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A Qualitative Study on the Perception of Virtual Reality Based Oral Health Education Contents for the Dental Professionals: with Focus Group Interviews Applied*

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ABSTRACT

The purpose of this study is to examine and understand the perceptions and the status of the virtual reality based oral health education contents among the dental professionals. Based on which, An attempt has been made to propose the direction which the VR based the oral health educational contents or programs ought to aim for. The study participants were selected by using the non-probability sampling methods as dental hygienists and dentists with more than 3 years of work experience at dental institutions. A total of 15 participants were selected, including 4 clinical dental hygienists, 5 public dental hygienists, and 6 dentists. The focus group interviews were conducted in June and July 2022, and they were conducted twice for each group. Through the focus group interviews, 11 central topics were derived - experiences by using the VR based contents, considerations, necessity of training, expected effect, effective class contents, appropriate type for production, manpower to carry out, preparation for performance, improvement in the perception of the subject, difficulty of use, and pressure. When producing the virtual reality based educational contents, it would be necessary to prepare a plan to increase the convenience of use, and consider the working environment and purpose of the use of dental professionals.

1. Introduction

Virtual reality (hereinafter, “VR”) is a science and technology which enables people to feel as if they are in a real situation by reproducing the environments or situations that are difficult for

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them to experience by using the technologies such as computer graphics (You & Park, 2019). The contents produced by using such virtual reality (VR) technology can build a system for people to indirectly experience the actual training situations (So, 2016), and it would be possible to perform repetitive training without being constrained by time and space, and hence, it has emerged among the new educational methods in the field of education (García, et al., 2016). Moving forward, it is predicted that various fields of application and equipments related to the virtual reality (VR) technology will be developed and further grow by convergence across various industries (Chun, et al., 2017), and hence, in the field of dentistry, it is also considered timely to develop and distribute the virtual reality (VR) based educational contents for the public.

Recently, in the field of dentistry, educational contents through which people can acquire dental treatment techniques by using the virtual reality (VR) have been developed, and the effects have been reported (Rhienmora et al., 2010; Moon et al., 2016; Park et al., 2018; Jeong et al., 2021). In 2010, Rhienmora et al. developed a dental education system that can help people practice the dental treatment process in a virtual environment by using a haptic equipment and conducted a study to verify its validity, while Moon et al. (2016) developed the dental implant surgery education contents by using virtual reality, conducted a simulation, and used the HMD (Head Mounted Display) to create a sense of immersion in the dental education reality where there are not many surgical skill education methods, claiming that the virtual reality based education, which can enhance performance, has advantages.

In 2018, Park et al. (2018) developed the contents for tooth extraction practice by using the virtual reality technology and determined the effect. Consequently, they claimed that it can contribute to overcoming the limitations of tooth extraction practice education by establishing a virtual surgical environment, and that education and learning may be provided according to the needs of learners and instructors, and in 2021, Jeong et al. (2021) reported that the ease of use varies depending on the level of proficiency of users of virtual reality contents. However, the existing VR based educational contents are mostly produced for the purposes of acquiring professional skills (Park et al., 2016; Moon et al., 2016; Park et al., 2018).

If the virtual reality technologies are applied for the oral health education for the public, it would be possible to educate them on the various contents without restrictions of time and space, and it seems that the high educational effects may be expected, yet the studies on such are very inadequate. Furthermore, in order to develop the oral health education contents that may be used effectively for and by the public, the perception and competencies of the manpower who utilize and practice them are also important, and it would be necessary to collect opinions from the field of dentistry. Hence, this study is a basic one intended for the development of the virtual reality based oral health education contents for the public, and it was intended to examine and understand the perception of dental care manpower's virtual reality based educational contents and their intention to utilize the developed educational contents. Furthermore, based on which, an attempt has been made to propose the direction in which the VR based oral health education contents or programs ought to progress.

2. Materials and Methods

2.1 Research design

This study is a qualitative one which conducted a focus group interviews to examine the perception of dental care manpower on the oral health education contents based on the virtual reality.

