MSA UNIVERSITY ENGINEERING JOURNAL

Virtual Reality as A Tool to Enhance Students' Perceptions of Architectural Historical Spaces

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Abstract

The future relied on advanced and smart technologies after covid. Teaching strategies became more virtually oriented. Despite the important role of visiting historical sites in architectural students' knowledge and space perception. The study aim is to highlight the significance of virtual related technologies in teaching as a smart strategy to enhance students' perceptions in architectural universities and cope with the future of technology, specifically in "History of Architecture" courses. An overview of virtual related technologies will be presented, exploring different techniques, elements and types, this will be built on a theoretical study. In addition, the significance of virtual spaces on students' perceptions will be investigated through a non-equivalent quasi experimental study. A group of students will experience a historical space through a non-immersive virtual tour, and the other group will experience the same space through 2D photographs.

Findings of the study presented the effect of virtual related technologies in enhancing the architectural students' perceptions toward historical sites. For a better understanding of spaces in architectural universities.

Keywords: Virtual reality, virtual related technology, non-immersive and semi-immersive techniques, quasi experimental approach, history of architecture courses

ENGINEERING JOURNAL Volume 2 Issue 2
Received Date January 2023
Accepted Date March 2023
Published Date March 2023
DOI: 10.21608/MSAENG.2023.291904

1. Introduction

There is an increase in using advanced technologies in architecture [1, 2, 3, 4] Although architecture has a long history of two-dimensional (2D) plans for building design, projects have drawn to be more complex and require the implementation of 3D technologies. In addition to 3D modelling tools, Virtual Reality has increasingly become a required implementation in architectural projects recently [2, 3]. Virtual reality creates more opportunities when it comes to designing and space perception and understanding [5, 2].

Implementation of virtual related technologies in architecture educational facilities has offered opportunities for students to operate and visualize building design, as well as enhance student's perception of space and imagination [4, 6, 7, 8], see fig. 1. Although it is mostly being implemented in technical modules, theoretical courses rely on traditional learning techniques and site visits for its importance in space perception [9, 10].

Concerning theoretical courses in architecture, Historical places with significant architecture features, located around the globe, are crucial for an architect or an architecture student to visit, explore, experience and acknowledge to develop important life and architectural skills [8, 10], such site visits involves several challenges, including time, expenses, and ease of transportation [5, 11]. Previous literature mentioned that there are innovative alternatives to enhance students' perception and space understanding in the limited site visits [12, 5, 8, 10, 13, 14, 15]. However, this was not the case in architectural education facilities in Egypt especially after the limited site visits due to the covid 19 and the lockdown in 2020 [12].

Therefore, this study aims to investigate the appropriation of virtual reality technique in enhancing architectural students' space experience and perception to historical spaces. It includes a discussion concerning the technology of virtual related technology, and an investigation of students towards perceived space experience using virtual reality, this will rely on a non-equivalent group experimental research strategy.

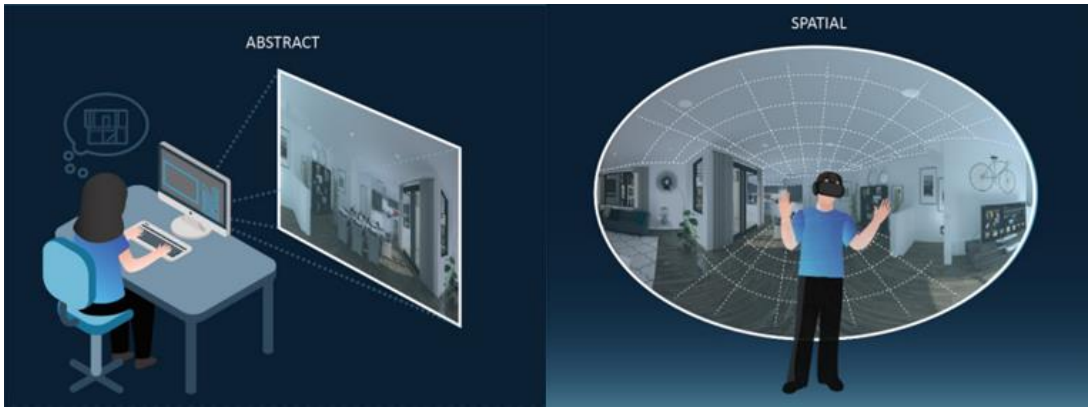

fig. 1 spatial view port compared to two-dimensional perception [2]

2. Virtual Related Technology

Mastering virtual related technologies have become a major requirement for architects and architecture students [16, 7]. Growing literature stated that they provide an opportunity for students to experience spaces with a different perspective (see figure 2), and even operate sites without limitations [2, 6]. It is a tool that can be used to enhance students' perception, remove exploration limits, encourage students' creativity, and spark their imaginations, in addition to deliver immersive learning experiences [6, 11]. Previous literature suggested that using AR and VR in education, as well as combining the two technologies to create mixed reality, can help students achieve better results [9, 6, 15].

