






**Studying the Factors of Virtual Museum Design on the Visitors' Intention and Satisfaction**  
**INTERACTIVE ARTICLE COVER**

**About the Journal**

<b>Journal DOI</b>	<a href="https://dx.doi.org/10.21659/rupkatha">https://dx.doi.org/10.21659/rupkatha</a>
<b>Journal Home</b>	<a href="http://www.rupkatha.com">www.rupkatha.com</a> 
<b>Indexed by</b>	<a href="#">Scopus</a>  <a href="#">Web of Science: Emerging Sources Citation Index (ESCI)</a>  <a href="#">DOAJ</a> 
<b>Journal Metrics</b>	CiteScore 2020: 0.2   SJR 2020: 0.162   SNIP 2020: 0.193   JCI 2020: 0.50

**About the Issue**

<b>Issue</b>	<b>Vol. 14, No. 4, 2022   "Global Anxieties in Times of Current Crises"</b>
<b>Editor</b>	Tirtha Prasad Mukhopadhyay
<b>Affiliation</b>	Universidad de Guanajuato
<b>Issue DOI</b>	<a href="https://doi.org/10.21659/rupkatha.v14n4">https://doi.org/10.21659/rupkatha.v14n4</a>
<b>TOC</b>	<a href="https://rupkatha.com/v14n4.php">https://rupkatha.com/v14n4.php</a> 

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<b>Title</b>	<b>Studying the Factors of Virtual Museum Design on the Visitors' Intention and Satisfaction</b>	
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<b>Article DOI</b>	<a href="https://doi.org/10.21659/rupkatha.v14n4.22">https://doi.org/10.21659/rupkatha.v14n4.22</a>	<b>Pages:</b> 1-19
<b>Abstract</b>	<a href="https://rupkatha.com/v14n422">https://rupkatha.com/v14n422</a> 	
<b>Full-text PDF</b>	<a href="https://rupkatha.com/V14/n4/v14n422.pdf">https://rupkatha.com/V14/n4/v14n422.pdf</a> 	
<b>Article History</b>	<b>First Published: 26 December 2022</b>	
<b>Article Impact</b>	<a href="#">Check Dynamic Impact</a> 	
<b>Copyright</b>	<a href="#">Aesthetics Media Services</a> 	
<b>Licensing</b>	<a href="#">Creative Commons Attribution Non-Commercial 4.0</a> 	

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# Studying the Factors of Virtual Museum Design on the Visitors' Intention and Satisfaction

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## Abstract

This study is to suggest a plan for attracting visitors who are a requisite for the survival of museums by combining design factors that visitors can most easily recognize in virtual museums and linking the satisfaction of visitors through the research on the relationship between the design factors of virtual museums in national museums and the satisfaction of visitors. To meet the purpose of the study, the theoretical basis of virtual museum, design factor, satisfaction, and intention to visit was examined through domestic and foreign literature and previous studies. Based on this, research the model and research hypothesis were set up and verified through empirical research. For a more empirical study, after the suitability of the questionnaire through previous studies was examined, 400 questionnaires were distributed to visitors who visited the enterprise exhibition hall in the metropolitan area of Korea. Of these, 340 were used as the final analysis data. The collected questionnaires were analyzed by demographic analysis, descriptive statistics analysis, validity and reliability analysis, correlation analysis, and multiple regression analysis using SPSS Ver. 25. Based on the results of the empirical statistical analysis, the study set the direction of the research considering the realistic meaning of the research results. Through the empirical analysis of this study, it was found that the satisfaction with the design factors of colour, graphics, and letters visitors to the virtual museum lead the s to a positive intention of visiting the museum based on the future existence and operation. Therefore, while the promotion of museum collections or museum-related products is very important when the operation or opening of a virtual museum is intended, the persons concerned should recognize that improvement of design factors is an important thing to induce the audience's on-site visit. In this regard, this study implies that it found out that design factors are important aspects attracting visitors and suggested the direction of maintenance and operation of museums. In future studies, it is required to expand the selection of objects for the operation and maintenance of private museums, not national museums. In addition to the design factors presented in this study, it is necessary to research to maximize the efficiency of the virtual museum operation through the verification of various design-related factors.

**Keywords:** Virtual Museum, Design, Design Elements, Satisfaction, Visiting Intention.

## 1. Introduction

If the experience of a museum in the past is limited only to offline visits in the way of providing and exchanging information, today, museums provide information in various forms online and offline. While museums were sites with retro vibes that visitors could not enjoy unless they visited the sites, Now, visitors can watch them online at their current location without visiting the site. Also,

People with physical disabilities can visit the museum without difficulty. The emergence and development of the Internet, digital technology, and multimedia technology present the possibility of opening new exhibition media and exhibition techniques that could not be thought of before.

National museums in Korea have been continuously making efforts to provide information, knowledge, and cultural space to residents and to serve as a space for mutual exchange, away from the simple artefact exhibition-oriented museum operation in the past by the years of the 2000s. Through these efforts, museums have escaped from the heavy, static, and authoritative images of the past, but they have suffered a lot of difficulties due to the decrease in visitors who visit the museum during the recent Covid-19 crisis.