2.2 Study subjects

This study was conducted after receiving an approval from the Bioethics Deliberation Board of 00 University (IRB approval number: SHIRB-202204-HR-158-02-3) for the ethical protection of the subjects. The study subjects were classified into clinical dental hygienists, public health dental hygienists, and dentists, and were also recruited by the convenience sampling of the non-probability sampling methods. The clinical dental hygienists and dentists recruited subjects by seeking the cooperation from the dental care institutions located in the metropolitan area, and the public health dental hygienists contacted one executive officer of the Korean Dental Hygienists Association to request for the recruitment of study subjects, and then recruited after receiving a recommendation. The final study subjects were selected as those who agreed to participate after listening to the purpose of this study, and had at least 3 years of work experiences to ensure the homogeneity among the three groups. The subjects were consisted of 4 clinical dental hygienists, 5 public health dental hygienists, and 6 dentists by group, and the detailed personal information is as illustrated in Table 1.

Table 1. Characteristics of the subjects

No	Type	Gender	Age	Final education status	Details type	Work experience
1	Clinical dental hygienist	Female	36	Bachelor	Dental clinic	10 years
2		Female	28	Master	Dental hospital	3 years
3		Female	27	Master	Dental hospital	3 years
4		Female	26	Bachelor	Dental clinic	3 years
	Average age		29.25±4.57			
5	Public health dental hygienist	Female	38	Bachelor	Public health center	13 years
6		Female	46	Master	City hall	24 years
7		Female	53	Master	City hall	30 years
8		Female	54	Bachelor	Public health center	15 years
9		Female	59	Master	Public health center	31 years
	Average age		50.00±8.15			
10	Dentist	Female	38	Doctor	Dental clinic	8 years
11		Female	40	Doctor	Dental clinic	14 years
12		Female	38	Master	Dental clinic	11 years
13		Male	47	Doctor	Dental clinic	14 years
14		Male	37	Master	Dental clinic	4 years
15		Male	43	Doctor	Dental clinic	14 years
	Average age		40.50±3.83			

2.3 Period and method of data collection

In 2018, the researcher in charge of the data collection and analysis for this study participated in the training program for the “Collection and Analysis of Qualitative Data” hosted by the Korea Council for University Education to enhance the understanding of qualitative research methods, and has also conducted qualitative studies (Jung et al., 2019; Jung et al., 2021; Nam & Lee, 2021).

The focus group interviews were conducted over the two months of June and July 2022, after completing a semi-structured and open-ended questionnaire and distributing it to the study subjects in advance by email. The interviews were conducted by two researchers who took over the dental hygienist group and the dentist group, each respectively. Prior to the interviews, each researcher provided the guidance on the purpose of study and research method for each group, explained the necessity of recording the interviews and the method of conducting the interviews, and secured consent for each. Each interview entailed about 2 hours, and was conducted twice per group. The first interview was conducted face-to-face, and the researcher and study subject coordinated the meeting time and place in advance, and the second interviews was conducted online by using the Zoom platform. All interviews were recorded and transcribed, and the impressions of the study subjects' phrases, facial expressions, and actions were recorded on the spot. The second interviews were organized and carried out based on the contents recorded during the first interviews and the contents summarized in the field after the first interviews.

2.4 Research tools

To examine and understand the dental care manpower's perception of the virtual reality based oral health education contents, the questionnaire was formed by referring to the related previous studies (Kim et al., 2021; Park et al., 2018). Thereafter, in order to increase the validity of the research contents, one professor of dental school and one professor of dental hygiene who had experiences in the virtual reality educational contents production research were sought for consultations on the research tool, and the contents were corrected and supplemented. Some of the questions were structured on a Likert 5-point scale, and the study subjects were asked to enter their responses in the questionnaire on their own, following which, the interviews were conducted. The interviewing questions were organized in the order of introductory questions, transition questions, main questions, and closing questions. After the introductory questions, the transition questions began with the semi-structured and open-ended questions in the form of “Do you know about virtual reality?”, and it was structured in the form of additionally presenting necessary questions according to the responses of the study subjects. The summary of the questions is as illustrated in Table 2.

