

MEDIATION BETWEEN DIGITAL SURROGATES AND VIEWERS BASED ON THE TECHNOLOGY ACCEPTANCE MODEL

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ABSTRACT

This study investigates the values of engaging with digital surrogates, including *Van Gogh Inside (VIE; 2016)*, *Monet's Impression Exhibition 2016 (MIE; 2015–16)*, and *Hello Michelangelo (2016–2017)*, based on a Technology Acceptance Model (TAM). Both usability for learning and usability for appreciation in perceived usefulness have significant correlations with the degree of satisfaction (DOS) and degree of immersion (DOI). Our findings show that the DOS not only has a significant correlation with the DOI but also influences the intention to use digital surrogates (intention to visit the exhibition, recommend the exhibition, and intention to visit digital exhibition) in all digital surrogates. It was found that the perceived ease of use has an influence on DOS and DOI in the case of *VGI* and *MIE*. This study unveils an insight on the values and qualities associated with the digital surrogates to evoke a sense of authentic experience as well as foster learning. In addition, it also demonstrates the suitability of TAM as an evaluation model for digital surrogates of remediating the originals.

Keywords: *Digital Surrogate, Technology Acceptance Model (TAM), Perceived Usefulness (PU), Perceived Ease of Use (PEOU)*

1. INTRODUCTION

The last two decades have witnessed a rapid and continuous change in museum environment with the development of information and technology (IT). It is widely acknowledged that IT not only can help museums realize their full potential as places for learning but also it can effectively solve many problems (e.g., presentation of collections) of traditional museums [1] [2]. Presentation can vary: from the manufacturing of high-quality digital copies of fragile works to creating virtual exhibits. In the latter case, a wider potential of audiences at remote locations worldwide can access museum collections [3].

The primary aim of introducing IT in museum settings is to enhance visitor experience in terms of meaning making; to help create preconditions for engagement by supporting the unfolding dynamics of visitor's exploration, reflection, imagination, and emotional attachment; and to improve dialogic exchange and participatory

ethos [4]. Meaning making, the object of analysis in various empirical studies and conceptual explorations, generally refers to an active interpretation of objects and events through which the interpretation of an individual or a group develops a personal meaning deeply integrated with one's own values, beliefs, feelings, and aspirations [5].

In museum contexts, IT was applied to digitalize collections, and early digitization might have been thought of as an actual technique used to create a digital surrogate of an analogue object. In other words, digital surrogates of artworks through technological reproduction are nothing new; however, whereas the reproductions usually serve pedagogical purposes either through slide lectures or the aide memoire postcards, the reproductions are "experienced" as authentic artworks [6]. Today the term digitization covers a range of activities from choice of object for preservation and archiving activities to be digitized through to possible end use of the digital material [7] [8].

Museums are constantly searching for new forms of exhibit and media technologies and developing diverse ways of conveying new messages and knowledge to achieve a broader audience with the Movement for a New Museology. In an environment with rapidly developing IT, the concept of digital exhibition becomes a major aspect in the development of museum exhibition [9]. Digital museums including virtual museums have been adopting many novel technologies to increase their visibility. The business community is also giving grants to museums and encouraging them to digitize in order to reach and benefit more users [10].

In particular, cinematic, interactive, and technology-driven digital surrogates have recently been widely spreadable, and viewers become immersed in a digitally remediating environment. For example, *Van Gogh Alive* (2015) as part of the 2015 Shanghai International Arts Festival’s special exhibition brought Van Gogh to life using over 3,000 images of his most famous artworks (Figure 1). These digital exhibitions generate an optical illusion that transforms the fusion between the projected image and real surface into a new object or a large projection screen that appears to be real [11].



Figure 1: The exhibition gallery of <Van Gogh Alive> in Shanghai (Source: Grand Exhibition)

2. PROBLEM STATEMENT AND RESEARCH HYPOTHESIS

Problem Statement and Research Purpose

In this study, the term “digital surrogate” is used to refer to a digital exhibition as a reproduction of artworks such as *Monet’s Impression Exhibition 2016* (2016), *Van Gogh Inside* (2015–2016), and *Hello Michelangelo* (2016–2017) (Figure 2). These digital exhibitions are the syntheses of traditional artworks and new media technologies (i.e., projection mapping and

motion graphics). They can be also characterized as digital representations of physical entities, not existing *per se* but acting complementarily to become an extension of artworks in the walled museums.



