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PAPER

Improving Engagement and Immersion with Interactive Cinematic Experiences in Mobile Virtual Reality

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ABSTRACT

This study explores how interactivity and immersion affect user engagement (UE) in mobile virtual reality (VR) interactive cinematic experiences, with a focus on the important role of cinematic communication quality (CCQ). Using a cross-sectional survey, data were gathered from 200 adult mobile VR users through validated multi-item scales measuring interactivity, immersion, CCQ, and UE. The data were analysed with partial least squares structural equation modelling (PLS-SEM) using fully reflective and reflective higher-order constructs. The structural results indicated that both interactivity ($\beta = 0.32$), and immersion ($\beta = 0.50$) are positive, significant predictors of CCQ, which in turn strongly impacts ultimate user engagement ($\beta = 0.55$). Bootstrapping analysis confirmed that CCQ fully mediates the relationships of both interactivity and immersion with UE. The results show that interactive and immersive technology only increases engagement when it improves the quality of the story. This highlights the key role of cinematic communication. The study presents a clear, evidence-based framework for designing mobile VR storytelling apps, emphasizing that strong storytelling is more important than technology alone.

KEYWORDS

interactive cinematography, immersion, virtual reality (VR), mobile computing, narrative engagement, user engagement (UE)

1 INTRODUCTION

Virtual reality (VR) represents a recent advancement in mobile computing. It has transformed digital storytelling by enabling users to experience narratives from within, rather than merely observing from a distance [1]. The widespread adoption of smartphone-based headsets has made immersive media broadly accessible, leading to the convergence of film, gaming, and interactive simulation [2]. Within these environments, users engage in more than passive story consumption. They select scene sequences, make decisions that influence narrative outcomes, and navigate story worlds through gaze and gesture. This interactivity increasingly blurs

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the distinction between author and audience [3]. Despite these advancements, the psychological mechanisms underlying such interactive features and their influence on meaningful user experiences remain insufficiently understood [4].

Interactivity has long been recognized as a key factor in the effectiveness of digital media [5]. Interactive cinema is characterized by story control, system responsiveness, and reciprocal communication with the narrative world [6]. While interactivity is theorized to enhance presence and emotional engagement, research in VR indicates that mere interactivity is insufficient; it must be meaningfully integrated with narrative content to create a satisfying experience [7].

Immersion is a related yet distinct construct, defined as the extent to which an individual becomes cognitively and sensually absorbed in the media being viewed [8]. In VR, immersion is often operationalized as the sensation of being enveloped by a synthetic environment, a condition that precedes and facilitates higher-order narrative engagement [9]. Although interactivity and immersion are established as key drivers of user engagement (UE) in interactive systems, their joint effects remain under-explored in mobile VR environments, where hardware limitations may alter perceptual outcomes compared to high-end, tethered systems [10].

In this study, cinematic communication quality (CCQ) is conceptualized as narrative engagement, which refers to the extent to which a story engages the user, facilitates comprehension of the narrative, sustains attention, elicits emotional responses, and fosters a sense of presence within the narrative space or diegetic world [11]. Narrative engagement lies between interactive affordances and immersion: interactive affordances are expected to enhance narrative communication by increasing a sense of personal involvement, while immersion provides a perceptual context that renders the narrative more immediate and consequential [12].

To address these empirical ambiguities, the present study proposes and tests a reflective-reflective structural model based on human-computer interaction and media psychology. Interactivity and immersion are conceptualized as independent variables expected to influence UE both directly and indirectly through the mediating effect of CCQ. Data from experienced mobile VR users are analysed using a quantitative survey approach and partial least squares structural equation modelling (PLS-SEM).

This study addresses the following central research question: What are the relationships between interactivity and immersion, as mediated by CCQ, on UE within interactive mobile VR cinematic experiences? This study integrates established measures from research on interactivity, cognitive absorption, narrative engagement, and UE to propose a theoretically robust and practically comprehensive framework.

2 LITERATURE REVIEW

2.1 Interactivity and immersion

Interactivity and immersion are two distinct yet closely related aspects of the mobile VR cinematic experience [13]. Interactivity refers to features that let users shape the narrative, such as making choices, receiving real-time feedback, and exchanging information with the system. In mobile VR, this often includes switching perspectives by moving your head, triggering events by looking at something, or selecting options by touching the smartphone screen. These features give users control over how the story unfolds [14].

