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Augmented Reality Application: Enhancing Visitor Experience at the Sabah State Museum

Mohd Darnish Syahmi Mohd Yatim[1], Nur Sabrina Rabusah[1], Aaqilah Omar[1], Alvin Gatu[1*], Nurafiqah Mohamad Musa[1], Nur Murniza Mohd Zaidi[1]

[1]*Universiti Teknologi MARA Sabah Branch, Kota Kinabalu Campus*

*alvingatu@uitm.edu.my

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ABSTRACT

Advancements in technology and its merging with tourism is making travel a more pleasurable and memorable experience. Now, more than ever, travelers and visitors can enjoy visiting places with the use of technical apparatus and the internet. The development and advancement of Augmented Reality (AR) in tourism enables people to use digital visual components, sound, or other sensory stimulation transmitted via technology to create an improved version of the real physical world. Hence, the purpose of this study is to examine the effects of Augmented Reality in augmenting the experiences of visitors to the Sabah State Museum specifically in terms of learning outcomes, entertainment experiences, and expectations met. The study applied a quantitative approach and analysis that focused on visitors to the museum who reside in Kota Kinabalu. Through purposive sampling technique and cross-sectional data collection, 388 responses met the requirements of the survey and were used for data analysis. Data was collected via Google Form while the survey questionnaire was adopted from various previous studies with some modifications. Based on the results, the learning outcomes significantly affected the visitor experience as AR was instrumental in increasing the learning outcome. In addition, it was found that using AR features attracted visitors to learn more using the technology provided by the museum. As for the entertainment experience, the results of the study also showed a positive effect of the usage of AR on the visitors' experience in the museum. Thus, the findings have important contributions particularly how AR can enhance the visitors' experience at the Sabah State Museum.

Keywords: augmented reality; visitor experience; museum; learning outcome; entertainment experience

INTRODUCTION

Many technological advancements have been made in recent years to boost tourist experiences. One of these innovations is augmented reality (AR), an interactive experience that encourages people to learn about history by delivering multimedia in the form of texts, images, audios, videos, and animations tailored to the displays and artifacts found in historical and heritage sites (Azuma et al., 2001). According to an analysis of current technologies developed today, the implementation of AR has been one of the most frequently discussed and its usage has been widely adopted to various fields, including the tourism sector to enhance the overall visitor experience (Yu et al.,

2010). needs to be visualised (Singhal et al., 2012). According to Tussyadiah et al. (2018), AR enhances users' experiences and is widely recognised as a useful tool for improving engagement with history and perception of the real world.

In the tourism industry, AR provides numerous possibilities of adding value to travellers by providing them a novel and inventive approach to explore unfamiliar surroundings (Cranmer et al., 2018). AR applications often aim to assist navigation in the museum, provide access to inaccessible collections and opportunities for social experiences and content generated by the users. In a recent study by Shehade, et al. (2020), it was found that all these applications created new avenues for experimentation with many museums around the world, incorporating such technologies to democratise and open up their collection to allow multiple interpretations. This is because the adoption of AR in museums could add value to heritage sites since it is viewed as an innovative method to preserve heritage, increase visitor happiness and experience and generate positive feedback from the tourist (Jung & Dieck, 2016). AR would logically be highly beneficial for the tourism industry (Fritz et al., 2005). Furthermore, Olsson et al. (2011), suggested that the use of AR in the appropriate devices be developed for the next-generation tourist guide because of its potential to personalise information freely according to the user's interest.

Furthermore, AR has been increasingly implemented to enhance visitors' experience and tourism research has long understood the importance of creating memorable experiences (Dieck et al., 2017). Pine & Gilmore (1998) stated that the tourist's experience comprises four realms which are entertainment, educational, esthetic, and escapist. Besides, Dieck et al. (2017), found that the role of AR is becoming increasingly important in the museum context because it is helping museums overcome two major issues which are authenticity and new museology. Han et al. (2014), highlights that the creation of AR is especially considered to be appealing, as visitors can use applications on their smartphones, reducing the barrier to engage and adopt. Other than that, a number of previous studies have confirmed the role of AR as an effective tool for education, highlighting its strength in creating interactive content that is easy to remember (Jung & Dieck, 2016). As part of the entertainment experience, Jung et al. (2016), proposed that users utilise applications for an enjoyable experience. Thus, latest advancements in information technologies have made the use of mobiles devices for everyday lives a norm, making it ever more important to integrate latest technological innovations into museum exhibitions to enhance visitor interaction (*Alliance of Museums*, 2014). Tom & Jung (2015) revealed that AR enables tourists to receive a dynamic and interactive museum and art gallery experience by bringing history and knowledge to life. In 2015, a study by murphy stated that the use of technologies such as AR will play an important role for future curators as more and more visitors expect the incorporation of these experiences into the museum visit. Furthermore, Anderson, et al. (2010), suggested the implementation of interactive virtual gaming to increase competitiveness among visitors to cultural heritage sites, as well as enhance the learning outcomes of visitors. It was argued that because of its capabilities, AR would logically be highly beneficial for the tourism industry (Fritz et al., 2005). Hosany and Witham (2010) revealed that in the tourism context, a well-staged experience leads to satisfied customers and encourages visitors' intentions to re-visit which is particularly important in the tourism industry.

