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Do Immersive Displays Influence Exhibition Attendees' Satisfaction?: A Stimulus-Organism-Response Approach

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Abstract: One of the fastest-growing trends in the exhibition industry is the utilization of immersive technology displays which provide exhibition attendees with enhanced interactive and dynamic experiences. However, little is known about the relationship between immersive technology displays and exhibition attendees' satisfaction. This study aimed to examine the relationship between exhibitors' immersive displays and exhibition attendees' satisfaction in relation to the Stimulus-Organism-Response (S-O-R) framework. Additionally, the study categorized immersive displays and compared them with exhibition attendees' socio-demographics. An online questionnaire survey was used for data collection, and a series of statistical analyses were carried out. The results revealed that 75% of respondents reported positive experiences with immersive displays, and some attendees were more satisfied with some of the immersive displays. Implications of the study are discussed.

Keywords: immersive display; exhibition technology; attendees' satisfaction; S-O-R framework

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1. Introduction

As exhibition organizers and exhibitors concentrate on meeting exhibition attendees' needs and wants by providing high-quality exhibition services to the full extent of their abilities, it is essential that they provide impressive and memorable moments to attendees [1–4]. For this reason, exhibitors aim to launch creative and diverse ways that attract and engage attendees at their exhibitions. One of the fastest-growing trends in exhibitions is the utilization of immersive technology displays, hereafter immersive displays, which provide an enhanced level of user interaction [4–6].

Exhibitions have become more diverse by utilizing immersive displays, such as unconventional displays, virtual reality (VR), and augmented reality (AR) technologies [4]. Previous research revealed that immersive experiences enhance the positive impact of exhibition attendees' reactions [6]. They found that exhibition attendees wanted more time interacting with motion displays and expected more multisensory displays in future exhibitions. Dancstep et al. [7] also reported that attendees concentrated on the social interactions at immersive exhibitions, inducing positive effects on attendees' socio-emotional experiences. According to Collin-Lachaud and Passebois [8], immersive display experiences drew the curiosity of attendees and affected attendees' socio-emotional aspects positively, ultimately increasing attendee numbers.

While the majority of existing studies focus on exploring technical designs for immersive displays, such as prototype systems of an immersive virtual product design [9], conceptual computer design systems for interaction [10], the spontaneous interface between the real and virtual worlds [11], and technologies that incorporate various systems [6,12–14],

few studies have examined the relationship between an exhibitor's immersive displays and exhibition attendees' satisfaction. Therefore, this study aimed to investigate the relationship between exhibitors' immersive displays and exhibition attendees' satisfaction in relation to the Stimulus-Organism-Response (S-O-R) framework [15]. More specifically, this study categorized immersive displays, evaluated variations in the perceptions of immersive displays with respect to attendees' socio-demographics, and examined the relationship between immersive displays and exhibition attendees' satisfaction. The study provides exhibition organizers and exhibitors with insights on how to prepare exhibition displays and booth designs to meet the needs and wants of future exhibition attendees.

2. Literature Review

This section reviewed exhibition trends, conceptual expression of immersive technology and its displays, and the connection between immersive displays and exhibition attendees' satisfaction through literature review. The Stimulus-Organism-Response (S-O-R) Framework is then introduced to explain that the use of immersive displays can be linked to exhibition attendees' satisfaction.

2.1. Exhibition and Its Trends

Exhibitions allow exhibition attendees to examine new products or ideas, perceive how they work, search for something unique, and see the most recent developments and market trends [16] as major marketing tools that advertise exhibitors' products and company brands [2]. Furthermore, exhibitions directly affect the economic activity of a region or country to generate a direct profit for the exhibition itself and create personal income through job creation for local residents [17,18].

One of the fastest growing trends in the exhibition industry that accomplishes various roles is applying advanced technologies to elicit positive and immediate responses from exhibition attendees [5]. The application of technologies, such as computer technology, network technology, and digital technology to exhibition activities, is an unavoidable trend [19] and has contributed to the increased variety of exhibitions [20]. For example, Liu et al. [21] stated that as the digital age continues, artistic creations applying holographic projection technology have exhibited in the field of digital media art. Zhuang [22] mentioned that a virtual exhibition hall that uses a computer to generate a realistic three-dimensional virtual scene provides vivid interaction for exhibition attendees. Moreover, many researchers reported that multimedia and immersive display technologies have been providing exhibition attendees with memorable experiences through intelligent and interactive exhibitions with immersion simulations they are unlikely to have in their daily lives [4,23]. In addition, immersive displays in exhibitions attract potential attendees [7], and they engage them to stay at the exhibitions longer [24].

In summary, the exhibition industry has adopted immersive technology to attract exhibition attendees and give them interactive activities they have never experienced.

2.2. Immersive Technology

The expansion of computer technologies has deeply influenced nearly every facet of society and has given many new opportunities in various industries. Immersive environments generated by computer technologies have provided us with new experiential places, allowing us to share and determine sensory data which result in different physical and mental sensations [25].

The concept of immersion can be explained as the interaction of physical movement and a movement-based controller, allowing users to feel immersed in a simulated environment [26,27]. Slater and Wilbur described immersion as a description of a technology that renders the extent to which the computer display delivers a broad, comprehensive environment and vivid illusions to the human senses [25]. Immersion is composed of the opportunity to be placed inside a computer-generated environment of proprioception, the awareness of position and movement of the body, and sensory data in real-time.

Immersive technology can be defined as the technique of enhancing the realism of a simulated environment in the real world by immersive viewing experiences [28]. Immersive technology is a unique feature that provides sensory experiences through a combination of high quality and digital information to the users [29,30]. Studies on how immersive technology creates an immersive experience [28,31], what kind of sensory experience immersive technology can provide to users [29,30], or whether they interact in a simulated immersive environment created by the user [9,32] have been conducted.

Immersive technology research that is prominent in hospitality and tourism is virtual reality (VR) and augmented reality (AR). The studies have dealt with the potential and realistic aspects of VR in the tourism industry [33], the effect of authentic experiences on VR tourism [34,35], the impact of VR technology on user awareness research that affects consumer behavior [36], a format or option to enable virtual exhibition [37], or a proposal of a technology that can be used for communication in a virtual conference [38]. Moreover, Yung and Khoo-Lattimore [39] introduced how VR and AR have been studied in tourism research between 1995–2016 through a systematic literature review, and Loureiro et al. [40] analyzed 20 years of research on VR and AR conducted in the tourism context using the text-mining approach. In these studies, research has continued in the field of hospitality and tourism along with the evolution of VR and AR-related technologies, and it is stated that these technologies have led to changes in tourism opportunities, experiences, and education.

In sum, immersive technology can lead to positive changes in users when used in conjunction with diverse design elements and interactions [26]. However, studies on immersive technology displays in the hospitality context are limited to VR and AR. Therefore, various immersive technology displays should be investigated to improve overall engagement and the experiences.