In mobile VR, interactivity often means switching perspectives by moving your head, triggering events by looking at them, or using touch input on the smartphone screen. These features let users control the direction of their story [15].

Immersion, however, is a perceptual and cognitive state defined by the occlusion of real-world stimuli and the percept of being surrounded by a 360-degree audio-visual field [16]. Interactivity concerns what the user can do, while immersion concerns what the user feels; that is, it is a quality of the system-user relationship, while immersion is a subjective experience of the medium's sensory richness. Studies that have explored interactivity and immersion have tended to isolate them from other factors or to treat them as alternative causes of media effects, but fewer have modelled interactivity and immersion as complementary causes within a single model [17].

Based on studies of video games and VR, there is evidence that both video game and VR presence predict increased enjoyment and presence separately, though the paths by which these effects occur may differ [18]. Immersion can also serve as a perceptual base: if the user is carried away, they will invest cognitive resources into the narration and consider interactive stimuli meaningful [19]. Interactivity, on the other hand, could serve as a motivational factor, keeping the audience exploring the story world and encouraging them to get involved in this narrative.

2.2 User engagement

User engagement represents the ultimate experiential outcome of interactive mobile VR cinematic systems, encapsulating the depth and quality of the user's connection with the technology-mediated narrative [20]. Engagement is a multi-dimensional reflective construct, as defined by O'Brien et al. [21], with four interrelated dimensions: focused attention, complete absorption and loss of self-awareness during the experience, perceived usability, an individual's subjective sense of control and ease of interaction with the system. This framework differs from satisfaction or enjoyment, which are one-dimensional measures, and encourages a more compelling VR experience by capturing attention, ensuring usability, creating sensory pleasure and fostering a sense of usefulness that warrants continued engagement [22]. Engagement is a design goal, and it's also a measure for communicative success, especially in the context of mobile VR where hardware limitations like low display resolution, narrow field of view, and possible discomfort from movement can jeopardize user experience [23]. Engagement has been demonstrated as a key dependent variable in educational VR studies, as it has been associated with positive outcomes, such as continued use intention, positive word-of-mouth and deeper learning within educational VR contexts [24].

2.3 Mediating role of cinematic communication quality

In interactive mobile VR, the provision of user control and system responsiveness allows viewers to co-construct the narrative trajectory, an active participation that deepens comprehension of story events and strengthens emotional bonds with characters by granting personal stake in outcomes [25]. Simultaneously, immersion facilitates a state of sensory absorption that excludes external distractions, enabling the story world to feel perceptually immediate and thereby intensifying both attentional focus and the sensation of being spatially present within the diegesis [26]. When a cinematic experience is communicated with high quality meaning the narrative is easily followed, holds unwavering attention, evokes genuine emotional responses, and transports the viewer into its world the user is more likely to report the focused attention, perceived usability, aesthetic appreciation, and felt reward that collectively constitute engagement [27]. Thus, interactivity and immersion do not simply exert direct, unmediated influences on engagement; rather, they enrich the very fabric of the story communication, which in turn elevates the quality of the overall experience [28]. Prior research in immersive journalism and VR documentary has hinted at this mediating pathway, demonstrating that narrative presence and emotional engagement function as intervening variables between technological features and audience impact [29], yet the full mediating role of CCQ as a multidimensional construct has not been formally tested within a single structural model [30]. By explicitly positioning CCQ as a mediator, the current study addresses this lacuna, proposing that the transformative potential of interactive and immersive mobile VR technologies is realised only when they successfully enhance the narrative experience, making the story more coherent, captivating, emotionally resonant, and transportive for the user.

2.4 Conceptual framework and hypothesis

Human-computer interaction literature and media psychology frameworks, this research introduces an integrated structural model to examine the transfer of technology-level attributes into psychological outcomes. The model centres on four primary constructs: Interactivity and Immersion function as independent antecedents, CCQ serves as a multidimensional mediator, and UE is identified as the ultimate dependent variable. Figure 1 shows the conceptual framework of the study.