To get over these difficulties, museums are continuously making efforts to attract visitors through various special exhibitions, cultural performances, local festivals, and other attractions. Especially, as the Internet and digital technology development, the virtual museum is operated which provides visitors with information related to the museum before visiting the museum. However virtual museums currently stay on the basic services such as offering information concerning a museum, collections, facilities, opening times, holiday guides, and colour. And simple layout, heavy colour, and uniformity of letters make a procrustean bed, or excessive uniformity, which subsequently makes visitors bored and does not draw a positive evaluation from visitors.

Therefore, this study intends to research the relationship between the design factors of the virtual museums in national museums, the satisfaction of the visitors to the virtual museum, and the intention to visit. To this end, the study aims to suggest the following plans for the maintenance of museums and the attraction of visitors based on sustainability by combining design factors that visitors can most easily recognize in virtual museums and linking them with visitors' satisfaction.

First, the study analyzes the design factors of virtual museums as the main factors in the maintenance and survival of museums to confirm whether each factor has a significant effect on satisfaction and intention to visit. Also, it recognizes the importance of satisfaction of visitors who visited virtual museums and aims to contribute to the improvement of visiting in the future.

Second, the purpose of this study is to suggest a plan to secure the competitiveness of museums through the transition to the positive awareness of museums necessary for the operation, upgrade, and new opening of virtual museums by identifying the difference in the effects of design factors on satisfaction and intention to visit.

To meet the purpose of the study, the study seeks the theoretical basis of the virtual museum, design factor, satisfaction, and intention to visit by examining domestic and foreign literature and previous studies, and based on this, the study model and research hypothesis are set up and verified through empirical research. The empirical study confirmed the suitability of the questionnaire through previous studies and asked the visitors who had visited the virtual museum of national museums to fill out the questionnaire in the sample area for 21 days from January 10, 2022, to January 31, 2022. A total of 400 questionnaires were distributed and 368 questionnaires were collected. Of the collected questionnaires, 340 questionnaires were used as the final analysis data except for 28 questionnaires that were unfaithful.

The collected questionnaire data was used as basic data for empirical analysis, and demographic analysis, validity and reliability analysis, correlation analysis, simple regression analysis, and multiple

regression analysis were conducted using the statistical package program SPSS Ver. 22. Based on the results of the empirical analysis, the study suggests the realistic meaning of the results and the research direction of the follow-up studies.

## **2. Theoretical Background**

### **2.1. Virtual Museum**

#### **2.1.1. Concept of Virtual Museum**

A museum is a non-profit institution that contributes to the development of society and society by collecting, preserving, researching, and exhibiting tangible and intangible heritage of human society for education, research, and enjoyment (International Council of Museums, 2022). In addition, according to the Museum Act, a museum is defined as a facility where historical remains, archaeological artefacts, anthropological literature, folklore, art, animals, plants, mineral, technology, and industrial remains are collected, preserved, surveyed, researched, exhibited, and educated to contribute to the development of culture, arts and sciences and the promotion of cultural enjoyment and lifelong education in the general public (Museum and Art Gallery Promotion Act., 2022). In other words, museums are institutions that provide history and cultural heritage to the public in the form of exhibitions (Ryu et al, 2016).

As the desire for intellectual inquiry and cultural enjoyment has increased socially, more and more people are looking for cultural space. In turn, interest in museums has also increased (Song & Koo, 2020). This interest expands the role of the museum as an educational and cultural space and expects various forms of activities for visitors.

In future museums, the introduction of digital technology is the most important feature and a key factor of communication. The introduction of digital technology has positive effects such as an expansion of experience and an increase in viewing efficacy. Therefore, in 2020, the Ministry of Culture, Sports and Tourism and the National Museum Foundation of Korea said that they should create a smart museum through the production and provision of new and diverse content based on digital innovation free from a passive attitude toward collection, exhibition and preservation, and seek ways to create joint value with visitors as a place of education and a role of cultural mediator (MunHwaIlbo, 2020).

Virtual Museum has become a term standing for future museums that do not exist. It has an identity as a museum, but it is one virtually established on the web or mobile and is spreading in various forms. Virtual museums are also called the terms Cyber Museum, Online Museums, Internet Museums, Electronic Museums, Digital Museums, Hypermedia Museums, and Meta Museum.

Virtual museums covering all of these names can be usually defined as a space that "store, display, preserve and disseminate information on history, science, culture and arts accessible through digital media, DVDs, the Internet, smartphones, GPS (Global Positioning System), portable computer PDA (Personal Digital Assistant), and physical exhibition space where you can experience virtual reality" (Um et al, 2015).

(Huhtamo, 2003) emphasized that, above all, it is not simply an online substitute for physical museums in the real world (Huhtamo, 2003). Although it is very important to put the collections in virtual museums online and to create search engines for them, it is only a 'pre-condition' for virtual

museums. The conceptualization of virtual museums requires a historical and philosophical consideration of the dualistic distinction between virtual and real, time and space, aura and reproduction, material and non-material, linearity and nonlinearity, and works and viewers (Choi & Lee, 2003).