Virtual related technologies can be defined as a computerized virtual world that creates an interactive system, they could create an immersive environment that allows users to operate and explores with no need for transportation [3]. Immersion could be mentally and/or physically; mental immersion is the perception of being in a particular space or place. and physical immersion is the feeling of present physically in space [3, 6], which Provide computer-generated sensation to one or more of the human senses [3, 16] see fig. 2. immersion could be classified into [2]:

- Non-immersive virtual world, a non-interactive experience [17], which users engage with a virtual environment through a computer and can control some characters or activities within the experience, but the virtual environment does not interact with you directly.it relies in tablets and pc monitors for visual display and surrounded sounds or headphones for audio.
- Fully Immersive Virtual Reality, it guarantees that the interactive virtual experience is as realistic as possible [17]. It would feel as if one were physically present in the virtual world. To give a genuine virtual experience, special equipment such as VR glasses, gloves, and body detectors with sense detectors for aural, visual, and haptic experience [18], and the virtual world reacts in real time to offer users with a realistic virtual experience.
- Semi-immersive virtual reality is a non-interactive experience [17], hybrid of non-immersive and fully immersive virtual reality experiences. one can move around in a virtual environment using a computer screen or virtual reality glasses, but there are no tangible feelings to add to the experience.

Moreover, in relevance to the level of immersion, there are various virtual worlds, all could be described as categories of extended reality (See fig. 3): as extended reality is the future of virtual related technologies and will shape public spaces and smart cities [19, 20, 21].

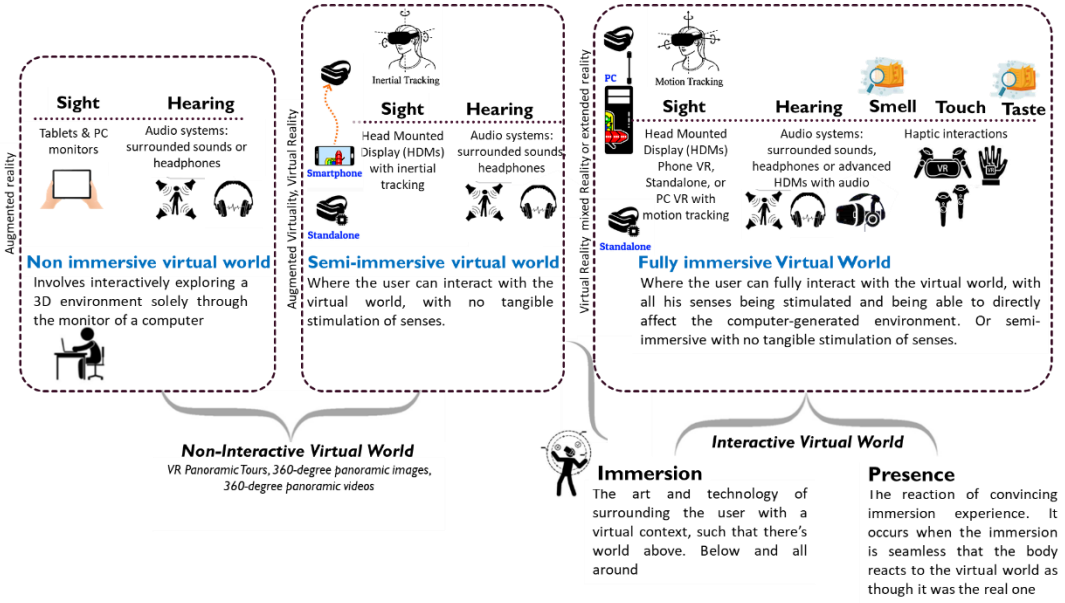

fig. 2 Types of virtual related technologies, after [3, 15, 22].

