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Virtual Reality-Based Library User Education Program Development

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ABSTRACT

Virtual Reality (VR) is one of the core components of the fourth industrial revolution as a technology that makes the virtual world feel as if it is real. VR is being used in various fields such as entertainment, advertisement, education, medical care, training, sports, and tourism, as well as providing contents for such things as games and videos. Libraries are already looking for ways to utilize VR from various angles, such as operating experiential programs. The purpose of this thesis is to develop and propose a VR-based library user education program. In order to achieve the purpose of the study, we analyzed previous studies from a theoretical perspective to find a way to construct a user education program, and also to derive possible implications based on examples of countries such as the United States and Korea that are already introducing and applying VR technology to library services. Therefore, the user education program proposed in this study can be used as a basic building block when many libraries want to develop VR-based programs in the future.

Keywords: virtual reality, library user, library user education, education program, development of user education program

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1. INTRODUCTION

According to "Global smartphone user penetration forecast by 88 countries: 2007-2026," announced by market analysis company Strategy Analytics, as of June 24, 2021 the number of global smartphone users is 3.95 billion, which is half of the world's population of 7.9 billion people (Wu & Kumar, 2021). In 1994, when the world's first smartphone was released, there were only 30,000 users. It is predicted that more than five billion people will use one by 2030, and this communications devise has become an indispensable life tool.

The fact that many people use smartphones means that individuals create a lot of data on digital media and the Internet. Users are able to interconnect with various functions and media anytime and anywhere based on cloud-based technologies. In other words, if in the past connections were possible only when people and their devices met in person in the real world, now it is an era of possibility where people can achieve infinite expansion in the virtual digital world – the new reality. It can be said that we are living a life where the boundary between real life and virtual reality is blurred and we are able to experience new things that we were unable to in the past.

Virtual Reality (VR) is a technology that creates a specific environment or situation through a computer simulation and makes it as if the user is actually interacting with it. Augmented Reality (AR) is a technology that combines virtual information or images with the reality we see with our eyes. It is a core technology that realizes mixed reality and is currently being applied to various industries under the leadership of many countries. The library is also striving to provide a variety of services using cutting-edge technologies of this nature.

Not all libraries are implementing VR-based services, and even if they do, they are still in the preliminary stages, focusing on basic experiences. Consequently, research on VR-based library services is also biased toward application and operational conditions. However, as the number of libraries providing VR-based services is expected to gradually increase, this study aims to develop and propose a VR-based library user education program that can aid and be commonly applied to all libraries.

2. RESEARCH METHOD

2.1. Research Questions

This study began with the following questions.

1) Will it be possible to develop a VR or VR-based library user education program?
2) If possible, how can the library user education program be designed?

2.2. Research Objectives

Starting with the two research questions posed above, this study aims to propose a detailed and robust design plan for a VR-based library user education program.

2.3. Research Procedure

This study was conducted according to the following methods or steps to achieve the objectives already stated.

First, in terms of the main theory and associated technologies of VR, the VR positioning elements of public libraries and the composition of user education were systematically reviewed. The effects of VR-based education were also analyzed from previous studies on the subject.

Second, VR-related cases and technology used in library services in countries such as the United States (US), Canada, Singapore, and Korea were analyzed to derive 'best practices' in finding ways to design library user education programs.

Third, a design plan for a VR-based library user education program was proposed, focusing on the results and possible implications sought through designed case studies and analyses.

3. LITERATURE REVIEW

3.1. VR

In January 2016, as the term 'fourth industrial revolution' appeared at the World Economic Forum, VR also drew considerable attention. The Fourth Industrial Revolution refers to a change in which technology convergences as the boundaries between digital, physical, and biological domains disappear. In other words, it refers to the era of 'hyper-connectedness' in which the real world and virtual space, such as people, machines, intelligence, and services are connected centering on data (Korea Institute of Design Promotion, 2016).

VR is part of a spectrum of related technologies ranging from mostly real experiences to completely virtual experiences, such as augmented reality, augmented virtuality, and mixed reality (Milgram et al., 1995). VR is commonly defined as an experience in which users remain physically within their real world while entering a virtual world (comprising three-dimensional objects) using a headset with a computer or a mobile device (Lessick &

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Kraft, 2017).

