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A Study on Current Status of National Science Museums' Online Service

SeongEun KIM[1], Yong KIM[2]

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Abstract

Purpose: This study is a prior study for expanding the science museum's online services. Based on case studies, we propose an online service for science museums in the future. **Research design, data, and methodology:** This study analyzed online-based science museums services trends. The data was collected based on the cases of five national science museums. To understand the characteristics of science museum's online services, we analyzed the status of digital content provided by each science museum and the operation method of online special exhibitions. **Result:** The national science museums provided online services through virtual science museums, SNS, and YouTube. However, the services still imposed limitation on facilitating active learning for visitors. In the case of SNS and YouTube, it is only a one-time promotional tool. **Conclusion:** This study suggests the need for concrete measures to utilize the abundant content accumulated so far in actual education. Additionally, it emphasizes the importance of content development incorporating new platforms.

Keywords: Science Museum, Science Education, Science Exhibition

JEL Classification Code: I23, L82, L86

1. Introduction

The science museums are a science learning space outside of school that aims to explore scientific principles based on scientific technology and stimulate interest in science. Visitors often visit science museums expecting to develop scientific knowledge rather than formal studies tailored to the curriculum (Kim et al., 2010). Teachers who teach science classes also recognize that science museum learning arouses interest and curiosity in science and helps students remember what they have learned longer (Han et al., 2010). Additionally, science museums have the advantage of being able to reflect the latest issues and trends faster than textbooks. Exhibitions are planned to reflect the needs of consumers, and content is expanded by reflecting STEAM convergence education and the latest technology in education operations.

As exhibition content and experiential education play an important role in visitors' decision to visit science museums (Kim et al., 2022), continuous development of educational content and new exhibitions are necessary. To sustain immersion and encourage participation, science exhibitions have developed into a complex fusion of various contents and expressions using various media. Exhibits using digital realistic technologies such as VR and AR are used to better explain scientific principles that are difficult to understand.

1 First Author. Student, Department of Edutech, Graduate School, Korea National Open University, Seoul, South Korea. Email: kse9124@gmail.com
2 Corresponding Author. Professor, Department of Edutech, Graduate School, Korea National Open University, Seoul, South Korea. Email: dragonknou@knou.ac.kr

Experience elements implemented in augmented reality have a positive effect on visitors' immersion (Choi & Pyeon, 2015). As a result of developing and operating augmented reality content related to tidal flats, which are difficult to experience in the field, we were able to provide an experience like the actual field indoors (Lee et al., 2019). Active experiences rather than fixed exhibitions can increase interest in the process of performing quests and help with learning.

Due to the recent spread of COVID-19, demand for online activities has increased in all sectors of society. The science museum is expanding digital-based content in new forms such as integrated special exhibition exhibitions in an online environment, and virtual science museums using the Metaverse platform, YouTube, and SNS. Online platforms have the advantage of not requiring maintenance costs and being able to attract platform users as potential customers (Kim et al., 2021). It can also function as a device that can encourage people to visit the science museum after first accessing the services provided by the science museum online. Through this, we were able to expand the demand base limited to existing adjacent regions to the entire country and see new possibilities for the spread of scientific culture in the online space.

Digital-based content is actively used in science museum exhibitions, education, and promotions, and recently, digital content and games have been used as science education tools to improve educational effectiveness and virtual spaces such as Metaverse have been used as exhibition halls. In this study, we analyze the status of digital-based content in the five national science museums in Korea and suggest future development directions.

2. Literature Review

2.1. Using Digital Contents as a Learning Tool

Ko and Lee (2019) studied the impact of improving elementary school students' motivation and attitude toward science learning by utilizing the rich digital content of the science museum website to overcome the physical limitations of the science museum. As a result of the study, digital content had a positive effect on improving both elementary school students' science learning motivation and attitude. Through this, it was confirmed that self-directed learning and individualized learning using digital content as a learning tool are possible. There is a need to develop digital content so that it can function as a learning tool in connection with the school curriculum.

Lee and Kim (2020) studied the use of digital content as a learning tool and its teaching effectiveness, focusing on the archive characteristics that facilitate the production and storage of information in digital content. Digital archives have the advantage of being able to quickly produce, transmit, share, and accumulate information based on a network. Additionally, it provides convenient access to digital objects and can be combined with innovative technologies such as augmented reality. As a result of conducting classes using digital archives, it was found that the use of digital content strengthens interest and motivation to learn and induces self-directed learning.