'Virtual' as an adjective is a concept that has been discussed in Western philosophical history for a long time and comes from Latin 'Virtualis.' It is a medieval language that came from translating Aristotle's "Dynamis" when translating the concept of potential, power, and square into Latin. However, as 'virtual' has become a solid concept of images such as objects in mirrors which are not actual representations of illusions, it has often been used to stand for 'unreality.' 'Virtual' is often used (often negatively) to stand for 'unreal' because it is assumed that 'reality' is a material realization, that is, a figure that can be detected. However, the dualism of reality versus virtual is wrong it is too simplified an approach. Therefore, 'virtual' is not the opposite of 'real' but the opposite of 'actual' (Cha, 1998).

So today, the virtual meaning does not exist, but it should be seen as an entity with the potential that can become a reality (Kim, 2017). So, 'virtual' should not be approached from the point of view of whether it is true or false about everyday reality, but rather as a factor of tension that raises questions about what we call "reality" and accepts and reflects new perspectives.

### **2.1.2. Characteristics of Virtual**

The representative feature of virtual museums is that they can be easily and quickly shared through the network and the provision of digitalized information. First, the most important feature of a virtual museum is that the collection as a learning resource is provided as digitalized information, not as an actual object in a museum site. Through multimedia and digital technology, exhibits can be processed in various ways, and the scope of experience can be extended to the point that is impossible with original exhibits or reproductions of museum sites. Digital technology used in virtual museums enables new communication in learning by expanding and strengthening the awareness and experience of actual original exhibits. It is important to make the virtual museum valuable for learning by producing and sharing useful and meaningful knowledge by the learner himself through the vast information resources of the museum.

Second, the collection of digitalized information can be easily and quickly shared through information networks among museums (Oh, 2009). Based on the cooperation and integration between museums, is a great advantage of a virtual museum that cannot be found in a museum site because visitors can experience various collections from various museums beyond the limits of physical space. In terms of content virtual museums can give learners a richer choice by mutually supporting expertise and providing integrated information and resources possessed by various institutions.

## **2.2. Design Components of Virtual Museum**

### **2.2.1. Virtual Museum Design**

Design is a factor that makes visitors understand the nature of information and business provided by websites at a glance. Visitors' perception during the first visit is mostly determined through the design of the website, so the design concept should be established by reflecting the characteristics of customers, characteristics of contents, and characteristics of businesses (Park, 2007). Therefore,

the design excellence of a virtual museum can affect the image of the museum or site, and satisfaction with the sensory aspect of a virtual museum can be recognized as a pleasant and interesting visit for visitors.

In the early days of the introduction of virtual museums, visitors to virtual museums were simply public relations-oriented means such as museum guidance, the introduction of exhibits, and event guidance. Recently, adhesion – the time to stay on the site – has become more important than publicity. The longer visitors stay on the site, the better the museum awareness, the image of the museum, and the actual visit rate. Since the virtual museum cannot see actual things, the introduction of exhibits and museums superior to actual things is increasing due to complementary factors such as sound, video clips, and graphic processing. Therefore, it is necessary to pay greater attention to design so that virtual museums can give a strong impression of the layout, colour, font, information status, and image composition of a virtual museum.

The design of a virtual museum should be based on actual exhibits, and it requires images and videos that can highlight the use of words and phrases which can cause noticeable intense colours or interests for differentiation. This means that these various design elements should be arranged harmoniously on the Internet. So, the design concept of a virtual museum is determined by the effects of navigation, colour, graphics, multimedia, layout, and letters. The image formed by the visitors of the virtual museum can be changed depending on how they are used, and it can meet the needs of the visitors of the virtual museum and induce continuous visits.

### **2.2.2. Design Factors of Virtual Museum**

In the previous studies on design factors of websites, Cha Young-joo (2000) selected 6 components of digital design such as navigation, graphics, colour, multimedia, layout, and homepage structure (Cha, 2000). (Jeong, 2007) stated the factors as planning, information architecture, navigation, layout, icon, labelling, colour, letter, etc. (Nam, 2008) composed of the factors with colour, character, layout, graphics, animation, etc.

Therefore, this study selected 4 design components of a virtual museum and researched layout, colour, graphics, and letters which are considered to have the highest design concept among various design components presented in various previous studies. The layout means arrangement, make-up, and composition, and each screen composition is woven into a premise to induce the reader's gaze.

In the design of a virtual museum, layout plays a significant role in inducing people to see virtual museums and attracting the attention of visitors only if all the design elements of a web page such as letters, graphics, icons, textures, and colours are harmonized (Lim, 1998). Generally, elements that constitute layouts include Logo, Header, Footer, Global Navigation, Local Navigation, and Contents.