This study provides information of how AR could help in enhancing the tourists' experience in museums. It is adapted from a previous study entitled "Augmented Reality Application: Enhancing Visitor Experience in Labuan Museum" by Chan & Ismail (2019). Thus, the researchers of the present study focused on the application of augmented reality features towards enhancing the visitor experience at the Sabah State Museum. Based on the study conducted by Chan et al. (2019), despite the prevalence of AR in some countries' museum exhibitions, there are some national museums in Malaysia that have yet to adopt augmented reality in their exhibition. In addition, there is a lack of research on how AR applications enhance the visitor experience in museums and little attempts have been made to examine factors enhancing visitor experience using both AR and VR technologies (Jung et al., 2016). Moorhouse et al. (2017), posit that there is only limited research on technology enhanced visitor engagement using AR. Thus, the researchers have conducted this research to determine the extent to which AR enhances the visitors' experience at the Sabah State Museum, which was chosen as the setting of this study.

LITERATURE REVIEW

Augmented reality application at the Sabah State Museum

The current method used for Augmented Reality at the Sabah State Museum is Quick Response (QR) code as part of the museum's way to showcase information on its artifacts in a modern way. Another method implemented by the museum is the projected screen information. The screen projector is used upon request such as a group of students that visit the museum for a school trip. The museum started using AR technology in 2019 during the celebrations of two special occasions: commemorating the last male Sumatera Rhinoceros and the official 66th birthday celebrations of the Sabah Yang Dipertua Negeri (TYT) Tun Dr Juhar Mahiruddin. By providing AR features such as the QR code, the Sabah State Museum can provide relevant and easy access to information which will be displayed for the visitors in an attractive and meaningful way that will enhance its visitors' experience.

For the research model, there are several variables included which are Learning Outcome, Entertainment Experience, Expectation Met and Visitor Experience. This study also identified the effects of the independent variables toward the dependent variable. A Pearson Correlation test was performed to measure the strength and direction of the linear relationship between the variables.

Learning outcome

AR technology has also been found in public learning environments in museums to enhance visitors' experience as it greatly improves information access and enhances functionality of the exhibits. The AR features in the museum also enables the museum to enhance the visitors' learning outcome with a wide range of available resources like videos, interactive maps, gamification, and access to media streams. Besides, it can provide not only facts and knowledge but also deliver realistic contexts and reconstructions of events, therefore enhancing the entire learning experience and making it more applicable (Dieck et al., 2016). In addition, new technologies provide relevant and tailored information, serving to enhance interpretation and engagement with object-rich collections (Lehn & Heath, 2005).

Howland et al. (2012), stated that meaningful learning can take place with the use of ICT and should be conducted in an active, constructive, authentic, intentional, and cooperative manner. According to Ding (2017), AR allows visitors to obtain knowledge of the displayed cultural artifacts via an engaging and informative way. Furthermore, Chan et al. (2019), mentioned that the implementation of AR has turned those museums into unique mediums that offer sophisticated understanding about museum artifacts by augmenting interaction between visitors and museum, making information to be more expressive and intriguing. Therefore, leveraging AR capability can maximise the learning experience. Puspasari et al. (2019), pointed out that AR has the ability to fulfil the above requirement and it can stimulate several senses leading to improved learning skills and memorisation. Visitors can gain more knowledge via the extra layers of information presented by AR applications and thus create a much stronger engagement with the museum. According to Azuma et al. (2001), AR promotes learning of history through the conveyance of multimedia that is responsive to the displays and ancient artifacts that are situated in various museums. It enhances reality instead of substituting it like virtual reality does, which is computerised information. AR is designed to be relevant to visitors by engaging them with AR-supported devices or AR mobile applications.

H1: Learning outcomes have positive effects on visitors' experience at the museum.