The Korea Foundation for the Advancement of Science and Creativity developed and provided Science Level Up, a content that applies gamification to scientific knowledge. Park et al. (2018) studied the impact of Science Level Up on science classes. As a result of the study, it was confirmed that science classes using gamification content stimulate learners' interest in learning and have a positive effect on their motivation to learn science. Digital content in the form of gamification also had a positive impact on learners' perception of science teaching methods.

Lee and Shin (2019) also conducted a study to apply the educational content of Science Level Up of the Korea Foundation for the Advancement of Science and Creativity to elementary school science classes. Topics were extracted in line with the elementary school science curriculum and reorganized by applying gamification elements. The experiment was conducted by dividing the participants into a research group that applied the reconstructed program and a comparison group that applied general science classes. The research was conducted on science-learning emotions, science-related self-concept, science-learning motivation, science-related attitudes, and career aspirations. As a result of the study, the average score of the study group was high in all areas, and there was a statistically significant difference. Through this, it was found that science education using gamification content does not only pursue fun but can increase concentration and interest in learning and expect long-term academic improvement.

2.2. Virtual Space Exhibition

Hong (2022) developed and operated a virtual museum using Minecraft, a metaverse-based online game. Minecraft's high degree of freedom, two-way communication ability, and game elements were selected as a suitable platform for virtual museum development. Among the exhibition contents, content that could be developed in the form of a game was selected to compose a story and design the space. As a result of a satisfaction survey of users, a high proportion of respondents responded that the level of implementation of the virtual exhibition was similar to the actual one and that they were able to obtain knowledge or information through the virtual exhibition. Users had the

characteristic of increasing interest as activities within the metaverse space became more specific and complex.

Song (2022) conducted exhibition practical training using the Metaverse platform to overcome the limitations of existing exhibition practical training, which made it difficult to predict the results of exhibition planning due to a lack of equipment and space for practical training. We conducted hands-on training to prepare for an exhibition in Metaverse using the spatial platform. As a result of the practical training, the ideas conceived during the exhibition planning stage were implemented in the form of an exhibition, increasing understanding of the exhibition theme and improving problem-solving skills. However, detailed spatial settings were difficult, and the lack of 3D data on archaeological artifacts were cited as a limitation of the practice.

Choi and Lee (2022) analyzed cases of folk painting exhibitions using the Metaverse platform and proposed the development of functional games in terms of gamification. Metaverse can be moved freely using an avatar, increasing immersion in the exhibition space, and allowing it to be perceived as a real space. Functional games within the exhibition space must be designed to fit the purpose and theme of the exhibition and provide appropriate enjoyment. As a simple yet playable game to learn folk tale information, drawing a landscape with stamps, drawing a book street with stickers, and drawing Korean characters were proposed.

3. Methodology

To understand the status of science museums' online services, we looked at the types of services at five national science museums under the Ministry of Science and ICT (Central National Science Museum (hereinafter "Central"), Gwacheon National Science Museum (hereinafter "Gwacheon"), Daegu National Science Museum (hereinafter "Daegu"), Gwangju National Science Museum (hereinafter "Gwangju"), and Busan National Science Museum (hereinafter "Busan")) (see Table 1).

Table 1: Online Service Web Site of the Five National Science Muse

Institution	Central National Science Museum	Gwacheon National Science Museum	Daegu National Science Museum	Gwangju National Science Museum	Busan National Science Museum
Location	Daejeon	Gyeonggi	Daegu	Gwangju	Busan
Homepage URL	www.science.go.kr	www.smart.science center.go.kr	www.dnsm.or.kr	www.sciencecenter.or.kr	www.sciport.or.kr
Yutube Channel	@nsm_science @sciencemuseumtv	@gnsmscience	@Scientry	@user-fx7zq2gf9u	@sciportbusan
Instagram QR Code	@NSMSCIENCE	@SCIPIA.GNSM	@DNSM_SCIENCE	@GNSMVISIT	@SCIPORT_BUSAN
Online Science Museum	https://vr2022.science.go.kr/intro/				
Metaverse Science Museum	-	-	-	https://zep.us/play/ 2N5KmX	https://zep.us/play/ 8rQlJM

