360 VR (virtual reality) Educator: Transforming teachers into interactive content creators

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The integration of immersive technologies, such as 360-degree virtual reality (VR) in education presents a promising avenue for enhancing teaching and learning. However, educators often face challenges due to limited technical expertise and resource constraints. This study examined the usability and readiness of educators in adopting the 360 VR Educator platform – a tool grounded in Mayer's (2005) cognitive theory of multimedia learning – which enables educators to create interactive lessons using 360-degree videos and images. These can be experienced in fully immersive modes (via Google Cardboard and Android smartphones) or semi-immersive modes (via Android tablets). A total of 45 educators participated in a usability evaluation using the System Usability Scale provided qualitative feedback through open-ended responses. The Technology Readiness Index was also employed to assess their adoption readiness. Findings revealed acceptable usability, with educators appreciating the platform's immersive and interactive capabilities. However, some reported difficulties with the interface and navigation. The analysis indicated that optimism and innovativeness significantly influenced platform acceptance. Over 80% of participants expressed willingness to recommend the platform to peers. The study underscores the importance of training and technical support and affirms the potential of 360 VR tools in transforming traditional teaching methods through immersive learning experiences.

Implications for practice or policy:

- Structured training programmes should be provided to help educators effectively integrate 360 VR into their teaching practices.
- 360 VR technology should be incorporated into subjects where visualisation and spatial understanding can enhance student learning.
- Institutions should promote a culture of innovation to encourage educators to adopt immersive technologies.
- Clear guidelines and user-friendly resources should be developed to support educators in creating VR content.
- Opportunities should be created for educators to share VR teaching experiences and best practices with peers.

Keywords: 360-degree virtual reality (VR), immersive learning, professional development, usability evaluation, System Usability Scale (SUS), Technology Readiness Index (TRI), digital pedagogy

Introduction

The integration of information and communication technologies (ICT) and technology-enhanced learning has become more frequently used in addressing contemporary educational challenges, including diverse learning needs and preferences and students' demand for more engaging, meaningful learning experiences (Bayne, 2014; DiLullo et al., 2011; Hussin, 2018). The role of ICT in both teacher education and education, in general, is vital as not only can it lead to increased learning outcomes and educational development but also increase a nation's socio-economic development (Bhattacharjee & Deb, 2016; Sarkar, 2012). However, successful ICT integration remains complex, requiring not only appropriate digital infrastructure and resources but also well-trained educators capable of effectively implementing these technologies (Fu, 2013).

Recent years have witnessed growing interest in immersive technologies, particularly augmented reality, virtual reality (VR) and 360-degree VR. These technologies hope to transcend traditional educational boundaries, with the aim of enriching both teaching and learning processes while meeting students' expectations for engaging, meaningful learning experiences (Corbillon et al., 2017; Lampropoulos et al., 2022; Martín-Gutiérrez et al., 2017; Reyna, 2018). 360-degree VR refers to immersive experiences combining 360-degree videos, static panoramic images and interactive elements within a virtual environment (Albus & Seufert, 2022; Wolf et al., 2023). Unlike traditional VR, which relies solely on computer-generated content, 360-degree VR integrates real-world footage captured via spherical cameras, enabling authentic spatial exploration (Taylor et al., 2025). This approach aims to balance cost-effectiveness with immersion, making it accessible for educators with limited technical resources. Multiple systematic reviews have documented some positive impacts of 360-degree VR technologies on student learning and teacher professional development, albeit primarily in specific circumstances (Kavanagh et al., 2017; Pirker & Dengel, 2021; Radianti et al., 2020; Snelson & Hsu, 2019). As hardware requirements become less demanding and more affordable (Jensen & Konradsen, 2018), these technologies are gaining traction across educational sectors, from K-12 to higher education and adult training (Freina & Ott, 2015; Merchant et al., 2014).

Despite this fact, significant barriers persist in the widespread adoption of 360-degree VR in education. Educators often struggle to develop and implement VR learning experiences due to limited technical expertise, insufficient resources, inadequate equipment and gaps in digital literacy (Kavanagh et al., 2016; Vert & Andone, 2019; Yusof et al., 2019). Furthermore, research indicates a pressing need to evaluate the usability, effectiveness and learning outcomes of 360-degree VR experiences from both educator and student perspectives (Hamilton et al., 2020; Radianti et al., 2020).

This study examined educators' perceptions of the effectiveness and user experience of the 360 VR Educator platform through an analysis of their feedback, utilising both the System Usability Scale (SUS; Brooke, 1996) and the Technology Readiness Index (TRI; Parasuraman & Colby, 2015). The research addresses five key questions:

1. What is the overall usability of the 360 VR Educator platform, as measured by the SUS?
2. What features of the 360 VR Educator platform are most utilised and appreciated by educators?
3. What challenges do educators face when using the 360 VR Educator platform?
4. How do educators perceive the potential of the 360 VR Educator platform to change their teaching practices?
5. What is the relationship between the TRI scores and the educators' rating of the 360 VR Educator platform?

By answering these questions, we aim to provide insights to help bridge the gap between technological innovation and its practical implementation among educators, particularly for those new to immersive technologies, which is crucial for the effective design and integration of these technologies in teaching practices.