2.3. Immersive Displays

According to Merchant et al. [41], immersive displays (stimuli) contribute to users' reactions to immersive experiences by mediating users' cognitive and affective responses. This finding is similar to a study by Suh and Prophet [27] who suggested that a user's cognitive and affective responses to immersive displays (stimuli) influence the results of immersive technology responses. They categorized various immersive displays (stimuli) as follows: visual displays (projector, holographic display, stereoscopy, head-up-display [HUD], head-mounted-display [HMD], and hand-based display), auditory displays (headphone, 3D sound speaker), haptic displays, and movement tracking displays (marker-based, vision-based, sensor-based, and hybrid tracking).

Based on the classification of immersive displays [27] and the literature review, among visual displays HMD is often used with other sensory stimuli displays for VR, so it is classified as combination sensory displays [14,30]. Hand-based display, which shows the changed visual elements through gestures [42], is excluded from the visual sensory category because it links to the sensor tracking of movement tracking. HUD is mainly used for vehicle navigation [43], so it is excluded from this study. Among movement tracking displays, vision-based and marker-based tracking are primarily used in camera applications, so they are classified as AR mobile application under a combination of sensory stimuli. Lastly, Cave Automatic Virtual Environment (CAVE), which frequently uses VR [30], is added under the category of combination sensory stimuli.

Overall, immersive displays can be categorized as visual, auditory, haptic, and movement-tracking displays. Combination displays are added as an additional display category. Table 1 shows a total of ten immersive displays that were examined in the literature review: visual displays (projector, holographic display, stereoscopy), auditory displays (headphone, 3D sound speaker), haptic displays, movement tracking displays, and combination displays (mobile application for AR, and HMD and CAVE for VR).

Table 1. Immersive displays by the sensory stimuli.

Sensory Factor	Immersive Displays	Reference
Visual displays	• 3D Image Projector • Holographic Display • 3D Stereoscope	Suh and Prophet [27] Xia et al. [44] Takaki and Uchida [45] Hong et al. [46] Klahr [47]
Auditory displays	• Headphone • 3D Sound Speaker	Schautz et al. [48] Schoeffler et al. [49]
Haptic displays	• Touch Screen	Jackman [50] Vi et al. [6]
Movement-tracking displays	• Sensor-Based Tracking	Bekele et al. [30]
Combination displays	• Head Mount Display (HMD) • Mobile Application	Ashline and Lai [14] Arce et al. [13] Bekele et al. [30]

The following summarizes five immersive displays (stimuli) in the literature review.

Visual displays. Research on three-dimensional (3D) display technology has been actively conducted, employing a combination of old-fashioned and up-to-date technologies [46]. Through various technologies, exhibition attendees can see actual 3D images created in space with the naked eye [44]. Among the various 3D image display methods, the most frequently used one is an image generated outside a flat screen in a vertical direction and a type of 3D display that can be viewed in a 360-degree direction [45]. Xia et al. [44] used a floating 360-degree light field 3D image display based on a high frame rate projector and a flat light field scanning screen that allows viewing a 3D image display without a device to create vivid 3D scenes floating in the air.

A hologram is an image of an object which is reconstructed based on the principle of interference that diffracts light, and holography is one of the technologies that perfectly composes holograms [46]. There are two basic beams for generating a hologram: the object beam, which is used to illuminate the object, and the reference beam, which directly illuminates the recording medium [51]. Holographic technologies have been developed and popularly used in the exhibition industry, such as computer-generated holographic displays [46,51] and multiplexed lens-array holographic displays [52].

The stereoscopic display is a 3D display using a stereoscope that allows two slightly different 2D images to be viewed as one merged stereoscopic image [47]. The visualized stereoscopic image is easier to interpret than a 2D image, giving viewers a more realistic 3D visual perception [10]. The most prominent example of the stereoscopic display experience in exhibitions is the use of polarized glasses provided by movie theaters to watch 3D movies, such as the movie Avatar which was released in 2009 [53].

Auditory displays. At some exhibitions, visitors tour exhibition booths using headphones. A welcome message, an introduction to the exhibition hall, or a description of the exhibited art are automatically produced by exchanges between the visitor's receiver and the transmitter placed in the exhibition hall [48]. The implementation of audio tours has proved to attract many visitors to exhibitions [54]. Especially when multi-sensory experiences are trending, it is natural to combine sound with other sensory technologies to provide a more immersive experience [6].

Auditory feedback technology plays a vital role in increasing the realism of experiences. Spatial sound reproduction provided through speakers has evolved from two-channel stereo to surround sound and 3D sound [49]. Schoeffler et al. [49] explained that 3D audio, an electro-acoustic system, works through the context of its application, such as in a concert performance, motion picture theater, domestic hi-fi installation, computer display, or individual head-mounted display. The spatial sound provided for the VR experience relies on the layering processes and distribution of sounds over time or mixing that creates

an optical illusion that the listener is located elsewhere in the virtual space. By adjusting the mixing architecture, the listener can feel the natural distance effect in the space [55]. Filho et al. [56] claim that in virtual 3D implementation, sound settings are an essential element along with objects (color, reflection characteristics, textures), lighting, interactions, and behavior. Therefore, 3D audio enhances the overall listening experience of users [49] and has been increasingly applied in many fields, including entertainment, simulation, VR [57], training, and healthcare [58].

Haptic displays. Haptics is the electronic or mechanical generation of movement that a user can experience through the sense of touch. Haptic technology output through a computer system or similar system allows people to touch and feel objects, and its use is increasing in multiple fields. Haptic technology has been popularly utilized to create a user's immersive experience [50], and tactile sensor displays [6] have been applied to enhance the visual art experience [12]. It is also used in design systems to design and modify models [10]. Haptic technology is developed and used in the form of haptic mice, gloves, joysticks, and, presently, the touch screen. By placing control inputs on the surface of a touch screen, users can feel the tactile interaction between themselves and the device every time they touch a screen. In addition, by placing an array of bumps that can be moved on a display screen, the user can create the desired shape or draw a line on the touch screen [12].

Movement-tracking displays. For a realistic immersive experience, it is important to accurately track the position of objects or movements in the real world because virtual objects can be superimposed in the right place only when the location or motion is correctly tracked [59]. Among popular movement tracking methods, sensor tracking displays have been frequently examined in previous studies [30,59,60]. Sensory tracking is largely divided into electromagnetic tracking and acoustic tracking. In the case of electromagnetic tracking, tracking is performed by measuring the strength of the magnetic field between the viewpoint and the measurement object or target. Sensory tracking plays a role in controlled environments because of the low latency and high response rate, but it is affected by other magnetic fields [30]. Acoustic tracking obtains information via estimating the distance from ultrasonic sound waves from a user-worn device to a fixed speaker sensor. When emitting an identifiable sound signal in a certain space, a wireless signal is periodically exchanged between a user-worn device and the fixed speaker sensor. When using acoustic tracking, errors can occur in transferring information in noisy surroundings; thus, acoustic tracking can be combined with other tracking methods for higher accuracy [61].

