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A Qualitative Study on Perception of Virtual Reality-Based Oral Health Education Contents: Focus Group Interviews*

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ABSTRACT

The purpose of this study is to examine and understand the perceptions and intention to utilize of the virtual reality-based oral health education contents among the general public. The study participants were selected by using the non-probability sampling methods. A total of 15 participants were selected, including 5 young people, 5 middle-aged people, and 5 elderly people. The focus group interviews were conducted in December 2022 and February 2023, with two sessions for each group. Through the focus group interviews, four core categories and ten central topics were derived. The four core categories were derived from the focus group interviews, including experiences and perceptions, educational effects of content, considerations, and limitations of utilization, and the central themes were: experience of using VR-based content, feelings after using VR-based content, expectation of new educational effects, utilization of environmental factors, activation of education, considerations needed, absence of content information, technical limitations, lack of content, and insufficient environment for educational operation. When developing and implementing virtual reality-based oral health education content, it is necessary to consider age-specific characteristics and come up with a way to complement the limitations of virtual reality-based educational content.

1. Introduction

With the advent of the Fourth Industrial Revolution, immersive content is becoming a way of education that can maximize the effectiveness of education (Nam et al., 2020). Virtual Reality

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(VR) is a core field of immersive content, and its use and interest in the field of education and learning is growing because it allows users to experience and learn environments or situations that are difficult to experience in reality (You & Park, 2019). VR-based educational content has the advantage of improving the immersive experience of learning, helping to motivate learners and improve their concentration, and analyzing learning effects (Shim et al., 2013; So, 2016; García et al., 2016). Therefore, VR-based educational contents are becoming one of the alternatives to new educational methods in the medical field, such as rehabilitation training and brain training (So, 2016), and it is predicted that various technologies related to VR will continue to be developed and advanced in the future (Chun et al., 2017).

Recently, educational contents have been developed and the effectiveness of VR-based technologies have been reported in the field of dentistry (Moon et al., 2016; Park et al., 2018). Moon et al. (2016) developed and applied VR-based dental implant surgery education content, and concluded that VR-based education has great advantages in the field of dental education, where there are not many ways to teach surgical skills. Park et al. (2018) developed and applied VR-based tooth extraction training content, and concluded that it can contribute to overcoming the limitations of practical training by enabling education and learning according to the needs of learners and instructors. In addition, in a study that examined the perceptions of dental personnel on VR-based educational contents (Lee & Choi, 2022), they showed high awareness of the development of VR-based educational contents and education using them, but they argued that it is necessary to consider the working environment of dental personnel and the purpose of utilization. However, to date, the VR-based contents developed in the field of dentistry are mainly for learning dental practice skills.

For the promotion of oral health, the formation of a correct lifestyle is very important, and for this purpose, the development and utilization of educational contents that can make oral health promotion behaviors habitual is necessary, and new approaches are needed to provide a better educational experience. The application of virtual reality (VR) technology to provide oral health education to the public can provide a variety of experiences without the constraints of time and space. It is differentiated from traditional education methods in that it can provide opportunities for experiences that would be difficult in the real world, and it can improve learning by increasing learners' engagement and interest (García et al., 2016). Therefore, it is necessary to develop and apply contents that can promote the oral health of the public.

In order to develop oral health education contents that can be well utilized by the public, it is important to first understand the awareness and willingness of the target audience, and it is necessary to collect and reflect their opinions. In particular, VR-based educational contents are known to show differences in ease of use depending on the user's skill level (Jeong et al., 2021), and some age groups with limited access to or unfamiliarity with digital technology may have negative perceptions of education using VR-based educational contents. Therefore, based on the hypothesis that 'the general public will recognize the need for the development of VR-based oral health education contents', this study aimed to examine the perception and intention to utilize VR-based oral health education contents by dividing the general public into young, middle-aged, and elderly people by age group as a basic study for the development of VR-based educational contents.

2. Materials and Methods

2.1 Research design

This study is a qualitative study to investigate the awareness and willingness to utilize virtual reality-based oral health education content through focus group interviews among the general population.