Related work

360-degree VR in education

VR creates computer-generated three-dimensional environments characterised by immersion, active participation, presence, engagement, immediacy and interactivity (Bryson, 1996; Freina & Ott, 2015; Sherman & Craig, 2003). When effectively designed, these VR environments can achieve sophistication that incorporates social and psychological elements (Blascovich & Bailenson, 2011) and potentially simulates physical presence within digital experiences (López-Belmonte et al., 2022). This technology produces a distinctive perceptual phenomenon where users feel strongly present while remaining aware of their virtual surroundings (Slater, 2018). VR technologies encompass two main categories: desktop VR, which simulates real or imaginary environments through conventional interfaces, and immersive (non-desktop) VR, which offers a perception of being in an environment without actually being in it (Freina & Ott, 2015). Although both forms incorporate affective and cognitive factors, desktop VR allows the use of relatively inexpensive systems and common input and output devices and interfaces (e.g., computer monitor, touch screen, keyboard, joystick or mouse) (E. A.-L. Lee et al., 2010; Makransky & Petersen, 2019). In contrast, immersive (non-desktop) VR employs specialised hardware including head-mounted displays, motion trackers and hand controllers (e.g., Oculus Rift, HTC Vive or Google Cardboard), enabling users to move more freely within the physical space while controlling their state in the virtual environment (Murcia-López & Steed, 2016; Parong & Mayer, 2018; Radianti et al., 2020). Although VR can offer significant benefits through immersive and interactive experiences across various domains when implemented effectively, substantial challenges persist regarding the requisite knowledge, technical expertise, time investment and costs associated with creating realistic environments (Kittel et al., 2020). The integration of 360-degree VR presents a promising solution to these challenges.

Specifically, 360-degree VR technology can potentially transcend some of the limitations of traditional video formats by providing omnidirectional content accessibility, enabling users to explore multiple viewing angles and adjust their perspective in real time. (Ferdig & Kosko, 2020; Lampropoulos et al., 2021). Although 360-degree VR lacks direct environmental interaction capabilities, it offers engaging experiences (Roche et al., 2021) as it provides a feeling of presence, self-directed control of view direction and immersion (Feurstein, 2018). Therefore, 360-degree VR can be used in conjunction with fully immersive VR to create even more interactive and intriguing experiences and environments by integrating both computer-generated digital content and multi-perspective content captured through spherical cameras, effectively leveraging the strengths of both technological approaches (Kavanagh et al., 2016).

In contrast to conventional virtual scenarios found in desktop and immersive VR, 360-degree VR enriches virtual environments with real-world footage and may foster more authentic learning experiences (Kittel et al., 2020; Pirker & Dengel, 2021). This technology has emerged as a particularly effective educational tool promoting positive learning behaviours (Di Natale et al., 2020). It may facilitate learner-driven and student-centred learning (Adnan et al., 2020), has been shown to enhance student satisfaction and learning outcomes in specific contexts (Allcoat & von Mühlenen, 2018) and delivers more interactive and engaging learning experiences in comparison to conventional learning approaches (Martín-Gutiérrez et al., 2017). Additionally, by immersing students in secure virtual environments and allowing them to explore previously inaccessible real-life scenarios, 360-degree VR opens new pedagogical possibilities and overcomes many traditional classroom constraints (Freina & Ott, 2015; Häfner et al., 2018; Hamilton et al., 2020; Hodgson et al., 2019; Yusof et al., 2019).

Empirical studies demonstrate that 360-degree VR can potentially facilitate multifaceted learning experiences in specific circumstances, encompassing student-generated content (Cochrane, 2016), experiential learning (Argyriou et al., 2020), inquiry-based approaches (Ou et al., 2021), self-directed learning (Araiza-Alba et al., 2021), situated learning (Di Natale et al., 2020) and practical skill development (Pham et al., 2018). Research findings indicate enhanced student engagement metrics, with significant improvements in satisfaction, acceptance and participation levels (Violante et al., 2019; T. Yang et al., 2021). Research studies on student engagement highlight the role of interactive technologies in promoting students' active participation (Fredricks et al., 2004; Henrie et al., 2015). For example, gamified elements and immersive media have been linked to heightened motivation and cognitive involvement (Deterding et al., 2011). Student behavioural analyses reveal increased focus, interest and immersion in learning activities (Kim et al., 2022), while cognitive assessments demonstrate improvements in active participation, intrinsic motivation, knowledge retention and higher-order thinking skills (Kavanagh et al., 2017; Sultan et al., 2019). Studies consistently report enhanced learning achievement, effectiveness and motivation across various educational contexts (Ou et al., 2021).

The technology's efficacy extends beyond traditional learning metrics, demonstrating positive impacts on communication and social skill development (Adnan et al., 2020) through reduced interaction barriers (Guervós et al., 2019). Psychological assessments indicate improvements in emotional responsiveness (Ulrich et al., 2019), self-concept (Yusof et al., 2019) and stress reduction (T. Yang et al., 2021), alongside enhanced cognitive, psychomotor and affective capabilities (Jensen & Konradsen, 2018). Although the majority of research supports positive learning outcomes, meta-analyses have identified some neutral and limited negative effects (Hamilton et al., 2020; Pirker & Dengel, 2021; Snelson & Hsu, 2019), suggesting the technology's impact varies across different implementation contexts.

The versatility of 360-degree VR is evidenced by its successful implementation across diverse educational domains (Pirker & Dengel, 2021; Snelson & Hsu, 2019), including environmental sciences (Ou et al., 2021), engineering (Violante et al., 2019), linguistics (Adnan et al., 2020), medical education (Arents et al., 2021; Sultan et al., 2019), healthcare (Ulrich et al., 2019), surgical training (Yoganathan et al., 2018), veterinary medicine (Guervós et al., 2019), geography (Prisille & Ellerbrake, 2020), field studies (Cheng & Tsai, 2019; Huh, 2020), religious studies (Johnson, 2018), safety training (Araiza-Alba et al., 2021), cultural heritage preservation (Argyriou et al., 2020), marine biology (Choi et al., 2018), construction safety (Pham et al., 2018) and mining education (Kalkofen et al., 2020). Despite these successes, 360-degree VR faces challenges, including limited interactivity compared to fully immersive six degrees of freedom VR, which may restrict user engagement in complex tasks (Kittel et al., 2020).