Combination displays. To provide users with the optimal immersive display experience, exhibitors use various multimedia systems, including multimedia scenes, touch screen systems, three-dimensional holographic projection systems, electronic sky displays, spectra vision, and video models [4]. A variety of multimedia systems allow exhibition attendees to actively participate in immersive environments, such as virtual reality (VR) and augmented reality (AR) [27]. Xiao [20] comments that a high-level VR system can provide a sufficiently immersive experience to make users feel as if they are both in a virtual environment and a real destination.

2.4. Factors That Influenced Exhibition Attendees' Satisfaction

Satisfaction is a customer's overall affective reaction derived by comparing their pre-purchase expectation level for a product or service with the actual performance experience after purchase [62]. The exhibition attendee's satisfaction is contingent upon a variety of factors related to the exhibition. Attendees consider the number and range of new products on display [63], the comfort and design of the booths [2], the quality of communication with exhibitors in the booths, and the time spent interacting with exhibitors [3]. Attendees also consider local attractions in the venue's surrounding area, the reputation, accessibility, safety, and exhibition facilities [64].

Attendee satisfaction proves important to exhibitors for several reasons. According to Lee [65], satisfaction is essential to encourage the attendee's participation. Moreover, the

attendee's satisfaction is a factor that not only spreads positive word of mouth (WOM) [66], but also positively influences revisit intention and loyalty [67]. Therefore, to elicit the aforementioned effects, exhibitors strive to seek and provide a unique opportunity to gather industry trends and meet the satisfaction and expectations of attendees [68].

The appearance of immersive displays in present exhibitions has led to more studies examining attendees' experiences using these devices. According to various studies, immersive displays have drawn the attention of and evoked positive reactions from attendees because immersive technology gives attendees expectations of their actual experience, even before using the device, and increases the realism of the exploit in a virtual environment [28]. For example, in research conducted by Collin-Lachaud and Passebois [8], 61% of the interviewees provided positive feedback on their immersive display experiences. Danchstep et al. [7] suggested that attendees concentrated on social interactions while interacting with immersive displays. Vi et al. [6] also revealed that attendees wanted to spend more time using the immersive displays at the exhibition.

Thus, to meet attendees' expectations and increase their satisfaction, exhibitors should consider attendees' interest in immersive displays and use immersive technologies extensively [69].

2.5. Stimulus-Organism-Response (S-O-R) Framework

The Stimulus-Organism-Response (S-O-R) framework was proposed by Mehrabian and Russell from environmental psychology theory. This framework explains that various environment cues act as stimuli (S) that affect an individual's cognitive and affective reactions (O) and in turn, elicit positive or negative behavioral responses (R) [15].

This S-O-R framework has been applied to study consumer behaviors. For example, Zhang et al. [70] used the S-O-R framework to prove the extent to which the characteristics of social media sites (S) affect customers' co-creation experience (O) and influence future participation intentions (R). Peng and Kim [71] revealed that the hedonic and utilitarian values of shopping and environmental factors (S) positively influence repurchase intentions (R) by forming positive attitudes and purchasing emotions toward online shopping (O). There are also cases of using the S-O-R framework to identify consumer behaviors in hospitality literature. For instance, Roy et al. [72] indicated that positive online recommendation behaviors of potential customers (R) could be obtained by increasing perceived service quality (O) which were affected by eWOM cues, such as eWOM valence, volume, and image reviews (S). Chen et al. [73] described the process by which festivalscape (S) increases participants' desire to attend festivals (O) and ultimately determines their satisfaction and behavioral intentions (R).

The S-O-R framework has been used in research to explain immersive displays and experiences. For example, Jin et al. [74] used the S-O-R framework to reveal that the characteristics of immersive quantified information design in the convergence mode of mobile intelligence and wearable computing (S) stimulate users to create immersion (O) and that the immersion state of these users leads to their continuous participation behavior (R). Moreover, Kim et al. [34] and Atzeni et al. [35] applied the S-O-R framework to explain the structural relationship among authentic experience (S), tourists' cognitive and emotional responses (O), and attachment to VR tourism, VR tourism visit intention, and its satisfaction (R). In addition, Suh and Prophet [27] asserted that the studies showing the function, user experience, and performance of immersive technology are lacking. Based on their findings, they analyzed relevant immersive technology studies and consolidated outcomes by adapting the S-O-R framework. They concluded that various immersive displays (stimuli) affect attendees' perceptions (organisms), and in turn, their satisfaction (response). In this study, the experience of immersive displays acts as stimuli that affect attendees' perception. After attendees have experienced immersive displays, they can have personal perceptions of immersive displays. And lastly, this perception of immersive displays can influence the attendees' satisfaction.

In sum, the S-O-R framework can explain how the various immersive displays (stimuli) affect attendees' perceptions (organism), which in turn affect their satisfaction (response).

This study tests the relationship between the attendees' perceptions (organisms) and their satisfaction (response) based on the S-O-R framework. One hypothesis guides this study.

Hypothesis 1 (H_1). *Exhibition attendees' perceptions of immersive displays affect their satisfaction positively at exhibitions*.

3. Method

3.1. Measurement Development

This study developed a self-administered questionnaire to investigate exhibition attendees' perception of the general technology display use, their awareness and satisfaction with the ten types of immersive displays, and their preferences for future experiences. First, this study modified questions adopted from the exhibition service perceptions, quality, and satisfaction literature [69,75–78] to examine exhibition attendees' overall perception of the technology displays at the exhibitions. These questions were measured on a 5-point Likert scale to determine the following: (1) how much the attendees like using the technology displays at the show, ranging from 1 (extremely dislike) to 5 (extremely like); (2) how much did the technology displays influence the show, ranging from 1 (extremely uninfluential) to 5 (extremely influential); (3) how helpful were the technology displays in obtaining information at the show, ranging from 1 (extremely unhelpful) to 5 (extremely helpful); (4) how the attendees think about the quality of immersive displays, ranging from 1 (very poor) to 5 (excellent); and (5) how satisfied the attendees are with the use of immersive displays, ranging from 1 (extremely dissatisfied) to 5 (extremely satisfied). The respondents were also asked to answer their overall satisfaction with the show(s) and what the attendees would like to see in future exhibitions. Each respondent was given a list of ten types of immersive displays in the questionnaire and asked to rank them based on what they would like to experience (1 being the most and 10 being the least desired).