Figure 2: The exhibition posters of <Monet’s Impressionism Exhibition>, <Van Gogh Inside: Festival of Light and Music>, and <Hello Michelangelo> (Source: BonDavinci and Media & Art)

In the case of Grand Exhibition’s *Van Gogh Alive*, a million visitors came to the exhibition, and the three digital exhibitions mentioned above attracted more than 200,000 spectators. They aimed to create a diversified viewing experience to promote a dialogue between art and viewers and simultaneously to allow visitors to be immersed in the artist’s work rather than observe it. This immersive experience was designed to augment the traditional viewing ritual of solitary communion with the real exhibits by holistically scaling up the fragments of digitized oil painting to encompass the body and its sensory functions.

By projecting high-resolution images of the paintings on projection screens and floors, visitors are able to have a walk-through experience of the painter’s works in the digitally remediating environment. The effect puts viewers into the paintings themselves as viewers marvel at the vibrant colors and detail achievable only through large high-definition projections (Figure 3).

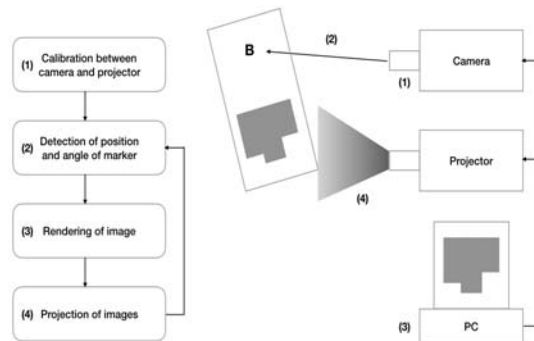


Figure 3: Work Flow of Projection Mapping [12]

Rather than seeing it from afar or through glass planes as in a typical fine arts museum, visitors get to wander through the space and explore and engage with the artist's works, transcending any traditional curatorial approach (Figure 4). The software deftly orchestrates still images, graphics, video, animation, and sound into a single show that can include a wide range of display surfaces. While navigating the exhibition, visitors can not only learn about the artist's life but also get insight into the original artworks through a variety of multimedia displays.



Figure 4: The exhibition gallery of <Monet's Impressionism Exhibition>, <Van Gogh Inside: Festival of Light and Music>, and <Hello Michelangelo> (Source: BonDavinci and Media & Art)

When an art work becomes a digital surrogate, the most important requirement of technologies is that they should cognitively and emotionally support visitors to mediate and engage with the original artwork. In some cases, digital technologies should become *transparent* and not distract visitors from the authentic artifacts. In this situation, digital surrogates can usurp the quality of original artworks. Moreover, they may intrude on the authentic ambience in art museums.

As new media technologies become capable of capturing the physical properties of an original faithfully, museum professionals fear that “the shift towards more popular exhibition techniques risks blurring the boundaries between the museum as a site of moral and social uplift and rational learning and other less reputable cultural sites focusing on amusement and spectacle.” [13] In addition, viewers often express reservations about the quality and authenticity of digital reproductions [14]. The *must-have* urgency of new media technology and the beguiling promises of a new and better way of doing things—this enchantment of the new—is a technological fetish that draws us all [15]. Thus, if museums are to engage a broad range of the public in today's media-saturated world, it will require understanding in embracing new media technologies.

While replicating the physical features of artworks in digital surrogates continues to progress,

many argue that the qualities inherent in an artwork become irretrievably lost in the process of technological reproduction [16], referring to Benjamin's concept of aura to claim the superiority of the unmediated artwork experience over the remediated experience via new media technology [17]. Critics also caution that today's media technology entertains at the expense of accuracy, distracts from real knowledge, and undermines the educational experience [18]. On the contrary, some contend that digital reproductions have been undervalued [19], asserting that they can generate an authentic experience that is as esthetically valuable as with the experience of the originals [20].

The development of digital surrogates is mostly focused either on “process” (authentication of data) or “product” (closer to reality and technical artistry) but does not necessarily consider “user” (end-user's perception of the content and experience) [21]. Consequently, interpretation has always been understood as a linear process. In particular, new media technology must be thoroughly examined before applying because much of them overlook the purpose of exhibiting and applying the technology rationally.

There are obviously mixed feelings about the quality of digital surrogates as digital reproductions of original works of art [22], and little is known of their values in terms of cognitive and affective learning and meanings of viewing experience in a museum environment. The primary concerns authors voice are how viewers perceive the values and qualities associated with the digital surrogates: Can digitally remediated artworks evoke a sense of authentic experience in terms of art appreciation? Is it possible to move beyond questions of aura to discuss how technically remediated experience of digital surrogates can inspire curiosity and foster learning? What is the impact of factors (e.g., storytelling factor, technical factor, and environmental factor) for viewing experiences in digital surrogates? Do new media technologies used in digital surrogates enhance viewing experience?