Brooks (1999) presented four important technologies in VR as follows:

1) The visual (and aural and haptic) displays that immerse the user in the virtual world and that block out contradictory sensory impressions from the real world;
2) The graphics rendering system that generates, at 20 to 30 frames per second, the ever-changing images;
3) The tracking system that continually reports the position and orientation of the user's head and limbs; and
4) The database construction and maintenance system for building and maintaining detailed and realistic models of the virtual world.

VR or AR is a phenomenon that has been in its varying growth stages for years (in the case of VR, decades, as far back as the 1930s). But today, with a headset available to some and a hand-held device available to many, it benefits library users who are fully expecting such enriched services in the future to include VR or AR (Massis, 2015).

In particular, VR environments can contribute to increasing the motivation of learners as well as to the enhancement of exploration and problem-solving skills. This is done by enabling multimedia learning environments that have been utilized so far in education and through three-dimensional stereoscopic environments (Leem, 2001). Furthermore, VR technology is a highly potential tool for supporting learning of abstract content areas that have previously been difficult to understand, which is why it is considered a system of very high educational value in the future (Rheingold, 1991).

In the 'Digital Human Library' (2021), through an article titled "Why use virtual tours (VT) & virtual reality in the public library?", the elements that the public library utilizes for tours and VR as a powerful participatory learning environment for members are presented as follows.

1) Add Context to Learning: When library members immerse themselves in a virtual environment, they are transported to a place which provides another layer of context to the learning experience.
2) Provoke and Sustain Inquiry: When library members are transported to new learning environments to explore topics and content, what they see and experience inevitably leads to questions and potential inquiries.
3) Learn by Doing: VT & VR by nature are interactive experiences – engaging library members as designers of their own learning.
4) Connect Emotionally to Learning: Library members engage with the content in VR environments; they are stimulating their brains in ways that support retention of new information and experiences.
5) Personalize Learning: VT & VR is a powerful personalization tool for learners at any age. Not only are library members able to choose the environments they wish to explore, but they have opportunities to self-direct the pace of learning and how they engage with the content.
6) Learn Visually: VT & VR experiences help everyone visualize the content and concepts they are learning, making it easier to comprehend.
7) Inspire Creativity: VR can take library members to new levels of creativity never before experienced.
8) Take Risks: VR can provide library members with an immersive personalized learning environment where they can explore new content on their own. These kinds of individualized experiences can have significant therapeutic outcomes for library members who experience anxiety in various situations.
9) Scale Learning Experiences: VT & VR give librarians the power to expose their members to experiences they might not otherwise have in life – such as trips to manufacturing plants, botanical gardens, and museums, or access to full technology labs where they can experiment and explore. VT & VR makes scaling unique educational experiences possible.

Librarians are always on the cutting edge of these technologies to engage their customers, and using such tools to encourage higher levels of information literacy through all of the combined tools available to them is critical to student success (Massis, 2015).

3.2. User Education

One of the most important parts of any social education system is the library. Libraries make use of user education to exert social education functions, make self-advocacy, or improve the usage of literature. Mastery of the library technologies can only be achieved through user education as well as information resources and literature retrieval skills, all of which improve the user's ability to access information. By performing user education, we can deal well with the relationship between collection and utilization of information resources as well as strengthening

the close tie between users and the library, engaging more members of society to make use of the library, thus ensuring the best use of library resources. User education can at the same time help strengthen the popularity of library knowledge, enhance user awareness, and cause general attention and support for the library from society. This will in turn promote the use of the library, improve its social status, and develop its multiple functions, thus promoting the development of the library cause (Zhu, 2009). User education is an essential task of any library to make its resources visible and available to outreach (Sun & Rader, 1999).

Zhu (2009) presented contents of library user education, patterns of library user education, and issues that should be paid attention to during education, which Table 1 summarizes briefly.