Colour has a strong affinity for emotion. Starting from nature, everything around us has a colour, and in these colours, we associate meanings. In addition, colours show various functions and roles by providing beauty, delivering information quickly and easily, forming a consensus of emotions, creating an atmosphere, and changing the environment in a non-mechanical way. Therefore, if colour is properly used, it can be the most powerful tool to improve the efficiency of information

expression in a wide range of areas, but if it is used inappropriately, the function of the display system can be significantly reduced (Jeong, 2004).

Colours play a major role psychologically, and they play an important role in consumers' purchasing decisions. The importance of colour effects on the web page can be divided into five categories: attention-grabbing effects, psychological effects, association effects on an object, memory enhancement effects on an object, and the creation of an aesthetically pleasing atmosphere (Kim, 1999). Therefore, one should carefully choose colours so that they do not feel rejected because of colours.

Graphics are important in that they indicate how effective the site will be to show its first impression. Since the purpose of virtual museums or content designed to attract the attention of visitors in terms of visual perspective is to induce visitors to visit the service realistically, it will affect visitors' behaviour if virtual museums reflect aspects of design fluently. Typography refers to the design of letters to maximize visual aesthetics by using fonts and characters as the most basic information delivery symbols of humans. It is the aspect where art and technology are combined (Kim, 2008).

Letters as the most important element in the design of virtual museums are not only basic symbols that deliver meanings but also important media to convey messages. When using letters, the style of the letters should be used appropriately. The most important thing in letters is legibility and readability. Legibility refers to the degree of easily recognizing letters or information that can be read quickly. The conditions that determine readability include the size and shape of letters, the length of lines, contexts, space between letters, and margins. Readability refers to the degree of easily understanding letters and symbols in print, calligraphy, and handwriting in their appearance. The elements that determine the readability include the stroke, slope, angle, style, colour, and opacity of the symbol.

## **2.3. SATISFACTION**

### **2.3.1. Concept of Satisfaction**

The interest in satisfaction for customers has emerged since the 1970s, and it is used as a term for customer satisfaction, overall satisfaction, and consumer satisfaction according to the research subjects in various fields. In the aspect of behavioural psychology, it is used as a measurement variable to understand and predict human behaviour. In economics, it is used as a measure of efficiency, and in morphological psychology, it is used as a measurement variable of perception of visual information. Accordingly, the approach to satisfaction is largely made from the perspective of cognition, evaluation, emotion, and cognitive-emotional response.

From a cognitive perspective, customer satisfaction means recognizing whether the compensation for the price paid by the consumer is appropriate or inappropriate. In terms of evaluation, it means evaluating the subjective satisfaction level of expectation after experiencing products or services. Emotional-empirical aspect refers to emotions caused by awareness of products or services and evaluation of using them. Finally, the aspect of cognition and emotion combined refers to the emotional response caused by confirmation or disconfirmation with products and services.

Early studies on satisfaction are mainly based on the expectancy disconfirmation theory, but recent studies are being conducted in the direction of the preceding factors of satisfaction (Choi, 2007).

Satisfaction based on the expectancy disconfirmation theory is an evaluative concept of the emotion of expectation before experience and the comprehensive psychological state caused by the confirmation or disconfirmation of emotion perceived after the experience. It regards satisfaction and dissatisfaction as a comparison process and evaluates the emotional response to satisfaction caused by the confirmation or disconfirmation of expectation by comparing the expected result and the perceived achievement after the experience (Yang, 2008). This is to evaluate the degree of people's perception of psychological state that perceives the experience as expected.

Generally, the satisfaction that people perceive subjectively is based on the perceived result. However, to improve the satisfaction of an object, it is also necessary to approach it by distinguishing the expectation before the experience and the result after the experience. Above all, the design elements of virtual museums need to establish physical environmental conditions that can meet the expectation before experience. All these things considered, overall satisfaction can be summarized as the psychological concept of prediction, including the evaluation of the results obtained from experience or the satisfaction of the expectation before experience.

Therefore, this study defines satisfaction as a response to the satisfaction state of the design elements of the virtual museum and defines the satisfaction state of the design factors of the virtual museum as a judgment of the audience on whether it was provided on a pleasant and interesting level.

### **2.3.2. Value and Effect by Satisfaction**

The value and effect of virtual museums through customer satisfaction are as follows. First, high customer satisfaction induces the improvement of loyalty of existing visitors, maximization of positive word-of-mouth effect, prevention of departure of existing visitors, reduction of marketing failure cost, reduction of new visitor creation cost, and improvement of museum reputation.

Second, the loyalty of museums according to customer satisfaction ensures continuous viewing, which helps to operate the museum for a long time.

### **2.4. Visiting Intention**

Visiting intention is the probability that an individual's beliefs or planned behaviour will occur, and it is a special behaviour that the individual is visiting to choose an action to place (Kim et al, 2014).

Visits to certain areas will appear if the images and self-images that visitors have for the target area coincide (Fakeye & Crompton, 2007). Images for a specific area affect the attitude of an individual toward the destination, and the intention to visit is influenced by the attitude. Therefore, the image of a specific area directly or indirectly affects the intention to visit.