This study aims to answer the questions posed above by analyzing viewer experiences at *Monet's Impression Exhibition 2016* (hereafter, *MIE*), *Van Gogh Inside* (hereafter, *VGI*) and *Hello Michelangelo* (hereafter, *HM*). It also discusses the possible implications of non-authentic but engaging and entertaining art experiences for cognitive and affective learning. Evaluating viewers' experiences

with digital surrogates provides museums with valuable insights on ways to use new media technology in their exhibition environments and contribute to the construction of a substantial body of empirical knowledge aimed at resolving concerns pertaining to the creation of digital surrogates in museums.

3. RESEARCH METHODOLOGY AND RESEARCH MODEL

3.1 Research Methodology

To investigate the overall experience of viewers found in three digital surrogates, we conducted a survey using a quantitative methodology for each exhibition. In each survey, we had a population of university students (n = 50) categorized as a digitally-native and tech-savvy generation. For this research, we conducted a preliminary survey consisting of 10 questions to the visitors of *MIE* from December 20, 2015 to January 20, 2016. As for demographics, visitors in their 20s had the highest response rate (less than 19: 6.3%, 20s: 50%, 30s: 25%, 40s: 15.6%, and 50s: 6.1%). According to oral interviews following the survey, participants in their 20s displayed the highest recognition and survey rate for digital exhibitions based on masterpieces. Therefore, this research chose a population in their 20s who had the highest response rate and were used to digitalized masterpiece exhibitions.

We provided the participants with free tickets to three exhibitions to allow them to have the same viewing experiences in three exhibitions. Participants' previous museum visiting experience varied in terms of frequency. More than 90% of the participants had previous viewing experiences with the originals and almost the same ratio of participants experienced authenticity and aura in the originals (Table 1).

The questionnaire consisted of 20 statements to measure participants' perceptions on the digital surrogates on a scale from 1 to 5 (where 1 = *not agree* and 5 = *strongly agree*) (Table 2). We collected empirical and cumulative data from the surveys for comparative analysis for a year. Following the data collection, we also performed a frequency analysis, a correlation analysis, and an analysis of variance using SPSS 11.0 software to ensure data integrity.

Table 1: PVE of the Population

PVE	VGI (%)	MIE (%)	HM (%)
Previous experience with the originals	91.7	91.7	90.8
Experiencing authenticity and aura in the originals	93.8	91.4	90.8

PVE = Previous viewing experience; VGI = ; MIE = ; HM =

Table 2: Elements of Questionnaire

Elements	Number of question
PVE	2
PU & PEOU	8
ATVDS	6
ITUDE	4

3.2 Research Model

We adopted and extended the Technology Acceptance Model (TAM) [23] to gauge participants' engagements with digital surrogates using a variety of new media technologies. TAM was one of the most popular research models relevant to the information system theory to predict the use and acceptance of technology by users [24]. According to TAM, perceived usefulness (PU) and Perceived Ease of Use (PEOU) were the most important determinants of actual system usage, and they are relevant to users' behaviors (Figure 5). External variables such as social, cultural, and political factors influenced these two factors, and they could form a positive attitude towards viewing experiences in the digitally remediated environment (Figure 6).

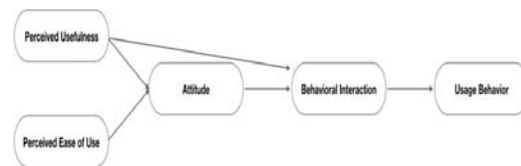


Figure 5: TAM by F. D. Davis (1989)

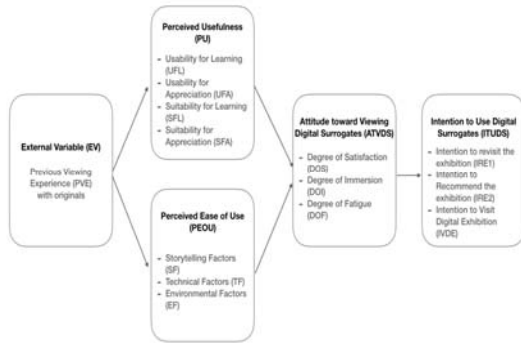


Figure 6: Research Model

In this study, PU (Table 3) and PEOU (Table 4) are operationally defined and their correlations between degree of satisfaction (DOS) and degree of immersion (DOI) are derived. PU is measured with variables of usability for learning (UFL) and usability for appreciation (UFA) with factors. However, the influence of three factors—Storytelling Factor (SF), Technical Factor (TF), and Environmental Factor (EF)—on PEOU is analyzed (Figure 1).

In terms of PEOU, SF, TF, and EF were derived based on the research of immersion factors in exhibitions [25] [26], and those factors were measured on a Likert scale (table 4). The influence of a narrative’s descriptive features for SF and the new media technology embedded in digital surrogates for TF were considered. In contrast, EF comprises the size and form of screen display, background music, and optimal exhibition environment for viewers to explore in a suitable environment concerning visitor density. In the case of degree of fatigue (DOF), degree of technological fatigue is approached by three aspects caused by new media technology, motion graphic effects, and immersiveness of exhibit media. In addition, the correlations of DOF with DOS, DOI and PU [suitability for learning (SFL) and suitability for appreciation (SFA)] are derived to verify the impact to the viewing experiences.