Table 1 summarizes the stages of 'Contents of library user education,' divided into 'Basis-oriented education,' 'Information literacy education,' and 'Information technology education.' Among them, 'Basis-oriented education' includes the most basic contents about libraries, including the concept of libraries, an introduction to library services, and regulations on how to use books (such as book lending). 'Information literacy education' includes accessing, processing, and absorbing information to help create new capabilities. This is because users' ability to use information helps to increase the efficiency of library use. Finally, 'Information technology education' includes multimedia technology, database technology, and network technology. These technologies will help users store, extract, develop, and explore information, and enhance their ability to utilize technologies.

Next, in 'Patterns of library user education,' 'Strengthening oriented education, paying attention to practical training,' 'Holding training course, topical lecture and seminar,' 'Setting up literacy retrieval courses in colleges and universities' are the different categories. Among them, 'Strengthening oriented education, paying attention to practical training' is a way to increase the effectiveness of training by running guided tours to introduce users to various departments of the library. 'Holding training courses, topical lectures and seminars' is a strategy for universal users to achieve short-term results, including inviting experts to host various seminars, operate mobile libraries, or meet information needs as much as possible through telephone counseling. 'Setting up literacy retriever courses in collections and universities' is a university-specific information search program based on user-centered teaching and learning activities to help students understand various search theories, methods, strategies, and technologies. Finally, 'Web-based information literacy' includes measures to help users make the most of the resources collected through their own web pages.

'Issues that should be paid attention to during education' include 'conducting it in a planned way,' 'combining the groups and the individuals,' 'contacting closely with practice,' 'grasping the characteristics of different users,' and 'taking into account the potential users.'

Nowadays, the marketing of library services and communication with the mass of users in regards to services and the collection of the library has become more relevant than ever within academic libraries. The emergence of Web 2.0 technologies empowered users with the ability to access libraries on a 24/7 basis through numerous tools and platforms like online video creation and sharing. In a study from 2011 it was shown that 71% of online American users had watched videos on video sharing websites such as YouTube or any other video sharing website (Moore, 2011). This increased usage of video sharing websites demonstrates the power of multimedia and its

Table 1. Composition of library user education

Item	Contents of library user education	Patterns of library user education	Issues that should be paid attention to during education
Step	The basis-oriented education	Strengthening oriented education, paying attention to practical training	Conducting it in a plain way
	Information literacy education	Holding training courses, topical lectures, and seminars	Combining the groups and the individuals
	Information technology education	Setting up literacy retrieval courses in colleges and universities	Contacting closely with practice
	-	Web-based information literacy education	Grasping the characteristics of different users
	-	-	Taking into account potential users

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ability to provide personalized content experiences. The implementation of personal touch within outreach, marketing, and communication is possible especially when libraries push their content out to users by establishing additional access points through sites such as YouTube, and/or by making their videos available on the library's website. Creating an online video presence requires long-term commitment from the library if it is to provide up-to-date communications that can attract the views of the viewer community (Little, 2011).

The purpose of using VR in user education is not simply to enjoy three-dimensional images, but to help users accept the library more realistically and closely through virtual experiences. In planning education programs for library users, it is necessary first to define goals and objectives. After this, course content and timing of the various stages are decided, together with the teaching methods and media to be used. The result of this planning is then tested in a practical situation, and evaluation is carried out in order to assess the effectiveness of the program. Fig. 1 illustrates the decision flow process for the development of a course of education in relation to existing practice (Fjallbrant, 1979).

3.3. Effects of VR-based Education

Yoo et al. (2018) synthesizes and analyzes the specific effects of the VR, AR, and MR (Mixed Reality) on learning performance by using meta-analysis on the related field. The result shows that the overall effect size for the learning performance of VR, AR and MR based learning is 0.873, which represents a large effect size. The effect size for VR was 0.743 and for AR based learning it was 0.994. In the 95% confidence interval [-0.214, 0.838], MR-based learning was not significant. In conclusion, their study's findings indicated that VR, AR, and MR-based learning was effective for the students' learning outcomes. The extensive results of the studies also enable the use of the strategy, evidence-based practices for design, and the operation of classes for VR, AR, and MR-based learning.