2.1. Virtual Reality

the virtual reality, where the surrounding environment is a virtual unreal environment and the user is completely shut down from the real environment [23, 7, 9]. Previous literature indicated that virtual reality became more convenient in the teaching facilities [7, 6] to be used in practical and theoretical courses for its engaging opportunities and could be implemented within lecturing the PowerPoint presentation [6].

2.2. Augmented reality/Virtuality

the Augmented realty or virtuality, where the surrounding environment are real but with virtually added objects on the portable screen [23, 9]. it is more affordable than the other virtual related technologies, and it is more used in preschool teaching facilities, and encourage more collaborative learning [6, 18]

2.3. Mixed Reality

Augmented reality and virtual reality provide limited experience compared to mixed reality [17], which is a mixture of virtual reality and augmented virtuality [23, 9]. It is now seen as the future of technology in the field as it provides a more flexible and allow users to control more their learning strategies [6]. Mixed reality includes sensory feedback and enhanced space experience [17]. It also provides Proprioception, which is the ability to sense position and location [24].

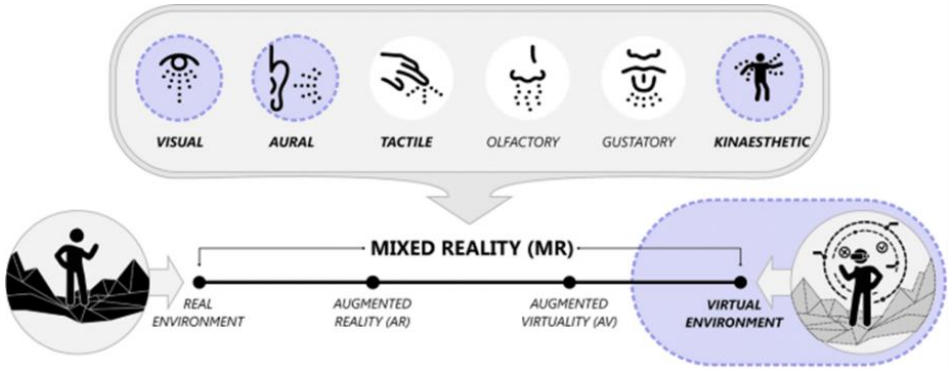

fig. 3 types of virtual related technologies [17].

In addition to the mental and physical immersion, virtual related technologies could evolve the future of immersion and presence by providing the sensory stimulation experience rather than limited space experience to visual and auditory feedback. The experience of the virtual world could develop the four types of affordances, cognitive, physical, functional, and sensory, The colour and light will be experienced in relation to space not static on screen, the motion detection, the sounds and haptic feedback will relate also to space [17].

in the light of the previous, as virtual reality is more convenient for students engagement in univesities and pervious literature stated is significance in enhancing space experience, and as semi immersive techniques would be more affordable than fully immersive technologies, an expreimental research strategy was done to investigate the appropriation of using virtual reality to enhance historical space experience of architectural students in Egyptian universities as below:

3. Method

The aim of this study is to analyse the effect of implementing virtual reality technique in architecture historical courses on Egyptian students who experienced historical courses during the Covid 19 Pandemic. this was depicted through an experimental study on architectural students in the British university in Egypt, especially in history of architecture course. This aims to develop a complete understanding of methods of implementation of virtual reality in educational facilities as well as the results of implementing such technology.

The participants were thirty-two architecture students of degree year three. The experiment was done in April of the academic year 2021-2022 using a non-equivalent group method, to analyse students' perception towards a historical space with and without virtual reality technology implementation and provided a comparative analysis. All thirty-two participants had never physically visited the selected site, and the selected chosen site was the Church of Gesù Nuovo in Naples, Italy (see fig.4). It was selected as it may be not as familiar to students. as the experiment aims to measure students' perception of an unfamiliar space.

Participants were divided into two groups of 16 students each, Group A was the control group, as participants only viewed photos and 2D images of selected site (see fig. 5). Group B was the treatment group as participants experienced a virtual tour of selected site1.