3.2. Data Collection

The questionnaire survey asked respondents who were over the age of eighteen and had attended an exhibition adopting various technology displays in the past 18 months. Data were administered and collected through the Qualtrics survey company. A total of 1086 questionnaires were distributed, and 320 completed responses were returned. These 320 responses were reviewed based on whether the respondent experienced each immersive display. Among them, a total of 285 respondents who answered "have tried" five or more items on each immersive display were used for data analysis. The questionnaire consisted of three sections. The first section collected information regarding the respondents' awareness of the immersive displays at exhibitions. The second section examined immersive displays with individual impact and satisfaction using a 5-point Likert scale. The third section collected respondents' socio-demographic information, such as gender, age, education background, and motivation for attending the exhibition(s).

3.3. Data Analysis

First, descriptive statistics and frequency analysis were conducted to profile each survey respondent's socio-demographic characteristics. Second, frequency analysis was calculated to identify the exhibition attendees' perception of the immersive displays. Third, independent samples *t*-test and one-way ANOVA test were carried out to investigate whether there was any statistically significant difference within the socio-demographic groups. A multiple regression test was conducted to test the relationship between the exhibition attendees' perceptions of immersive displays and their overall show satisfaction. Lastly, descriptive statistics were carried out to determine which immersive displays the attendees most preferred to see in future exhibitions. IBM SPSS 25.0 was utilized for data analysis.

4. Results

4.1. Socio-Demographic Profile

Descriptive analysis and frequency analysis were performed to obtain the socio-demographic profile of the respondents. Table 2 shows the respondents' socio-demographic characteristics. Of the 285 respondents, 71.9% were male, and 28.1% were female. The majority of respondents were 40 to 49 years old (37.2%), followed by 30 to 39 years old (34.4%). In terms of the highest education level, 40.4% of the respondents had a master's degree, followed by 28.8% having a bachelor's degree. The majority of respondents (79.7%) had a bachelor's degree or above, which indicates that respondents were composed of educated people.

Table 2. Respondents' socio-demographic profile (*N* = 285).

Socio-Demographics	Frequency	Percent (%)
Gender		
Male	205	71.9
Female	80	28.1
Age		
18–20	8	2.8
21–29	41	14.1
30–39	98	34.4
40–49	106	37.2
50–59	19	6.7
60 or above	13	4.6
Education		
High school graduate	37	13.0
2-year diploma or equivalent	21	7.4
Bachelor's degree	82	28.8
Master's degree	115	40.4
Doctoral degree	30	10.5

Respondents were also asked to choose the types of exhibitions that they attended and experienced immersive displays. The response sheet contained a list of exhibition types, such as consumer exhibitions, EXPOs, art exhibitions, museums, and others, to which the respondents could check all that applied. A total of 662 responses were submitted by the 285 attendees. Multiple response analysis was conducted to examine the type of exhibitions respondents attended according to their socio-demographic characteristics. As displayed in Table 3, the results of the multiple response analyses included gender, age, and education with respect to a type of exhibition. In the order of most attended shows to least, the results were as follows: consumer exhibitions (30.1%), museums (26.1%), art exhibitions (23.6%), EXPOs (18.9%), and all others (1.4%). These results also show that immersive displays can be experienced in various exhibitions.

4.2. Perception of Immersive Displays at Exhibitions

Based on their previous experiences, respondents were asked to verify their perceptions of immersive displays using a 5-point Likert scale. Five questions were provided regarding how respondents felt when using immersive displays, how much immersive displays influenced the show's impressions, and how helpful immersive displays were in obtaining information.

Regarding how respondents felt when using immersive displays, more than 50% of the positive responses were observed. Ninety percent (90.8%) of respondents answered "like" or "extremely like" to the 3D video projection experience. Eighty-six percent (86.6%) answered "like" or "extremely like" to the holographic display experience. Eighty-five percent (85.7%) answered "like" or "extremely like" to headphone. The immersive display with over 20% "neutral" responses was CAVE (31.6%). Table 4 summarizes the results.

Table 3. Types of exhibitions attended by socio-demographic (Multiple responses, $N = 662$).

Socio-Demographics	Consumer Exhibition		EXPO (Trade Fair)		Art Exhibition		Museum		Others	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%
Overall	199	30.1	125	18.9	156	23.6	173	26.1	9	1.4
Gender										
Male	159	33.5	89	18.8	103	21.7	116	24.5	7	1.5
Female	40	21.3	36	19.1	53	28.2	57	30.3	2	1.1
Age										
18–20	2	13.3	0	0	7	46.7	6	40.4	0	0
21–29	29	32.6	15	16.9	24	27.0	21	23.6	0	0
30–39	75	29.5	48	18.9	65	25.6	63	24.8	3	0.5
40–49	75	32.2	45	19.3	49	21.0	59	25.3	5	0.8
50–59	11	25.6	11	25.6	6	14.0	14	32.6	1	0.2
60 or above	7	25.0	6	21.4	5	17.9	10	35.7	0	0
Education										
High school graduate	17	23.0	8	10.8	22	29.7	27	36.5	0	0
2-year diploma or equivalent	13	28.3	9	19.6	10	21.7	12	26.1	2	0.3
Bachelor's degree	57	29.4	43	22.2	42	21.6	51	26.3	1	0.2
Master's degree	89	32.5	49	17.9	66	24.1	66	24.1	4	0.6
Doctoral degree	23	31.1	16	21.6	16	21.6	17	23.0	2	0.3

Note. The percentage of gender, age, and education are added up to 100% by row.

Table 4. Perception of feeling using immersive displays.

Immersive Displays	Extremely Dislike	Dislike	Neutral	Like	Extremely Like
3D Video Projection	4 (1.4%)	1 (0.4%)	21 (7.4%)	107 (37.5%)	52 (53.3%)
3D Stereoscopic	1 (0.4%)	6 (2.1%)	46 (16.1%)	115 (40.4%)	117 (41.1%)
Holographic Display	2 (0.7%)	1 (0.4%)	35 (12.3%)	109 (38.2%)	138 (48.4%)
Headphone	2 (0.7%)	3 (1.1%)	36 (12.6%)	127 (44.6%)	117 (41.1%)
3D Sound Speaker	1 (0.4%)	5 (1.8%)	46 (16.1%)	95 (33.3%)	138 (48.4%)
Haptic (Touch Screen)	3 (0.7%)	3 (1.1%)	38 (13.1%)	120 (42.1%)	122 (42.8%)
Sensor Tracking (Motion Play)	1 (0.4%)	6 (2.1%)	41 (14.4%)	108 (37.9%)	129 (45.3%)
HMD (VR)	2 (0.7%)	6 (2.1%)	49 (17.2%)	92 (32.3%)	136 (47.7%)
CAVE (VR)	1 (0.4%)	10 (3.5%)	90 (31.6%)	83 (29.1%)	101 (35.4%)
Mobile Application (AR)	0 (0.0%)	4 (1.4%)	42 (14.7%)	114 (40.4%)	125 (43.9%)

Regarding how much immersive displays influenced the respondents' impression of the show, the highest-rated response was for 3D video projection (85.7%), followed by a holographic display (82.5%). Three displays were tied for third: 3D sound speaker (77.2%), sensor tracking display (77.2%), and AR mobile applications (77.2%). The immersive displays that had over 20% of "neutral" responses were CAVE (30.2%), 3D stereoscopic display (21.8%), headphone (21.4%), and haptic display (20.7%). Results are reported in Table 5.