Allcoat and von Mühlenen (2018) studied the effects of learning in a VR environment on performance, emotion, and participation after allocating 99 participants to traditional (textbook style) and VR & video. The result was that participants in the traditional and VR conditions improved their overall performance (i.e., learning, including knowledge acquisition and understanding) in comparison to those in the video condition. The participants in the VR set also displayed a better performance for 'remembering' than those that were in the traditional and video condition. Self-ratings of emotions before and after the learning phase showed an increase in positive emotions and a decrease in negative ones for the VR condition learners. On the other hand, there was a decrease in positive emotions in both the traditional and video conditions. The Web-based learning tools evaluation scale also found that participation in the VR condition reported higher engagement than those in the other conditions. Overall, VR displayed an improved learning experience in comparison to traditional and video learning methods.

Mehta (2018) observed that the usage of virtual real-

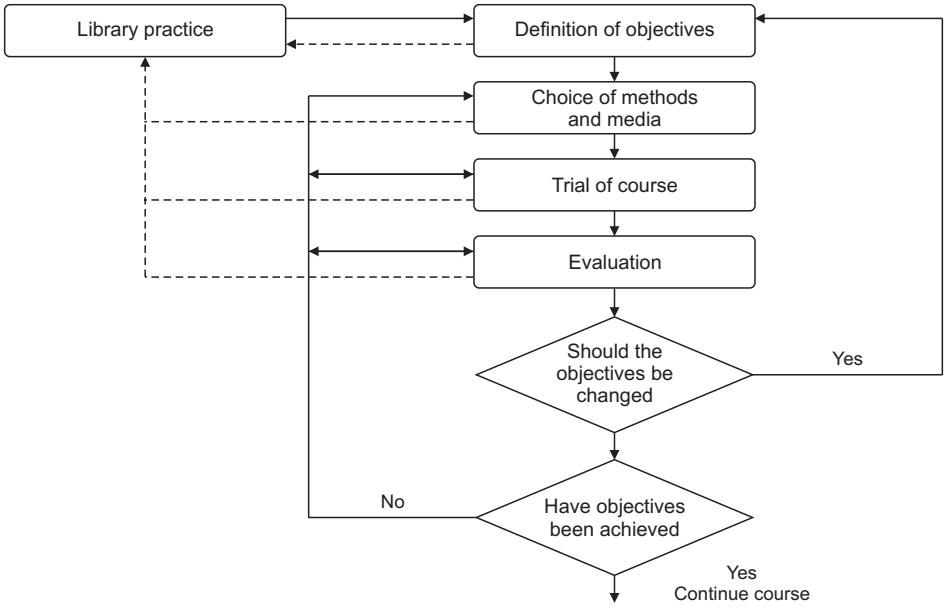

Fig. 1. Development of a course of education in relation to existing practice.

ity is particularly good for general questions with a visual or spatial component and that traditional learning via reading remains the more effective way for memorizing figures or absorbing minute details (things that are not as important as grasping general concepts and ideas). He also found out that there is an overwhelming preference among students for learning with a virtual reality component in place of traditional learning.

Choi and Kim (2020) developed and applied VR-based biology programs for sixth-grade elementary school students to explore their effects on cognitive and definitive domains. Based on the results, the following model shows the unique characteristics of virtual reality as it relates to the learning effect – presented as shown in Fig. 2.

Combining the research results above, it can be said that VR-based education provides an improved experience compared to existing methods in terms of results for such things as interest in learning, understanding, and knowledge acquisition. However, since these studies were not conducted for all generational population groups, a more detailed approach would be required, especially for digital natives, the generation born and raised in a digital environment. This will be more effective because they can freely use digital languages.

4. CASE ANALYSIS

4.1. Case Analysis 1: Using VR in the Library

Hahn (2017), Howard et al. (2018) conducted research on VR services that could be provided by libraries. In addition, Pope (2018), Cook et al. (2019), and Patterson et al. (2019) conducted a study that presented that current status of VR services provided by libraries. Lee and Chung (2020) reviewed the above research and presented the types of VR services as shown in Table 2.

Kim et al. (2021) selected 11 public libraries in the US and Canada that are running VR programs relatively well by searching keywords such as VR, Virtual Reality, and Public Library VR, and summarized the current status as shown in Table 3.