The National Science Museums provide scientific and cultural services online using YouTube, SNS (Instagram), and online special exhibitions. The status of digital content provided by each science museum and the operation method of online special exhibitions were analyzed as follows to examine the characteristics of the science museum's online service. First, to understand the status of content provided online by the National Science Museums, we analyzed YouTube and SNS opening dates, number of subscribers, and major content. In the case of YouTube, the content type of videos with more than 10,000 views was classified. Second, in the case of YouTube videos, the top five video contents were analyzed based on the number of views to determine what content people are interested in. Lastly, we analyzed the status of the National Science Museums' online exhibition service to understand the form of online exhibitions and the extent of use of metaverse-based technology.

4. Result

There are two main types of digital-based content operated by the National Science Museums. First, posts in the form of videos and card news are uploaded to YouTube or SNS to deliver news about the science museum or provide educational materials. Second, special exhibitions that have been held are recorded with special cameras and provided online, or the Metaverse Science Museum is operated using the Metaverse platform.

All five national science museums promote science museum events and post their science education content on YouTube and social media. (see Table 2). In the case of the Central, it operates an additional "science museum TV" channel in addition to its channel. The main contents based on YouTube playlists include education, exhibitions, events, and promotions. Although there were differences in YouTube launch dates for each organization, there was a tendency for the number of subscribers to increase as more videos were uploaded. There was a total of 74 content with more than 10,000 views on YouTube, of which educational content accounted for the largest proportion at 49. Gwacheon Science Museum, which had the largest number of subscribers, had the most content with more than 10,000 views, of which educational content accounted for the largest portion.

Table 2: Operation status of YouTube and SNS(Instagram)

Institution			Central		Gwacheon	Daegu	Gwangju	Busan
			Central	Science Museum TV				
Youtube	Opening date		2015.04.	2020.01.	2013.03.	2015.01.	2020.03.	2016.05.
	Number of subscribers		15k	12k	87k	9k	3k	5k
	Number of videos		1,030	1,075	1,485	675	539	518
	Total views		1,101k	1,674k	6,807k	1,053k	280k	959k
	Main Content		Event Education	Education Event	News Education	Junior Science Communicator	Event Exhibition	Event Exhibition
	Highest Views		280k	26,000	48k	110k	15k	220k
	Over 10,000 views	Education	2	11	25	7	3	1
		Exhibition	0	0	2	3	0	8
		Event	7	0	1	0	0	4
SNS	Opening date		2018.01.		2018.01.	2016.03.	2016.01.	2017.01.
	Number of Followers		10k		13k	10k	7.5k	17k
	Number of Posts		1.3k		0.9k	1.4k	1.3k	1.5k

Note: As of January 2024

In the case of SNS, educational content in the form of card news is posted or science museum news is promoted. Busan Science Museum and Gwacheon Science Museum, which have more followers than other institutions, often held events with small prizes. This shows that events that can encourage participation are important to increase SNS followers.

The top 5 most viewed content types for each organization were analyzed (see Table 3). Content types were classified into education, exhibition, and event. The most viewed content was how to use the ChatGPT, which recorded 280,000 views. Because ChatGPT is a topic of the latest scientific issues, it appears to be a result that reflects people's interest. Although Gwacheon and Daegu did not have particularly many views, they recorded a steady number of views mainly for their scientific principles and experiment content. In the case of Busan, although it focuses on exhibition content compared to other institutions, it recorded a high number of views considering the number of subscribers.

Table 3: Top 5 digital content posted on YouTube

Institution	1st	2nd	3rd	4th	5th
Central	[Education] Chat GPT	[Event] Invention Contest	[Event] Science Performance	[Event] Invention Contest	[Event] Invention Contest
	280k	50k	24k	21k	10k

