.1 Tours Using Matterport Technologies

One of the main reasons teachers request virtual tours is the difficulty of accessing certain locations, which cannot be visited by large groups of students. Examples include environments such as state-of-the-art recording studios or surgical centers in hospitals (Fig. 2).

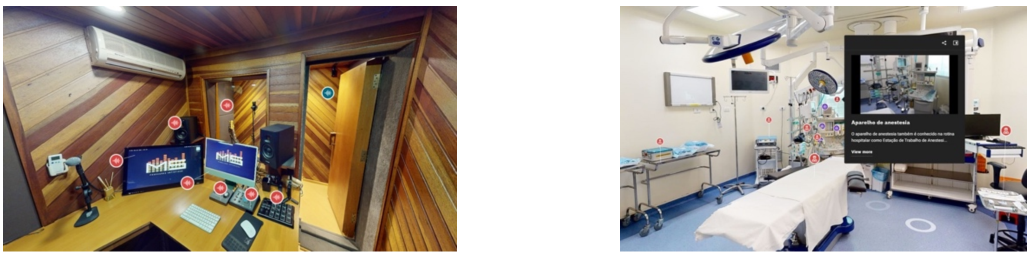

**Fig. 2.** Musical Studio and Surgical Center Tours (left to right).

Through these two tours, the student needs to navigate the space, learn about different types of equipment, and understand their features and functions. In some interactions, the student can listen to an explanatory audio – in the case of the music studio, it's a song resulting from a mixing process. In the case of the surgical center, it's the characteristic sound triggered by one of the devices. To delve deeper into a topic, both tours allow the student to read more detailed texts or even watch a video (during the journey). These are all features that can be implemented based on the native functionalities of the Matterport technology suite. Within the Matterport online environment, it's possible to create mattertags that correspond to points of interest (or interaction), which can be accessed during the tour, leading to interactions via text, images, videos, or external links. We opt for this approach primarily when the goal is to reach the largest possible number of students, providing easy access to the tours via smartphones, tablets, or browsers, particularly in scenarios where VR devices are either unnecessary or unavailable.

## 2.2 Tours Using Our Proprietary Solution (Factory Virtual Tour Example)

The *Factory Virtual Tour* is a collection of immersive experiences based on virtual tours that immerse engineering students in various factory visit contexts. In contrast to native Matterport tours, which are characterized by free and continuous navigation along a path, our educational tours allow for the organization of accessible areas and the determination of a specific order of navigation, if this aligns with the teacher learning objectives.

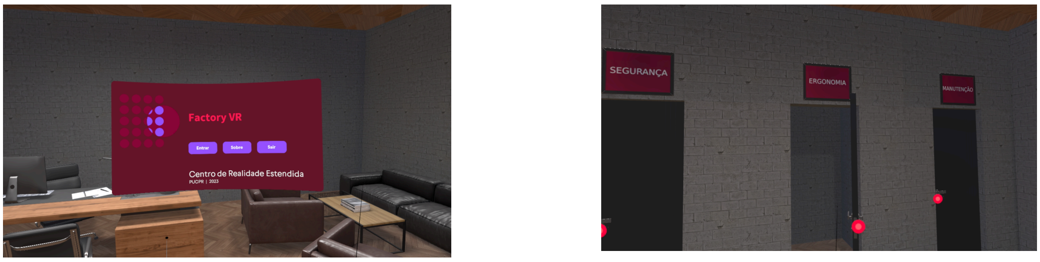


**Fig. 3.** Factory Virtual Tour navigation system.

Fig. 3 (left image), shows an example of the menu system that provides access to one of the tours in the collection (Factory VR). Students can navigate through different factory environments (right image) either freely or with guided pathways. Teachers have the flexibility to grant access to all entry points at once or organize the tour in stages, allowing access progressively as students advance and complete specific parts of the tour. In addition to interaction elements such as text, audio, images, and videos embedded in the system, we offer additional forms of user interaction for educational purposes.

As students navigate through the factory, they encounter industrial equipment that serves as the focus of their professor's teaching and learning process. In the *quiz interaction* shown in Fig. 4 (left image), the student views an image of the factory and is prompted to test his knowledge through a question with possible answers. The system provides immediate feedback to the student. Besides viewing images, the student can watch a video, or even listen to the operation of a specific piece of equipment and be prompted to take an action. In the example shown in (Fig. 4, right image), he watches a video observing the operation of a particular process. At the end of this interaction, he is asked to decide on an action based on what he observed. As a result, he receives feedback or even proceeds to explore new spaces.

**Fig. 4.** Factory Virtual quiz interactive feature and feedback.


**Fig. 5.** Final feedback and tour completion.

To maintain engagement, quiz interactions are alternated with audiovisual elements, preventing the experience from becoming tiresome. At the tour's end, students can review mistakes and correct answers (Fig. 5 – left image), receiving a numerical score. A final message (Fig. 5, right image) signals the conclusion.

To illustrate how our seven-stage process was applied in the *Factory Virtual Tour*, we examine the quiz interaction feature (Fig. 4, left image). During the **Evaluation (1)** stage, we identified that the teacher's learning objectives aligned well with an interactive assessment format, confirming the use of our proprietary solution. In the **Briefing (2)** stage, the teacher defined the quiz content while reviewing a 2D map with marked interaction points, ensuring alignment with learning goals. **The Planning (3)** stage involved task allocation: one specialist handled audiovisual design, while a programmer focused on development. During **Pre-Production (4)**, we captured factory images and created a quiz prototype for validation. In **Production (5)**, the quiz was implemented and tested, with immediate feedback added to enhance engagement. **Post-Production (6)** involved refining the quiz based on feedback from students and the teacher, improving usability and educational value. Finally, in **Final Documentation (7)**, the quiz was officially validated and approved by the teacher. Our proprietary solution, built for VR using the Pico Neo3 Pro headset [4], exemplifies the methodology developed with Unreal Engine [2]. It is being refined into a flexible template adaptable to various environments beyond industrial settings. Unlike Matterport's native technology, which restricts Mattertags in VR, our solution overcomes this limitation by incorporating structured navigation, interactive quizzes, and audiovisual enhancements, expanding user interaction and engagement.