Visiting intention can be said to be the will of potential visitors to a specific area, and it can be understood as a preceding step of realizing visiting behaviour as a step of selecting a specific tourist destination through the evaluation of tourist destinations in the complex decision-making process (Kim & Yoon, 2012). In general, the visiting intention is a special intention of visiting with a mindset to choose the behaviour of visiting. Such behavioural intentions are referred to by various terms like 'purchase intention' and 'repeated repurchase intention' according to the research object, and in the service field such as tourism and hotel, they are named 'visiting intention' or 'using intention' as a behavioural intention of potential tourist (Choi, 2005). Hospers



(2009) defined visiting intention as an intention to act and said that it was "an intention that an individual would or would not do in any act."

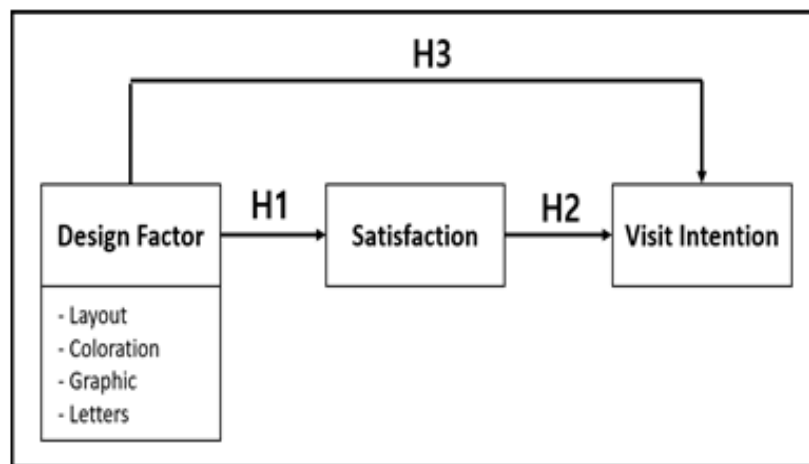
Therefore, this study defines the probability of an actual visit with the individual belief or planned behaviour of the visitor after viewing the virtual museum and having satisfaction based on the definition of previous studies on the intention of visit, or the willingness of the individual to visit the museum.

### 3. Research Design

#### 3.1. Research Model and Hypothesis

This study presumes that design factors of virtual museums have a highly sensitive impact effect on visitors. Therefore, to suggest solutions for further development of virtual museums and the sustainability of museums, the relationship between satisfaction and intention of visit according to design factors of virtual museums is empirically analyzed.

To study the effects of design factors on satisfaction and intention to visit virtual museums, Fig 1 and the following research model were proposed based on previous studies presented for theoretical backgrounds empiric to the flow of the study.



**Fig.1.** Research Model

This study set the following hypotheses based on the results of previous studies to investigate the interaction between 'design factors of virtual museums' as an independent variable, 'satisfaction' as a parameter, and 'intention to visit' as a dependent variable. As for the influence of design factors on satisfaction, (Kim, 2003) argued that design factors among the factors of internet service quality have a positive impact on satisfaction in the study on the influence of hotel internet service quality on customer satisfaction and repurchase. The study on the contents analysis of consumer bulletin boards of internet clothing shopping malls, (Choi, 2004) showed that visitors respond sensitively to photos, colours, layouts, and so on in the clothes of shopping mall web pages. Her study concluded that satisfaction with such factors caused positive behavioural intentions of visitors.

As for the effect of satisfaction on the intention to visit, Noh Yong-ho et al. (2009) studied the Woopo Swamp ecotourism website and stated that the more satisfied users are with the quality of the website, the more possible users are to show positive behavioural intentions such as

recommendation and revisit (Wang & Hsu, 2010). In addition, Song Jin-ah and Hong Seung-Pyo said that, in terms of the effect of website quality on satisfaction and behavioural intention in B2C e-commerce of travel agencies, the more satisfied users are with design factors, the higher the possibility of positive behavioural intention is made (Song & Hong, 2021).

As for the influence of design factors on the intention to visit, (Yuan & Chung, 2015) found that colours, layouts, graphics, and letters among web design factors had a positive impact on consumer's intention to purchase in the study of the influence of online shopping mall web design factors on consumers' intention to purchase

Based on the results of previous studies, this study set up the sub-hypothesis according to the sub-variables of hypothesis 1, hypothesis 2, hypothesis 3, and design factors as follows.

Hypothesis 1. Design factors of virtual museums will have a significant effect on satisfaction.

1-1 The layout of design factors will have a positive effect on satisfaction.

1-2 The colour of design factors will have a positive effect on satisfaction.

1-3 The graphics of design factors will have a positive effect on satisfaction.

1-4 The letter of design factors will have a positive effect on satisfaction.

Hypothesis 2. Satisfaction will have a significant effect on the intention to visit.

Hypothesis 3. Design factors of virtual museums will have a significant effect on the intention to visit.

3-1 The layout of design factors will have a positive effect on the intention to visit.

3-2 The colour of design factors will have a positive effect on the intention to visit.

3-3 The graphics of design factors will have a positive effect on the intention to visit.

3-4 The letter of design factor will have a positive effect on the intention to visit.