Beyond its impact on student learning, 360-degree VR can enhance educators' professional capabilities and pedagogical effectiveness. Specifically, it allows teachers to hone their skills, improves their noticing and awareness, reduces anxiety and provides diverse viewing angles to analyse the complexity and effectiveness of their approaches and better prepare and organise their study lessons (Ferdig & Kosko, 2020; Kim et al., 2022; Roche et al., 2021). Although educators may initially encounter challenges in designing and implementing 360-degree VR experiences without adequate training and tools, some studies suggest that after gaining familiarity with appropriate tools, educators may find that 360-degree VR can offer a relatively lower entry barrier and potentially provide a more cost-effective and flexible approach to creating interactive content compared to fully immersive VR systems (Brown & Green, 2016; Kavanagh et al., 2016). Importantly, 360-degree VR should be understood not as a replacement for traditional face-to-face teaching, learning and training methodologies, but rather as a powerful complement to enhance and support these established practices (Yoganathan et al., 2018; Yusof et al., 2019).

Several 360-degree VR content creation platforms such as ThingLink, InstaVR, Marzipano and Google Tour Creator have attempted simplifying the creation and management of 360-degree content, enabling educators to integrate multimedia elements like images, videos, and interactive hotspots without advanced programming skills. Although these tools enable basic scene linking, hotspot interaction and image embedding, they often lack educational scaffolding and structured pedagogical guidance tailored for teachers. Moreover, limited integration with teacher-student interactivity and support for gamified elements remains a significant drawback. The 360 VR Educator platform is specifically developed to bridge these gaps by offering a pedagogically grounded authoring and delivery platform aligned with Mayer's (2005) cognitive theory of multimedia learning (CTML) and designed with teacher-centred workflows and educational interactivity.

Theoretical background

Research demonstrates that multimedia learning enriches and transforms traditional learning activities and course material (Djurovic & Djurovic, 2010), extending into online learning modules (Y. W. Li et al., 2013) and self-learning activities (Castro-Alonso, de Koning et al., 2021) to enhance student engagement, motivation and knowledge retention. Within this context, multimedia is conceptualised through the combinational use of visual and verbal information, leading to mental representations that facilitate multimedia learning (Mayer, 2005). Among the theoretical frameworks in this domain, CTML, proposed by Mayer (2005) has established itself as one of the most comprehensive approaches. Grounded in dual coding theory and cognitive load theory, CTML provides empirically supported guidelines for instructional design that align with cognitive processing mechanisms while minimising extraneous cognitive load (Chiu & Churchill, 2015; Kennedy et al., 2013).

Empirical investigations of CTML have examined diverse educational approaches and technological applications. These studies encompass flipped learning methodologies (Almasseri & AlHojailan, 2019), interactive video elements (Cojean & Jamet, 2021), video annotations (Y.-S. Lai et al., 2011) and various technological implementations including VR (Kartiko et al., 2010), augmented realiy (Sommerauer & Müller, 2014), computer-based simulations (Hsu, 2020), digital simulations (Gegenfurtner et al., 2014), content acquisition podcasts (Kennedy et al., 2014) and multimedia pedagogical agents (Castro-Alonso, Wong et al., 2021). Hsu (2020) used computer-based simulations to refer to geometric learning via desktop software, while Gegenfurtner et al. (2014) employed digital simulation-based training to describe a broader range of digital training environments. Research findings indicate that dynamic and animated graphics (F.-Q. Lai & Newby, 2012) and texts (Luzón & Letón, 2015) effectively support learners in managing complex tasks and developing problem-solving capabilities, demonstrating enhanced learning outcomes compared to static picture-based instruction (Rudolph, 2017; C. Yang et al., 2018). However, Tversky et al. (2002) cautioned that animations may hinder understanding if not carefully designed, as excessive complexity or irrelevant motion can increase cognitive load and distract learners. Thus, the effectiveness of dynamic graphics depends on their alignment with instructional goals and cognitive principles (Mayer, 2020). In immersive environments, CTML demonstrates particular effectiveness when integrated with generative learning strategies (Parong & Mayer, 2018) and appropriate content segmentation (Rey et al., 2019).

Building on Mayer's (2020) established CTML principles, the development of the 360 VR Educator platform incorporates several key design elements: (1) multimedia principle – integrating pictures and words, (2) spatial contiguity principle – ensuring proximity between corresponding visual and verbal elements, (3) temporal contiguity principle – synchronising related pictures and words, (4) voice principle – employing natural human narration, (5) segmenting principle – organising content into user-paced segments, and (6) signalling principle – implementing emphasis cues for crucial concepts. The platform development particularly considered the immersion principle, which suggests that immersive virtual learning environments adhering to instructional multimedia design principles can achieve enhanced learning outcomes compared to less immersive media (Makransky & Mayer, 2022).

Professional development of teachers in ICT

Teacher efficacy remains central to the successful integration of ICT in educational practices (Comi et al., 2017). Contemporary educational environments demand educators develop digital competencies and implement innovative technological approaches to address the evolving needs of a digital society and maintain pedagogical excellence (Esteve-Mon et al., 2020). Research indicates that although teacher training, digital literacy and pedagogical innovation are crucial elements in professional development, significant gaps persist in current educational systems and training methodologies (Fernández-Batanero et al., 2020; Garzon Artacho et al., 2020).