2.2 Research subjects

This study was approved by the Institutional Review Board of 00 University (IRB approval number: SHIRB-202207-HR-165-02) for the ethical protection of human subjects. The subjects were recruited by convenience sampling using non-probability sampling methods, and the age groups were divided into young adults (20-39 years old), middle-aged adults (40-64 years old), and elderly adults (65 years old or older) (Kim et al., 2019). The number of participants for each age group was selected by referring to previous studies (Lee & Choi, 2022) and asking two researchers with experience in qualitative research for advice on the number of participants to investigate the characteristics and experiences of each age group in this study. Young adults and middle-aged adults were recruited through publicity on Facebook, and the elderly were recruited by requesting cooperation from senior welfare centers. The final study subjects were selected from those who agreed to participate in the study when the purpose of the study and the method of participation were explained, and the detailed demographic information is as follows Table 1.

Table 1. Characteristics of subjects

No	Type	Gender	Age	Final education status	Occupation
1	The youth	Female	27	University graduate	Office workers
2		Female	21	Attending university	University student
3		Female	21	Attending university	University student
4		Male	24	Attending university	University student
5		Male	29	University graduate	Office workers
	Average age Mean±SD		24.4±3.2		
6	Middle-aged	Female	58	University graduate	Housewife
7		Female	53	College graduate	Housewife
8		Female	42	University graduate	Teacher
9		Male	50	University graduate	Office workers
10		Male	55	University graduate	Office workers
	Average age Mean±SD		51.6±5.5		
11	The elderly	Female	76	Elementary school graduation	Inoccupation
12		Female	75	Elementary school graduation	Inoccupation
13		Female	79	No education	Inoccupation
14		Male	81	Highschool graduation	Inoccupation
15		Male	74	Elementary school graduation	Inoccupation
	Average age Mean±SD		77.0±2.6		

2.3 Data collection period and methods

This study was conducted over a period of about three months from December 2022 to February 2023 using the focus group interview method. Focus group interviews were conducted by age group, and a semi-structured open-ended questionnaire was prepared and distributed to the participants in advance. Before the interview, we explained the purpose and methodology of the study, the need to record the interview, and how the interview would be conducted, and obtained consent. The interview was conducted in two sessions of about two hours each, and was conducted face-to-face. All interviews were recorded and transcribed, and we also focused on the behavior, words, and facial expressions of the subjects during the interview process to record their feelings. The second interview was conducted by asking questions that needed to be supplemented based on the contents of the first interview and the contents of the field notes, and listening to the answers.

2.4 Research instrument

To explore the perceptions and needs of virtual reality-based oral health education contents, we constructed a questionnaire based on previous studies (Kim et al., 2021; Park et al., 2018; Lee & Choi, 2022), and then consulted with two researchers experienced in qualitative research to enhance the validity of the study contents. The interview questions started with a transition question in the form of a semi-structured open-ended question after a brief explanation of the procedure, followed by the main question, then the closing question, and then additional questions according to the participants' answers. A summary of the questions is as follows Table 2.

Table 2. Divisions and contents of the questions

Division	Question content
How to proceed	- Research objectives and methods - How to record and proceed - Definition of terms - Question and answer method
Conversion question	- Experience with virtual reality-related content
Main question	- Effectiveness of oral health education using VR - Necessity of oral health education using VR - Why do you think oral health education using VR is necessary? - Reasons why I think oral health education using VR is not necessary - Intention to use oral health education content using VR - Reasons for wanting to use oral health education content using VR - Reasons for not wanting to use VR-based oral health education content - Practicality of VR-based oral health education content - Factors needed for effective oral health education using VR - Educational environments needed for effective VR-based oral health programs and operations - Support needs for the use of virtual reality in oral health education - Barriers to VR-enhanced oral health education - Materials and content for VR-based oral health education - Types of VR-enhanced oral health education - Psychological burden of oral health education using VR - Reasons for psychological burden
Closing question	- Questions or additional comments - Closing remarks