Table 3: Operational Definitions of PU and Detail Factors

Factors	Detail Factors
UFL	Understanding the artworks and artists
	Arousal of curiosity and searching for information
	Fertilizing conversation with companions
UFA	Artistic value and properties to the originals
	Authenticity and aura to the originals
	Interactivity and immersiveness to the originals

Table 4: Operational Definitions of PEOU and Detail Factors

factor	Detail Factors
SF	1: new interpretations and approaches to the originals
	2: thematic exhibition circulation
	3: dynamic elements through motion graphics
	4: visibility and readability of interpretative materials
TF	1: interactivity
	2: motion graphic effects
	3: high-resolution images
	4: sound effects
EF	1: big-sized screen
	2: curved screen
	3: background music
	4: optimal exhibition environment

We set up six hypotheses based on the research model to examine the overall evaluation of viewers’ experiences in the digitally remediated environment. In order to illuminate viewers’ acceptance of technologies used in three digital surrogates, we focus on the relationship among PU and DOS and DOI as well as the relationship among PEOU and DOS and DOI (Table 5).

Table 5: Hypothesis

No.	Hypothesis
H1	DOS has a correlation with DOI
H2	DOS has a correlation with ITUDS
H3	PVE has a correlation with DOS
H4	PVE has a correlation with DOI
H5	PU has a correlation with DOS
H6	PU has a correlation with DOI
H7	PEOU has a correlation with DOS
H8	PEOU has a correlation with DOI
H9	Motion graphic effect has a correlation with DOF
H10	Immersiveness of media has no correlation with DOF

4. FINDINGS

4.1 Properties of Three Digital Surrogates

We adopted the notion of the realms of experience into the questionnaire and asked participants to define their experiences in the digital surrogates [27]. According to the results of the frequency analysis, entertainment value was much higher than other values among the realms of experience (Figure 7). This hedonic value stimulated participants’ power of imagination and enjoyment (VGI: 89.7%, MIE: 64.2%, HM: 17.9%) and multisensory experience (VGI: 65.2%, MIE: 44.9%, HM: 21.3%).

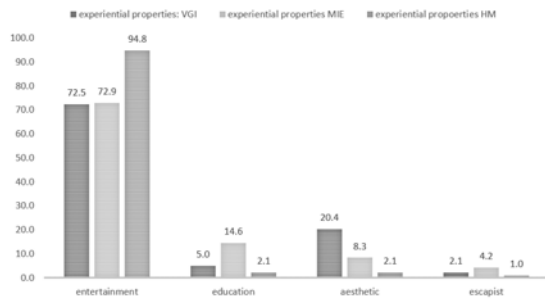


Figure 7: Properties of Three Digital Surrogates (%)

Participants took pleasure in encountering the artists as well as the unforeseen images. However, some participants felt less satisfied with the quality of digital surrogates caused by the injudicious manipulation through motion graphics. Motion graphic effects that moved part of the original artwork or utilized timely effect inherent to the original artwork received positive feedback compared to irrelevant ones (VGI: 72.9%, MIE: 41.7%, HM: 17.6%).

VGI had a high aesthetic property and MIE had a high educational quality among the three digital exhibitions. Regardless of the differences in museum visiting frequency, the majority of participants (VGI: 89.6%, MIE: 86.6%, HM: 80.0%) regarded digital surrogates as the fruit of technological reproductions. In addition, VGI was highly appreciated among the three digital exhibitions (VGI: 89.7%, MIE: 56.2%, HM: 21.4%) in terms of technological excellence.

4.2 DOS and DOI in Three Digital Surrogates

Overall, VGI was prominent compared to other digital surrogates in terms of attitudes toward viewing digital surrogates (ATVDS) (DOS and DOI) (Figure 8). In the same vein, intention to use digital surrogates (ITUDS) [intention to visit the exhibition (IRE1), recommend the exhibition (IRE2) and intention to visit digital exhibition (IVDE)] of VGI was found to be much higher than MIE and HM (Figure 9). The immersiveness of exhibit media in VGI (81.7%) was also higher than that of MIE (57.9%) and HM (24.1%).