Entertainment experience

According to Benny (2015), an entertainment experience is an activity that provides amusement and pleasure. In addition, entertainment is the most crucial part in today's tourism environments and refers to the tourist's ability to enjoy activities for pleasure (Jung et al., 2016). Besides that, a

study conducted by Xu et al. (2017), shows that the use of AR can improve entertainment and engagement from various perspectives. Thus, according to Nechita and Rezeanu (2019) museums are currently carrying out their educational roles to young audiences as they are considered to be eager for a sensorial challenge, empathy, entertainment, emotion, and authenticity, and AR could be the proper tool to facilitate this. Additionally, AR technologies can give consumers choices to choose from, manipulate, or respond to the retailer or user-generated content to provide entertainment value (Scholz & Smith, 2016).

During a visitor's visit to the museum, AR can provide educational information, but can also offer entertainment through games and quizzes. Meanwhile, according to Jung and Han (2014), the integration of AR into the tourist experience illustrates a noteworthy entertainment factor for tourists, positively influencing and increasing the educational effect at the same time. Furthermore, Jung et al. (2016), stated that as part of the entertainment experience, users can utilise the application for an enjoyable experience. Jung et al. (2016), also asserted that both education and entertainment drive the overall tour experience. Besides, a study conducted by Savela et al. (2020), shows that entertainment value is also an important factor in itself and becomes even more relevant when investigating AR game outcomes in the context of recreational activities. According to Von et al. (2019), one of the reasons for this growing popularity of AR is that it offers a fundamentally different entertainment experience.

H2: Entertainment experience has a positive effect on visitors' experience in museums.

Expectations met

According to Sadeh et al. (2012), a customer's expectation is an influential variable in the service industry. It is crucial for organisations to understand their customers' needs and to produce goods and services that fulfill their expectations by providing and critically thinking about their requirements (Buttle, 2012). In terms of tourism and other related businesses, the services provided such as tourism information, a relaxing and enjoyable environment, friendly staff, and good advice, are regarded as elements to meet the needs and expectations of tourists. According to Harris (2013), expectations are personal views of the outcomes that will follow from experiences, which might be positive or negative.

A study by Bosque et al. (2006), indicated that expectations are developed by prior experiences. Expectations are constantly shifting as consumers become more aware of alternative service providers in the ever-expanding tourism industry. In addition, customers' expectations are predictions of what will happen during a specific transaction, based on what the customer believes, transacts, and believes the expectation will look like. As a result, positive and bad visitor experiences have broader implications than satisfied and dissatisfied visitor experiences, which merely reflect whether visitors' expectations are met or not (Crotts & Magnini, 2010).

Ultimately, AR features can enhance the visitor experience because it can fulfill expectations. Expectations depict people's needs from the present to the future. Personal experience is a barometer of what is going on. Thus, it is vital to study visitor expectations because this will help to learn more about what visitors want from their experience and allow them to better meet their needs and generate high satisfaction with all products and services provided (Boonpat & Suvachart, 2014).

H3: Expectation met has a positive effect on visitors' experience at the museum.

Visitor experience

A study conducted by Cutler and Carmichael (2010) has found the factors that will likely affect visitor experiences, such as learning outcome, overall experience, and expectation met. Therefore, the integration of AR in museums has various benefits for the visitor and these benefits may enhance the overall visitor experience during their visit to the museum. Chan and Ismail (2019) also point out that visitors can gain more knowledge via the extra layers of information presented by the

AR applications and thus create a much stronger engagement with the exhibition. This statement has also been supported by Jung & Dieck (2016), where the AR approach in the museum can strengthen visitor satisfaction and experience, generate positive feedback from visitors, attract new audiences as well as promote active learning outcomes.

Leue et al. (2015), stated that sharing stories and putting forward enhanced content are some examples of how museums can use AR to enhance the visitor experience. Meanwhile, Krevelen and Poelman (2010) posit that by providing additional content without disturbing the surroundings of visitors was considered an important aspect of AR for the visitor experience. Claudia et al. (2016), indicated that AR would allow visitors to gather more in-depth information by themselves which was considered a big advantage for senior visitors and revealed that an AR application would enable visitors to get as much content as required, allowing for a more interactive and enjoyable experience. According to Ding (2017), AR is not only beneficial to the tourism industry but the visitors' experience as well, due to three factors: it is a platform for infinite layers of information, a dynamic tool for engagement and an ingenious tool for education.

Tom and Jung (2015) suggest that this technological advancement has improved the user-friendliness and efficiency of the tourist AR experience, which is thought to contribute to the overall acceptance of these applications. Besides, Tom et al. (2015), revealed that AR enables tourists to be exposed to a dynamic and interactive museum and art gallery experience by bringing history and knowledge to life. Dieck et al. (2015), stated that the experience is perceived as enlightening, enjoyable, exciting, and fun. This helps visitors to engage with art in a new way that is positive for individual visitors and gives the user a sense of empowerment.