2.5 Analysis methods

Questions were answered on a Likert 5-point scale, with 1 being ‘strongly disagree’ and 5 being ‘strongly agree’, and the mean and standard deviation were calculated. Interview data were analyzed using open coding and analyzed based on Guba and Lincoln’s (Guba & Lincoln, 1981) criteria to ensure internal validity. First, to ensure credibility, we repeatedly listened to the recorded interviews during the interview process and organized the data by referring to the notes taken in the field, and showed them to the research subjects to confirm the contents. In order to ensure auditability, the contents of the interviews were described verbatim in order to exclude arbitrary interpretation by the researcher and make it easy for the reader to understand, and the parts that needed to be supplemented during the first interview were asked again during the second interview, and the answers were heard and organized. The collected data were then organized into meaningful statements by referring to Giorgi’s (Giorgi, 1997) research, and then themes were derived for each paragraph, which were then subcategorized into common themes, and finally core categories were derived. In addition, two researchers with experience in qualitative research were consulted to supplement the content.

3. Results

3.1 Perception of VR-based educational content

The perceptions of virtual reality-based educational contents were as follows, with an average of 2.95±1.17 out of 5 points Table 3.

By question, ‘It is necessary to develop virtual reality-based educational contents’ showed the highest awareness with an average score of 3.40±0.61, and ‘It is necessary to educate using virtual reality-based educational contents’ showed the lowest awareness with an average score of 2.62±1.31.

By age, young adults had the highest perception of “I am willing to use virtual reality-based educational content” with a mean of 4.00±1.00, and the lowest perception of “I have a psychological burden to use virtual reality-based educational content” with a mean of 1.60±1.89. Middle-aged people showed the highest perception of “willingness to use VR-based educational content” with a mean of 3.60±1.14, and the lowest perception of “psychological burden to use VR-based educational content” with a mean of 2.40±1.52. The elderly showed the highest perception of “I have a psychological burden to use virtual reality-based educational content” with a mean of 4.80±0.45, and the lowest perception of “I need training using virtual reality-based educational content” with a mean of 1.00±0.00.

Table 3. Perceptions of virtual reality-based oral health education content {Unit: Mean±SD}

Classification	The youth	The middle-aged	The elderly	Total
The need to develop virtual reality-based training content	3.80±0.84	3.20±0.45	3.20±0.45	3.40±0.61
The need for training utilizing virtual reality-based training content	3.60±0.89	3.20±0.84	1.00±0.00	2.62±1.31
Intention to use VR-based educational content	4.00±1.00	3.60±1.14	1.40±0.55	3.00±1.41
Psychological barriers to using VR-based educational content	1.60±0.89	2.40±1.52	4.80±0.45	2.93±1.65
Practicality of VR-based educational content	2.40±1.14	3.40±0.55	2.40±0.55	2.73±0.85
Effectiveness of education using virtual reality-based educational content	3.20±0.84	3.00±0.00	2.80±0.45	3.00±0.52
Total	3.10±1.19	3.14±0.80	2.60±1.31	2.95±1.17

3.2 Identifying themes related to dental personnel's perceptions of virtual reality-based educational content

The results of deriving themes related to the perception and reality of virtual reality-based educational contents are as follows Table 4.

A total of 60 meanings were constructed based on the original data, and 17 themes and 10 central themes were derived based on this, and 4 core categories were derived through systematic conceptualization.

The four core categories were derived from experiences and perceptions, educational effects of content, considerations, and limitations of utilization, and the central themes were derived from experiences of using VR-based content, feelings after using VR-based content, expectations of new educational effects, utilization of environmental factors, activation of education, matters that need to be considered, absence of content information, technical limitations, lack of content, and insufficient environment for educational operation.