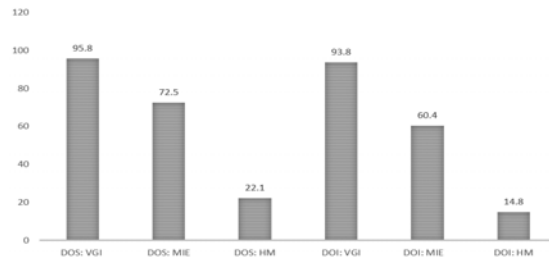


Figure 8: Comparison of DOS and DOI in Three Digital Surrogates (%)

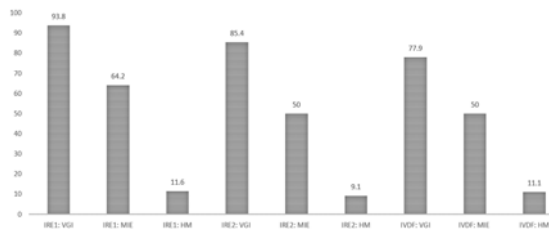


Figure 9: Comparison of IRE1, IRE2 and IVDE in Three Digital Surrogates (%)

In this study, the correlation between both higher DOS and DOI and the longer viewing time was proved (Figure 10). Interestingly, the previous experiences with originals were irrelevant to DOS in all digital surrogates. However, they influenced DOI only in the case of MIE (.173*, $p < .05$). However, the museum visiting frequency of participants did not have a correlation with DOI but influenced the DOS. As visitors showed higher frequency of museum visiting, their DOS (VGI: $-.197^*$, MIE: $-.165^*$, HM: $-.322^*$) decreased. This indicated that participants with a high frequency of museum visiting were less satisfied with the digital reproductions due to the lack of authenticity and integrity of the originals.

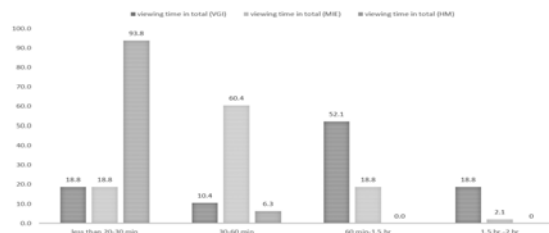


Figure 10: Viewing Time in Three Digital Surrogates (%)

Our findings showed that the DOS not only had a significant correlation with the DOI (VGI: .722**, MIE: .584**, HM: .438**) but also influenced the ITUDS (IRE1, IRE2, and IVDE) in

all digital surrogates (Table 6).

Table 6: The Correlation between DOS and IRE1, IRE2 and IVDE (** $p < .01$, $p^* < .05$)

ITUDS	VGI: DOS	MIE: DOS	HM: DOS
IRE1	.629**	.543**	.443**
IRE2	.670**	.702**	.578**
IVDE	.659**	.549**	.333*

4.3 PU: The UFL and UFA and their correlation with DOS and DOI

Overall, the ratios of UFL factors were higher than those of UFA factors although there was very little deviation between the two ratios in all digital surrogates (Figure 11 and Figure 12). Participants highly valued the factors of UFL and UFA in VGI among three digital surrogates. On the contrary, HM was rated relatively low in all factors of UFL and UFA.

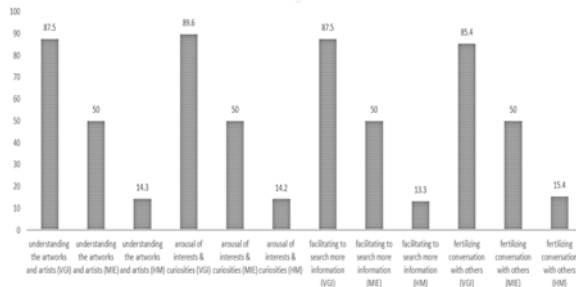


Figure 11: Ratio of UFL of Three Digital Surrogates (%)

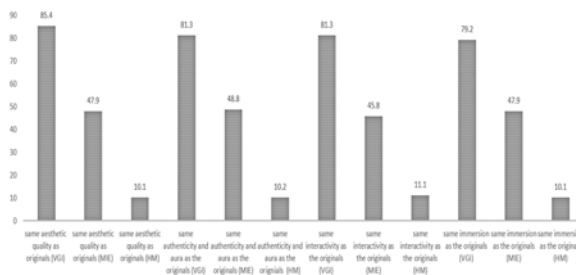


Figure 12: Ratio of UFA of Three Digital Surrogates (%)

In this study, we also explored the relevance between pictorial sameness and esthetic sameness by comparing the ratios of the SFL and SFA (Figure 13). In all digital surrogates, the ratios of the SFL were higher than those of the SFA. In particular, the SFL and SFA of HM were relatively low, compared to VGI and MIE.