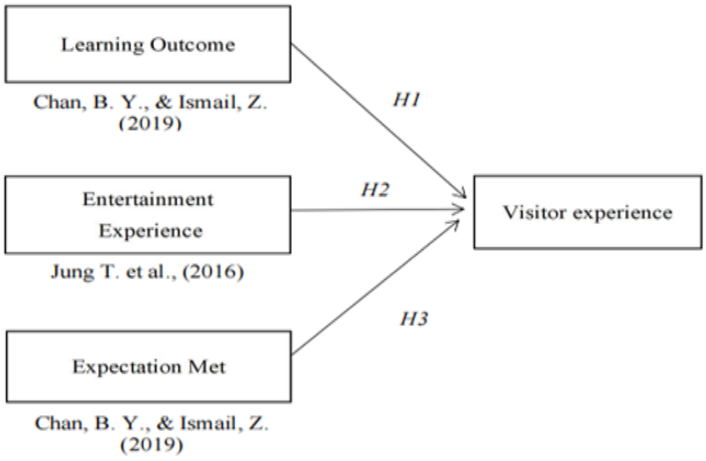

Figure 1. Research model

METHODOLOGY

The study applied a quantitative approach and analysis which focused on visitors residing in Kota Kinabalu and have visited Sabah State Museum. Sabah State Museum was selected because of its location, and it was the most convenient museum in town to conduct the research. In addition, Sabah State Museum has been using AR for quite sometimes thus it aligns with the researchers' objectives of this study. The data collection was based on the pre-COVID statistics because in the previous years (2020 and 2021) the Sabah State Museum did not receive many visitors due to the pandemic. The study also used two combinations of a sampling method which was stratified and a snowballing method for the data collection. The data were collected via google form. 388 usable responses were collected in this study. The questionnaire consisted of six parts with part a being about the respondents' visiting history to the Sabah State Museum. If respondents answered "yes", they could proceed to the next part while if respondents answered "no", they would not proceed to the next part. Part B covered the demographic questions. Parts C, D, E, and F covered questions

according to the three variables respectively: learning outcome, entertainment experience, expectation met, and lastly the respondents' visitor experience at Sabah State Museum. The items were measured using a 5-point likert scale with the codes ranging from (1) Strongly Disagree to (5) Strongly Agree.

Cronbach's Alpha test indicates that 0.6 to 0.7 is an acceptable level of reliability while 0.8 or more suggests a very good strength of association. A Pearson Correlation test was performed to measure the strength and direction of the linear relationship between the variables (learning outcome, entertainment experience, expectation met and visitor experience) and to test the hypothesis of this study. The Pearson Test determines the strength and direction of the linear association between two variables that makes no assumption of causality.

RESULTS

Demographic of respondents who have visited Sabah State Museum

Table 1. Demographic frequency analysis (N=388)

Variables	Categories	Frequency	Percentage (%)
Gender	Male	218	56.2
	Female	170	43.8
Age	18-24	184	47.4
	25-34	141	36.3
	35-44	38	9.8
	45 and above	25	6.4
Level of education	Certificate	78	20.1
	Diploma	132	34.0
	Degree	158	40.7
	Master	15	3.9
	Phd	5	1.3
Occupation	Student	149	38.4
	Government Servant	47	12.1
	Private Servant	163	42.0
	Unemployed	14	3.6
	Retired	12	3.1
	Others	3	0.8

Table 1 shows that the majority of the respondents (56.2%) were males and 43.8% were females. The age groups were those from 18-24 years old (47.4%) followed by 25-34 years old (36.3%), 35-44 years old (9.8%) and the smallest group were those 45 years old and above with 6.4%. Around 40.7% of them had earned a bachelor's degree, 34.0% were diploma holders, 20.1% respondents had certificates and 3.9% were Master holders. In terms of occupation, about half of the respondents were working in the private sector (42%) and the others comprised students (38.4%), government servants (12.1%), the unemployed (3.6%) and retired (3.1%) and others (0.8%).

Descriptive analysis

Table 2 shows the minimum and maximum mean responses, as well as the mean and standard deviation. The internal consistency reliability of the variables was tested using the Cronbach's Alpha test. A standard measure of Cronbach's Alpha is 0.6 to 0.7 that indicates an acceptable level of reliability, while 0.8 or more suggests a very good strength of association (Tavakol & Dennick, 2011).

Based on Table 2, the learning outcome variable showed 252 respondents (M = 3.98, SD = 0.666) agreed that they learned something new by using AR at the Sabah State Museum. Next, 241 respondents (M = 4.01, SD = 0.719) agreed that AR stimulated their curiosity to learn new things with 62.1%. Meanwhile, around 185 respondents (M = 4.08, SD = 0.803) agreed that the experience has made them knowledgeable, with 47.7%. Lastly, 161 respondents (41.5%) agreed that the AR provided a good experience for learning (M = 4.05, SD = 0.856).