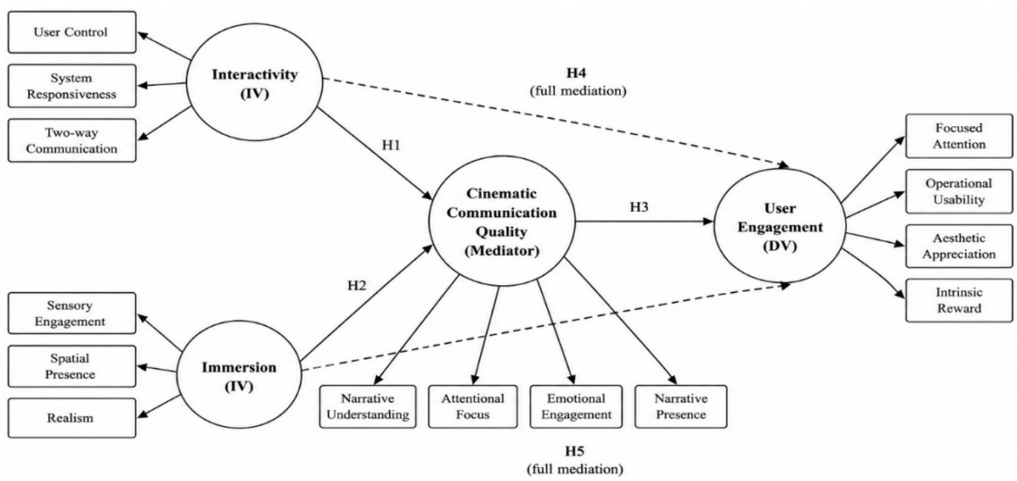

Fig. 1. Conceptual framework

H1: Interactivity has a significant positive relationship with cinematic communication quality. Higher levels of user control, system responsiveness, and two-way communication improve users' understanding and experience of VR cinematic content, thereby enhancing communication quality.

H2: Immersion has a significant positive relationship with cinematic communication quality. When users engage their senses, experience realistic scenes, and feel present in the space, they become more involved in the VR environment. This improves the quality of cinematic communication.

H3: Cinematic communication quality has a significant positive relationship with user engagement. If users understand the story well and feel an emotional connection, they tend to pay more attention, find the experience easier to use, and feel more engaged.

H4: Cinematic communication quality mediates the relationship between interactivity and user engagement. Interactivity improves user engagement indirectly by enhancing the quality of cinematic communication and narrative experience.

H5: Cinematic communication quality mediates the relationship between immersion and user engagement.

Immersion increases UE through its positive influence on cinematic communication quality and emotional narrative involvement.

3 METHODOLOGY

3.1 Research design

This study uses a cross-sectional quantitative survey to test the proposed links between interactivity, immersion, CCQ, and UE in mobile VR interactive cinematic experiences. Since the main goal is to examine a theory-based structural model, the research takes a confirmatory approach.

3.2 Population and sampling

This study focuses on adults aged 18 and older who, in the six months before the survey, used at least one interactive cinematic app or 360° narrative experience on a mobile VR platform such as Google Cardboard, Samsung Gear VR, or Daydream on a smartphone. We used a purposive sampling approach. We recruited participants from various online spaces, including VR groups on Reddit, Facebook, and Discord, university VR labs, and Amazon Mechanical Turk (MTurk). To ensure only qualified people took part, the survey included questions asking them to confirm which mobile device they used and to name the interactive cinematic experience they had recently completed. The survey ensured participants were qualified by asking them to name their mobile device and the interactive cinematic experience they had just completed.

3.3 Data collection procedure

A self-administered online questionnaire was hosted on Qualtrics. The landing page provided an information sheet regarding study objectives, voluntariness, and data confidentiality. Informed consent was obtained electronically via a mandatory checkbox before respondents could access the survey. The questionnaire has four sections.

1. The first covers eligibility and mobile VR usage habits.
2. The second uses several questions to measure each of the four main topics.
3. The third includes one question about satisfaction to check nomological validity.
4. The last section asks about age, gender, and how often participants use VR.

The items for the four core constructs were randomly mixed within each scale to reduce common method variance. To spot inattentive respondents, two attention-check items were included that asked participants to select "Strongly Agree". The survey took about 10 to 12 minutes to complete, and no personal information was collected. Data was gathered over eight weeks, with a reminder sent through recruitment channels at the four-week mark.

3.4 Measurement instruments

In this study, all latent constructs are measured with multi-item reflective scales based on previously validated tools. Each item was reworded to suit the interactive cinematic mobile VR setting. Participants rated each statement on a five-point Likert scale from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). For higher-order constructs, the measurement model uses a fully reflective-reflective approach, where each dimension is a reflective first-order latent variable, and the overall construct is a reflective second-order factor.