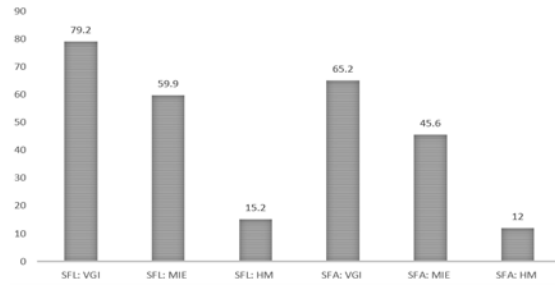


Figure 13: Ratio Comparison of SFL and SFA of Three Digital Surrogates (%)

To verify the correlation between the previous viewing experiences and SFL and SFA, we implemented the standard derivation. Consequently, the standard derivation value of SFL was higher than that of SFA in each digital surrogate. Thus, the previous viewing experiences with the originals influenced SFL rather than SFA in all digital surrogates (Table 7).

Table 7: The Standard Derivation Value of SFL and SFA in relation to the Previous Viewing Experience with the Originals

	SFL	SFA
VGI	3.25	3.05
MIE	3.92	3.60
HM	3.63	3.47

Three factors of UFL were significantly correlated with the SFL ($p < .01$), and three factors of UFA had correlations with the SFA ($p < .01$) (table 8). In addition, three factors in both UFL and UFA in PU were correlated with DOS and DOI in all three exhibitions (table 9).

Table 8: The correlation between SFL and factors of UFL, and the correlation between SFA and UFA (** $p < .01$, $p^* < .05$)

Factors of UFL	VGI: SFL	MIE: SFL	HM: SFL
Understanding the artworks and artists	.640**	.605**	.493**
Arousal of interests & curiosities	.597**	.586**	.420**
Fertilizing conversation with others	.557**	.428**	.288*
Factors of UFA	VGI: SFA	MIE: SFA	HM: SFA
Artistic value and aesthetic properties	.632**	.419**	.493**
Authenticity and aura to the originals	.389**	.331**	.420**
Interactivity and immersiveness	.428**	.586**	.288*

TABLE 9: The correlation between DOS and factors of UFL and UFA and the correlation between DOI and factors of UFL and UFA (** $p < .01$, $p^* < .05$)

Factors of UFL	VGI: DOS DOI	MIE: DOS DOI	HM: DOS DOI
Understanding the artworks and artists	.605** .456**	.465** .455**	.290* .378*
Arousal of interests & curiosities	.599** .671**	.433** .460**	.384* .265*
Fertilizing conversation with others	.472** .464**	.424** .379**	.363* .387*
Suitability for learning	.593** .658**	.438** .389**	.275* .324*
Factors of UFA	VGI: DOS DOI	MIE: DOS DOI	HM: DOS DOI
Artistic value and aesthetic properties	.547** .493**	.363** .420**	.332* .298*
Authenticity and aura to the originals	.439** .610**	.378** .394**	.302* .286*
Interactivity and immersiveness	.423** .715**	.405** .550**	.305* .321*
Suitability for art appreciation	.697** .780**	.584** .538**	.292* .288*

4.3 PEOU: The correlation between factors of PEOU and DOS and DOI

We compared the ratios of the three factors of DOS and DOI in each surrogates. According to the results of the frequency analyses, the influence of SF was commonly higher than other factors in the case of DOS. On the contrary, that of TF was highly valued compared to SF and EF in the case of DOI (Table 10) in all digital surrogates. This data showed that new media technology had a great impact on DOI rather than DOS of the digital surrogates.

Table 10: The Ratio of Three Factors on DOS and DOI (%)

factor	VGI: DOS	MIE: DOS	HM: DOS
SF	44.8	38.1	35.9
TF	28.4	31.8	30.8
EF	26.8	30.1	33.3
	VGI: DOI	MIE: DOI	HM: DOI
SF	30.9	31.8	30.8
TF	40.7	35.3	34.9
EF	28.4	32.9	34.3

For detailed factors of DOS, new interpretation and approaches to the originals and thematic exhibition circulation in SF, motions graphic effects, and high resolution images received positive feedback in TF, having been highly rated (Figure 14). Finally, background music and

optimal exhibition environment (VGI), curved screens and big sized screens (MIE), and curved screens and optimal exhibition environment (HM) had been highly evaluated in EF.