As displayed in Table 6, the most useful informative display was the 3D video projection (87.8%), followed by the haptic display (81.4%), sensor tracking display (81.4%), and headphone (81.1%). The displays that over 20% of respondents selected as "neutral" were CAVE (28.8%), 3D stereoscopic display (21.4%), and 3D sound speaker (20.4%).

Regarding the quality of the immersive displays, more than 50% of respondents answered that the quality of immersive displays they used was "good" or "excellent" for all ten displays. Respondents gave the highest ratings for the 3D video projection (89.8%). The holographic display came second (85.9%), and headphone ranked third (85.6%). The displays that over 20% of respondents found "neutral" were CAVE (28.1%) and AR mobile application (21.8%). Results are shown in Table 7.

Lastly, respondents were most satisfied with 3D video projection (89.2%) at the show, followed by sensor tracking display (84.9%), and holographic display (84.5%). CAVE (32.3%) had more "neutral" answers than any other display. Results are shown in Table 8.

4.3. Perception of the Immersive Displays among Socio-Demographics

4.3.1. Different Perception of the Immersive Displays by Gender

As indicated in Table 9, an independent *t*-test was conducted to examine the mean difference in the perceptions of ten immersive displays by gender. Statistically significant differences were found in three out of ten immersive displays: 3D video projection, headphone, and 3D sound speaker. Male respondents had a higher perception of 3D video projection, headphone, and 3D sound speaker than female respondents. There were no statistically significant differences between male and female in the rest of the seven immersive displays.

Table 5. Perception of the extent of influence on impression of the show(s).

Immersive Displays	Extremely Uninfluenced	Uninfluenced	Neutral	Influenced	Extremely Influenced
3D Video Projection	3 (1.1%)	1 (1.4%)	34 (11.9%)	115 (40.4%)	132 (46.3%)
3D Stereoscopic	1 (0.4%)	10 (3.5%)	62 (21.8%)	111 (38.9%)	101 (35.4%)
Holographic Display	1 (0.4%)	4 (1.4%)	45 (15.8%)	106 (37.2%)	129 (45.3%)
Headphone	3 (1.1%)	11 (3.9%)	61 (21.4%)	110 (38.6%)	100 (35.1%)
3D Sound Speaker	1 (1.1%)	11 (3.9%)	51 (17.9%)	112 (39.3%)	108 (37.9%)
Haptic (Touch Screen)	2 (0.7%)	8 (2.8%)	59 (20.7%)	105 (36.8%)	111 (38.9%)
Sensor Tracking (Motion Play)	4 (1.4%)	9 (3.2%)	53 (18.6%)	121 (42.5%)	99 (34.7%)
HMD (VR)	1 (0.4%)	13 (4.6%)	52 (18.2%)	111 (38.9%)	108 (37.9%)
CAVE (VR)	4 (1.4%)	18 (6.3%)	86 (30.2%)	82 (28.8%)	95 (33.3%)
Mobile Application (AR)	3 (1.1%)	9 (3.2%)	53 (18.6%)	121 (42.5%)	99 (34.7%)

Table 6. Perception of how helpful displays were for obtaining information at the show(s).

Immersive Displayers	Extremely Unhelpful	Unhelpful	Neutral	Helpful	Extremely Helpful
3D Video Projection	1 (0.4%)	4 (1.4%)	30 (10.5%)	121 (42.5%)	129 (45.3%)
3D Stereoscopic	4 (1.4%)	6 (2.1%)	61 (21.4%)	108 (37.9%)	106 (37.2%)
Holographic Display	1 (0.4%)	3 (1.1%)	51 (17.9%)	110 (38.6%)	120 (42.1%)
Headphone	1 (1.1%)	4 (1.4%)	47 (16.5%)	125 (43.9%)	106 (37.2%)
3D Sound Speaker	1 (0.4%)	5 (1.8%)	58 (20.4%)	102 (35.8%)	119 (41.8%)
Haptic (Touch Screen)	1 (0.4%)	5 (1.8%)	47 (16.5%)	110 (38.6%)	122 (42.8%)
Sensor Tracking (Motion Play)	2 (0.7%)	6 (2.1%)	45 (15.8%)	114 (40.0%)	118 (41.4%)
HMD (VR)	3 (1.1%)	9 (3.2%)	45 (15.8%)	121 (42.5%)	107 (37.5%)
CAVE (VR)	4 (1.4%)	14 (4.6%)	82 (28.8%)	94 (33.0%)	92 (32.3%)
Mobile Application (AR)	2 (0.7%)	8 (2.8%)	52 (18.2%)	112 (39.3%)	111 (38.9%)

Table 7. Perception of the quality of immersive displays at the show(s).

Immersive Displays	Very Poor	Poor	Neutral	Good	Excellent
3D Video Projection	1 (0.4%)	5 (1.8%)	23 (8.1%)	114 (40.0%)	142 (49.8%)
3D Stereoscopic	1 (0.4%)	4 (1.4%)	43 (15.1%)	125 (43.9%)	112 (39.3%)
Holographic Display	1 (0.4%)	5 (1.8%)	34 (11.9%)	109 (38.2%)	136 (47.7%)
Headphone	3 (1.1%)	3 (1.1%)	35 (12.3%)	114 (40.0%)	130 (45.6%)
3D Sound Speaker	2 (0.7%)	4 (1.4%)	47 (16.5%)	101 (35.4%)	131 (46.0%)
Haptic (Touch Screen)	1 (0.4%)	3 (1.1%)	39 (13.7%)	124 (43.5%)	118 (41.4%)
Sensor Tracking (Motion Play)	1 (0.4%)	2 (0.7%)	46 (16.1%)	108 (37.9%)	128 (44.9%)
HMD (VR)	2 (0.7%)	5 (1.8%)	40 (14.0%)	107 (37.5%)	131 (46.0%)
CAVE (VR)	2 (0.7%)	8 (2.8%)	80 (28.1%)	91 (31.9%)	104 (36.5%)
Mobile Application (AR)	1 (0.4%)	6 (2.1%)	62 (21.8%)	128 (44.9%)	88 (30.9%)

Table 8. Perception of satisfaction with immersive displays at the show(s).