Table 4. Elicit themes around perceptions of virtual reality-based oral health education content

Category	Primary subject	Secondary subject
Experience and perception	Experiencing VR-based content	Differences in experience exist
	Feelings after using VR-based content	Fun and liveliness
		The need to adapt
Educational effectiveness of content	Expectations for the effectiveness of new training	Attitude and engagement
		Generating interest
	Utilizing environmental factors	Compensating for space limitations
	Activation of training	Ease of use
		Providing a variety of learning opportunities
Considerations	Things to consider	Different levels of adaptation by age
		Psychological burden
		Difficulty operating the device
	Lack of content information	Need for promotion

Category	Primary subject	Secondary subject
Limitations	Technical limitations	Limitations of production technology
		Difficulty in implementing each training content
	Lack of content	Simplicity of organization
		Lack of related content
	Inadequate environment for training operations	Necessity and absence of equipment required for operation

3.3 Semantic description of perceptions related to virtual reality-based oral health education content

3.3.1 Topic 1. Experience and perception

Young adults mostly had experience using virtual reality-based content and showed positive perceptions of utilization, middle-aged adults showed perceptions that it is a medium that requires adaptation, and older adults showed perceptions that it is difficult to adapt alone.

3.3.1.1 The youth

"I think it would be great to create content based on virtual reality, because I think it's more realistic to watch a 3D or 4D movie than to just watch a video, so it would be great if it could be developed."

"I've done things like earthquake experiences in the past, and I think it would be great to be able to experience things like that."

3.3.1.2 The middle-aged

"When I did it before, I was a little bit scared at first, but then I did it, and then it was okay, and then the second time I did it, it was a lot easier, so I think the most important thing is to be able to do it again and again."

"It's not something I'm personally interested in, so even if it's there, I don't think I'm going to use it unless it's really fun or helpful. It's not something I'm used to, so I think some people will be okay with it and some people will be uncomfortable with it."

3.3.1.3 The elderly

"Virtual reality? I don't know what that is."

"It's good to have people come and learn about anything, but when they tell you to use something like this, you can't do it by yourself, and even if you learn, you don't know what to do next. It's happened to me a couple times, so you need someone to help you."

3.3.2 Topic 2. Educational effectiveness of content

The perception of educational effectiveness was relatively high because it could induce interest, and the perception of easy-to-follow content was good, while the perception of utilization was negative for the elderly.

3.3.2.1 The youth

“I think it would be inefficient to use VR for training, I think it would be time consuming and expensive to train people, I think it would be more helpful to have shorter videos that are just easy to watch.”

“I don’t think there’s any reason not to use it if you’re willing to create that content and share it, but I think it shouldn’t have any physical or time constraints so that you can use it anywhere.”

“I think it’s a way to create a little bit more interest, a little bit more excitement in participating in that training. I think it’s more likely to be remembered and understood in a deeper way if you’re doing it hands-on like that rather than just learning from a text or a video that’s going to be given to you.”

3.3.2.2 The middle-aged

“I have a job, so I don’t think it’s feasible to learn something at a specific time or place. If there is content that I can easily watch at home, I will use it.”

“Brushing your teeth or something like that. I think it would be good to make it simple and easy to follow.”

“I think we would learn a lot faster if we could experience something new and have fun with it, like we did with the virtual reality rides and things like that.”

3.3.2.3 The elderly

“At my age, it’s not fun if you use something and tell me to do it by myself, it’s fun if I meet people and do it with them, so I like to meet the teachers and talk to them and learn from them.”

“I think I’d get dizzy if I had to wear something on my head. I can’t do that. If it’s on my phone, I might try it, but it has to be easy to do or I won’t do it.”

3.3.3 Topic 3. Considerations

It was recognized that it is an easy medium for young people to apply and that there is a difference in utilization depending on the user’s perception; it is necessary to promote the developed content; and it is difficult for the elderly to adapt.

3.3.3.1 The youth

“I’ve played games and stuff like that, where you’re kind of crossing a bridge or something, and you know it’s not really there, but I’m not good at crossing things like that because I’m really scared of heights, and I’m not good at crossing things in games.”

“It’s just utilizing the content, and I don’t feel like I have to be good at it, so I don’t feel like it’s too much pressure.”

“I think it depends on how you utilize it. I think people who want to use that content will use it, and if they’re not interested, I don’t know.”

3.3.3.2 The middle-aged

"I've tried it with my kids in the past, but it made me dizzy and I felt like I was going to fall over, so I haven't done it since." "I don't think I'd get the hang of it if I did it a bunch of times, but I think it would take me a while to get used to it."

"I think the practicality depends on how you utilize it. I think younger people will like that kind of content."