Analysis of teachers' technology adoption patterns reveals that self-efficacy and technology-related beliefs significantly predict their receptiveness to technological integration in classroom settings (Tondeur et al., 2016). Studies emphasise the critical role of pedagogical and technological readiness in effective

ICT implementation (Hasse, 2017), suggesting that optimal outcomes require development of both technical and pedagogical digital competencies (Tømte, 2015). Effective professional development programmes incorporate hands-on experiential learning and practical application opportunities in authentic teaching scenarios (Admiraal et al., 2016; Y. Li et al., 2018).

These findings on technology adoption patterns are further supported by international research. In their study of German vocational teachers, Spangenberger et al. (2023) found that educators identified technical concerns, pedagogical integration difficulties and institutional resource constraints as barriers to VR adoption, despite recognising its potential benefits for practical skill development. This consistency in identified challenges across different educational contexts suggests common themes in teacher concerns regarding immersive technology implementation.

The increasing demand for engaging, student-centred learning experiences has heightened the significance of interactive technologies in educational contexts. Research demonstrates their capacity to enhance educational quality, facilitate teaching processes, promote student metacognition and address diverse learning needs (S. C. Lee et al., 2015; Shakhnoza & Makhbuba, 2020). Studies of preservice and in-service teachers indicate positive predispositions towards implementing immersive technologies, including 360-degree VR, when supported by adequate training (Billingsley et al., 2019; Theelen et al., 2019). This underscores the importance of comprehensive ICT training programmes that develop both theoretical knowledge and practical competencies (Bower et al., 2020; Theelan et al., 2020), particularly in creating and implementing effective, authentic learning experiences (Tondeur et al., 2015).

Design and illustration of 360 VR Educator

We developed the 360 VR Educator platform using UNITY and hosted it on a local server. It is a non-commercial, custom-built platform created specifically for educational purposes. The design and development were guided by Mayer's (2005, 2020) CTML principles and involved iterative feedback from educators through pilot testing. The 360 VR Educator platform (see Figure 1) can enable educators to create and deliver interactive lessons in virtual reality, supporting both teacher-guided instruction and student-centred learning approaches. With its interface, teachers can design structured educational content within immersive VR environments. The platform incorporates interactive elements such as panels, portals and audio features with the aim of enhancing engagement. This section examines the platform's key components and the design principles that informed its development.

Figure 1. Login page of 360 VR Educator platform

Platform architecture

The design of the 360 VR Educator follows a hierarchical structure (see Figure 2):

- Courses: At the highest level, educators can create entire courses, providing a course name and description. Each course can then be modified, shared or deleted as needed.
- Lessons: Within a course, multiple lessons can be created. These lessons serve as the core instructional units.
- Chapters: Lessons consist of chapters, which are either 360-degree images or 360-degree videos. Each chapter can include additional interactive elements, adding depth to the educational experience.

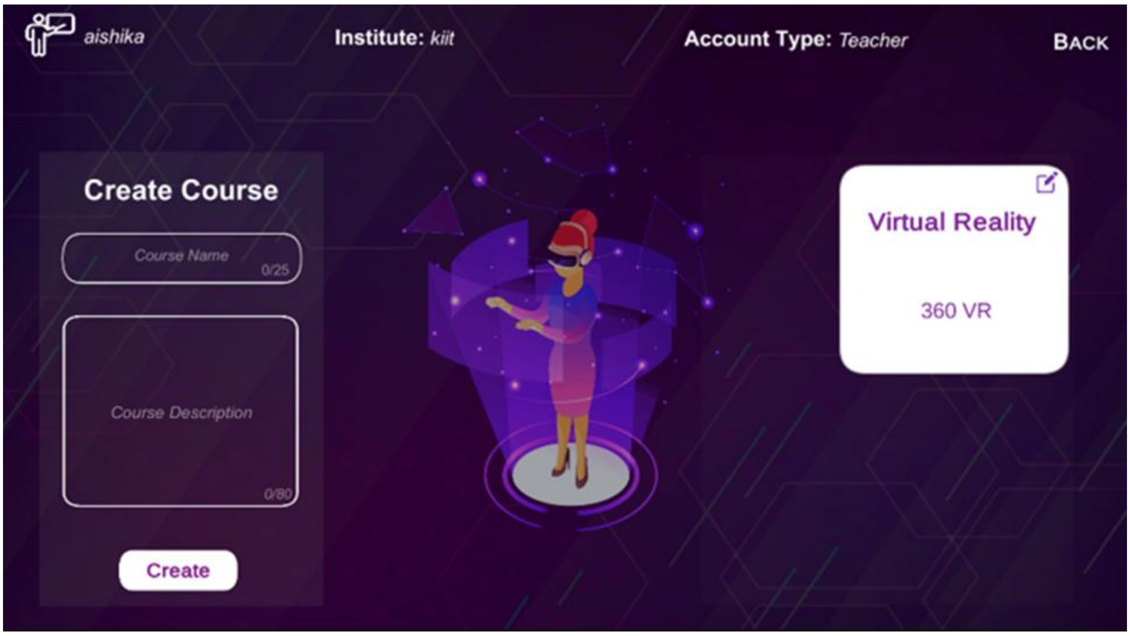

Figure 2. Hierarchical structure of the 360 VR Educator platform

Interactive elements and user experience

To enhance student engagement and immersion, the platform allows the inclusion of several interactive components, referred to as game elements (see Figure 3):

- Panels: These elements allow the integration of images, text, and buttons within the virtual environment. Teachers can customize panels to provide additional instructional material or interactive tasks.
- Audio: Audio elements enable the addition of voice narration or sound effects to guide learners or enhance the learning atmosphere.
- Portals: These elements serve as navigation tools, allowing users to seamlessly move between chapters, thus creating a cohesive and flowing learning experience.