Immersive Displays	Extremely Dissatisfied	Dissatisfied	Neutral	Satisfied	Extremely Satisfied
3D Video Projection	2 (0.7%)	3 (1.1%)	26 (9.1%)	121 (42.5%)	133 (46.7%)
3D Stereoscopic	1 (0.4%)	4 (1.4%)	43 (15.1%)	126 (44.2%)	111 (38.9%)
Holographic Display	1 (0.4%)	4 (1.4%)	39 (13.7%)	111 (38.9%)	130 (45.6%)
Headphone	3 (1.1%)	7 (2.5%)	40 (14.0%)	125 (43.9%)	110 (38.6%)
3D Sound Speaker	3 (1.1%)	4 (1.4%)	50 (17.5%)	107 (37.5%)	121 (42.5%)
Haptic (Touch Screen)	1 (0.4%)	7 (2.5%)	51 (17.9%)	116 (40.7%)	110 (38.6%)
Sensor Tracking (Motion Play)	2 (0.7%)	4 (1.4%)	37 (13.0%)	111 (38.9%)	131 (46.0%)
HMD (VR)	1 (0.4%)	7 (2.5%)	43 (15.1%)	126 (44.2%)	108 (37.9%)
CAVE (VR)	1 (0.4%)	10 (3.5%)	92 (32.3%)	97 (34.0%)	85 (29.8%)
Mobile Application (AR)	0 (0.0%)	9 (3.2%)	47 (16.5%)	119 (41.8%)	110 (38.6%)

Table 9. Comparison of immersive displays by gender: independent *t*-test.

Immersive Displays	Composite Mean		*t* value	Sig.
	Male	Female		
3D Video Projection	4.41	4.19	2.678	0.008 *
3D Stereoscopic	4.19	4.03	1.824	0.069
Holographic Display	4.30	4.22	0.949	0.344
Headphone	4.25	3.98	3.257	0.001 *
3D Sound Speaker	4.25	4.06	2.174	0.031 *
Haptic (Touch Screen)	4.18	4.24	−0.697	0.487
Sensor Tracking (Motion Play)	4.25	4.18	0.793	0.430
HMD (VR)	4.21	4.10	1.210	0.227
CAVE (VR)	3.97	3.82	1.456	0.147
Mobile Application (AR)	4.18	4.02	1.917	0.056

* $p < 0.05$.

4.3.2. Different Perception of the Immersive Displays by Age

A one-way ANOVA test was performed, and a post hoc comparison of Tukey's HSD test was carried out to determine any statistically significant differences among the six age groups. As presented in Table 10, significant relationships between the age groups and the immersive displays existed. Perceptions of 3D video projection, 3D stereoscopic display, holographic display, headphone, haptic display, sensor tracking display, CAVE, and AR mobile application were significantly different among age groups. Exhibition attendees of the 40 to 49-year-old group and 60 or above group showed a higher positive perception for 3D video projection display than that of the 20 to 29-age old group. In addition, exhibition attendees aged 60 or above showed a higher perception toward 3D stereoscopic display than the 20-year-old or less group. In general, the 40 to 49-year-old group showed statistically significant differences from many other age groups in the perception of immersive displays.

4.3.3. Different Perception of the Immersive Displays by Education

As indicated in Table 11, a one-way ANOVA test was carried out to examine any statistically significant differences among respondents' education with respect to respondents' perception of immersive displays. Four immersive displays showed statistically significant differences among the education levels in terms of the perception of immersive displays. They are 3D video projection, 3D stereoscopic, HMD, and mobile applications.

Table 10. Comparison of immersive displays by age: one-way ANOVA.

Immersive Displays	Composite Mean						F Value	Sig.	Post-hoc
	(1) (*N* = 8)	(2) (*N* = 41)	(3) (*N* = 98)	(4) (*N* = 106)	(5) (*N* = 19)	(6) (*N* = 13)			
3D Video Projection	4.48	3.99	4.29	4.51	4.26	4.55	5.109	0.000 *	2 < 4, 6, 1, 2, 3 < 4
Holographic Display	4.40	4.06	4.20	4.39	4.25	4.65	2.887	0.015 *	2 < 6
Headphones	3.90	4.04	4.16	4.32	3.92	3.97	2.654	0.023 *	N/A
3D Sound Speaker	4.00	4.03	4.16	4.33	4.08	4.09	1.672	0.141	N/A
Haptic (Touch Screen)	4.10	3.85	4.17	4.33	4.18	4.35	3.917	0.002 *	2 < 4
Sensor Tracking (Motion Play)	3.98	4.03	4.18	4.43	4.04	4.08	3.769	0.003 *	2 < 4
HMD (VR)	4.00	3.96	4.14	4.30	4.22	4.18	1.821	0.109	N/A
CAVE (VR)	3.55	3.65	3.88	4.15	3.69	3.89	3.689	0.003 *	2 < 4
Mobile Applications (AR)	3.83	3.85	4.14	4.30	3.93	4.05	3.994	0.002 *	2 < 4

Note. (1) 20 or less; (2) 21–29; (3) 30–39; (4) 40–49; (5) 50–59; (6) 60 or above. * $p < 0.05$.

Table 11. Comparison of immersive displays by education: one-way ANOVA.

Immersive Displays	Composite Mean					F Value	Sig.	Post-hoc
	(1) (*N* = 37)	(2) (*N* = 21)	(3) (*N* = 82)	(4) (*N* = 115)	(5) (*N* = 30)			
3D Video Projection	4.14	4.29	4.28	4.42	4.54	2.468	0.045 *	N/A
3D Stereoscopic	3.83	4.05	4.11	4.25	4.29	3.625	0.007 *	1 < 4, 5
Holographic Display	4.09	4.30	4.29	4.27	4.52	1.833	0.123	N/A
Headphone	3.99	4.14	4.11	4.24	4.32	1.679	0.155	N/A
3D Sound Speaker	4.01	4.17	4.10	4.30	4.31	2.098	0.081	N/A
Haptic (Touch Screen)	4.04	4.19	4.21	4.21	4.29	0.748	0.560	N/A
Sensor Tracking (Motion Play)	4.03	4.11	4.25	4.28	4.32	1.367	0.246	N/A
HMD (VR)	3.86	4.26	4.08	4.29	4.37	4.250	0.002 *	1 < 4, 5
CAVE (VR)	3.74	3.70	3.85	4.06	4.01	2.094	0.082	N/A
Mobile Application (AR)	3.89	4.07	4.07	4.21	4.31	2.643	0.034 *	N/A

Note. (1) High school graduate; (2) 2-year diploma or equivalent; (3) Bachelor's degree; (4) Master's degree; (5) Doctoral degree. * $p < 0.05$.