Interactivity is modelled as a second-order, reflective-reflective construct with three first-order reflective dimensions, based on McMillan and Hwang [31] and Liu et al. [32]: *User Control*, *Responsiveness*, and *Two-Way Communication, each measured by 3 items*. Immersion is measured as a unidimensional reflective construct using five items taken from the *Focused Immersion* dimension of Agarwal and Karahanna's [33] cognitive absorption scale. Cinematic communication quality used as mediating variable, and this construct is modelled as a second-order reflective-reflective factor whose lower-order components correspond to the four dimensions of the Narrative Engagement Scale developed by Busselle and Bilandzic [33]. UE used as dependant variable using the 12-item User Engagement Scale Short Form (UES-SF) by O'Brien et al. [34], which is structured as a second-order reflective-reflective construct with four reflective dimensions of three items each: *Focused Attention*, *Perceived Usability*, *Aesthetics*, and *Reward*.

3.5 Data analysis strategy

The collected data were checked for missing values, univariate outliers, and straight-lining using SPSS 28. Any data with more than 15% missing values or that failed the attention check was removed. For missing values below 5%, the median was used to impute them. Normality was assessed using skewness and kurtosis. For PLS-SEM analysis, the standard algorithm was run for 3,000 iterations, and bias-corrected and accelerated (BCa) bootstrapping was performed with 5,000 subsamples to test the significance of path coefficients and indirect effects.

For reflective first-order constructs and lower-order components, we checked outer loadings (should be above 0.708), internal consistency (α above 0.70), average variance extracted (AVE above 0.50) and used the Fornell-Larcker Criterion to assess indicator reliability, internal consistency, convergent validity, and discriminant validity. After confirming measurement quality, we assessed the structural model.

To check for collinearity among predictor constructs, we used variance inflation factors (VIF less than 5). The model's explanatory power was measured by the coefficient of determination (R^2) for endogenous constructs, with 0.75, 0.50, and 0.25 considered large, medium, and small, respectively. Predictive relevance was checked using blindfolding-based Q^2 (should be above 0). We also calculated effect sizes (f^2) for each structural path, with 0.02 indicating small, 0.15 indicating medium, and 0.35 indicating large.

4 RESULTS AND DISCUSSION

4.1 Descriptive statistics and correlation

Table 1 shows that mean scores for the constructs ranged from 3.65 for Immersion to 3.89 for UE on a five-point scale. This indicates that participants scored moderately to moderately high across all constructs, with UE highest. The standard deviations ranged from 0.71 to 0.83, showing a good level of variance and supporting the use of structural modelling. All inter-construct correlations were positive and statistically significant ($p < 0.01$).

The strongest correlation was between CCQ and User Engagement ($r = 0.70$). Interactivity also showed moderate, positive, and significant correlations with Immersion ($r = 0.58$) and the mediator ($r = 0.62$).

Table 1. Descriptive statistics and correlation matrix

Construct	Mean	SD	1	2	3	4
1. Interactivity	3.82	0.71	0.82			
2. Immersion	3.65	0.83	0.58**	0.79		
3. Cinematic Communication Quality	3.74	0.78	0.62**	0.69**	0.81	
4. User Engagement	3.89	0.74	0.55**	0.61**	0.70**	0.8

Note: ** $p < 0.01$.

Figure 1 presents the mean scores and standard deviations of the four study constructs Interactivity, Immersion, CCQ, and UE using bar graphs with error bars.

4.2 Measurement model

Before looking at the structural relationships, we checked the measurements assessed to make sure each ref construct constructed and valid. We analysed indicator loadings, internal consistency, convergent validity for the higher-order constructs, and discriminant validity for both the higher-order constructs and the unidimensional Immersion scale as first-order dimensions.

Table 2. Measurement model assessment

Construct/Dimension	Items	Loadings Range	ρ_c	AVE
Interactivity				
User Control	3	0.782–0.846	0.857	0.667
Responsiveness	3	0.795–0.868	0.872	0.695
Two-Way Communication	3	0.771–0.832	0.843	0.642
Immersion	5	0.748–0.824	0.874	0.581
Cinematic Communication Quality				
Narrative Understanding	3	0.802–0.863	0.881	0.712
Attentional Focus	3	0.756–0.831	0.838	0.634
Emotional Engagement	3	0.789– 0.872	0.869	0.689
Narrative Presence	3	0.813– 0.885	0.893	0.736
User Engagement				
Focused Attention	3	0.775– 0.849	0.859	0.67
Perceived Usability	3	0.768– 0.827	0.845	0.646
Aesthetics	3	0.791– 0.860	0.87	0.69
Reward	3	0.804– 0.878	0.886	0.722

Note: *p < 0.001.