These elements are included with the aim of providing options for users to interact with content in the virtual space, potentially moving beyond passive observation.

Figure 3. Interactive game elements in the 360 VR Educator platform

Guiding and monitoring student progress

The platform supports a teacher-student interaction model where educators can guide students through lessons. Teachers can send alerts to direct students to specific parts of a lesson, with real-time notifications updating the teacher on student progress. This feature aims to provide instructors with tools to guide students through the learning experience while potentially allowing for student autonomy within the virtual environment. The teacher can click on the flag icon (highlighted with a red circle) to create an alert. Additionally, the teacher can monitor which students have completed the guided activity and has the option to stop the guide by clicking the "X" button once the task is completed (see Figure 4):

- Alert system: Teachers can create alerts tied to specific elements, prompting students to explore designated areas or complete assigned tasks.
- Guidance and completion: Upon completing the guided tasks, students can notify the teacher, providing a seamless feedback loop that enhances the instructional process.

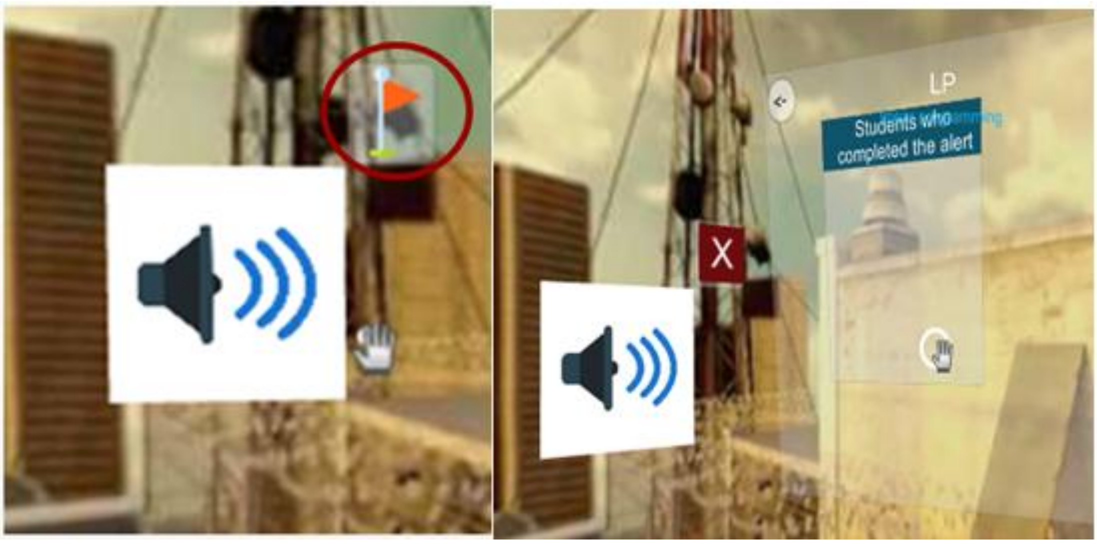

Figure 4. Teacher-student Interaction in the 360 VR Educator platform with alerts and real-time progress tracking

VR experience mode

A distinctive feature of the 360 VR Educator is its immersive VR Experience Mode, which enables users to engage with educational content within a VR setting that enhances cognitive immersion and interactivity. In this context, "immersive" refers to a panoramic, 360-degree visual environment that surrounds the user, creating a sense of presence, as opposed to traditional 2D screen-based experiences (Slater, 2018). Currently supported on Android devices – specifically smartphones and tablets – this mode leverages affordable, widely accessible hardware to deliver immersion. Users can experience the content either through a head-mounted display such as Google Cardboard, paired with an Android device, or by tilting and rotating the device in handheld mode to explore the 360-degree environment. The mode includes a reticle pointer for interacting with game elements, such as selecting panels or navigating portals, enhancing user agency within the virtual space. Although head-mounted displays provide a fully immersive experience by isolating the user's field of view, the handheld option offers a semi-immersive alternative, broadening accessibility for educators and students without specialised equipment. This dual-mode approach enhances cognitive engagement, as students interact with content dynamically, fostering deeper understanding and retention of information (Makransky & Mayer, 2022).

Evaluation of 360 VR Educator

Sample and research design

The study employed a single-group usability design with post-survey evaluation, comprising 45 educators (23 male, 22 female) from a university located in the eastern part of India. Participant demographics (Table 1) indicated that 67% possessed over 10 years of teaching experience, with the remainder distributed between 0–5 years (18%) and 5–10 years (16%). Domain distribution showed 31% from science or engineering fields and 69% from other disciplines. Regarding technological proficiency, 67% reported intermediate skills, 29% basic skills and 4% advanced skills. Notably, 96% of participants had no prior exposure to 360 VR technology. This study was ethically approved by the Indian Institute of Technology Kharagpur, India.

Table 1
Demographic details

Factors	Category	Number	Percentage (%)
Gender	Male	23	51
	Female	22	49
Teaching experience	0–5 years	8	18
	5–10 years	7	16
	Above 10 years	30	67
Domain	Science or Engineering	14	31
	Others	31	69
Technology skill level	Basic	13	29
	Intermediate	30	67
	Advanced	2	4
Previous experience of 360 VR	Yes	2	4
	No	43	96

Instruments

SUS questionnaire

SUS served as the primary evaluation instrument, comprising 10 items with alternating positive and negative statements (Brooke, 1996). Using a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*), the SUS score calculation followed a standardised procedure: summing odd-numbered question scores minus 5 (X), calculating even-numbered question sum (Y) and multiplying (X + Y) by 2.5 (Bangor et al., 2008). The resulting 0–100 scale corresponds to established usability ratings: worst imaginable (< 30), poor (30–50), OK (50–70), good (70–80), excellent (80–90) and best imaginable (> 90).

Demographic and qualitative assessment

Demographic data collection included teaching experience, domain expertise and technological proficiency. Open-ended questions elicited qualitative feedback regarding platform usability (see the Appendix).

TRI

TRI, a 16-item instrument, assessed technology adoption readiness across four dimensions: optimism, innovativeness, discomfort and insecurity (Parasuraman & Colby, 2015). The 5-point Likert scale responses were analysed with positive scoring for optimism and innovativeness, while discomfort and insecurity measures employed reverse scoring (Hao & Chon, 2021).

Procedure

The 2-week workshop consisted of six sessions, each lasting approximately 2 hours, with three sessions per week. This workshop on the 360 VR Educator platform is designed to equip educators with the knowledge and skills necessary to create immersive and interactive learning experiences using 360-degree VR technology. A detailed breakdown of the workshop structure is presented in Table 2. The educators were first introduced to the 360 VR Educator platform, which allows the creation of interactive lessons using 360-degree videos, images and game elements. The participants were guided on how to use the platform's key features, including creating courses, adding chapters and integrating game elements like audio, panels and portals into their lessons.

Once familiar with the platform, the educators were asked to complete a set of tasks designed to assess the usability of the 360 VR Educator. These tasks included creating a course, designing lessons, integrating multimedia content and navigating through VR environments. After completing the tasks, participants were asked to fill out the SUS questionnaire. Additionally, the educators provided qualitative feedback via open-ended survey questions, which sought insights into the challenges they faced, the features they found useful and their overall impression of the platform’s usability. To further assess participants' readiness to adopt new technology, TRI was administered.

Table 2
Workshop session content for 360-VR Educator

Week	Session	Title	Content focus	Activities	Duration
1	1	Introduction to 360 VR and Immersive Learning	Overview of immersive technologies, benefits of 360 VR, case studies	Interactive discussion: How 360 VR fits into current teaching practice	2 hours
	2	Hands-on with the 360 VR Educator platform	Walkthrough of platform, exploring interactive features, creating 360-degree media	Create a simple course using pre-existing media, group discussion	2 hours
	3	Technical Skills Assessment and Support	Assessment of technical skills, common technical challenges	Q&A on technical concerns, troubleshooting	2 hours
2	4	Designing for Immersion and Interaction	Principles of immersive learning design, interactivity, engagement	Sketch lesson ideas with 360 VR, group discussion	2 hours

5	Creating Interactive Lessons	Guide to creating interactive lessons, storytelling, simulations	Hands-on creation of lesson, peer review and feedback	2 hours
6	Workshop Wrap-Up and Showcase	Reflecting on lessons learned, showcasing completed lessons	Showcase final lessons, group critique and feedback	2 hours

Data analysis

The analysis comprised frequency distributions and mean values of SUS scores to determine the platform's overall usability. Qualitative data from feedback questions and open-ended questionnaires underwent content analysis following established methodological protocols. The analytical process involved initial data coding and theme identification, followed by thematic code reorganisation. The findings were quantified through frequency-to-percentage conversion to enhance objectivity and comprehensibility of the qualitative data (Wei et al., 2015). For TRI evaluation, the analysis incorporated frequency and variable scores for descriptive statistics. Linear regression analysis examined the relationship between TRI factors and educator platform ratings. Statistical analyses were conducted using SPSS version 22.

Results

SUS results

The overall average SUS score from 45 educators was 68.33, which falls within the "OK" category, indicating moderate usability. Figure 5 illustrates the distribution of SUS scores, where 26 educators (58%) scored in the "OK" range, while 18 educators (40%) rated the platform as "Good". Only one educator rated the platform in the "Excellent" category, and no participants rated it in the "Poor" or "Worst Imaginable" categories. These results suggest that although the platform is perceived as functional, there is room for improvement in terms of user experience.

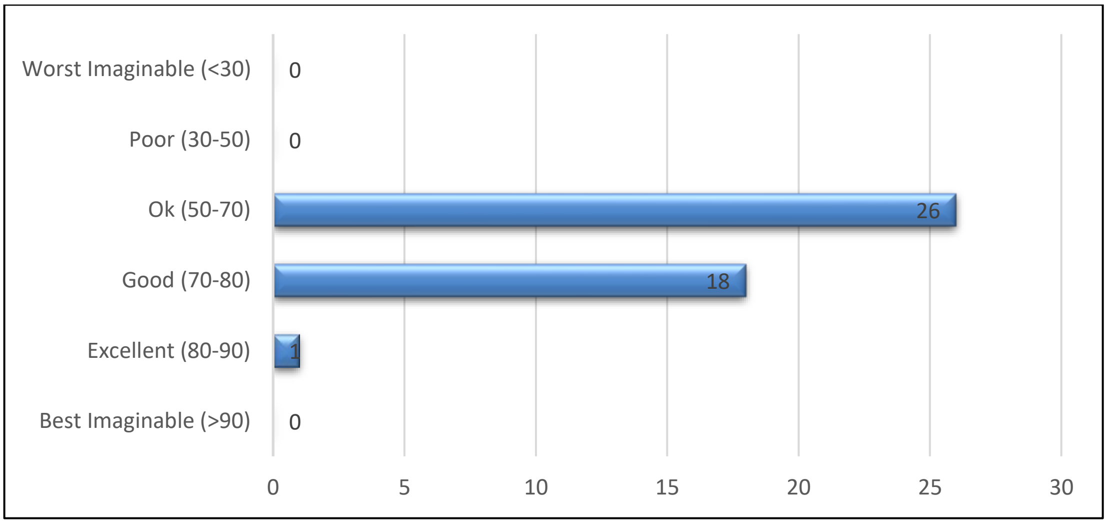

Figure 5. Statistics of SUS scores

Feedback and open-ended survey results

Table 3 shows the results of feedback from the educators who participated as users in the usability testing. Educators highlighted several features of the 360 VR Educator platform that were highly appreciated.

More than 60% of participants found the platform to be helpful in delivering engaging lessons, particularly noting the 360-degree view feature. This immersive element was praised by 41% of educators for making the teaching process more dynamic and engaging. Additionally, 23% of participants appreciated the ability to incorporate multimedia elements such as video, audio and images, while 21% emphasised the value of being able to present virtual environments that simulate real-life experiences. The simplicity of the platform and the user-friendly interface of 360 VR Educator platform were mentioned by 15% of participants as a key benefit of the platform. These features contributed to making the platform interactive and suitable for a variety of teaching contexts.

Despite the positive feedback, educators encountered several challenges while using the platform. The complexity of the application was the most commonly reported issue, with 35% of educators noting difficulties related to the lack of editing and autosave functions. Navigation within the platform was also cited as problematic by 22% of participants, who found it difficult to move between different sections. Additionally, 27% of educators reported that preparing multimedia content (such as text, video, audio and images) for lesson creation was time-consuming and challenging. Finally, 16% of participants experienced issues with Internet connectivity and the online uploading of content, which hindered the ease of lesson delivery.

When asked about the potential of the 360 VR Educator platform to influence their teaching practices, 43% of educators expressed that it is a promising tool, particularly for teaching geographical or historical topics. These educators highlighted the platform's ability to create immersive experiences that could not be easily replicated in traditional classroom settings. Moreover, 16% of participants believed that the platform offers a new way to interact with students, enhancing student engagement through its interactive elements. However, 22% of educators were unsure about the extent to which the platform would change their teaching practices, suggesting that further training and practice might be necessary for widespread adoption. An additional 19% indicated that while the platform holds potential, it may take time to fully integrate it into their regular teaching routines.

Table 3
Educators' feedback regarding 360 VR Educator

Feedback type	Verbal comments	Responses
Usefulness of 360 VR Educator	360 VR educator was useful	62%
	360 VR educator maybe useful	36%
	360 VR educator wasn't useful	2%
Key features of 360 VR Educator	Options offered to add video/audio/image content and simulation	23%
	360 view feature that makes the teaching process more interesting	41%
	To see things in real-life virtually	21%
	Simple and user-friendly interface	15%
Difficulties faced in 360 VR Educator	Preparation of text/image/video/audio file to create lectures is tough	27%
	Internet and online uploading issues	16%
	Not user friendly and navigation issue	22%
	Complexity in using application/no editing/no autosave function	35%
To what extent will 360 VR Educator change the teaching practice?	Not sure it may change	22%
	Could be adapted slowly/more practice is needed	19%
	A good tool to support teaching using VR especially for geographic/historic regions	43%
	New way to further interact with students	16%
Recommendation to use 360 VR Educator	Yes	83%
	No	17%

TRI results

Table 4 shows the descriptive statistics of the factors related to TRI. The skewness and kurtosis values of each variable are within the recommended range of |3| and |10| respectively (Kline, 2005). The optimism factor had the highest mean score (*M* = 16.09, *SD* = 3.204) while insecurity had the lowest (*M* = 10.91, *SD* = 3.139). The TRI scale was used to assess the participants' readiness to adopt new technologies. The regression analysis revealed that two key factors of the TRI – optimism and innovativeness – were significant predictors of educators' ratings of the 360 VR Educator platform (see Table 4). Educators with higher scores in optimism (β = 0.643, $p < 0.05$) and innovativeness (β = 0.249, $p < 0.05$) were more likely to give higher usability ratings to the platform. Together, these factors explained 50.9% of the variance in the overall rating scores (adjusted R^2 = 0.509). Discomfort and insecurity, the other two dimensions of the TRI, did not show significant relationships with platform ratings. These findings suggest that educators who are more optimistic about technology and open to innovation are more likely to positively assess the usability of the 360 VR Educator platform.

Table 4
TRI scale statistics

Factors	Mean (Max score = 20)	SD	Skewness	Kurtosis
Optimism	16.09	3.204	-1.529	4.437
Innovativeness	11.78	2.662	-0.121	-0.698
Discomfort	13.24	2.698	-0.345	0.362
Insecurity	10.91	3.139	0.561	0.591

Table 5
Results of regression analysis

Variable	Predictor	β
Rating value	Optimism	0.643*
	Innovativeness	0.249*
	Discomfort	0.126
	Insecurity	0.1
Adjusted R^2		0.509
F value		12.4
Sig *F* value		0.00

*$p < 0.05$.

Discussion and conclusion

The 360 VR Educator platform demonstrates promise as a tool for creating immersive educational experiences, particularly in specific subject areas where visualisation and experiential learning are crucial. The overall SUS score of 68.33 indicates moderate usability. This moderate rating suggests that although the platform displayed potential, there remains substantial room for improvement in terms of user experience. This aligns with previous research on educational technology where their initial implementations often face usability challenges achieving before optimal user experience levels (Jensen & Konradsen, 2018).

