"Kathakali" & Virtual Reality: An Experiment

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ABSTRACT

Virtual reality (VR) is a computer technology or computer-mediated technology that duplicates the real environment by simulating the user's physical presence and environment in a way that allows the user to interact with it. The current study details a virtual reality experiment conducted to study the immersive virtual experience of Kathakali. The experiment was carried out among 33 participants (general audience) of the Red Beard Festival, a renowned Kathakali performance festival in Kerala. The performances were recorded in Insta 360 camera and projected the visuals in a Head-Mounted Display (HMD). The Virtual Experience Questionnaire (VEQ, v2) developed by Tcha-Tokey et al. (2016) was administered to evaluate the user experiences of Kathakali in virtual reality. The key variables included presence, engagement, immersion, flow, emotion, skill, judgement, experience consequence, and technology adaptation. Statistical analysis suggested nearly half of the participants had prior awareness regarding virtual reality, however, only a few participants had prior virtual experience of Kathakali. The range of scores obtained for engagement and immersion was found to be relatively consistent with the other components. Correlation analysis indicated significant positive and negative associations between various components of immersive virtual experience. Females were found to have immersed more in skill-based experiences, whereas males were found to have higher judgement and technology adoption. Significant differences were found in judgement, experience consequence, and technology adaptation of the participants hailing from different localities. No significant differences were found in the immersive virtual experience of participants belonging to different age and education groups.

Keywords: *Kathakali, Virtual Reality, Experiment, Virtual Experience*

INTRODUCTION

Virtual reality (VR), is a computer technology or computer-mediated technology that duplicates the real or imagined environment by simulating the user's physical presence and environment in a way that allows the user to interact with it (Isaac, 2016) . The term "Virtual Reality" is used to describe the technology or medium used to create and convey the synthetic experience, or simulated experience itself (Kim, 2005) . Another term for VR is absorbing interactive, it is a machine mediated experience in a user synthetic (simulated) environment (Mandal, 2013).The word "Virtual" means physically does not exist but can be seen with the help of software. Virtual Reality takes the viewer to a completely immersed environment that manoeuvres the brain into believing it is somewhere else. The idea of VR can be seen in Ivan E Sutherland's work in the 1960s, he says the core aim of 3D display is to show the user or audience a perspective image that changes as he moves (Sutherland, 1968).

VR is lingjing technology meaning VR uses computer interfaces, it consists of three elements such as immersion, interactivity and visualisation (Wang, 2012) . In 1992 researchers Fuchs H & Bishop G defined VR as the direct manipulation of the real world into interactive graphics (Bishop & Fuchs, 1992) . Cruz Neira C. defines VR as an immersive, interactive, multi-sensory and system-generated 3D environment that gives the user a 360 degree of the real world (Neira C, 1993). 360-degree videos are of two types stereoscopic & monoscopic; monoscopic are seen in Google Street or Facebook/YouTube 360-degree videos, it has flat renderings which doesn't require HMD. Stereoscopy requires HMD for projection because it renders 360 degrees to each eye separately (Orellana, 2016).

VR helps to navigate 3D models and environments (Moro et al., 2017), and measures psychological presence or users' realities levels (Heeter, 1992). VR recreates experiences which leads to high realism (Botella et al., 2017). Higher the interaction higher the stimuli which lead to higher rates of realism in audience behaviour (Banos et al., 2000). Jonathan writes that VR can be defined as a simulated real environment through telepresence (Steuer, 1992).

VR gives a stunning experience of immersive reality (Johnson, 2021). Immersion means the complete involvement of the user in the virtual space, he or she will be separated from the real space (Muhanna, 2015). VR creates imagination in people's minds and enhances user perception (Faisa, 2017). VR is a medium in progress by itself and it is more than drugs, when we wear the HMD it will transport us to a different realm of imagination (Schnipper, 2020). People are moving to new virtual spaces as the real world is integrated into the virtual, the more the immersion the more the addiction to the virtual world (Cline, 2004). In VR, the input devices play a major role; they capture the user's motions in the real world and convert them into VR codes. Some of the important input devices are joystick & HMD (Head Mount Display) (Cipresso et al., 2018). Virtual Reality is experimental in nature and keeps changing its dimensions (Stevens, 1995).

The contemporary art scene in India is getting more and more vibrant. This is because people want to make sense of their experiences of living in a modern world. Kathakali is the dance drama of Kerala, it is famous for its vibrancy, costume and impressive performance (Meenakshi, 2017).The stories are expressed through facial gestures, body movements and emotions, the Indians express emotions at their best (Tony, 2020). Technology has brought Kathakali global connectivity (Dhanapalan, 2018). The internet is brimming with a wide variety of Kathakali performances, just like many other classical art forms like music concerts, dances and professional Kathakali artists started using social media for their core performances (Menon et al., 2021) .