## 3 Discussion

The development of educational virtual tours, as explored in this article, reflects the increasing demand for immersive and interactive learning experiences within education. By combining native Matterport tours with our proprietary solution, we provide innovative tools that directly address our educational objectives. By integrating audiovisual elements, interactive quizzes, and structured navigation paths, we offer an effective alternative for accessing environments that may be challenging to visit physically, such as the places showcased in our examples. The design and development of customized educational tours require a methodical process aligned with educators' needs. Chen et al. [5] proposed a development model involving iterative design cycles. Similarly, we developed a seven-stage process tailored to creating our tours. Both approaches incorporate game design concepts [6] and principles of user-centric design. Our interactive features, particularly the quiz interaction, are rooted in these principles. The use of virtual reality (VR) is becoming integral to education, offering students a strong sense of presence and immersion [7]. Educators in our projects naturally gravitate towards VR, recognizing its potential to boost student motivation. However, evaluating the educational effectiveness of VR compared to traditional teaching methods requires comprehensive research [8]. In our educational products, we conduct immersion analyses based on the framework proposed by Beck et al. [9], which identifies three core dimensions: system, narrative, and challenge. The system dimension addresses the technical aspects underpinning the experience, such as hardware and software. The narrative encompasses the creation of an engaging context through storytelling, settings, and interactions. The challenge pertains to user agency, enabling active participation and problem-solving [10]. In the Factory Virtual Tour described in Section 2.2, the system dimension (use of VR and high realism) and the challenge dimension (quiz interaction feature) are the most significant in contributing to the immersive experience.

Recent studies highlight the growing adoption of VR in education, particularly for creating engaging learning experiences. Radianti et al. [11] identified gaps in VR applications, such as the neglect of learning theories and a focus on usability over learning objectives. Similarly, Pellas et al. [12] noted improvements in STEM education through VR but emphasized the need for more rigorous studies to measure learning outcomes. Hamilton et al. [13]

found that VR often outperforms traditional methods in achieving learning goals, based on comparative studies. Our methodology aligns with these insights. The seven-stage process ensures learning theories are integrated into immersive experiences, with teachers specifying desired outcomes from the start. We prioritize learning objectives over design and usability, incorporating student feedback in the Post-Production stage. The immersion framework (system, narrative, and challenge) provides a structured evaluation, addressing the need for rigorous metrics highlighted by Pellas et al. [12]. The integrated assessment system measures performance and refines the tool, aligning with Hamilton et al.'s [13] focus on learning outcomes. Recently, we have critically analyzed our interactions, recognizing that quizzes could be replaced by activities promoting student agency. We believe decision-making enhances immersion, offering a stronger sense of presence in the virtual environments we design.

## 4 Conclusion and Future Work

Educational virtual tours are increasingly popular in teaching approaches that leverage interactivity and immersion. Once the educational content is developed by the requesting teacher, many tours can be created using Matterport's native technologies. Our proprietary solution expands these possibilities by incorporating audiovisual elements, interactive quizzes, and structured navigation, tailoring experiences to new contexts and pedagogical objectives. This is evident in the integration of quizzes and navigation paths, which provide dynamic interaction and efficient student assessment and feedback.

Currently, the virtual tours are being used in engineering courses by five professors, with some classes held in dedicated spaces at our Extended Reality Center for collective viewing and discussion. Each professor adopts their own didactic approach, while the integrated interactive quiz provides immediate feedback on student understanding, enabling real-time adjustments. Although student engagement is strong, more in-depth quantitative studies are planned to assess the tool's long-term effectiveness. While there is no concrete evidence yet of the tours' lasting impact on learning outcomes, they are crucial in scenarios where students cannot access physical spaces due to safety or institutional restrictions. The tours align with the university's competency-based education model, focusing on learning outcomes and active methodologies. Each project identifies specific learning goals based on the professor's syllabus, ensuring the tool supports planned objectives. A pedagogical guide accompanies each tour, offering best practices while allowing flexibility for adaptation. A logistical challenge is scaling VR headset use, such as the Pico Neo3, for large engineering classes. Active learning methodologies help overcome this by promoting collaboration, even with limited devices. Dedicated spaces in the Extended Reality Center, like the immersive auditorium and Master Cave, further facilitate student engagement. These considerations highlight the importance of addressing logistical constraints early in development to ensure accessibility and effectiveness across diverse teaching contexts.

Our seven-stage design process was developed to align with the educational goals of teachers and streamline our team's workflow, ensuring clarity and efficiency in creating interactive educational tours. This model standardizes production stages while allowing personalization based on pedagogical needs. Guided by design and game design principles, our solution adapts intuitively to educational demands, focusing on enhancing student engagement. The evolution of our proprietary solution has been driven by teacher feedback, leading to features like interactive quizzes and new navigation forms. However, we remain attentive to the potentials and limitations of these elements, critically analyzing their impact on student immersion and learning. Moving forward, the analysis of immersion dimensions will remain a guiding principle for developing tours and other immersive products. Future research will focus on implementing quantitative studies to assess student engagement and learning outcomes, building on the current practical applications of the tours in educational settings.

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