By a post hoc test, mean values were compared to see differences between education level groups. For the 3D video projection, the doctoral degree group had the highest mean value (M = 4.54), while the high school diploma group had the lowest mean value (M = 4.14). For the AR mobile applications, the doctoral degree group showed a higher positive perception of immersive displays than the high school diploma group. Overall, the result demonstrated a statistically significant difference between some education levels and the perception of immersive displays.

4.4. Relationship between Attendees' Perceptions of Immersive Displays and Overall Show Satisfaction

As displayed in Table 12, a multiple regression analysis was performed to determine the relationship between the exhibition attendees' perceptions of immersive displays and overall show satisfaction. The mean of the perceptions for each of the ten types of immersive displays was independent variables, and the overall show satisfaction was a dependent variable.

Table 12. Relationship between perception of immersive displays and overall show satisfaction: Multiple Regression Analysis.

Immersive Displays	B	SE	Beta (β)	t	Sig.	VIF
3D Video Projection	0.281	0.068	0.292	4.157	0.000 *	2.735
3D Stereoscopic	0.138	0.061	0.150	2.265	0.024 *	2.424
Holographic Display	0.177	0.054	0.190	3.305	0.001 *	1.829
Headphones	0.056	0.061	0.060	0.917	0.360	2.383
3D Sound Speaker	−0.027	0.063	−0.030	−0.427	0.670	2.755
Haptic (Touch Screen)	0.120	0.055	0.123	2.178	0.030 *	1.782
Sensor Tracking (Motion Play)	0.006	0.054	0.006	0.110	0.913	1.880
HMD (VR)	0.104	0.058	0.112	1.771	0.078	2.241
CAVE (VR)	0.015	0.045	0.020	0.346	0.730	1.827
Mobile Applications (AR)	−0.047	0.055	−0.049	−0.846	0.398	1.885

Note. R^2 = 0.507, Adj. R^2 = 0.489, F = 54.326, * $p < 0.05$.

Examining the model, 50.7% of the variation in "exhibitor attendees' overall satisfaction" was explained by the ten types of immersive displays. Multicollinearity was measured by variance inflation (VIF), and all independent variables of VIF values were under 2.8. Among the independent variables, VIF values did not exceed 5.0, which is an acceptable VIF value [79] indicating that independent variables are not correlated. From the model, 3D video projection (t = 4.157, p = 0.000), 3D stereoscopic display (t = 2.265, p = 0.024), holographic display (t = 3.305, p = 0.001), and haptic display (t = 2.178, p = 0.03) appeared to affect the exhibition attendees' overall show satisfaction positively. Comparing standardized partial regression coefficient (β), the 3D video projection variable explained 29.2% of the variation in exhibition attendees' overall satisfaction, followed by the holographic display (19%), 3D stereoscopic display (15%), and haptic display (12.3%).

The model indicated a positive relationship between immersive displays and exhibition attendees' satisfaction, which supports the hypothesis that exhibition attendees' perceptions of immersive displays (organism) affect exhibition attendees' satisfaction (response) at the exhibitions. Therefore, the result verifies that the S-O-R theory can be partially applied to research in the exhibition field.

4.5. Attendees' Expectations of Immersive Displays in Future Exhibitions

This study asked about attendees' preferences for immersive display experiences in the future. A questionnaire randomly listed ten types of immersive displays used in the study and asked, "Which technology display would you like to experience more in future shows? Rank the following technology displays in order of preference." Respondents listed the immersive displays they would like to experience from most (1) to least (10). Thus, as shown in Table 13, the immersive display with the lowest sum value is the highest preferred experience for future shows.

Table 13. Ranking of preference for immersive displays in the future.

Immersive Displays	Sum	Preference Ranking
3D Video Projection	814	1
Holographic Display	1116	2
HMD (VR)	1370	3
3D Stereoscopic Display	1477	4
CAVE (VR)	1733	5
3D Sound Speaker	1776	6
Headphone	1805	7
Sensor Tracking (Motion Play)	1836	8
Mobile Application (AR)	1850	9
Haptic (Touch Screen)	1890	10

Note. Each immersive display is ranked 1 (the most preferred immersive display) to 10 (the least preferred immersive display).

A 3D video projection display was the most preferred technology that respondents wanted to see in future exhibitions. The second, third, fourth, and fifth preferred immersive displays were holographic display, HMD (VR), 3D stereoscopic display, and CAVE (VR), respectively. These five immersive displays are generally categorized and described as visual–sensory stimuli. For instance, 3D video projection, holographic display, and 3D stereoscopic display directly stimulate the user's sense of sight. Similarly, HMD and CAVE generate VR experiences by combining the user's visual, sound, and touch senses. Overall, the result indicated that exhibition attendees would prefer to see visually stimulating displays in future exhibition visits and presented information that exhibitors should consider for future exhibitions for the attendees' overall show satisfaction.

5. Discussion

5.1. Theoretical Implications

The study investigated the relationship between the attendees' perceptions of immersive displays used in exhibitions and their level of satisfaction. Additionally, the study categorized immersive displays and examined the differences in exhibition attendees' perception of immersive displays with respect to socio-demographics, age, and education. This study has several theoretical implications.

First, this study contributes to the body of knowledge regarding the immersive displays used in the exhibition industry. Suh and Prophet's study [27] classified immersive system features according to four sensory stimuli: visual, auditory modality, haptic interface, and movement tracking, and listed the systems that stimulate each sense. This study examined previous literature to propose immersive displays corresponding to the immersive system features. In analyzing the literature, we tried to increase the reliability of immersive display classification upon sensory stimuli categories by identifying how various immersive displays work and stimulate the user's senses. To narrow the scope to the immersive displays in the exhibition site, if the function of the system feature proposed in Suh and Prophet [27] is for other technical support purposes, it was excluded from the study. Thus, the category of combination displays was added to classify the immersive displays. This is because, in the case of immersive displays such as VR and AR, these are the displays that stimulate two or more senses. Therefore, it cannot be distinguished by a single sense. In identifying the immersive displays corresponding to the combination displays, the HMD, classified as visual displays in the previous literature, was rearranged as the combination displays. This is because the HMD is not used only for visual stimulating purposes. In addition, vision-based and marker-based tracking, classified as movement tracking displays, are mainly used in an AR mobile application through a camera, so it has been rearranged as the combination displays. This study theoretically suggested the classification of immersive displays used in exhibitions by analyzing the operation methods, stimulated senses, and utilization of all immersive displays.