Table 2 and Figure 2 shows that all indicator loadings were above the recommended value of 0.708 and were statistically significant, indicating good item reliability. Each construct also showed satisfactory internal consistency, with composite reliability values ranging from 0.838 to 0.893. AVE values met the 0.50 threshold, with Immersion at 0.581 and Narrative Presence at 0.736, confirming convergent validity. The heterotrait-monotrait (HTMT) ratio of correlations was used to test discriminant validity. All HTMT values for the different constructs were below the conservative limit of 0.85. The Fornell-Larcker criterion was also met, as the square root of each construct's AVE was higher than its highest correlation with any other construct.

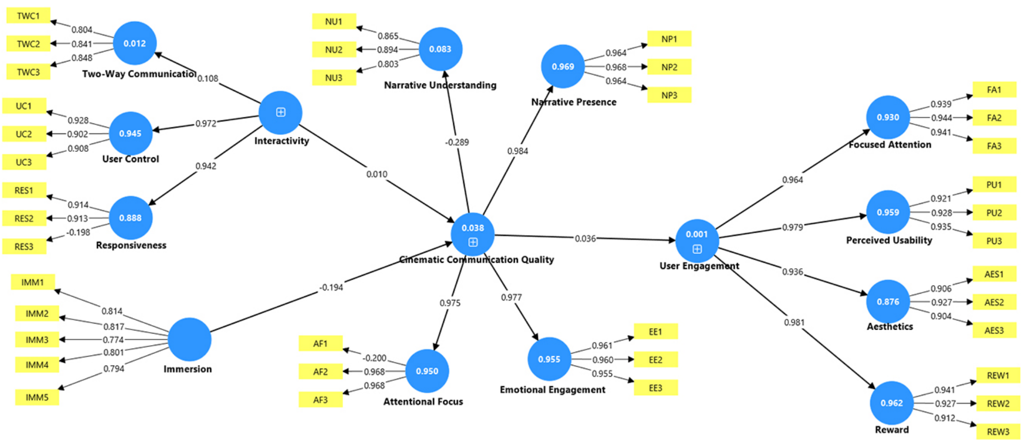

Fig. 2. Measurement model

Table 3. Discriminant validity–Fornell-Larcker criterion

Construct	1	2	3	4
1. Interactivity	0.82			
2. Immersion	0.58	0.79		
3. Cinematic Communication Quality	0.62	0.69	0.81	
4. User Engagement	0.55	0.61	0.70	0.80

Table 3 shows that the square root of the average variance extracted (AVE) for each latent variable, found on the diagonal of the correlation matrix, is higher than its highest correlation with any other variable. The values are 0.82 for Interactivity, 0.79 for Immersion, 0.81 for CCQ, and 0.80 for UE. For example, Interactivity (0.82) is higher than its highest correlation with CCQ (0.62). Similarly, Immersion (0.79) is higher than 0.69, Cinematic Communication Quality (0.81) is higher than 0.70, and User Engagement (0.80) is higher than 0.70.

4.3 Structural model

Once the measurement model was confirmed, we estimated the structural model to test the proposed direct and indirect relationships among Interactivity, Immersion, CCQ, and UE. The collinearity diagnostics showed that all predictor variance inflation factors (VIFs) were below 3.0, indicating no multicollinearity.

Table 4. Structural model results

Hypothesis	Path Relationship	β	T-Value	P-Value	95% BC CI	F^2	Supported
H1	Interactivity → CCQ	0.32	4.25	< 0.001	[0.18, 0.46]	0.13	Yes
H2	Immersion → CCQ	0.5	6.48	< 0.001	[0.35, 0.64]	0.31	Yes
H3	CCQ → User Engagement	0.55	7.12	< 0.001	[0.40, 0.69]	0.43	Yes
Mediation	Indirect Path						
H4	Interactivity → CCQ → UE	0.18	3.85	< 0.001	[0.09, 0.27]	–	Yes
H5	Immersion → CCQ → UE	0.28	5.32	< 0.001	[0.18, 0.39]	–	Yes

Notes: β = Standardised path coefficient; BC CI = Bias-corrected confidence interval based on 5,000 bootstrap subsamples. f^2 values: 0.02 (small), 0.15 (medium), 0.35 (large). CCQ = Cinematic Communication Quality; UE = User Engagement.