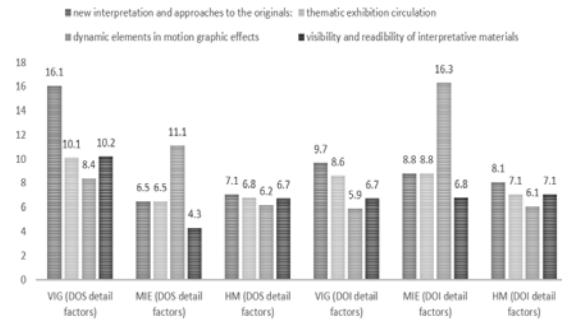


Figure 14: Comparison of SF Detail Factors of DOS and DOI in Three Digital Surrogates (%)

For detailed factors of DOS, new interpretations and approaches to the originals (VGI), dynamic elements through motion graphics (MIE), thematic exhibition circulation and visibility and readability of interpretative materials (HM) in SF, sound effects and motion graphic effects (VGI), motion graphic effects and interactivity (MIE & HM) (Figure 15) in TF, big sized screens and optimal exhibition environment (VGI & HM), and big sized screens and curved screens (MIE) in EF showed the biggest influence compared to other detailed factors (Figure 16).

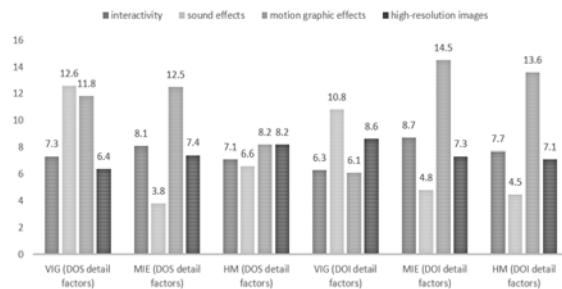


Figure 15: Comparison of TF Detail Factors of DOS and DOI in Three Digital Surrogates (%)

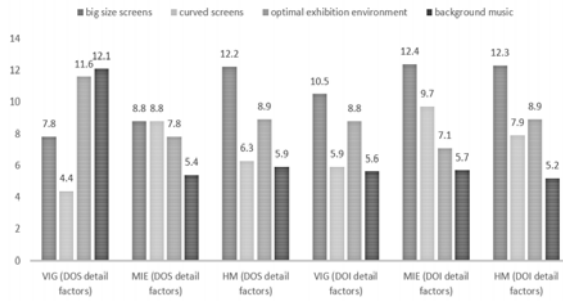


Figure 16: Comparison of EF Detail Factors of DOS and DOI in Three Digital Surrogates (%)

All detail factors of PEOU were correlated with DOS and DOI in the case of VGI and MIE at a significance level (** $p < .01$). In the case of HM, only a few detailed factors of PEOU had an influence on DOS and DOI, in particular, none of EF detailed factors had a correlation with DOS and DOI (Table 11).

TABLE 11: The correlation between Detail Factors of PEOU and DOS & DOI (** $p < .01$, $p^* < .05$)

PEOU and Detail Factors	VGI: DOS/DOI	MIE: DOS/DOI	HM: DOS/DOI
SF 1: new interpretations and approaches to originals	.674** .594**	.545** .498**	.405** .194
SF 2: thematic exhibition circulation	.364** .367**	.473** .469**	.191 .080
SF 3: dynamic elements through motion graphics	.559** .390**	.509** .512**	.520** .375**
SF 4: visibility and readability of interpretative materials	.502** .572**	.513** .555**	.501** .281*
TF 1: interactivity	.388** .606**	.490** .477**	.163 .267
TF 2: motion graphic effects	.457** .673**	.410** .468**	.213 .122
TF 3: high resolution images	.630** .709**	.447** .436**	.286* .287*
TF 4: sound effects	.551** .584**	.392** .421**	.242 .181
EF 1: big-sized screen	.644** .565**	.372** .471**	.251 .093
EF 2: curved screen	.477** .655**	.341** .437**	.110 .077
EF 3: background music	.414** .428**	.416** .296**	.239 .255
EF 4: optimal exhibition environment	.650** .541**	.374** .380**	.211 .016

According to the data of frequency analysis, VGI received positive feedback not only in the immersiveness of exhibit media but also in the suitability for using new media technology and the suitability for expressive elements used by motion graphic (table 12). In the case of MIE, detail factors of DOF showed the highest value with the exception of degree of technological fatigue caused by immersiveness of exhibit media. MIE, with the most number of motion graphic effects, exhibited two to three times a higher value for the degree of technological fatigue caused by motion graphic effects compared to that of VGI.

TABLE 12: The Immersiveness of Exhibit Media, the Suitability for Using New Media Technology, the Suitability for Expressive Elements Used by Motion Graphic Effects and Detail Factors of Degree of Technological Factors in Three Digital Surrogates (%)

Detail factors	VGI	MIE	HM
The immersiveness of exhibit media	81.7	57.9	24.1
The suitability for using new media technology	85.4	63.3	37.5
The suitability for expressive elements used by motion graphic effects	69.8	51.6	40.0
Degree of technological fatigue caused by new media technology	43.8	57.9	18.8
Degree of technological fatigue caused by motion graphic effects	48.8	72.5	31.3
Degree of technological fatigue caused by immersiveness of exhibit media	54.7	50.0	27.1
DOF caused by environmental factors	33.4	40.0	32.5
DOF caused by viewing experience	31.9	42.4	40.1