The current study details a virtual reality experiment conducted to study the immersive virtual experience of Kathakali. The experiment primarily aimed at exploring how the expressions, gestures, and vibrant costumes mark the effectiveness of the play in a virtual environment.

OBJECTIVES

To determine the immersive virtual environment experience of Kathakali among the audience for the Redbeard festival performance.

RESEARCH METHODOLOGY

An experiment was conducted to study the immersive virtual environment experience of the audience for the Redbeard festival performance. The performance was recorded in Insta 360 camera, they are designed to shoot high-resolution content specially designed for Virtual reality (VR) or 360 degrees and projected the visuals in a Head-Mounted Display (HMD). HMD immerses the user into the virtual world, this headset consists of two small high-resolution LCDs (Liquid Crystal Display) or OLED (Organic Light Emitting Diode) or monitors which provide different images for each eye in a 3D graphics virtual environment. HMD contains three focus adjustment buttons (Right, Centre & Left), which can be adjusted to the participant's eye power.

Figure 1. Experiencing the performance in 360 degrees

Figure 2. The participant was asked to walk and turn around to experience the full experience of VR

Figure 3. This participant was aged 65 years, he was asked to walk with the HMD on his face to experience the 360 degrees. At this stage, he faced little dizziness and motion sickness, he took help from another participant to hold his hand.

The experiment was carried out among 33 participants (general audience) recruited through purposive sampling. The key variables adopted from the Virtual Experience Questionnaire (Tcha-Tokey et al., 2016) by are

1. Presence: Presence is being there in the virtual environment, which can be grouped into two: physical presence and social presence. The sense of presence is defined as the degree to which participants subjectively feel that they are somewhere other than their actual physical location because of the effects of a computer-generated simulation (Kim, 2005).
2. Engagement: It is the activity of the person who is experiencing Virtual Reality or the energy in the action of the experiencer consisting of emotional, cognitive and behavioural forms.
3. Immersion: It is the illusion that VR replaces the user's sensory stimuli with virtual sensory stimuli.
4. Flow: This is defined as a happy psychological state of a sense of control of the user who is interacting with the VR.
5. Emotion: This is explained as the feelings or emotions of the user who is interacting with VR (Satisfaction, Joy, Disappointment, Anxiety, Pleasure and Frustration).
6. Skill is defined as the facts and information gained from his activity in VR. This variable helps to understand the attitude of a user toward computer technology, and the degree to which he feels comfortable with a computer.
7. Judgement is defined as the overall experience judged by the user in the virtual environment.
8. Experience consequence: The user can experience physiological disturbances such as motion sickness, stress, dizziness and headache while experiencing VR.
9. Technology Adoption: TA is the efforts, actions, decisions and measures taken by the user for future use or intention to use the virtual environment.

PROCEDURE

The participants were welcomed and informed consent was taken from them. They were briefed about Virtual Reality, the objective and nature of the current experiment, and the pros and cons involved. The participants were asked to wear a Head-Mounted Display (HMD) as per the instructions given. The HMD was calibrated to obtain the best visual results. They were later asked to fill up the Virtual Experience Questionnaire (VEX, v2) based on their immersive virtual experience of Kathakali.

RESEARCH QUESTIONS

1. What is the extent of immersive virtual experience perceived by the audience?
2. What is the relationship between different components of immersive virtual experience?
3. Is there any difference in the perception of immersive virtual experience with respect to age, gender, education, and locality?

DATA ANALYSIS

The participants' responses to the Virtual Experience Questionnaire (VEQ, v2) were coded and analysed using SPSS (Version 28). Descriptive statistical measures were considered for analysing the extent of the immersive virtual experience of the audience. Pearson's correlation coefficient was calculated for analysing the relationship between different components of immersive virtual experience. Independent sample t-test and one-way ANOVA were conducted for group comparisons of immersive virtual experiences.

RESULTS

Table 1. Frequency Distribution and Percentages

Domain	Category	Frequency	Percentage
Age	Less than 15 years	2	6.1
	16-45 years	22	66.7
	46-75 years	9	27.3
Gender	Male	20	60.6
	Female	13	39.4
Educational Qualification	Below 10th	4	12.1
	10th matriculation	1	3.0
	Higher secondary	10	30.3
	Under graduation	8	24.2
	Post-graduation	9	27.3
	Graduation	1	3.0
Locality	Urban	6	18.2
	Semi-Urban	17	51.5
	Rural	10	30.3

Prior Awareness	Yes	15	45.5
	No	18	54.5
Prior Experience	Yes	5	15.2
	No	28	84.8
Total (*n*)		33	100

Table 1 shows the socio-demographic profile and prior exposure to virtual reality among the participants. The sample consisted of 33 individuals, out of which 20 are males (60.6%) and 11 are females (39.4%). The majority of the participants belong to the age group 16-45 years (66.7%). Most of the participants hail from semi-urban localities (51.5%). Approximately half of the participants had prior awareness regarding virtual reality (45.5%), however, only a few participants had an immersive virtual experience of Kathakali prior to the experiment (15.2%).