Second, the study shows a numerical result of attendees' perceptions of general technology displays and immersive displays. Previous studies of technology displays and immersive displays investigated a system for a specific technology display [43,45,46,52,56,59–61,80,81], showing the differences between the proposed system [9,11,55,57,82,83] and the existing system, or attendees' reactions to the proposed system [29,53,54,84–87]. However, in this research, various displays are presented simultaneously, showing the result of perceptions to displays as a whole. In particular, the results for the overall awareness of technology display usage, such as satisfaction of use, quality, influence, and helpfulness, can help understand the attendees' perceptions. Moreover, in this study, the results of the attendees' perceptions regarding specific technology display terms are presented numerically. The results show that nine out of the ten terms have an awareness level of 75% or greater, and one display with over 60% awareness among respondents. These results validate the previous studies claiming that immersive displays have been a trend for several years [88–91].

Third, this study verifies that the Stimulus-Organism-Response (S-O-R) framework presented in a study [27] can be practically applied to exhibitions. The S-O-R framework is a model in which various factors act as the stimuli that affect an individual's cognition, and naturally, the individual's influence as a response to behavior [15]. The study statistically explains the relationship between the attendees' perceptions (O) and their satisfaction (R). The result shows that the attendees' perceptions of ten immersive displays (O) have positively affected the attendees' overall satisfaction with the exhibition (R). In this study, by applying the S-O-R framework, structural model tests for all relationships were not performed; however, partially proving the relationship of S-O-R through multiple regression analysis verifies that the S-O-R theory can be applied to research in the exhibition field.

Finally, the study shows that exhibition attendees prefer to use immersive displays [6–8,78,92] by demonstrating the relationship between the immersive displays and the satisfaction of exhibition attendees. Moreover, this study presents the perception and satisfaction of each specific immersive display. For the ten displays presented in the study, attendees showed a high level of positive perceptions, and only four displays out of ten immersive displays affected attendees' exhibition satisfaction ($R^2 = 0.507$). This result expanded research between exhibition immersive displays and attendees' satisfaction.

5.2. Managerial Implications

Results reveal a justification for using immersive displays for exhibitions. To increase the attendees' satisfaction, exhibitors can consider which immersive displays can be more helpful to them according to their target segments and exhibition goal. The study provides exhibitors with helpful information to attract exhibition attendees' interests and to help them design strategies to effectively convey their information to the attendees.

Exhibitors should understand the attendees' awareness of immersive displays provided in the industry and plan in detail which immersive displays to use in their exhibitions. They should begin conducting thorough preliminary market research and preparing a high-quality immersive display. This study shows that 3D video projection, holographic display, headphones, haptic display (touch screen), and HMD for VR are the immersive displays with the most satisfactory quality. Additionally, exhibitors need to consider the main purpose of installing immersive displays. In other words, different immersive displays can be used depending on whether the exhibitor is utilizing such displays to influence the attendees' impressions of the exhibition, provide sufficient information about the exhibition, or simply provide enjoyment and satisfactory experiences to attendees. For example, according to the results of this study, if the purpose of the installation is to impress participants with a visually attractive show, exhibitors can consider installing 3D video projection, holographic display, 3D sound speaker, sensor tracking display, and/or AR mobile application. If the purpose of the installation is to deliver sufficient information, exhibitors can consider installing 3D video projection, haptic display, sensor tracking display, and/or headphone display. If exhibitors want to focus on pleasure and providing a satisfactory experience, they can consider using 3D video projection, holographic display, headphone,

and/or sensor tracking display. In addition, this study indicates some displays that affect specific groups based on gender, age, and educational background. Therefore, exhibitors can use the results when marketing for a particular demographic segment.

This study presents immersive displays that exhibitors should consider for future exhibitions. This study also shows the results of immersive displays that attendees want to experience in the future. The notable part is that attendees have high expectations for displays that provide visual sensory stimuli. The top five displays with the highest expectations are 3D video projection, holographic display, HMD, 3D stereoscopic display, and CAVE, which provide basically visual stimulation. Among these displays, 3D video projection, holographic display, and 3D stereoscopic display can affect overall show satisfaction.

6. Conclusions

The present study examined the use of immersive displays which have been utilized in various shows, such as consumer exhibitions, EXPOs, art exhibitions, museums, and more. More specifically, this research categorized immersive displays and investigated exhibition attendees' perceptions of immersive displays in exhibitions and how those immersive displays affected their level of satisfaction.

First, based on sensory stimuli through an extensive literature review, the study categorized immersive displays used in exhibitions. The classification is divided into five categories: visual display, auditory display, haptic display, movement-tracking display, and combination display. The immersive displays corresponding to each sensory factor were identified through the literature review and then used in the questionnaire.

Second, the study found that immersive displays are essential elements in many exhibitions. The respondents indicated that they have a positive perception of the use of immersive displays. Many have affirmatively responded that immersive displays have influenced their overall impression of the shows and helped them obtain useful information. Eight displays showed more than 80% recognition, and the other two displays had between 60% and 80%.

Third, through this study, we were able to uncover the perceptions of the attendees regarding immersive displays for various exhibitions. 3D video projection seemed to be the most preferred and satisfying display for the attendees. Not only did the attendees find the 3D video projection useful, but they also found it to be the most enjoyable. In addition, they thought that 3D video projection helped them obtain information and influenced their impressions of the show.

Fourth, when the ten immersive displays' mean differences were examined in gender, statistically significant differences in 3D video projection, headphone, and 3D sound speaker were found. Men are more likely to use those immersive displays than women. When age was investigated in the perception of immersive displays, there was a significant relationship with 3D video projection, 3D stereoscopic display, holographic display, headphone, haptic display, sensor tracking display, CAVE, and AR mobile application. Attendees between 40 and 49 years old are more likely to use those immersive displays than those between 21 and 29 years old. Examining the perception of immersive displays and education levels, four displays showed significant interactions: 3D video projection, 3D stereoscopic display, HMD, and AR mobile application. Those who earned a master's or higher educational degree were more likely to use those immersive displays than those who earned a bachelor's degree or below.

Fifth, from comparing the perception of immersive displays with exhibition attendees' satisfaction for the overall show, four displays are significant ones: 3D video projection, 3D stereoscopic display, holographic display, and haptic display. These four displays that influenced the attendee's satisfaction are typically categorized as visual–sensory stimuli and tactile–sensory stimuli. Therefore, the finding suggests that more visually stimulating immersive displays promote higher exhibition satisfaction ratings from attendees.

Finally, 3D video projection, holographic display, HMD, 3D stereoscopic display, and CAVE were selected as exhibition attendees' most preferred displays for future shows.

Thus, the finding suggests that exhibition attendees' expectations are heavily influenced by the sense of sight and a combination of multiple sensory stimuli.

7. Limitations and Future Research

This study has a few limitations. First, the data used in the study is limited in generalizing the results given the number of participants. Second, this study applied the S-O-R framework only for investigating the relationship between perception and satisfaction (only the O-R relationship), which means that the full S-O-R model was not tested; thus, the relationship for the S-O relationship was unidentified. Therefore, a statistical model test using the S-O-R model is recommended in future studies.

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