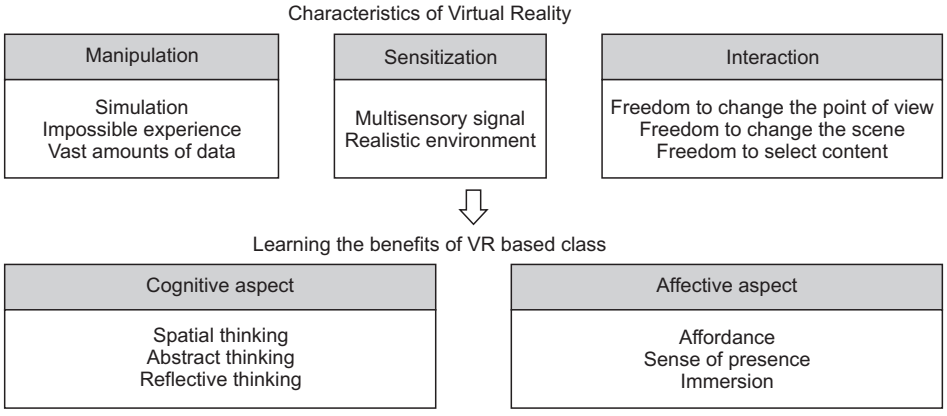

Fig. 2. Model of learning in VR based class, incorporating unique characteristics of VR. VR, Virtual Reality.

Table 2. Types of VR services

Types of services	Contents	Method
VR experience	Exploring VR technology through VR devices and content	Use of makerspace, borrowing equipment outside the library, using inside the library, building a separate space for use, and attracting interest through briefing sessions
VR research	Provide VR as a new research tool, use it for data visualization and study content development	
VR education	Classes using VR, workshop, individual and group training through VR, content development education, VR literacy education	
VR tour	VR tour creation	
Collection access	View materials through VR, access 3D-based digital collections	
VR environment creation	Create an immersive learning environment for students	

VR, Virtual Reality; 3D, three-dimensional.

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Table 3. VR programs at selected North American public libraries

No.	Library	VR contents	To be used	How it works
1	Cologne Library	Education, architecture, space travel, games, etc.	More than 16 years old	- Proceed by reservation - Up to 3 hours available - Time varies by device (Oculus Rift, HTC Vive) - VR workshop - VR-related events (Virtual Reality Day, etc.)
2	Coquitlam Public Library	Contents distributed in STEAM and Oculus by subject, such as fun, education, etc.	More than 13 years old	- Proceed as a multiple rounds program - Tuesday: 14:00-16:00 - Available for approximately 15 minutes per session - Users fill out the consent form before using VR - Age 13-18 requires parental consent
3	Cranston Public Library	Has more than 1,000 contents	More than 12 years old	- Proceed as a multiple rounds program - Participate in reservations after checking the schedule on the calendar on the library site - V-lab operation with the support of several institutions
4	Ela Area Public Library	Various contents provided: YouTube 360, Oculus, direct shooting	More than 12 years old	- Proceed by device-specific reservation - Librarian authentication required before using VR - Training before using VR
5	Eugene Public Library	Learning content: space, sea, human body, planet, various countries Oculus provides content available	More than 13 years old	- Proceed by reservation - Reservations available during library opening hours on Thursday, Friday, and Sunday - Up to 1 hour available - Available for 20 minutes per session
6	Everett Public Library	Content including blood flow, White House tours, International Space Station expeditions, and more	More than 13 years old	- Proceed with free experience - Saturday 13:00-16:00 - Available for 15 minutes - If under the age of 18, parental consent is required
7	Fraser Valley Regional Library	Providing STEAM learning content	More than 10 years old	- Proceed as a multiple rounds program - Participate after checking the program schedule - Fill out the consent form before using VR - Over 48 inches tall - Necessary to fill out a parental consent form for minors
8	Jacksonville Public Library	Content such as visiting cities in different countries, exploring the human body, and experiencing roller coasters	More than 13 years old	- Proceed as a multiple rounds program - Participate after checking the program schedule - Fill out the consent form before using VR - 13-17 years old; parental consent form required
9	Los Angeles Public Library	Google Earth VR (virtual travel) and learning content	More than 13 years old	- Proceed as a multiple rounds program - Participate after checking the program schedule
10	Queens Public Library	Experience program operation	More than 13 years old	- Proceed as a multiple rounds program - Participate after checking the program schedule
11	San Francisco Public Library	Game: Virtual Reality event operation	13-18 years old	- Proceed as a multiple rounds program - Saturday 13:00-15:00

VR, Virtual Reality; STEAM, science, technology, engineering, arts and math.

