Augmenting learning through Virtual Reality Applications in Education

Introduction
Student engagement is one of the most important factors for effective learning, be it any mode of education, online or offline (Czerkawski & Lyman, 201; Gillett-Swan, 2017). Reeve et al. (2004) defined engagement as "the behavioural intensity and emotional quality of a person's active involvement during a task" (p.1). Student engagement can be related to behavioural, cognitive and emotional dimensions of student learning (Redmond et al., 2018). This is achieved using various strategies and technologies. Fatawi et al. (2020) noted the impact of concept maps on student engagement and learning outcomes. They reported an improvement in learning outcomes and effective cognitive, emotional and behavioural changes in the students. Peer interaction is another strategy (Chadha, 2019) where student-content interaction, student-instructor interaction, and student-student interaction can deepen learning, enhance critical thinking and boost problem solving skills. Cookson et al. (2020) recommended the use of animated instructional videos for increasing student engagement with the course material. Korkealehto & Leier (2021) found telecollaboration effective for promoting intercultural competence. Blended learning (Shohel et al., 2020); providing authentic learning experiences (Bornschlegl & Cashman, 2018); and digital gaming (Li, Peterson & Wan, 2022) etc are also reported to enhance student's engagement and learning performance.

Virtual Reality applications in education
The applications of virtual reality, augmented reality, and mixed reality have seen a continuous upward trend in education. Alsop (2022) reported the global market for virtual reality, augmented reality and mixed reality to increase up to USD 250 billion by 2028. Crowe & LaPierre (2018) report that virtual / mixed reality applications are highly effective instructional tools for K-12 and higher education. Moura et al. (2021) reported about the feeling of "being there" as an immersive experience of the virtual reality applications as it satisfies various sensory stimuli and hence an ideal medium for embodied experiences. Virtual reality applications have varied uses and in many industries. It is of great help for tourists to have virtual tours in planning about visiting a destination (Jasrotia, 2022). Gomes et al. (2019) reported the advantages of virtual reality as 3D simulations of the virtual museum for its historical and cultural value.

With the advancement of hardware and software and lowering the costs, the immersive technologies are gaining the attention of teachers and educationists. Immersive technologies represent augmented reality (AR), virtual reality (VR) and mixed reality (MR). The immersive experiences are created by a blend of physical and virtual world. These experiences can be fully or partially or non-immersive. These involve integration of various media like images, audio, video or animation. With the help of suitable hardware like Head Mounted Devices (HMD), the learning experiences make the user feel the imagery (virtual) world as the real environment.

In this paper, we report about our work where we created virtual reality content. As has been suggested by the reviewers of our proposal, we also suggest future research areas.

Creating virtual reality experiences for heritage places in India

Purpose
With the purpose to highlight the places of national importance, we created the VR content for places like Mahatama Gandhi Ashram in Wardha, Maharashtra State, Gandhi Samarak at New Delhi, Taj Mahal in Agra, Uttar Pradesh, Qutub Minar in New Delhi and some other monuments
of national important and cultural heritage. These places hold high historical significance and thus are important from curriculum point of view as well.

**Tools used**
The VR content was created using 360 degree camera like Theta S, LG360 CAM and Insta 360R. After capturing the VR content, it was synthesised using Open Source tool H5P, StorySphere portal, Lapentor and Adobe Premiere Pro and Adobe Creative Cloud. We also used Google free application StreetView. Mobile based HMD and VR Boxes (like Google Cardboard) were also used to demonstrate immersion to the participants.

**VR tour of Mahatma Gandhi Ashram – Wardha, India**
[http://360degree.mijr.org/?page_id=4410](http://360degree.mijr.org/?page_id=4410)
Mahatama Gandhi is one of the prominent leaders of India's freedom struggle. His philosophy of non-violence, his theory of simple living and high thinking and ideology have deep impact on our society and moral values. In this VR Content we created a virtual tour of his place in Wardha, Maharashtra State of India where he lived.

**360º virtual tour of Raj Ghat Samadhi of Mahatma Gandhi**
[https://youtu.be/pw_z-h0Lqu8](https://youtu.be/pw_z-h0Lqu8)
This highly revered place is in New Delhi and visited by millions of persons paying their homage to Mahatama Gandhi, ordinary or VIPs. The VR tour of this place can be viewed on laptop or television or on mobile phone using VR Box.

**Virtual Tour of The Great Buddha Statue**
[http://360degree.mijr.org/?page_id=4410](http://360degree.mijr.org/?page_id=4410)
This place is situated in Bodh Gaya in Bihar state and has high historical and religious value. The Buddha statue is around 80 feet tall and one of the most visited site in the region.

*Image: Front gate of Great Buddha Statue. Markers are visible on the screen for navigation or extra information*

**Virtual Tour of the Tomb of Ghiyssudin Tughluq, New Delhi**
Ghiyasuddin Tughlaq was the founder of the Tughlaq dynasty in India. His tomb is located in Tughluqabad, New Delhi, India. This VR content is also interactive in nature and the VR tour can be done with a VR box or without it.

Image: Landing screen of the Tomb of Ghiyassudin Tughluq, New Delhi

For viewing it with VR box, open the site [http://360degree.mijr.org/tomb-of-ghiyassudin](http://360degree.mijr.org/tomb-of-ghiyassudin) on mobile phone and then put the mobile phone in a VR box and click the WebVR button to have splitscreen effect.
Nature of VR Content
The VR content created can be viewed as both non-immersive and immersive. For non-immersive, it can be played on a computing machine or a projector systems. The interaction with content can be done using computer mouse, keyword keys or trackball. These are easily viewable on mobile phones also. The markers and other information in the VR content assist the viewers to navigate.

Method
The VR content was shown to the students of class 10th, 11th and 12th in a School in Haryana state. The content was displayed using mobile phone as well as HMD to the students. After the students experienced the virtual tour, they were asked to share their views about the effectiveness of this content.

Findings
The students expressed positive comments about the VR content. Some of the comments are as hereunder:
“I am able to visit the places and learn about the history by seeing it. It was not possible for me to travel to such places”
“it looks like I am standing at the place I am seeing in this device”
“I was able to listen to prayers and other commentary of the Bapu’s ashram”
“I am happy to move around the garden in all directions by moving. This is very exciting”

Conclusions
This is our work in progress and we continue to create more VR content. Due to cost factors we are using simple tools and hardware. So far the reactions and feedback of teachers and students has been encouraging. Such VR content is a good option for self-directed learning and offers a unique pedagogy. We recommend that schools / institutions may have a VR lab and some inexpensive cardboard boxes so that students can experience the potential such interactive content. Training to the teachers for developing VR content is also needed.

Suggestions for further research
1. VR Content for subject disciplines may be created for example botanical gardens or animal zoos or architecture or scientific experiments.
2. Research on immersive experiences as human-computer interaction (HCI) is recommended.
3. There are mobile apps for VR content. Mobile is a ubiquitous device and thus pedagogical value of VR mobile based content may be examined.
4. H5P is a great open source application for creating interactive content. It is great to create interactive textbooks and thus research can be take up on examining the effectiveness of such medium.

References:


