

EXPLORING SCIENCE CENTER VISITORS' EXPERIENCES OF FULL-DOME CINEMATIC VIRTUAL REALITY PRODUCTIONS

Lena Pareto*, Iuliana Badica and Mikaela Åberg

Department of Education, University of Gothenburg, Sweden, Email:
lena.pareto@gu.se, iuliana.mihaela.badica@gu.se, mikaela.aberg@ped.gu.se

(*Main presenter and corresponding author)

ABSTRACT

Introduction

Immersive virtual reality (VR) is increasingly adopted in science centers to engage the public with science. Recent additions are digital full-dome immersive theatres (360 degrees) with large video projection (Schnall et al., 2012). The full-dome format is emerging as a cross-media and transdisciplinary educational tool, offering a unique experience (Cîrstea, 2023). As a niche format, it engages viewers through its immersive nature, which enhances emotional connection and memory retention, driven more by the filmic form than the content (Cîrstea, 2023; Plummer, 2023). The hemispherical projection surface envelops the observer's entire visual field, fostering a continuous, immersive experience (Lensing, 2023). Additionally, the full-dome environment's ability to offer multiple perspectives, seamless size scale transitions, and dynamic simulations provides significant educational advantages over traditional formats (Yu, 2019). This wraparound visual experience, combined with tightly integrated narration, creates a compelling "narrative journey" that enhances storytelling and learning (Yu, 2019). However, despite the increasing adoption of full-dome formats in science centers, there is a lack of research on how visitors perceive these immersive cinematic experiences, particularly regarding the emotional and cognitive impacts of storytelling in such settings.

Full-domes can present non-interactive cinematic productions, real-time simulations of virtual environments, live art performances, or virtual field trips, all complemented by surround sound (Lantz, 2007). Unlike head-mounted displays, full-domes offer a 360-degree field of view with limited interactivity, and a shared experience, making them particularly suited for cinematic virtual reality rather than for interactive games or simulations. Full-domes represent a fusion of art and science, functioning as a media form ideal for science communication (Lantz, 2011). Additionally, the full-dome documentary is regarded as one of the most recent innovations in edutainment film formats (Cîrstea, 2023).

This study examines a science center's use of full-dome cinematic VR productions, with a strong focus on storytelling (Wolfe et al., 2023). The emotional dimension of storytelling is not merely supplementary to scientific content; rather, emotions serve

as a key driver of both understanding and misunderstanding in science, significantly influencing visitors' learning experiences (Sinatra, 2022; Falk & Gillespie, 2009). VR cinematic productions intricately combine immersive technology with narrative elements to evoke emotions and engagement, with these components influencing one another in profound, sometimes unexpected, ways. Narratives fuel immersion by engaging emotions and heightening sensory experiences, while immersion, in turn, enhances the depth of the narrative. Thus, the effectiveness of a VR cinematic experience is contingent upon how effectively the plot, thematic appeal, visual and auditory effects, and narrative strength engage the audience both emotionally and cognitively.

Immersion and emotion both influence learning, but their relationship is complex. Barreda-Ángeles et al. (2020) found that more immersive presentations elicit stronger emotional responses but lead to less cognitive engagement when a 360° video is viewed through a VR headset compared to a computer screen. Similarly, Rose (2018) argues that affective engagement can be detrimental to cognitive engagement, as a high sense of presence may discourage a reflective stance toward the content. Therefore, this study aims to explore how cinematic VR storytelling productions are experienced in a full-dome theatre. We address the following research question: *How are VR cinematic storytelling productions perceived by visitors in a science center, and which elements of the productions have the most impact, as revealed by their descriptions of the most memorable moments from the show?*

Empirical setting

The digital full-dome examined in this study is a new attraction at the Universeum Science Center in Gothenburg, Sweden. It features a 443 square meter tilted hemispherical screen that envelops the audience. This installation is part of the national Wisdome project, based on visualization research conducted at the Norrköping Visualization Center and Linköping University. Currently, Universeum offers eight shows, ranging from 30 to 45 minutes in length, including three 2D and five 3D productions. Drawing from documentary film research (Studt, 2021), the shows are categorized into three genres: documentary, non-fiction, and animated fiction. All the programs focus on scientific topics, such as the mysteries of space, the depths of the ocean, visualization techniques, and molecular-level explorations.

Method

The study employs a mixed methods approach, combining a web-based survey and interviews with visitors. Participants are recruited voluntarily from regular visitors for interviews and all visitors are encouraged to scan the web-survey QR code after the show. Both methods focus on understanding visitors' motivations for attending the science center, using Falk's (2006) identity-related motivators, as well as their experiences of the show in terms of entertainment and educational value. The survey, inspired by a full-dome planetarium study (Peavy, 2019), also assesses what aspects of the show that are valued or less appreciated by the visitors. The post-show group interviews, lasting approximately 10 minutes, are recorded and transcribed. Memorable moments are gathered through free-text responses in the survey and via

free recall in the interviews, following the method used by Barreda-Ángeles et al. (2020).

Preliminary findings

To date, 182 survey responses and 15 group interviews have been collected. The distribution of shows among the survey respondents by genre includes 132 documentaries (63 in 2D, 69 in 3D), 32 non-fiction shows (9 in 2D, 23 in 3D), and 18 animated 3D fiction shows. The respondents consist of 20% children aged 4-14 years, 5% teenagers and young adults aged 15-24 years, and the remaining majority adults over 25 years, many of whom accompanied children. Gender distribution is balanced. The most common identity motivator is acting as a facilitator for a family member or friend. On a 7-point Likert scale, with "not at all entertaining" to "extremely entertaining," the average rating for entertainment value was 5.8. For educational value, rated from "not at all educational" to "extremely educational," the average rating was 5.7. Entertainment and educational value ratings showed a correlation. A significant difference was found in the entertainment value, with 3D shows rated significantly higher than 2D shows. However, no significant differences were observed in educational value between 2D and 3D formats, nor were there differences across age groups, gender, or between the various shows. The analysis of free-text survey responses and interviews is ongoing but has revealed interesting descriptions of participants' memorable moments and understanding of the shows. This qualitative data highlights the types of affective and cognitive engagement recalled by visitors, providing insights into key elements of the VR storytelling compositions.

Discussion and implications

The findings of this study have significant implications for science communication, informal learning, and the advancement of immersive reality technologies. Firstly, by employing a mixed-methods approach, the study addresses the existing research gap concerning the use of immersive reality full-domes in science centers and highlights their potential as powerful tools in increasing public engagement and understanding of scientific concepts. Additionally, the findings may inform the design of immersive technologies in science centers and museums, emphasizing the importance of narrative and affective impact in informal learning experiences. Overall, this study enhances understanding of engagement dynamics in immersive virtual reality environments and underscores the potential of immersive media in science education.

Keywords: Digital full-dome, immersive virtual environment, engagement, informal learning, storytelling, science center

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