According to the analysis in Table 3, the public libraries mainly provide hands-on content such as education, science, technology, and human exploration as multi-use programs for users ages 10 or older. It can be said that they are focusing on experiences that are aimed at exploring technologies through VR devices and contents. Therefore, it is increasingly necessary to find ways to expand services that can range from VR research to VR education, VR

tours, collection access, and VR environment creation.

4.2. Case Analysis 2: Using VR in the Library User Education

Although VR classes are already being practiced in various ways in schools, it is difficult to find cases where VR is used for educational purposes. The library still mainly operates programs focused on finding ways to introduce and apply VR. However, considering that it is not easy for users to use the library due to the COVID-19 pandemic situation, the VR Tour was produced and released on the website and YouTube (including access to the library and how to use it). Therefore, and in a broader context, the VR Tour is thought to be a way of training users beyond just orientation. Several examples are discussed below.

The National Institute of Education Library, Singapore (National Institute of Education Library, 2021) tested the concept of utilizing a 360-degree digital camera and VR software tools to create a VR library tour experience for its library users. While providing an overview of the library facilities and resources through its website, the users of NIE only get snapshots of the library through images and textual description of the library facilities and its resources. The scope that NIE set for its VR tour was to provide a way for users to get to know the library better and excite library usage (Fig. 3).

Since January 2020, Seoul National University in Korea has launched a VR Tour service that allows library users to access through its website. The VR Tour was designed to accommodate people who were unable to visit the library during the COVID-19 pandemic, and it was designed to provide a panoramic view of the library and various facilities. The Seoul National University Library (2021) consists of a central library main building, a government building, and nine other branches. The VR Tour shows facilities on all floors beginning at the entrance to the central library main building (Fig. 4).

The Ottawa Public Library and Library and Archives Canada Joint Facility (2021), which officially announced the name "Ādisōke" on August 5, 2021, also provides a video of "Take a Tour" on YouTube via its website. The contents of the video include details on how to come, explore the structure, and how to use the building (Fig. 5).

5. DESIGN OF AN USER EDUCATION PROGRAM

5.1. Select VR-enabled Content Type

VR content types can be divided into mission interaction and immersion types. Among them, the mission interaction type has the advantage of being able to convey information well through realistic descriptions because it allows users to directly insert additional information. The downside is that motion sickness can occur. On the other hand, the immersion appreciation type does not allow users to interact directly since there are no obstacles. It can also alleviate motion sickness phenomena as well as the advantages of being immersed and appreciated from

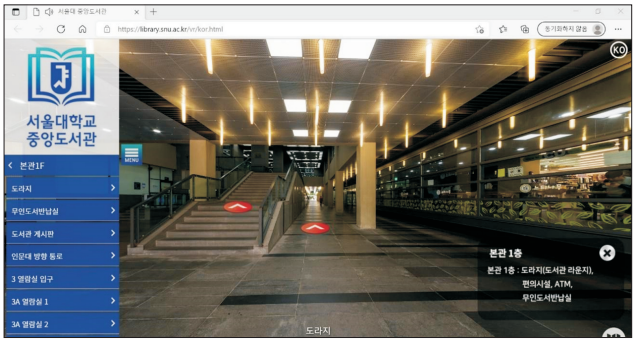

Fig. 4. VR tour of Seoul National University Library. VR, Virtual Reality.