The 360 VR Educator platform successfully implements many core CTML principles. The qualitative feedback reveals strong appreciation for the platform's core features, particularly its 360-degree visualisation capabilities, which 41% of educators highlighted as enhancing the teaching process. This finding indicates that educators perceived value in the platform's implementation of visual elements, which aligns with Mayer's (2005, 2020) CTML principle and supports research by Ferdig and Kosko (2020) and Kim et al. (2022) on the potential pedagogical value of immersive technologies. The ability to create authentic, experiential learning environments emerged as a key strength, consistent with findings from Di Natale et al. (2020) regarding the effectiveness of immersive virtual reality in education. However, the reported navigation difficulties (22% of participants) suggest potential violations of the spatial contiguity principle (Mayer, 2005), where related information may not be optimally positioned within the virtual space. This finding echoes the research by Castro-Alonso, de Koning et al. (2021) on the importance of spatial arrangement in multimedia learning environments.

The platform's chapter-based structure aligns with Mayer's (2020) segmenting principle, allowing educators to break content into manageable units. However, the reported complexity issues (35% of educators citing difficulties with editing and autosave functions) suggest that the implementation of user-paced segmentation could be improved. These challenges align with Rey et al.'s (2019) findings on the critical importance of proper content segmentation in multimedia learning environments.

The ability to integrate synchronised audio-visual elements was appreciated by 23% of educators, indicating successful implementation of the temporal contiguity principle. This feature's positive reception supports Mayer's (2020) emphasis on simultaneous presentation of corresponding visual and auditory information. However, the reported difficulties in content preparation (27% of participants) suggest that achieving optimal temporal synchronisation remains challenging for educators.

The TRI results provide important context for understanding adoption patterns. The significant correlation between optimism and innovativeness scores and platform ratings ($\beta = 0.643$ and $\beta = 0.249$ respectively) suggests that educators' predisposition towards technology plays a crucial role in their perception and potential adoption of the platform. This aligns with findings from Tondeur et al. (2016) regarding the importance of teacher attitudes in technology integration.

The study's findings highlight the critical role of professional development in supporting technology integration. With 95.56% of participants having no prior experience with 360 VR technology, the need for comprehensive training becomes evident. This aligns with recommendations from Bower et al. (2020) regarding the importance of structured support in implementing immersive technologies in education. The finding that 43% of educators view the platform as a promising tool for specific subject areas, particularly geography and history, suggests potential for targeted implementation in certain disciplines. This aligns with research by Pirker and Dengel (2021) on the effectiveness of 360-degree VR in specific educational contexts. However, the uncertainty expressed by 22% of participants about changes to their teaching practice indicates the need for clear demonstrations of pedagogical value and implementation strategies.

Limitations and future work

The study contributes to the growing body of research on immersive technologies in education by providing specific insights into educator experiences and needs. As educational institutions increasingly explore VR technologies, these findings can inform both platform development and implementation strategies.

Several limitations of this study should be noted. The sample size of 45 educators, although providing valuable insights, may not fully represent the broader educational community. Additionally, the short-term nature of the evaluation period may not capture the full potential of the platform after extended use and familiarity. Future research should consider longitudinal studies examining the long-term impact on teaching practices. Analysis of student perspectives should also be considered.

Conclusion

This study investigated the usability and educator readiness for adopting the 360 VR Educator platform, a tool designed to empower teachers in creating immersive, interactive lessons grounded in CTML (Mayer, 2020). The findings revealed moderate usability (SUS score: 68.33), with educators expressing enthusiasm for its immersive visualisation capabilities and interactive features, while identifying challenges such as interface complexity and content preparation demands. The TRI analysis underscored that educators' optimism and innovativeness influenced their acceptance of the platform, highlighting the role of psychological readiness in technology adoption.

The results emphasise the platform's potential to enhance pedagogical practices in disciplines requiring spatial and experiential learning, such as geography and history. However, its broader implementation necessitates addressing technical barriers through improved interface design, robust technical support and structured training programmes. The study also reinforces the importance of aligning immersive technology design with established pedagogical frameworks like CTML to optimise cognitive engagement and learning outcomes (Mayer, 2020).

Author contributions

Author 1: Conceptualisation, Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review and editing; **Author 2**: Formal analysis, Writing – original draft, Writing – review and editing; **Author 3:** Formal analysis, Writing – original draft; **Author 4:** Writing – original draft.

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Appendix

User information and Feedback Questions

1. How would you describe your technology skills? (Advanced, Intermediate, Basic, Beginner)
2. Are you comfortable with using any ICT tools in your teaching? (Yes, No)
3. Do you think technology supports your teaching? If yes/no, why?
4. Do you have any previous experience of using 360 VR educator? (Yes, No)
5. How much would you rate the 360 VR Educator? (1,2,3,4,5)
6. Did you find the 360 VR Educator useful? (Yes, No, Maybe)
7. What did you like about the 360 VR Educator?
8. What are the difficulties you faced with the functions of 360 VR Educator?
9. What can we do to improve the User Interface of 360 VR Educator?
10. How will you use the 360 VR Educator to teach your course? Please describe some important highlights.
11. What goals or benefits are you seeking through the use of 360 VR Educator in your teaching or course delivery?
12. How is 360 VR Educator relevant as a pedagogical practice in your course?
13. What barriers will you face in the development of courses using 360 VR Educator?
14. To what extent 360 VR Educator will change your teaching practice?