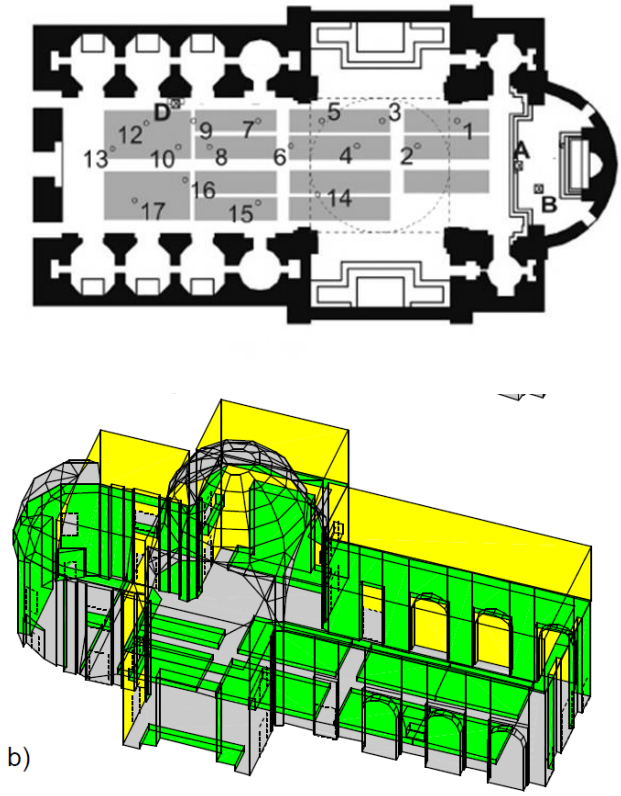

fig. 4 Church of Gesù Nuovo in Naples, Italy [25]. *this image was not shown to students*

A phone VR headset was used (Shinecon smart phone Headset used with iPhone 12 pro max smartphone), this headset allows a flexible experiment, it was chosen as it is the most suitable according to its low relative price, Availability, the adjustable IPD allowing flexibility for several number of participants, which reduces motion sickness and creates clear vision for each participant, Simple and light design allows for ease of use.

After the two groups' space experience procedure, each student was asked to draw a quick sketch showing the plan of the space perceived this aimed to assess the level of understanding and the space reading of students. Findings was presented through a comparative analysis between the two groups.

[1] 360 VR tour, URL: The Gesu Church in 360! - YouTube

fig. 5 photographs used for group A

4. Analysis and Results

After Group A experienced the traditional teaching method, they were asked about the space and, they all failed to describe it, using words like “in sufficient information” or “not enough visualization”, all 16 participants failed to sketch or explain the space, indicating lack of perception of space. Participants could only recall the interior style but failed to imagine or feel the space itself (see fig. 6). A student added that: “This method of teaching is usually followed by a visit of the site, but in the case of the selected site, a site visit would be very difficult and may be impossible.”

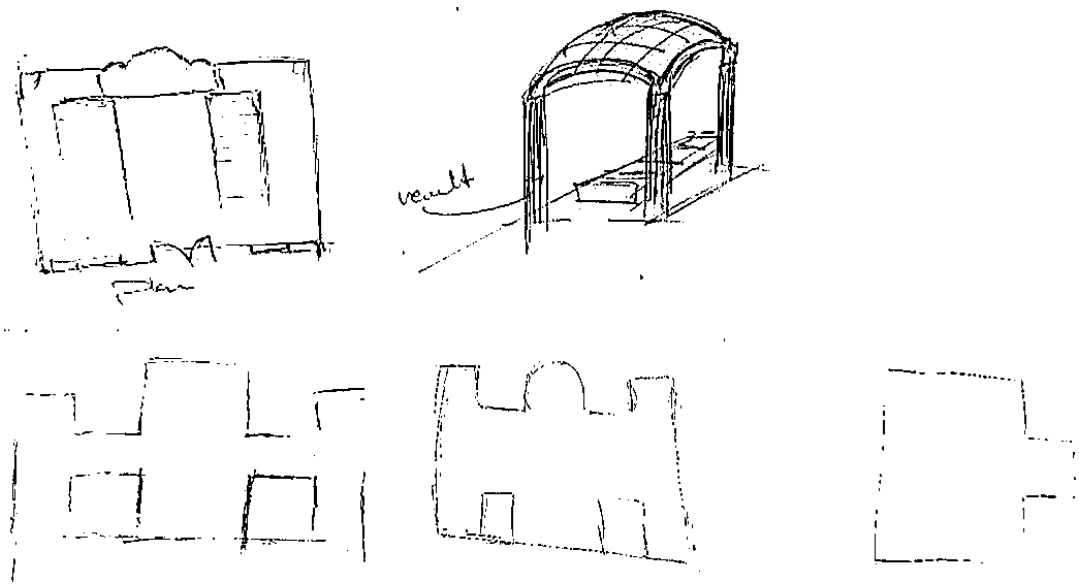

fig. 6 Example of participants quick sketches (Group A)
images show lack of space understandings and space readings