Science Museum TV (Central)	[Education] Tensegrity	[Education] Volcano Experiment	[Education] Make Slush	[Education] Environmental Adaptation	[Education] DNA Extraction
	26k	23k	17k	17k	15k
Gwacheon	[Exhibition] Infant Experience	[Education] Gyro	[Education] Typhoon and Tornado	[Education] Jupiter and Saturn	[Education] Bernoulli's principle
	48k	41k	37k	36k	35k
Daegu	[Education] Bernoulli's principle	[Event] Contest Promotion	[Education] Starch Experiment	[Event] Contest Promotion	[Education] Foucault's Pendulum
	110k	110k	100k	93k	16k
Gwangju	[Education] Acids and Bases	[Education] Hydrogen peroxide Decomposition	[Education] Maglev Train	[Education] Indicator Experiment	[Education] Molecular Cuisine
	15k	12k	10k	9k	9k
Busan	[Exhibition] Permanent Exhibition	[Exhibition] Special Exhibition	[Exhibition] Special Exhibition	[Event] Hello Maker	[Exhibition] Special Exhibition
	220k	55k	51k	44k	38k

Note: As of January 2024

The National Science Museums provide a service that allows you to film special exhibitions using panoramic VR and view them even after the exhibition ends (see Figure 1).

As a result of analyzing online special exhibition operation cases for four years from 2020 to 2023, a total of 30 special exhibitions can be viewed online to date (see Table 4). You can view special exhibitions without visiting in person through a PC, smartphone, or virtual reality (VR) device.

Figure 1: (a), (b) Online Science Museum (https://vr2022.science.go.kr/intro/index.html)

Table 4: Online science museum case analysis

Institution	2020	2021	2022	2023
Central	1	4	1	3
Gwacheon	1	1	1	1
Daegu	2	3	1	1
Gwangju	1	1	1	2
Busan	0	1	1	0
All institutions	1	1	1	0
Content	Exhibition commentary	Viewing mode, 3D experience zone	Viewing mode, Game	Viewing mode, Game

In 2020, a special exhibition filmed with panoramic VR and exhibition commentary by a guide were provided. From 2021, viewing modes have been divided into two types. It is divided into a general viewing mode, which allows users to move around the exhibition hall according to their will, and a theme viewing mode, which is a curated viewing mode that allows viewing according to thematic guidance. In 2021, visitors can enjoy simple games while viewing special exhibitions in a special space called the 3D Experience Zone (see Figure 2). Three games are provided, divided into three levels of difficulty by topic. The game consists of simple puzzle games such as shooting, running action, memory, and finding the difference.

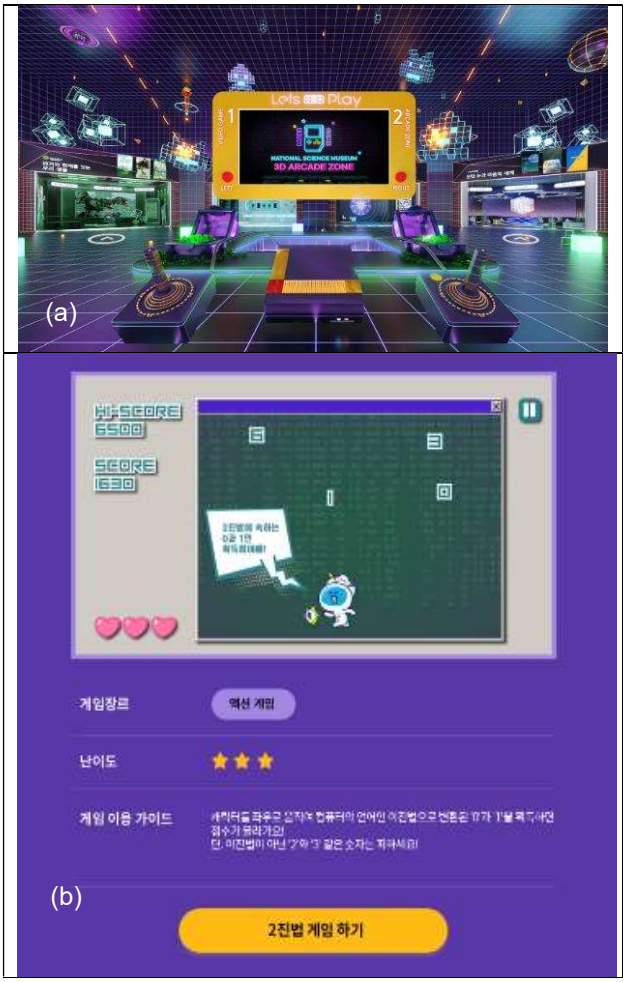

Figure 2: (a): Online Special Exhibition 3D Experience Zone and (b): Game

Gwangju and Busan are operating a Metaverse Science Museum using the Metaverse platform such as ZEP. (see Figure 3 and Figure 4). Visitors can move freely using customizable avatars in a virtual space like an actual science museum. Visitors can also communicate with connected parties at the same time using the microphone and camera functions.