Table 4 shows all three direct hypotheses were supported: Interactivity ($\beta = 0.32$, $p < 0.001$, $f^2 = 0.13$) and Immersion ($\beta = 0.50$, $p < 0.001$, $f^2 = 0.31$) were positive and significant predictors of CCQ, which in turn strongly predicted User Engagement ($\beta = 0.55$, $p < 0.001$, $f^2 = 0.43$). Effect sizes ranged from medium to large, with Immersion exerting a particularly strong influence on narrative communication quality. The specific indirect effects of Interactivity ($\beta = 0.18$, $p < 0.001$, 95% CI [0.09, 0.27]) and Immersion ($\beta = 0.28$, $p < 0.001$, 95% CI [0.18, 0.39]) on UE through CCQ were both significant, with bias-corrected confidence intervals excluding zero, thereby confirming H4 and H5 as full mediation pathways. These results demonstrate that the impact of system-level interactivity and sensory immersion on UE is transmitted entirely through the quality of the cinematic narrative experience, underscoring the pivotal mediating role of cinematic communication in mobile VR environments.

4.4 PLS predict

To assess how well the model predicts new data, we used the PLSpredict procedure in SmartPLS 4 with 10-fold cross-validation repeated 10 times. We then compared the prediction errors of the PLS-SEM model to those from a simple linear model (LM) for each indicator of the two endogenous constructs: CCQ and user engagement.

Table 5. PLS predict assessment

Endogenous Construct	Dimension	Q^2_predict	PLS-RMSE	LM-RMSE	PLS-LM Difference
Cinematic Communication Quality	Narrative Understanding	0.24	0.91	0.98	–0.07
	Attentional Focus	0.21	0.94	1.01	–0.07
	Emotional Engagement	0.26	0.88	0.94	–0.06
	Narrative Presence	0.29	0.85	0.92	–0.07
User Engagement	Focused Attention	0.19	0.92	0.98	–0.06
	Perceived Usability	0.17	0.96	1.03	–0.07
	Aesthetics	0.22	0.89	0.95	–0.06
	Reward	0.25	0.87	0.93	–0.06

Notes: Q^2_predict = predictive relevance indicator (> 0 indicates predictive relevance). PLS-RMSE = Root Mean Squared Error from PLS-SEM prediction; LM-RMSE = RMSE from linear model benchmark. Negative PLS-LM differences indicate lower prediction error for the PLS model.

Table 5 shows that all Q^2_predict values for endogenous dimensions are positive, ranging from 0.17 to 0.29, indicating that all are predictive relevant. The PLS model also consistently outperformed the LM model on all indicators, with lower RMSE values. According to the majority rule, this means the model has strong predictive power. Overall, the structural model demonstrated strong predictive power for engagement in mobile VR, supporting its generalizability for predicting narrative-driven engagement beyond the estimation data.

Figure 3 shows the predictive assessment results of the PLS-SEM model for CCQ and UE. The bar graphs compare PLS-RMSE and LM-RMSE values for each dimension, and the line chart on top shows Q^2_predict values.