RQ 1: What is the extent of immersive virtual experience perceived by the audience?

Table 2. Components of Immersive Virtual Experience (n=33)

Component	Range	Minimum	Maximum	Mean	SD	Variance
Presence	16	74	90	87.12	4.40	19.36
Engagement	5	25	30	28.94	1.58	2.49
Immersion	9	41	50	48.30	2.76	7.65
Flow	14	86	100	96.12	4.44	19.73
Emotion	54	56	110	85.55	20.08	403.19
Skill	28	32	60	53.82	8.29	68.77
Judgement	81	9	90	58.58	30.48	929.37
Experience Consequence	72	8	80	52.15	29.79	887.82
Technology Adoption	35	35	70	61.12	8.70	75.73

Table 2 demonstrates descriptive statistics corresponding to the various components of the immersive virtual experience of participants. It is shown that the range of scores obtained for engagement (Mean = 28.94, SD ± 1.58) and immersion (Mean = 48.30, SD ± 2.76) are relatively consistent than the other components.

RQ 2: What is the relationship between different components of immersive virtual experience?

Table 3. Correlation between components of immersive virtual experience

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Presence (**1**)	1	.74**	.83**	.78**	-.40*	.05	-.48**	-.40*	-.12
Engagement (**2**)		1	.58**	.56**	-.36*	.09	-.35*	-.28	.02
Immersion (**3**)			1	.71**	-.35*	.13	-.40*	-.32	-.01
Flow (**4**)				1	-.32	.05	-.51**	-.55**	-.17
Emotion (**5**)					1	.18	.88**	.79**	.45**
Skill (**6**)						1	-.01	.13	.66**
Judgement (**7**)							1	.94**	.37*
Experience Consequence (**8**)								1	.48**
Technology Adoption (**9**)									1

*p<0.05 **p<.001

Table 3 shows the association between different components of immersive virtual experience. A significant positive correlation was found between presence and engagement, presence and immersion, presence and flow, engagement and immersion, engagement and flow, immersion and flow, emotion and judgement, emotion and experience consequence, emotion and technology adaptation, skill and technology adaptation, judgement and experience consequence, judgement and technology adaptation, experience consequence and technology adaptation. A significant negative correlation was obtained among presence and emotion, presence and judgement, presence and experience consequence, engagement and emotion, engagement and judgement, immersion and emotion, immersion and judgement, flow and judgement, flow and experience consequence, judgement and experience consequence, judgement and technology adaptation.

RQ 3: Is there any difference in the perception of immersive virtual experience with respect to age, gender, education, and locality?

Table 4. One-way ANOVA comparing immersive virtual experience based on Age

		Sum of Squares	**Mean Square**	**F**	**Sig.**
Presence	Between Groups	16.42	8.212	0.40	0.66
	Within Groups	603.09	20.10		

Engagement	Between Groups	3.29	1.64	0.64	0.53
	Within Groups	76.58	2.55		
Immersion	Between Groups	7.69	3.84	0.48	0.61
	Within Groups	237.27	7.90		
Flow	Between Groups	3.475	1.73	0.08	0.92
	Within Groups	628.04	20.93		
Emotion	Between Groups	959.53	479.76	1.20	0.31
	Within Groups	11942.64	398.08		
Skill	Between Groups	29.636	14.81	0.20	0.81
	Within Groups	2171.27	72.37		
Judgement	Between Groups	1554.08	777.04	0.82	0.44
	Within Groups	28185.98	939.53		
Experience Consequence	Between Groups	920.92	460.46	0.50	0.61
	Within Groups	27489.31	916.31		
Technology Adoption	Between Groups	75.19	37.59	0.48	0.62
	Within Groups	2348.31	78.27		

*p<0.05

Table 4 demonstrates that there is no significant difference in the immersive virtual experience of presence, engagement, immersion, flow, emotion, skill, judgement, experience consequence and technology adaptation of participants across different age groups.