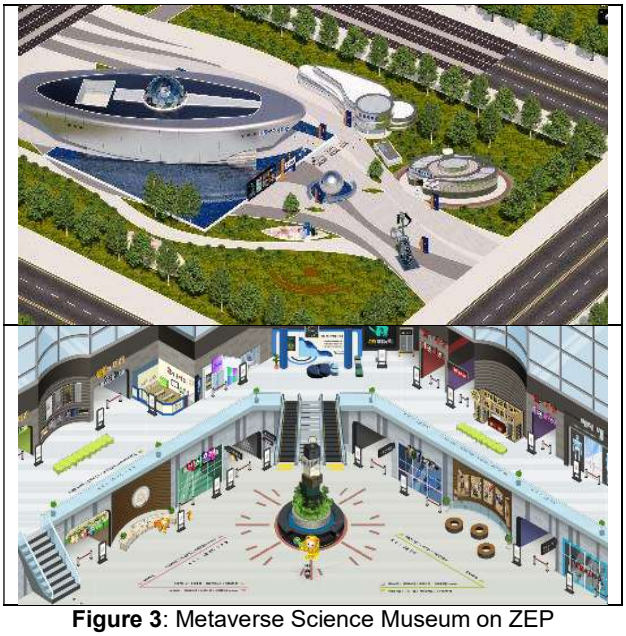

Figure 3: Metaverse Science Museum on ZEP (Science Center, Gwangju: https://zep.us/play/2N5KmX)

Figure 4: Metaverse Science Museum on ZEP (Sciport, Busan: https://zep.us/play/8rQlJM)

Gwangju's Metaverse Science Museum provides science museum information in connection with the science museum website rather than an exhibition function. The

Metaverse Science Museum in Busan has a conference room and training room for online classes. It contains gamification elements such as solving quizzes to earn badges to participate in events or playing claw machine games with coins picked up from all over the floor.

5. Discussion

The science museums are an informal educational institution that stimulates interest and curiosity in science through the latest scientific technology, experimental classes, and experiences that are difficult to handle in the classroom. (Ryu & Kim, 2016). After COVID-19, various attempts are being made to spread scientific culture online by expanding digital content. They use social platforms such as YouTube and Instagram to post educational content or promote science museum news and provide a service that allows you to view past special exhibitions online.

Museums and art galleries, which are representative exhibition halls, are making some efforts to go partially online, but there are many limitations to being a perfect alternative to offline exhibitions (Lee, 2020). Unlike museums or art galleries that focus on objects, science museums have a wide range of areas that can be shown online. All areas within the science museum, including education, exhibition commentary, and events, can be recorded and turned into content. The science museum's YouTube content contains a variety of videos, from simple science experiment videos to exhibition hall tours. Additionally, attempts have recently been made to improve the educational effectiveness and quality of science museum video content by applying storytelling techniques rather than one-sided information delivery (Kim et al., 2021).

The science museum's online special exhibition was filmed in panoramic VR and expressed as a 2D digital image. Videos were also used to show the movement of exhibits or to aid understanding. Visitors can use the mouse to move to the route they want to see, but the operation is not smooth, which reduces the sense of realism. A theme viewing mode was provided to enable individual study by topic, but it ended up being a one-sided explanation, making it difficult to find interaction. Although it can resolve the disappointment of the short viewing period of special exhibitions, it is only a record with an exhibition commentary without interaction with visitors, so there is a limit to encouraging active learning from visitors.

As such, until now, cyber science museums have been operated in the form of one-sided knowledge transfer. In the case of cyber science museums in Gwangju and Busan, which are operated on a metaverse platform such as ZEP, the space was created similar to the real one. To increase immersion, users directly manipulated the avatar to move around and utilized gamification elements such as badges and rewards. The ability to communicate with each other through microphones and cameras also took full advantage of the Metaverse. There are limits to exploring scientific principles and it is only an event for fun, but it is meaningful in that it is implemented in an interactive metaverse space.