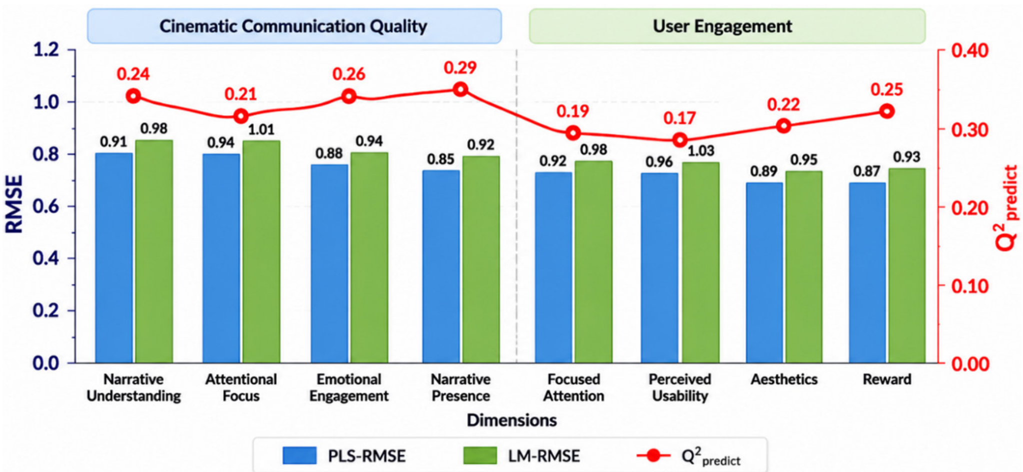

Fig. 3. PLS-predict assessment of endogenous constructs
Note: Lower RMSE and positive $\mathbf{Q^2_{predict}}$ values indicate good predictive relevance.

5 DISCUSSION

This study explored how interactivity, immersion, and the quality of cinematic communication relate to UE in mobile VR interactive stories. The findings showed that both interactivity and immersion were positively linked to communication quality in the film, which was the strongest predictor of UE. The link between immersion and story quality was much stronger than the link between interactivity and story quality. This suggests that a more immersive experience is more closely tied to building a cohesive, emotionally engaging story world than to simply giving users control or responsiveness [34].

This pattern aligns with theories that argue presence and transportation are key to understanding stories in immersive media [35]. The results show that the links between interactivity, immersion, and engagement are fully explained by the quality of the communication experience [36]. In other words, interactivity and immersion are only related to engagement when they also improve narrative understanding, focus, emotional involvement, and the sense of being in the story world [37].

Theoretically, this approach combines ideas from human-computer interaction, media psychology, and digital storytelling into a clear structural model. Defining interactivity as a second-order concept that includes user control, responsiveness, and two-way communication helps apply these ideas to cinematic VR. Modelling CCQ using the four dimensions of Narrative Engagement [26] also supports the scale's multidimensional nature and its validity in mobile immersive environments.

User Engagement was used to demonstrate the complex nature of engagement as a higher-level concept composed of attention, perceived usability, aesthetics, and reward. The model's predictive power was confirmed by PLSpredict results, which showed stronger predictions across all measured areas compared to the linear model benchmark. This level of predictive power is not often reported in PLS-SEM cross-sectional studies [30].

The connection between technological features and narrative experience can be measured using self-report surveys, even without changing the technology itself. This approach offers a solid framework for testing new theories. The study also addresses a gap in mobile VR research, since there has been little analysis of cinematic communication despite the rise of interactive 360° storytelling apps on mobile devices.

All the associations we found are correlational and do not establish or imply causality, as the study used a cross-sectional survey design. The results of the statistical mediation analyses generally support the theoretical model, which suggests that interactivity and immersion influence the quality of cinematic communication in relation to UE. However, the data do not rule out other possibilities, such as consumers reporting higher narrative quality after being highly engaged, or the chance that these relationships could go both ways over time. The terms "predictor" and "effect" are used in this context for clarity. Therefore, carefully avoided for the sake of using language that does not imply cause and effect and indirect co-variation. If one wants to test the hypothesized causal sequence directly, it requires either a longitudinal or an experimental design.

6 CONCLUSION AND RECOMMENDATIONS

This study introduced and tested a hierarchical framework to explain how media features influence user experiences in mobile VR storytelling. Using survey data from experienced mobile VR users and partial least squares structural equation modelling (PLS-SEM), the results show that system-level interactivity and sensory immersion strongly drive UE. The main finding is that CCQ, which includes narrative understanding, attentional focus, emotional engagement, and narrative presence, fully explains how these factors affect engagement. These findings show that advanced features such as functional control and sensory occlusion do not, by themselves, guarantee a strong user experience. Their impact depends on how well they support the main story. For developers, creators, and media psychologists, this study offers a clear and reliable framework. It demonstrates that, even with the limits of mobile VR hardware, strong storytelling remains the key to keeping users engaged. This study's cross-sectional design means we cannot draw conclusions about cause-and-effect over time; future research should use longitudinal or experience-sampling methods. We relied on participants' memories; recall bias may be a concern. Using controlled experiments with objective behavioural or physiological measures could help address this. Finally, since our sample came from tech-savvy VR enthusiasts, the findings may not apply to beginners, older adults, or people from different cultural backgrounds.

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