"I think people who want to use it will use it, and if they're not interested in it, I don't know, and I don't think we'll be able to use it even if it's developed and we don't know about it."

"Well, like I said, a lot of people don't know about it. Yeah, I think if they do know, and if they get to experience something like that, they might be able to use it."

3.3.3.3 The elderly

"When you go to a restaurant, you know, they have these computers where you order on a big screen, and it's hard for people our age to get used to, and we can't do that."

"I get scared when they tell me to do something while touching a machine, but if they tell me to wear something on my head, I don't think I'll do it. I'm sure other elderly people do too."

3.3.4 Topic 4. Limitations of utilization

There was a perception that it would be difficult to utilize in daily life if there was no related equipment, that it would be difficult to achieve a realistic feeling, and that elderly people would need constant help until they could adapt.

3.3.4.1 The youth

"I think there will be some difficulties when I first encounter it because it is an education method that I have not experienced, and I think there will be limitations because people who do not have VR-related devices cannot experience it in their daily lives."

3.3.4.2 The middle-aged

"Don't you need equipment to use it? I don't think I would have that equipment at home... and then I would have to go to a place with that equipment every time... it would be too much hassle."

"I don't think it's going to feel like real life... I think it's going to be too unrealistic... like a game... if you're brushing your teeth... it's not going to feel like you're actually brushing your teeth. I think curious kids might like it, but I don't think adults would find it very interesting."

3.3.4.3 The elderly

"I'm frustrated because I'm small, so I need to see something bigger so I don't get frustrated. I don't want to watch a lot of videos or anything like that. I think I would try to do simple exercises on my phone if I was told to do them, but someone would have to keep reminding me until I could do them well."

"I also find it very uncomfortable to watch on my phone because it's so small. It would be easier if it was on TV."

4. Discussion

The effectiveness of education depends on the learning method, and in general, only about 10% of the information is retained when reading, while about 90% is retained when experiencing or simulating (Lee, 2015). Learning with VR technology connects physical activity and cognition of learning content, and learning through interaction with the virtual environment retains relevant memories for a long time, and uses not only audio-visual but also motor nerves to further enhance learning efficiency (Kim, 2021; Wong et al., 2018). However, since VR-based education is an innovative approach that is different from traditional education methods, the general public may not have enough information about the effects and benefits of VR-based education. Therefore, this study examined the general public's awareness and intention to utilize VR-based educational contents.

When examining the perceptions of VR-based educational content, we found that, by age, young adults were the most likely to say, "I am willing to use VR-based educational content," and the least likely to say, "I feel psychologically burdened by using VR-based educational content." This is likely due to the fact that young adults are more familiar with digital devices than other age groups and are quick to adapt to new technologies. Young adults have experienced most VR-based content and are less likely to be intimidated by it. They also perceive VR as an innovative and exciting technology and are positive about its potential for use. Therefore, it was thought that VR-based educational content could be utilized as an effective oral health education material for young adults. However, there was also a perception that it lacked practicality as an educational content due to technical limitations and physical constraints such as not being able to use it without related equipment. Currently, virtual reality-based educational content that can be developed provides various possibilities for education, but it is also true that there are still technical limitations (Lee, 2019). Therefore, it is necessary to improve the quality of educational content through continuous research and development. In particular, in order for VR-based educational content, which is a realistic media, to be properly utilized, the sense of reality felt by the user plays a decisive role, so it is necessary to develop technologies that can increase the sense of reality in a virtual reality environment. In addition, the cost of purchasing equipment and utilizing content can be a burden, so it is necessary to find a way to reduce the financial burden.