## **3.2. Manipulating definition of variables, survey design and analysis method**

### **3.2.1. Manipulating definition of variables**

This study used layout, colour, graphics, and letters, which are four factors that are considered to meet the purpose of this study among the variables researchers used in the previous studies on design factors of virtual museums, which are independent variables. The measurement items were modified and supplemented according to the purpose of this study. The total 12 items are composed of 3 items such as high resolution, 3D image, and image expansion. The colour has 3 items such as preferred colour, colour consistency, and high brightness.

The item of layout consists of three items including internet chat, a simple check of web page contents, and production of the atmosphere of the actual museum. The letter consists of three items: consistency of font, preference of font using graphics, and use of various fonts. The measurement was measured using a five-point scale.

The measurement items on satisfaction were modified and supplemented according to the purpose of this study. The measurement items were 5 items such as colour satisfaction, graphic

satisfaction, layout satisfaction, letter satisfaction, and overall satisfaction, which were measured using a 5-point scale.

The items of the measurement on the intention of visit, which is a dependent variable of this study, were modified and supplemented according to the purpose of this study. The measurement items were three items: plan for visits or revisits, priority visit or revisit to other museums and intention of visit or revisit.

### **3.2.2. Manipulating definition of variables**

To achieve the purpose of this study, a survey was conducted on the subjects of the survey for 21 days from January 10, 2022, to January 31, 2022, targeting visitors who visited the virtual museum in a national museum in Korea. A total of 400 questionnaires were distributed and 368 copies were collected. Of the collected questionnaires, 28 copies were excluded due to the insincerity of responses, and 340 valid samples were used as the data for the final analysis. For the statistical processing of this study, SPSS Ver. 22 was used, and the significance level was verified based on 1%, 5%, and 10%. The specific analysis method is as follows.

First, to understand the demographic characteristics and general characteristics of the subjects of this study, frequency analysis was conducted, and descriptive statistical analysis was conducted to verify the average, standard deviation, and regularity of the main variables. Second, the reliability and validity of the scales used in this study were identified through factor analysis and reliability analysis.

The factor analysis was performed by the Varimax rotation method and the reliability analysis was performed by excluding the items that hinder internal consistency through Cronbach's  $\alpha$  coefficient measurement. Third, correlation analysis was conducted to diagnose the multiple collinearity problems between variables before hypothesis testing. Fourth, the hypothesis verification to confirm the relationship between variables based on the refined measurement items was verified by simple regression analysis and multiple regression analysis.

## **4. EMPIRICAL ANALYSIS**

### **4.1. Demographic Characteristics**

In the analysis of the demographic characteristics of the sample, 119 males (35.0%) and 221 females (65.0%) were females. It was higher than for males. As for age, 21 people (6.2%) were in their 10s, 52 people were in their 20s (15.3%), 119 were people in their 30s (35.0%), 98 people were in their 40s (28.8%), and 50 people in their 50s or older (14.7%), indicating that the age group using virtual museums is mainly in their 30s and 40s. In terms of educational backgrounds, 68 people were high school graduates (20.0%), 239 college graduates (70.3%), and 33 (9.7%) were from graduate levels. As for marital status, the number of unmarried persons was 146(42.9%) and 194 (57.1%) were married. The occupations were 92 office workers (27.1%), 43 students (12.6%), 12 civil servants (2.9%), 38 self-employed workers (11.8%), 34 professional workers (10.0%), 108 housewives (31.8%), and 13 others (3.8%).

**Table 1:** Demographic Analysis Results

	<b>Division</b>	<b>Frequency (name)</b>	<b>Ratio (%)</b>
Gender	Male	119	35.0%
	Female	221	65.0%
	Subtotal	340	100.0%
Age group	Teens	21	6.2%
	The twenties	52	15.3%
	The thirties	119	35.0%
	The forties	98	28.8%
	Over the Fifties	50	14.7%
	Subtotal	340	100.0%
Education	High School Graduation	68	20.0%
	College Graduation	239	70.3%
	Graduation From Graduate School	33	9.7%
	Subtotal	340	100.0%
Marital status	Unmarried	146	42.9%
	Married	194	57.1%
	Subtotal	340	100.0%
Job	Employee	92	27.1%
	Student	43	12.6%
	Public Official	12	2.9%

	Self-Employed Business	38	11.8%
	Professional Job	34	10.0%
	Housewife	108	31.8%
	Others	13	3.8%
	Subtotal	340	100.0%

**4.2. Validity, Reliability Analysis and Correlation Analysis**

**4.2.1. Validity and Reliability Analysis**

The results of calculating Cronbach's  $\alpha$  coefficient to verify the reliability of the measurement tool of the composition of the variables and the variables composed through exploratory factor analysis are as follows in Table 2. The KMO measure is .917, which is close to 1, so this tool can be seen as suitable data for factor analysis. Bartlett's unit matrix verification statistics also appeared to be 7382.736, which verified that it was not a unit matrix at the significance level .001. It means it is suitable for factor analysis.