In all three digital surrogates, neither degree of technological fatigue caused by new media technology nor DOF caused by viewing experience influenced DOS and DOI. However, degree of technological fatigue caused by motion graphic effects and degree of technological fatigue caused by immersiveness of exhibit media had correlations with DOS and DOI at the level of 0.01 (Table 13). In the case of HM with the lowest ratio of the immersiveness of exhibit media, degree of technological fatigue caused by motion graphic effect, and degree of technological fatigue caused by immersiveness of exhibit media had a level of significance lower than that of VGI or MIE, thereby demonstrating the influence of immersiveness of exhibit media on DOF.

According to the data of correlation analysis, three technological fatigues had correlations with SFL and SFA. Degree of technological fatigue caused by motion graphic effects displayed higher influence on SFA than SFL (** $p < .01$), but in the case of degree of technological fatigue caused by immersiveness of exhibit media, SFL showed a higher level of significance than that of SFA (** $p < .01$) (Table 13).

TABLE 13: The Correlation between DOS and Detail Factors of DTS (** $p < .01$, $p^* < .05$)

Detail factors of DOF	VGI: DOS DOI	MIE: DOS DOI	HM: DOS DOI
Degree of technological fatigue caused by new media technology	.219 .123	.122 .172	.143 .164
Degree of technological fatigue caused by motion graphic effects	.367** .543**	.574** .486**	.426* .397*
Degree of technological fatigue caused by immersiveness of exhibit media	.709** .627**	.661** .679**	.521* .601*
	VGI: SFL SFA	MIE: SFL SFA	HM: SFL SFA
Degree of technological fatigue caused by new media technology	.325* .547*	.387* .457*	.312* .452*
Degree of technological fatigue caused by motion graphic effects	.803* .699**	.523* .599**	.627* .478**
Degree of technological fatigue caused by immersiveness of exhibit media	.577** .498*	.525** .443*	.480** .412*

4. CONCLUSION AND IMPLICATIONS

To sum up the results of frequency analyses, the responses of participants to VGI occupied the dominance in ATVDS and ITUDS compared to the other two digital surrogates. Our findings showed that the DOS not only had a significant correlation with the DOI but also influenced ITUDS in all digital surrogates. In this study, we explored the relevance between pictorial sameness and aesthetic sameness by comparing the ratios of SFL and SFA. In all digital surrogates, the ratios of the SFL were higher than those of SFA. In terms of SFL, digital surrogates stimulated intrinsic motivations for

learning and provided participants with meaning making in the process of cognitive learning.

However, they did not guarantee the same quality of the originals, contrary to our assumption. In other words, although digital surrogates captured the physical properties of the originals in terms of pictorial sameness, they were not as aesthetically valuable as the originals for them. In addition, the previous viewing experiences with the originals influenced SFL rather than SFA in all digital surrogates. Both UFL and UFA in PU were correlated with DOS and DOI in all three exhibitions.

The influence of SF was commonly higher than other factors in the case of DOS. On the contrary, that of TF was highly valued in the case of DOI. All detail factors of PEOU were correlated with DOS and DOI in the case of VGI and MIE. In the case of HM, only a few detail factors of SF and TF had a correlation with DOS and DOI. Considering the relationship between DOF and DOS and DOI, degree of technological fatigue caused by motion graphic effects, and degree of technological fatigue caused by immersiveness of exhibit media were correlated with DOS and DOI in all digital surrogates. In the case of degree of technological fatigue caused by motion graphic effects, the significant level of SFA (** $p < .01$) was higher than that of SFL (* $p < .05$). On the contrary, the significant level of SFL (** $p < .01$) was higher than that of SFA (* $p < .05$) in the case of degree of technological fatigue caused by immersiveness of exhibit media.

In order for a digital surrogate to generate meaning as a form of exhibition with technologies, it should attract viewers' stimulation and attention in terms of PU and PEOU. In addition, in order to augment the immersiveness, which was the most important attribute of digital surrogates, considerations for DOF including degree of technological fatigue caused by motion graphic effects and degree of technological fatigue caused by immersiveness of exhibit media should come first during the media design process when utilizing technology.

While requiring further research, the study showed significant proof of the digital surrogate as suitable art appreciation medium, which generated authenticity, boosting its former value as a foster-learning tool. Digital surrogates with hedonic

values such as imagination and enjoyment and multi-sensory and immersive experience stimulated intrinsic motivation for learning. The study demonstrated not only the suitability for TAM as an evaluation model for digital surrogates for remediating the originals, but also two variables of TAM enabled the prediction of users' technology acceptance in digitally remediated environment.

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