Table 2. Variables descriptive analysis (N=388)

Variables item	Mean	SD
Learning outcome		
1. I learned something new using AR	3.98	.666
2. It stimulated my curiosity to learn new things	4.01	.719
3. The experience has made me knowledgeable	4.08	.803
4. AR provide a good experience for learning	4.05	.856
Entertainment Experience		
1. Using AR was amusing	3.98	.836
2. Using AR was captivating	4.01	.834
3. Using AR gave enjoy enjoyable experience	4.01	.876
4. Using AR was entertaining	4.00	.876
Experience Met		
1. Were your expectations met at the museum?	3.99	.852
2. I felt satisfied to use AR at museum	4.01	.857
3. AR at the museum make it easy for me	3.94	.880
4. Will you recommend it to friends, relatives, and family	3.97	.856
Visitor Experience		
1. AR is user friendly	4.11	.825
2. AR at museum did hold my attention	4.13	.852
3. Using AR contributed positively to my visitor experience	4.00	.848
4. AR at museum made me want to discover more about Sabah History	4.03	.865

As for the entertainment experience, about 182 respondents (46.9%) agreed that using AR was amusing (M = 3.98, SD = 0.836) while 192 respondents (M = 4.01, SD = 0.834) found that using AR was captivating (49.5%). In addition, 170 respondents agreed that using AR gave an enjoyable experience with 43.8% (M = 4.01, SD = 0.876). Finally, around 163 respondents (M = 4.00, SD = 0.876) agreed that using AR was entertaining.

Table 2 also shows the mean and standard deviation for expectation met. For the first question, 172 respondents (44.3%) agreed that their expectations were met at the museum (M = 3.99, SD = 0.852). Next, around 173 respondents (44.6%) agreed that they felt satisfied using AR at the museum (M = 4.01, SD = 0.857). Meanwhile, for the third question, 161 respondents (41.5%) found that using AR at the museums made it an easy experience for them (M = 3.94, SD = 0.880). Lastly, 169 out of 388 respondents (43.6%) affirmed that they would recommend AR to friends, relatives, and family (M = 3.97, SD = 0.856).

Table 3. Cronbach alpha value for each variable

Variables item	Cronbach alpha value
Learning Outcome	0.864
Entertainment Experience	0.871
Experience Met	0.850
Visitor Experience	0.836

Pearson correlation analysis

As shown in Table 4, the results of the Pearson Correlation analysis proved that the learning outcome, entertainment experience and expectation met affected visitor experience. Each result for the independent variables showed an accepted significant level which was below 0.01.

Table 5 shows the correlation test interpretation for independent variables and dependent variables. Rozi & Faridah (2011) stated that every *r* value in the correlation has its own interpretation. In relation to Table 5, it was indicated that reliability had a positive effect on visitor experience. The first variable, that is, the learning outcome, showed an r value of 0.711, indicative of a high positive linear relationship. The entertainment experience also had a similar result (r=0.752). Lastly, as for the expectation met, r was valued at 0.75. This can also be interpreted as a high positive linear relationship.

Table 4. Correlation test for variables

Correlations[b]					
		Learning Outcome	Entertainment Experience	Expectation Met	Visitor Experience
Learning Outcome	Pearson Correlation	1	.746**	.680**	.711**
	Sig. (1-tailed)		.000	.000	.000
Entertainment Experience	Pearson Correlation	.746**	1	.723**	.752**
	Sig. (1-tailed)	.000		.000	.000
Expectation Met	Pearson Correlation	.680**	.723**	1	.751**
	Sig. (1-tailed)	.000	.000		.000
Visitor Experience	Pearson Correlation	.711**	.752**	.751**	1
	Sig. (1-tailed)	.000	.000	.000	

**. Correlation is significant at the 0.01 level (1-tailed).

Table 5. Interpretation for value of r

r	Interpretation
r = 0	No relationship
r ≤ 0.5	Low positive linear relationship
r ≥ - 0.5	Low negative linear relationship
0.5 < r < 0.7	Moderate positive linear relationship
-0.7 < r < -0.5	Moderate negative linear relationship
r ≥ 0.7	High positive linear relationship
r ≤ -0.7	High negative linear relationship
r = 1	Perfect positive linear relationship
r = -1	Perfect negative linear relationship