In addition, Cronbach's  $\alpha$  coefficient was calculated, and the layout was .932, colour .917, graphic .886, letter .892, satisfaction .738, and intention to visit .786, all of which were .5 or more. Therefore, it can be said that the internal consistency of the questions is secured.

**Table 2:** Exploratory Factor Analysis Results

Clause	Component						Extract	Cronbach's $\alpha$
	Layout	Colour	Graphic	Letter	Satisfaction	Visit Intention		
layout 1	.826						.745	.932
layout 3	.821						.702	
layout 2	.803						.712	
colour 1		.819					.789	.917
colour 2		.811					.782	
colour 3		.789					.779	
graphic 3			.813				.755	.886

graphic 2			.789				.368	
graphic 3			.705				.747	
letter 2				.833			.836	.892
letter 3				.775			.754	
letter 1				.728			.722	
satisfaction 4					.775		.784	.738
satisfaction 5					.772		.781	
satisfaction 1					.698		.719	
satisfaction 3					.624		.684	
satisfaction 2					.591		.657	
Visit Intention 1						.701	.765	.786
Visit Intention 2						.692	.689	
Visit Intention 3						.643	.598	
Eigen Value	5.621	4.344	3.877	3.404	2.084	2.082		
Distribution(%)	18.232	14.314	13.206	11.880	6.911	6.517		
Accumulated Distribution(%)	18.232	32.546	45.752	57.632	64.543	71.060		
Notes: 1. KMO(Kaiser-Meyer-Olkin) =.917								
2. Bartlett = 7382.736, Degrees of Freedom = 435, Significance probability = .000								

#### 4.2.2. Correlation Analysis

The result of the correlation analysis between the variables used in this study is as follows. As a result of correlation analysis, the correlation between independent variables, parameters, and dependent variables was significant at the significance level of .01 for both tests. Therefore, the

variables used in this study are not problematic in the multiple collinearities raised in multiple regression analysis, and the suitability of data can be seen as secured.

**Table 3:** Correlation Analysis Results

Division	1	2	3	4	5	6
Layout	1					
Colour	.618**	1				
Graphic	.634**	.642**	1			
Letter	.453**	.454**	.413**	1		
Satisfaction	.501**	.449**	.516**	.384**	1	
Visit Intention	.492**	.447**	.422**	.362**	.656**	1

**\*\***, **\*** means statistically significant at 1% and 5%, respectively

### 4.3. Hypothesis Verification

#### 4.3.1. The Relationship between Design Factors and Satisfaction in Virtual Museums

The multiple regression analysis was conducted to test the sub-hypothesis of the sub-variables of the design factors and the 'hypothesis 1' that the design factors of the virtual museum have a significant effect on satisfaction. The analysis results are as follows in Table 4.

**Table 4:** Verification Results of Hypothesis 1

Model	Dependent Variables: Satisfaction					
	Nonstandardization Coefficient		Standardization	t-Value	Collinearity Statistic	
	B	Standard error (SE)	Regression Coefficient( $\beta$ )		tolerance limit	VIF
(Constant)	1.544	.190		8.219		
Layout	.145	.047	.194	3.254***	.714	1.431
Colour	.121	.043	.175	2.975***	.709	1.463
Graphic	.094	.037	.143	2.376**	.731	1.214
Letter	.118	.041	.149	2.475**	.803	1.249

R<sup>2</sup>(adj-R<sup>2</sup>)=..189(.176), F=14.403\*\*\*.

**\*\*\*, \*\*, or \* means statistically significant at 1%, 5% and 10%, respectively**

The F value of the multiple regression analysis of hypothesis 1 was 14.403, which was statistically significant at the significance level  $p < .01$ . The tolerance limit of all independent variables put into the model was close to 1, and VIF was also 1-2, indicating that there was no problem with the multiple collinearities among independent variables.

The multiple regression analysis to find out the effect of sub-variables of design factors on satisfaction showed that layout ( $t=3.254$ ,  $p < .01$ ), colour ( $t=2.975$ ,  $p < .01$ ), graphic ( $t=2.376$ ,  $p < .05$ ), and text ( $t=2.475$ ,  $p < .05$ ) were all significant. So, hypothesis 1 was adopted. Therefore, all the sub-variables of design factors had a significant positive effect on satisfaction.

The results of this empirical analysis mean that the design factors of virtual museums have a direct impact on visitors. Therefore, virtual museum operators should make efforts to improve the design and continuous education and service.

#### 4.3.2. The Relationship between Satisfaction and Visiting Intention

The simple regression analysis was conducted to test hypothesis 2 that satisfaction with design factors of virtual museums has a significant effect on the intention to visit. The analysis results are as follows in Table 5.

**Table 5:** Verification Results of Hypothesis 2

Model	Dependent Variables : Visit Intention					
	Non-standardization Coefficient		Standardization Regression Coefficient( $\beta$ )	t-Value	Collinearity Statistic	
	B	The standard error (SE)			Tolerance Limit	VIF
(Constant)	.638	.385		1.584		
Satisfaction	.768	.122	.354	6.538***	.904	1.157
R <sup>2</sup> (adj-R <sup>2</sup> )=..117(.116), F=42.634***.						