Based on the analysis of the status of online services in the science museum, the direction of digital-based content expansion is suggested as follows. First, concrete utilization plans are needed so that the abundant online content accumulated so far can be used for actual education. In many studies, it was found that the use of online educational content as a learning tool had a positive effect on science learning motivation and science attitude (Ko & Lee, 2019; Park et al., 2018; Lee & Shin, 2019). As non-face-to-face distance learning has expanded, many teachers have used video content such as YouTube during class (Jong & Son, 2021). There are many of online content provided by the science museum, but there is no simple way for teachers or parents to use it. Therefore, to use it as a learning aid, there is a need for a method that can guide textbooks and the latest science issues in connection with the online contents of the science museum. Second, it is important to develop content incorporating a new platform. It is important to develop a steady platform like the metaverse science museum. Games can also be used as educational tools to make abstract scientific concepts concrete and easy to understand.

References

Choi, E. J. & Lee, Y. S. (2022). A study on planning minhwa exhibitions and serious games based on metaverse platforms. *Journal of Korea Game Society, 22*(5), 3-14.

Choi, S. M. & Pyeon, J. M. (2015). A study on the augmented reality-based experience exhibition immersion. *Korea Society of Design Trend, 49*, 167-178.

Han, M. J., Yang, C. H. & No, T. H. (2010). Perceptions and educational needs of teachers for instructions for using the science museum. *The Korean Association for Science Education, 30*(8), 1060-1074.

Hong, S. H. (2022). A study on educational use of metaverse-based virtual museum through case analysis: Focusing on the case of the children's museum of the national museum of Korea. *National Museum of Korea, 6*, 117-146.

Jeong, E. J. & Son, J. W. Analysis of the users' viewing characteristics of youtube video contents related to science education. *Journal of Science Education, 45*(1), 118-128.

Kim, H. U., Kang, S. C. & Hong, O.S. (2022). Exploring the role of science centers for future education: Focusing on survey of visitor experiences and demand for space. *Journal of Research in Curriculum & Instruction, 26*(1), 68-79.

Kim, M. J., Kang, D. Y. & Lee, H. O. (2021). Analyzing storytelling represented in educational convergence content of science museums' youtube videos. *The Korean Society of science & Art, 39*(3), 11-25.

Kim, Y. S., Lee, S. H., Sohn, J. J., Kim, J. B. & Kweon, H. S. (2010). The study for the improvement of the informal science education program of the Gwachon national science museum based on the participant satisfaction. *Journal of Science Education, 34*(2), 279-290.

Ko, Y. R. & Lee, S. H. (2019). The effect of project based learning using cyber science museum on elementary school students' motivation for science learning and attitude toward science. *The Korea Society for fisheries and Marine Science Education, 31*(6), 1696-1707.

Lee, G. A., Hong, S. K., Jun, Y. Y., Lee, S. W. & Won, Y. T. (2019). A study on the development of the augmented reality exhibition content and evaluation of visitors' satisfaction in tidal flats biology and ecology. *Institution for Marine & Island Cultures, 54,* 145-168.

Lee, H. M. & Kim, M. S. (2020). Case study of digital contents for online education in college - Focused on virtual museum. *Korean Journal of General Education, 14*(4), 81-96.

Lee, Y. B. & Shin, Y. J. (2019). The effect of 'science level-up' science classes with applied gamification factors on positive experiences about science (PES). *Biology Education, 47*(1), 97-106.

Lee, Y. S. (2020). A study on changes to museum education and online educational content caused by the COVID-19 pandemic -With a focus on educational cases of the peabody museum of natural history in the U.S.A. and the tate modern museum in the U.K. *National Museum of Korea, 4*, 137-167.

Park, S. J., Lim, S. K., Rachmatullah, A., Ha, M. S. & Yoon, H. S. (2018). The effects of science class applied gamification contents. *The Korean Society for School Science,12*(1), 75-84.

Ryu, K. Y. & Kim, M. J. (2016). linking school curriculum with education in science museum. *Journal of Education & Culture, 22*(3), 73-98

Song, M. y. (2022). A study on the practical education for museum exhibitions using metaverse. *KOMUNHWA, 100*, 153-175.