Table 6. Summary of the hypotheses results

Hypotheses	Results
H1: Learning Outcome has positive effect on visitors' experience in museum	Supported
H2: Entertainment Experience has a positive effect on visitors' experience in museums	Supported
H3: Expectation Met has a positive effect on visitors' experience in museums	Supported

DISCUSSION

Based on the summary results in Table 6, hypothesis H1 was supported because the entertainment experience positively affected visitors' experience at the museum. In relation, a previous study by Chan & Ismail (2019) asserted a positive result concerning the learning outcome and visitor experience. Similarly, in this study, the results show that learning outcomes positively affect the visitor experience because AR offers users the possibility to utilise their own mobile hardware as pocked sized screens through which surrounding spaces become a stage for endless extra layers of information (Ding, 2017). Besides, the adoption of AR in museums could add value to heritage sites because AR is considered as an approach to museum innovation in preserving heritage, strengthen visitor satisfaction and experience, generate positive feedback from visitors, attract new audiences as well as promote active learning outcomes (Jung & Dick, 2016). Therefore, museums that use AR as one of their pull factors should maximise its capabilities and features to the fullest to positively affect the visitor experience and its learning outcomes.

Based on the results stipulated in Table 6, entertainment experience was found to be statistically significant with a strong positive correlation between entertainment experience and visitors' experience (H2) thus supporting the claim mentioned by Mehmetoglu & Engen (2011) that entertainment is considered an important dimension of the experience. Radder & Han (2015) pointed out that to meet museum visitors' needs, it is important to stage the experiences that they desire without ignoring the entertainment component. In order to immerse and engage audiences, museums are progressively incorporating innovative storytelling approaches and technologies by using ar. As a result, the entertainment experience played an important role in influencing the visitors' experience while they were visiting the Sabah State Museum.

Meanwhile, based on the findings shown in Table 4, it was discovered that the expectation met does positively affect visitor experience at the Sabah State Museum. This correlates with the study conducted by Chan & Ismail (2019), which found a positive effect between expectations met and visitor experience in museums. This study proved that the third hypothesis (H3) has been supported, as shown in Table 6. From other points of view, Bosque et al. (2006), pointed out that expectations are developed by prior experience while Beeho & Prentice (1997) stated that tourists who considered that their expectations were met will recommend the place that they had visited to their friends, families, and relatives and return to those places.

CONCLUSIONS

This study aimed to examine to what extent AR affected the visitor experience at the Sabah State Museum. The results of this study were similar to previous studies concerning the effect of AR on visitor experience (Chan & Ismail, 2019; Jung et al., 2016). Hence, it can be ascertained that AR has the features to increase the visitors' experience to another level.

The results on learning outcomes showed that AR significantly affected the visitor experience as AR plays an important role in increasing the learning outcome. In addition, the use of AR features increases visitors' interest to learn more by using the technology provided by the museum. As for the entertainment experience, this study's results also showed a positive effect on visitor experience with the usage of AR in the museum. Thus, the application of AR in the museum can boost every visitor's experience in terms of entertainment since the features of AR can offer interactive visual information. Furthermore, visitors' expectations were fulfilled when their visit to the museum was accompanied with the application of AR. This further entails that visitors' expectations surpassed what was expected before using AR. Having said that, the data analysis of the Pearson Correlation test result showed that all the independent variables significantly affected the visitor experience.

Introducing AR not only in Sabah State Museum but also to other tourism destinations will show some positive implications for destination marketing and management, tourism providers, and tourists. For instance, virtual destination experience can be implemented by governments and destination management organisations to pre-assessment of new programs, policies, and marketing campaigns for existing and emerging destinations. Next, virtual destination will help in controlling visitation to the overdeveloped destinations by giving the tourist to experience the destination virtually. Most importantly, virtual tourism will create a new tourism business opportunity for tourism providers in challenging times and indirectly it also creates a new niche market for distinct customer segments.

As a recommendation for future research, the researchers suggest that studies be conducted to examine and determine all types of AR that are currently used as well as those used previously. The second recommendation is that a study of a similar nature can be conducted in a different museum other than the Sabah State Museum since there were only few previous studies pertaining the AR effects on the visitor experience such as Labuan State Museum and National Museum. Lastly, the results of this study can contribute to elevating the use of AR in museums by providing museum administrators with information and a better understanding of how AR can enhance their visitors' experiences in the museum.

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CONFLICT OF INTERESTS

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

REFERENCES

Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. (2001). Recent advances in augmented reality. *IEEE Computer Graphics and Applications, 21(6),* 34–47. https://doi.org/10.1109/38.963459

Anderson, E. F., McLoughlin, L., Liarokapis, F., Peters, C., Petridis, P., & De Freitas, S. (2010). *Developing serious games for cultural heritage: A state-of-the-art review*. Virtual reality, 14(4), 255-275.