**\*\*\*, \*\*, or \* means statistically significant at 1%, 5% and 10%, respectively**

The F value of the simple regression analysis of hypothesis 2 was 42.634, which was statistically significant at the significance level  $p < .01$ . The tolerance limit of all independent variables put into the model was close to 1, and VIF was also 1-2, indicating that there was no problem with multicollinearity.

The effect of satisfaction on the intention to visit ( $t=6.538$ ,  $p < .01$ ) was significant, and hypothesis 2 was adopted, and satisfaction had a positive effect on the intention to visit.



The results of this empirical analysis mean that satisfaction with the design factors of virtual museums is a factor that causes positive intention to visit the museum. Therefore, it is necessary to continuously make efforts to develop and improve the design for satisfaction with the design of the virtual museum.

#### 4.3.3. The Relationship between Design Factors and Visiting Intention in Virtual Museums

Hypothesis 3 is that the design factors of the virtual museum have a significant effect on the intention to visit and the multiple regression analysis was conducted to test the sub-hypothesis according to the sub-variables of the design factors. The analysis results are as follows in Table 6..

**Table 6:** Verification Results of Hypothesis 3

Model	Dependent Variables: Visit Intention					
	Non-standardization coefficient		Standardization Regression Coefficient( $\beta$ )	t-Value	Collinearity statistic	
	B	Standard error(SE)			Tolerance limit	VIF
(Constant)	2.734	.093		27.507		
Layout	.081	.037	.122	2.194**	.702	1.421
Colour	.112	.023	.287	4.907***	.698	1.473
Graphic	.062	.021	.164	2.984***	.791	1.281
Letter	.094	.038	.141	2.465**	.746	1.324
R <sup>2</sup> (adj-R <sup>2</sup> )=..189(.176), F=12.689***.						

**\*\*\*, \*\*, or \* means statistically significant at 1%, 5% and 10%, respectively**

The F value of the multiple regression analysis of hypothesis 3 was 12.689, which was statistically significant at the significance level  $p < .01$ . In addition, the tolerance limit of all independent variables put into the model was close to 1, and VIF was also shown between 1 and 2, indicating that there was no problem with the multicollinearity between independent variables.

The multiple regression analysis results to find out the effects of the sub-variables of design factors on the intention to visit showed that the layout ( $t=2.194$ ,  $p < .05$ ), colour ( $t=4.907$ ,  $p < .01$ ), graphic ( $t=2.984$ ,  $p < .01$ ), and text ( $t=2.465$ ,  $p < .05$ ) were all significant. So, hypothesis 3 was adopted. Therefore, all the sub-variables of design factors had a significant positive effect on the intention to visit.

The results of this empirical analysis mean that the design factors of virtual museums are directly affecting the intention to visit museums. Therefore, the operators of virtual museums should

continue to improve and upgrade their designs to attract offline visitors who are directly related to the existence and operation of museums.

## **5. Conclusions**

This study was conducted to analyze the effects of design factors of virtual museums on satisfaction and visiting intention to virtual museums in national museums. In this study, the relationship between design factors (layout, colour, graphics, and letters) as independent variables, satisfaction as parameters, and intention to visit as dependent variables was examined.

As a result of the verification of hypothesis 1, the design factors of the virtual museum (layout, colour, graphics, and letters) had a significant positive effect on satisfaction. As a result of the verification of hypothesis 2, satisfaction with the design factors of virtual museums had a significant positive effect on the intention to visit. As a result of the verification of hypothesis 3, the design factors of the virtual museum (layout, colour, graphics, and letters) had a significant positive effect on the intention to visit. Therefore, hypothesis 1, hypothesis 2, and hypothesis 3 were all adopted.

Through the empirical analysis of this study, it was found that the satisfaction with the design factors of layout, colour, graphics, and letters for visitors coming to the virtual museum leads to a positive intention of visiting the museum which is a foundation of sustainability and continuous operation. Museums that operate virtual museums or those that want to design new virtual museums should make efforts to continuously improve the design of virtual museums. And operators of virtual museums should continue to improve and upgrade the design to attract offline visitors who are the direct basis of the sustainability and operation of the museum.

Therefore, while the promotion of museum collections or museum-related products is very important when the operation or opening of a virtual museum is intended, the persons concerned should recognize that improvement of design factors is an important thing to induce the audience's on-site visit. In this regard, this study implies that it found out that design factors are important aspects attracting visitors and suggested the direction of maintenance and operation of museums.

In this study, the design factors, satisfaction, and visiting intention of virtual museums in national museums were constructed and measured by qualitative evaluation through questionnaires. In future studies, it is necessary to expand the selection of objects for the operation and maintenance of private museums, not national museums. In addition, other than the design factors presented in this study, it is necessary to conduct further research to maximize the efficiency of virtual museum operation through the verification of various design-related factors.

## **Declaration of Conflicts of Interests:**

The authors reported no potential conflict of interest.

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