Table 5. Independent sample t-test comparing immersive virtual experience based on Gender

	Gender	**Mean**	**SD**	**t**	**df**	**Sig.**
Presence	Male	87.45	4.51	.52	31	0.58
	Female	86.62	4.35			
Engagement	Male	29.10	1.55	.71	31	0.27
	Female	28.69	1.65			
Immersion	Male	48.25	2.75	-.13	31	0.57

	Female	48.38	2.90			
Flow	Male	96.05	4.39	-.11	31	0.57
	Female	96.23	4.69			
Emotion	Male	86.50	19.46	.33	31	0.34
	Female	84.08	21.72			
Skill	Male	51.95	9.93	-1.64	31	0.01*
	Female	56.69	3.52			
Judgement	Male	60.80	26.54	.51	31	0.00*
	Female	55.15	36.62			
Experience Consequence	Male	53.05	29.42	.21	31	0.56
	Female	50.77	31.52			
Technology Adoption	Male	60.20	10.88	-.74	31	0.00*
	Female	62.54	3.30			

*p<0.05

Table 5 shows that there is a significant difference in the immersive virtual experience of skill, judgement, and technology adoption among males and females. Females were found to have immersed more skill-based experiences, whereas males were found to have higher judgement and technology adoption.

Table 6. ***One-way ANOVA comparing immersive virtual experience based on Locality***

		Sum of Squares	**Mean Square**	**F**	**Sig.**
Presence	Between Groups	37.95	18.97	0.97	0.38
	Within Groups	581.55	19.38		
Engagement	Between Groups	0.50	0.25	0.09	0.90
	Within Groups	79.37	2.64		
Immersion	Between Groups	9.25	4.62	0.58	0.56
	Within Groups	235.71	7.85		
Flow	Between Groups	107.91	53.95	3.09	0.06
	Within Groups	523.59	17.45		

Emotion	Between Groups	1987.54	993.77	2.73	0.08
	Within Groups	10914.63	363.82		
Skill	Between Groups	342.41	171.20	2.76	0.07
	Within Groups	1858.49	61.95		
Judgement	Between Groups	8058.94	4029.47	5.57	0.00*
	Within Groups	21681.11	722.70		
Experience Consequence	Between Groups	9149.54	4574.77	7.12	0.00*
	Within Groups	19260.69	642.02		
Technology Adoption	Between Groups	519.54	259.77	4.09	0.02*
	Within Groups	1903.96	63.46		

*p<.05

Table 6 illustrates that there is a significant difference in the immersive virtual experience of judgement, experience consequence, and technology adaptation of the participants on the basis of locality.

Table 7. One-way ANOVA comparing immersive virtual experience based on Educational Qualification

		Sum of Squares	**Mean Square**	**F**	**Sig.**
Presence	Between Groups	22.41	4.48	0.20	0.95
	Within Groups	597.10	22.11		
Engagement	Between Groups	5.47	1.09	0.39	0.84
	Within Groups	74.40	2.75		
Immersion	Between Groups	8.22	1.64	0.18	0.96
	Within Groups	236.74	8.76		
Flow	Between Groups	71.11	14.22	0.68	0.63
	Within Groups	560.40	20.75		
Emotion	Between Groups	1439.90	287.98	0.67	0.64
	Within Groups	11462.27	424.52		
Skill	Between Groups	513.46	102.69	1.64	0.18

	Within Groups	1858.49	61.95		
Judgement	Between Groups	4692.71	938.54	1.01	0.43
	Within Groups	25047.34	927.68		
Experience Consequence	Between Groups	6954.76	1390.95	1.75	0.15
	Within Groups	21455.47	794.64		
Technology Adoption	Between Groups	635.64	127.12	1.92	0.12
	Within Groups	1787.87	66.21		

*$p<0.05$

Table 7 demonstrates that there is no significant difference in the immersive virtual experience of presence, engagement, immersion, flow, emotion, skill, judgement, experience consequence and technology adaptation of the participants on the basis of educational qualification.

SUMMARY & CONCLUSIONS

Descriptive measures suggest that nearly half of the participants had prior awareness regarding virtual reality, however, only a few participants had prior virtual experience of Kathakali. The range of scores obtained for engagement and immersion was found to be relatively consistent with the other components. Correlation analysis indicates significant positive and negative associations between various components of immersive virtual experience. A significant difference in the immersive virtual experience of skill, judgement, and technology adoption was noted among males and females. Females were found to have immersed more in skill-based experiences, whereas males were found to have higher judgement and technology adoption. No significant difference was found in the immersive virtual experience of presence, engagement, immersion, flow, emotion, skill, judgement, experience consequence and technology adaptation of the participants across different age and education groups, however, a significant difference was found in judgement, experience consequence and technology adaptation of the participants hailing from different localities.

LIMITATION

At first, this experiment was planned to be conducted among 360 participants, but due to the pandemic situation, it was limited to 33 participants. Only a single HMD device was available, and it was difficult to sanitise the device after every use.

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