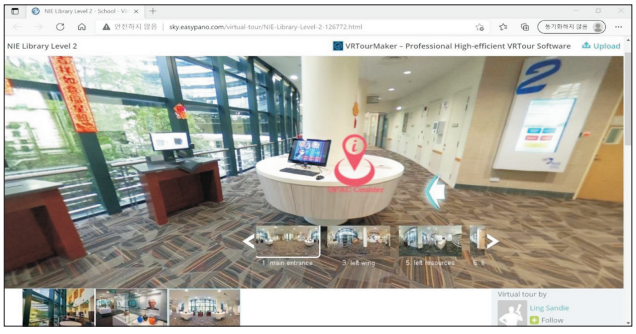

Fig. 3. VR tour of National Institute of Education Library. VR, Virtual Reality.

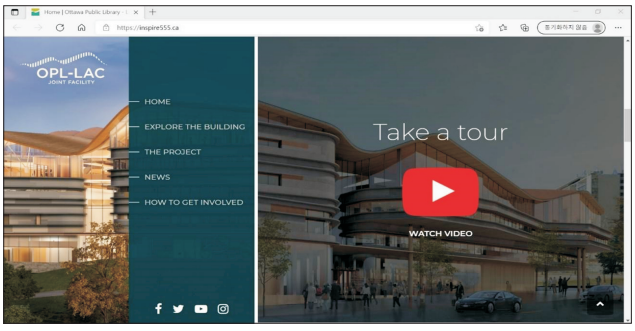

Fig. 5. VR tour of Ottawa Public Library and Library and Archives Canada Joint Facility. VR, Virtual Reality.

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beginning to end. Therefore, it would be desirable to select the 'immersion-sensitive' content type for library user education programs using VR.

5.2. Library User Education VR Content Composition

The VR contents for library user education are based on the 'Composition of library user education' proposed by Zhu (2009) in the first stage, 'Basis-oriented education' process, the second stage 'Information literacy education' process, and the third stage, 'Information technology education.' After organizing the process, the content to be included in each stage is described in detail. If users participate and follow each step-by-step educational process, they will be able to ameliorate and cultivate library usability.

5.2.1. Stage 1. The Basis-oriented Education Course

Library user education Stage 1 is the basics orientation education course, and the contents to be included in this stage are the things one needs to know about the library and library use. This includes the sequence of VR contents starting from the entrance of the library, and after guiding the virtual participant through each floor, it was configured to lead to the exit. The details of the contents include the location of the library and how to visit it, a brief guide on the overall structure (floor by floor) of the library, and general information on how to use it, such as closing days and the issuance of loan cards. Table 4 summarizes 'The basics oriented education course.'

5.2.2. Stage 2: Information Literacy Education Course

Library user education Stage 2 is an information literacy education course, and the educational contents can include digital basic literacy, the digital literacy academy, research support education, and academic resource utilization education. Table 5 is an information literacy education course composed based on digital information utilization education conducted by the National Library of Korea (2021).

5.2.3. Stage 3: Information Technology Education Course

Library user education Stage 3 is an information technology education course, which includes multimedia database and network technologies. Education at this stage will help users store, extract, develop, explore information, and enhance their ability to utilize technologies. Table 6 summarizes the contents that can be included in the information technology education course.

5.3. Determining the Type of VR Usage for Library User Education

5.3.1. VR Type

The virtual experience (VR type) of the actual library maintains the framework of a traditional library and im-

Table 4. Stage 1: the basics-oriented education course

Order	Place	Contents
1	Library entrance	Information on how to use the library, such as the location of the library and how to get there, a brief guide on the overall structure, closing days, and issuance of a loan card
2	Each floor	Information on the structure of each floor, information on how to use each library
3	Library exit	Introduction of library staff, homepage, and phone number information

Table 5. Stage 2: information literacy education course

Order	Subject	Contents
1	Digital basics	2021 Digital Trend, Copyright Special Lecture for Digital Citizens, Basic and Advanced Artificial Intelligence literacy Education
2	Digital literacy academy	Media literacy academy for parents, big data academy for office workers, entrepreneurship academy for young people, essay academy for middle-aged people.
3	Research support education	SPSS statistical analysis for thesis writing, NVivo statistical analysis for thesis writing, data analysis using text mining, basic and advanced R statistical analysis
4	Education using academic resources	Education using overseas academic DB, education using bibliographic management program RefWorks, and education using subscription electronic resources

DB, database.