American Alliance of Museums (2014), Trends Watch 2014, Centre for the Future of Museums.

Boonpat, O., & Suvachart, N. (2014). *Tourist Expectation and Tourist Experience in Cultural Tourism. J. of Tourism and Hospitality Management*, 2(3). https://doi.org/10.17265/2328-2169/2014.03.004

Benny, L. K. W. (2015). *Entertainment Studies–A Perspective. American International Journal of Research in Humanities, Arts and Social Sciences*, 10, 7-11.

Beeho, A. J., & Prentice, R. C. (1997). *Conceptualizing the experiences of heritage tourists. Tourism Managemen*t, 18(2), 75–87. https://doi.org/10.1016/s0261-5177(96)00103-3

Chan, B. Y., Ismail, Z. I. B. A., Jack, L. P., & Asli, M. F. (2019, November). *Augmented Reality Mobile Application: A Feasibility Study in a Local National Museum*. In Journal of Physics: Conference Series (Vol. 1358, No.1, p. 012057). IOP Publishing. Centre, L.I. (2019). www.econstor.eu. https://doi.org/10.32327/IJMESS.8.3.2019.12

Chan, B. Y., & Ismail, Z. I. B. A. (2019). Augmented reality mobile application: enhancing visitor experience in Labuan Museum. *International Journal of Advanced Research in Technology and Innovation*, 1(2), 40-49.

Cranmer, E. E., Tom Dieck, M. C., & Fountoulaki, P. (2020). Exploring the value of augmented reality for tourism. T*ourism Management Perspectives*, 35, 100672

Crotts, J. C., & Magnini, V. P. (2011). *The customer delight construct: is surprise essential?*. Annals of Tourism Research, 38(2), 719-722.

Cutler, Q. S., & Carmichael, B. A. (2010). *The dimensions of the tourist experience*. The tourism and leisure experience: Consumer and managerial perspectives, 3-26.

Fritz, F., Susperregui, A., & Linaza, M. T. (2005). *Enhancing cultural tourism experiences with augmented reality technologies. 6th International Symposium on Virtual Reality, Archaeology and Cultural Heritage* (VAST).

Han, D. I., Jung, T., & Gibson, A. (2013). Dublin AR: *Implementing Augmented Reality in Tourism*. Information and Communication Technologies in Tourism 2014, 511–523. https://doi.org/10.1007/978-3-319-03973-2_37

Harris, A. (2013). Teacher leadership and school improvement. *In Effective leadership for school improvement* (pp. 82-93). Routledge.

Hosany, S., & Witham, M. (2010). *Dimensions of cruisers' experiences, satisfaction, and intention to recommend*. *Journal of Travel Research*, *49*(3), 351-364

Han, D. D., & Jung, T. (2013). *Information and Communication Technologies in Tourism 2014*. Information and Communication Technologies in Tourism 2014, June 2015. https://doi.org/10.1007/978-3-319-03973-2

Heath, C., & Vom Lehn, D. (2005). *Accounting for New Technology in Museum Exhibitions*. International Journal of Arts Management, 7(3), 11–21.

Howland, J. L., Jonassen, D. H., & Marra, R. M. (2012). Pearson. *Meaningful Learning with Technology* (4th Edition).

Jung, T. (2016). Value of augmented reality to enhance the visitor experience: *a case study of Manchester Jewish Museum*. e-Review of Tourism Research, 7.

Jung, T., Tom Dieck, M. C., Moorhouse, N., & Tom Dieck, D. (2017, January). Tourists' experience of Virtual Reality applications. In 2017 IEEE International Conference on Consumer Electronics (ICCE) (pp. 208-210). IEEE.

Jung, T., & Han, D. (2014). *Augmented Reality (AR) in Urban Heritage Tourism 1 Introduction 2 Writing Style.* E-Review of Tourism Research, 5, 1–6.

Jung, T., Dieck, M. C. T., Lee, H., & Chung, N. (2016). I*nformation and Communication Technologies in Tourism* 2016, December 2018. https://doi.org/10.1007/978-3-319-28231-2

Jung, T., Tom Dieck, M. C., Lee, H., & Chung, N. (2016). *Effects of virtual reality and augmented reality on visitor experiences in museum*. In Information and communication technologies in tourism 2016 (pp. 621-635). Springer, Cham.

Leue, M., Jung, T. & Tom Dieck, D. (2015). Google Glass Augmented Reality: Generic Learning Outcomes for Art Galleries. In I. Tussyadiah, & A. Invesini (Eds.), *Information and Communication Technologies in Tourism* 2015 pp. 463-476. Heidelberg: Springer.