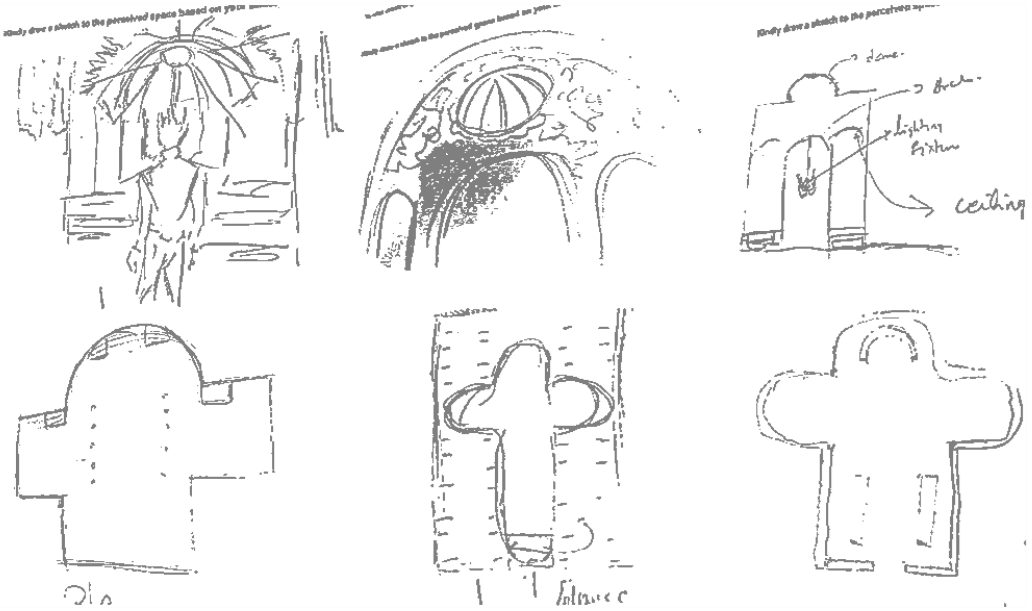

fig. 7: Example of participants quick sketches (Group B)
images show better space understanding and better plan and spaces readings.

Group B on the other hand (see fig.7), were fascinated by the technology. perception of the space was higher than that of Group A, that was shown by their sketches illustrate the plan and the spaces inside the church (see fig 6), During the Virtual Reality experience, students could look around, visualize the space, and see how the space was divided. The virtual tour of the site offered students a chance to visit a site in Naples, Italy without leaving their class. During the experience participants could identify the architecture style, the building components and design as well. During the questionnaire, student sketched plans and images with addition of notes that all indicate their level of understanding of the space. A student noted that "such experience would enhance "history of architecture" modules and would help us as we could visit all sites".

5. Discussion and Conclusion

There are several types of virtual related technology, that will shape spaces and educational courses that required knowledge concerning space experience, impacting community and cities smartness. This study investigated the impact of implementing virtual reality in "History of architecture" courses in Egypt through experimental research. The Study was applied on students who haven't experienced or visited historical sites due to Covid 19 pandemic and transportation limitations afterwards. The experiment results indicated that implementation of virtual reality technology could enhance students' perception of space and affected their level of understanding positively. the experimental study indicated that students' perception of space is very low when studying through the traditional form of teaching (through viewing 2D images). However, student who experienced the virtual reality techniques showed higher space perception and understandings. All participated students

have stated that implementing such technology would greatly be beneficial during the learning journey.

Finally, as architecture is a field that affects the world greatly; and architecture students are the designer of the future. therefore, they need to understand the past. Theoretical courses and especially “history of architecture” courses create a bridge between past and the present. And virtual related technologies are being developed and enhanced to be used in several practices. Implementing Virtual Reality supports that bridge that “history of architecture” courses aims to build. it is recommended to use the VR related technology in architecture educational facilities in Egypt and in the Middle East, to maintain a well-developing future that is coping up with surrounding technologies, latest technological advancements need to be available for today’s students. Due to time and budget limitations, this study could not assess fully immersive technologies and mixed reality in the enhancement of historical space experiences and understanding. Therefore, a deep study is recommended as future study.

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