Table 6. Stage 3: information technology education course

Order	Classification of course	Contents
1	Application programming (web & mobile)	JAVA, Oracle, HTML5, JavaScript, jQuery Mobile, AJAX, Servlet, JSP, Node.js, Android App etc.
2	Big data & Machine learning & Deep learning	Big data building, development, collection, storage, processing, analysis, visualization, Python, NumPy, Pandas, Hadoop, Spark, Cloud, Linux, NLP, Chatbot etc.
3	Web publishing & Web design	Photoshop, Illustrator, HTML5, CSS3, Bootstrap, WordPress, JavaScript, Hybrid App, UI/UX etc.
4	Network & Information security	LAN Switching, IP Routing, Redistribute, SLB, BGP, PBR, Gateway, VPN, VRF, ISAKMP, IPSEC, Nexus, Python, SW Security, Linux, System Security, Cisco etc.

plements a cyber-library through VR. This is used to promote information on how to use and/or upcoming events online. Many libraries already have VR Tour programs in operation. Therefore, for the VR type of library user education, the virtual experience VR method of the actual library is recommended.

5.3.2. Application of VR Content

VR contents are produced by shooting real space using multi-video equipment, but the biggest difference from the existing method is that 360-degree views must be filmed simultaneously. When shooting with multi-image equipment, important considerations include the size of the camera to be used, the viewing angle, and the process of splicing. In order to create a VR video, it is necessary to capture all 360-degree screens while overlapping the fields of view of at least six cameras. Currently, all-in-one equipment has been developed to complement this, and it is possible to shoot 360-degrees with a single camera. In addition, it is possible to create VR effects by editing normal videos that are not filmed in 360-degrees (Ko, 2018).

5.3.3. VR Utilization Device

There are various types of devices that use VR, but the one that can be applied realistically to library user education is immersive VR. Immersive VR refers to an interface that shows images through a display window when an Head Mounted Display device is mounted on the head, like eyeglasses.

6. DISCUSSION

Digital technology in the era of the fourth industrial revolution is being applied in many places, bringing about great and spectacular changes. In particular, among many technologies, VR is creating a new dimension of space by bridging the boundary between the physical world and the digital world through connections with the cyber world. Therefore, the purpose of this study was to propose a design plan for a VR-based library user education program. Questions that should be explored concerning VR and libraries, and the possible implementation thereof, include the following.

1) If it is possible to experience the space of a virtual library through VR devices anytime, anywhere, for what purposes should the library exist in the future?
2) What possibilities can VR open for libraries?
3) How should the library be changed in order to become a space necessary for citizens' lives in the future?

7. CONCLUSIONS AND SUGGESTIONS

The purpose of this study is to propose a design plan for a VR-based library user education program. In order to achieve the purpose of the study, we analyzed previous studies from a theoretical prospective and propose the following methods for constructing the user education program.

First, the content type using VR was selected as an immersive viewing type. This is because the immersive viewing type has the advantage of allowing users to immerse themselves in the user's education from start to finish (and can alleviate motion sickness).

Second, VR contents for library user education consists of 'Basis-oriented education' in the first stage, 'Information literacy education' in the second stage, and 'Information technology education' in the third stage. Among these, the first stage includes the most basic information for library and library use, and the second stage may include digital basic literacy, digital literacy academy, research support education, and academic resource utilization education. Subsequently, the last three stages include multimedia

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technology, database technology, and network technology.

Third, among the types of VR usage for education for library users, the VR type uses the virtual experience VR method of the actual library, and the application of VR contents uses multi-image equipment to produce 360 degrees of the actual space. Preference is given to immersive VR, an interface that shows images through a display window when the device is mounted on the head, not unlike that of eyeglasses.

VR can overcome the physical, temporal, and spatial limitations of traditional libraries, and make the library a space where one can experience new things. The popularity of libraries will only increase and make them a destination all will want to visit. Therefore, it is expected that many studies related to VR and AR utilization in libraries will be conducted in the future.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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