Malim, M. R., & Halim, F. A. (2011). *Business statistics*. Oxford Fajar.

Moorhouse, N., Tom Dieck, M., & Jung, T. (2017). *Augmented Reality to enhance the Learning Experience in Cultural Heritage Tourism*: An Experiential Learning Cycle Perspective. E-Review of Tourism Research, 8(January).

Mehmetoglu, M., & Engen, M. (2011). Pine and Gilmore's concept of experience economy and its dimensions: *An empirical examination in tourism*. Journal of Quality Assurance in Hospitality & Tourism, 12(4), 237-255.

M. Ding, *Augmented Reality in Museum*, Carnegie Mellon University, 2017-9 Azuma R, Baillot Y, Behringer R, Feiner S, Julier S and MacIntyre B 2001 Recent advances in augmented reality

Murphy, S. (2015). Gallery One at the Cleveland Museum of Art: Connecting Audiences to Art through Technology.

Nechita, F., & Rezeanu, C. I. (2019). Augmenting Museum Communication Services to Create Young Audience. Sustainability, 11(20), 5830. Doi: 10.3390/su11205830

Olsson, T., Lagerstam, E., Kärkkäinen, T., & Väänänen-Vainio-Mattila, K. (2013). Expected user experience of mobile augmented reality services: a user study in the context of shopping centres. *Personal and ubiquitous computing*, 17(2), 287-304.

Puspasari, S., Suhandi, N., & Iman, J. N. (2019, July). Enhancing The Visitors Learning Experience in SMB II Museum Using Augmented Reality Technology. In 2019 *International Conference on Electrical Engineering and Informatics (ICEEI) (pp. 296-300). IEEE*.

Pine, B. J., & Gilmore, J. H. (1998). *Welcome to the experience economy*. Harvard Business Review, 76, 97–105

Radder, L., & Han, X. (2015). *An examination of the museum experience based on Pine and Gilmore's experience economy realms.* Journal of Applied Business Research (JABR), 31(2), 455-470

Bosque, D. R., San Martín, H., & Collado, J. (2006). T*he role of expectations in the consumer satisfaction formation process*: Empirical evidence in the travel agency sector. Tourism Management, 27(3), 410–419. https://doi.org/10.1016/j.tourman.2004.10.006

Shehade, M., & Stylianou-Lambert, T. (2020). Virtual reality in museums: *Exploring the experiences of museum professionals*. Applied Sciences, 10(11), 4031.

Savela, N., Oksanen, A., Kaakinen, M., Noreikis, M., & Xiao, Y. (2020). *Does augmented reality affect sociability, entertainment, and learning?* A field experiment. Applied sciences, 10(4), 1392.

Scholz, J., Smith, A. N., (2016). Augmented reality: *designing immersive experiences that maximize consumer engagement*. *Business Horizons*. 59(2), 149–161.

Singhal, S., Bagga, S., Goyal, P., & Saxena, V. (2012). Augmented chemistry: Interactive education system. *International Journal of Computer Applications, 49(15).*

Tom Dieck, M.C., Jung, T.H., & Rauschnabel, P.A. (2018). Determining visitor engagement through augmented reality at science festivals: *An experience economy perspective*. Computers in Human Behavior, 82, 44-53

Tom Dieck, M. C., Jung, T., & Han, D. I. (2016). *Mapping requirements for the wearable smart glasses augmented reality museum application*. Journal of Hospitality and Tourism Technology

Tom Dieck, M. C., & Jung, T. H. (2017). *Value of augmented reality at cultural heritage sites*: A stakeholder approach. Journal of Destination Marketing and Management, 6(2), 110–117. https://doi.org/10.1016/j.jdmm.2017.03.002

Tom Dieck, M. C., & Jung, T. (2015). *A theoretical model of mobile augmented reality acceptance in urban heritage tourism. Current Issues in Tourism*, 21(2), 154–174. https://doi.org/10.1080/13683500.2015.1070801

Tavakol, M., & Dennick, R. (2011). *Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55*. https://doi.org/10.5116/ijme.4dfb.8dfd

Tussyadiah, I. P., Wang, D., Jung, T. H., & Tom Dieck, M.C. (2018). Virtual reality, presence, and attitude change: *Empirical evidence from tourism. Tourism Management*, 66, 140-154.

Xu, F., Buhalis, D., & Weber, J. (2017). *Serious games and the gamification of tourism*. Tourism Management, 60, 244–256.

Yu, D., Jin, J. S., Luo, S., Lai, W., & Huang, Q. (2010). *Visual information communication, chap. A useful visualization technique*: a literature review for augmented reality and its application, limitation and future direction.