Due to the rapid aging of Korea's population, the median age is rising, and middle-aged people are becoming the main actors of the era (Jo, 2020). Midlife is the stage before the transition to old age, and the health of midlife affects the health of old age. In this study, middle-aged adults showed the highest awareness of "I am willing to use VR-based educational content" and the lowest awareness of "I feel psychologically burdened to use VR-based educational content." This is because middle-aged and older adults recognize the need to use content that incorporates new technologies, but they are more likely to be slower to adapt than younger adults, and the degree of adaptation varies from person to person. Most of them had experienced virtual reality-based content through games or entertainment, and their perceptions varied. Especially those who are not familiar with digital technology feel burdened by using virtual reality-based content, so it is necessary to develop content that can be easily adapted through repeated education until they learn how to use the developed content and efforts to improve technology. In addition, middle-aged and elderly people hoped that virtual reality-based educational content would be produced in a way that they could easily use in their daily lives, and there were many opinions that it was important to promote the developed content. In this regard, high-quality contents that can experience virtual reality-based contents even on smartphones have been developed recently (Lee, 2019), so it is necessary not only to develop contents, but also to promote and utilize high-quality contents. In addition, it is necessary to find ways to increase the convenience of utilization by finding ways to utilize it without separate driving equipment.

The elderly were most likely to agree that there is a psychological burden of using VR-based educational content, and least likely to agree that there is a need for education using VR-based educational content. This was similar to the findings of Kim et al. (2018), who reported that, unlike younger people, the elderly are not familiar with the digital environment and have a lot of difficulty understanding how devices work and operating them. Most of the elderly showed a perception that even if they learned how to operate it, they often forgot it easily, so they found it difficult to use the content on their mobile phones, and that the content on digital devices could be utilized only if someone guided them. In a few years, Korea will enter an ultra-elderly society where the elderly will become more than 20% of the total population. Therefore, social concerns and research for the healthy life of the elderly are very necessary (Kim et al., 2018). In the field of oral health, it is also time to think about and make efforts for the healthy life of the elderly, and in order to develop virtual reality educational contents for the elderly, it is necessary to understand and consider the physical and cognitive characteristics of the elderly in various ways to maximize the ease of use. In addition, it is necessary to change perceptions and improve utilization capabilities through education and improved access to digital technology for the elderly.

The above findings were similar to those of Yoo et al. (2018), who reported that the educational effectiveness of VR-based educational content may vary depending on learner characteristics. Therefore, it is necessary to consider the characteristics and needs of learners by age when developing and utilizing VR-based educational contents. In addition, it is important to have good conditions to utilize it well.

As for the limitations of this study, the participants were recruited by non-probability sampling method and were limited to residents of some regions, and the lack of previous studies at home and abroad that directly investigated the general public's perception of virtual reality-based oral health education contents made it difficult to compare the results. Despite these limitations, this study is the first study to investigate the general public's perception and intention to utilize virtual reality-based oral health education contents, and it is meaningful that the contents that are difficult to grasp in various quantitative studies were examined in depth from the perspective of qualitative research. It is hoped that subsequent studies will develop contents that reflect the perceptions of the general public collected through this study as much as possible and analyze their effectiveness.

5. Conclusion

This study was conducted from December 2022 to February 2023 to examine the general public's perceptions of virtual reality-based educational content, and collected data from young adults, middle-aged people, and elderly people using a focused group interview method, and obtained the following results. The average perception of virtual reality-based educational content was 2.95±1.17 out of 5, and by question, "It is necessary to develop virtual reality-based educational content" showed the highest perception with an average of 3.40±0.61, and "It is necessary to train using virtual reality-based educational content" showed the lowest perception with an average of 2.62±1.31. Through the focus group interviews, four core categories were derived, including experiences and perceptions, educational effects of content, considerations, and limitations of utilization, and the central themes were: experience of using VR-based content, feelings after using VR-based content, expectation of new educational effects, utilization of environmental factors, activation of education, considerations needed, absence of content information, technical limitations, lack of content, and insufficient environment for educational operation. Young adults were more likely to have experienced virtual reality-based content than other age groups, and were less likely to feel burdened by using the content. Middle-aged and older adults had experienced VR-based content through games and entertainment, and their perceptions of VR-based content varied. Most of the elderly were found to be psychologically burdened by the use of VR-based educational content, and they also had somewhat negative perceptions of content using mobile phones. Based on the results of this study, it is important to consider the characteristics of each age group when creating and applying virtual reality-based oral health education contents, and it is necessary to prepare measures to compensate for the limitations of virtual reality-based educational contents.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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