Table 2. Divisions and Contents of the questions

Division	Question contents
Introductory question	- Explanation of the purpose and method of research - Information on recording and the manner of proceeding - Self introduction and the definition of terms - Questions and answers about the proceeding of research
Conversion question	- Experience of using the VR educational contents
Main question	- Need for education using the VR - Reasons for training using the VR - Need for education using the VR - Intention to use education using the VR - Reason for desiring to use the VR for education - Reason for the lack of intention to use the VR for education - Psychological burden for education using the VR - Reason for feeling the pressure - Effects of education using the VR - Elements needed for effective training using the VR - Practicalities of the VR based educational contents - Expected effects of using the VR for education - Educational environment needed for the effective VR based programs and operation - Matters requiring support for the use of virtual reality in education - Factors of obstruction for the VR utilized education - Factors to consider for education using the virtual reality - Classes and contents appropriate for the virtual reality based education - Type appropriate for the virtual reality utilized education - Intention to give lecture using the VR based educational contents in the future
Closing question	- Verification of questions or additional opinions - A word of gratitude

2.5 Analytical method

Among the perceptions of the virtual reality based oral health education contents, the questions consisted of the Likert 5-point scale were analyzed as 5 points for ‘very true’ and 1 point for ‘very untrue.’ The qualitative research data were analyzed in the form of open coding, which were organized as follows based on the criteria of Guba and Lincoln (Guba & Lincoln, 1981) to secure the internal validity. First, the reliability of the data was secured by repeatedly listening to and organizing the notes and recorded interviews recorded by the researcher on the spot. Second, the researcher first demonstrated the contents organized to the interviewees and received their confirmations. Third, the study results were secured by quoting and describing the language and phrases of the study subjects as they are to ensure that the readers could easily understand them without arbitrary interpretations by the researcher, and the portions which were not accurately understood during the first interviews were questioned again during the second interviews and reflected. Thereafter, while repeating the process of reading through and reviewing them by using the research results on numerous occasions, the topics for each sentence and paragraph were derived with a focus on meaningful statements, and such were again classified into the subcategories by common subjects, then the subcategories were classified to derive the core categories. Referring to the study of Giorgi (Giorgi, 1997), as for the core categories, first, 'overall perception stage', second, ‘semantic unit classification stage', third, 'daily expression term transformation stage', and fourth, 'all transformed integration of the semantic unit structure stage' were derived based on a total of 4 stages, and the contents were supplemented based on the advice of two researchers experienced in the qualitative research.

3. Results and Discussion

3.1 Perception of Dental Medical Personnel on Virtual Reality-Based Educational Contents

The results of examining the perception of the virtual reality based educational contents of dental care manpower are as illustrated in Table 3. By the job category, the public health dental hygienists demonstrated the highest perception with an average of 4.13±0.76 points, while the clinical dental hygienists demonstrated the lowest perception with an average of 3.08±0.70 points. By question, 'I'm willing to use the virtual reality based educational contents' demonstrated the highest perception with an average of 4.00±0.85 points, while the dentists scored an average of 3.50±0.84 points, which was lower than that of the dental hygienists. This could be considered in connection with the different scope of work and the medical service contents for each job category of dental care manpower (Moon et al., 2020; Ryu et al., 2022), and the oral health education for the public given the nature of the work, as the perception of public health dental hygienists who have many opportunities to practice turned out to be high. In addition, 'There is a psychological pressure on the use of the virtual reality based educational contents' demonstrated the lowest perception with an average of 2.53±1.46 points, and the public health dental hygienists had an average of 3.40±1.14 points, demonstrating a higher psychological pressure for use than the other jobs. This result was considered to be related to the fact that the public health dental hygienists participating in this study were older (50 years old on average) than the other jobs and had little experiences with the virtual reality based educational contents. Furthermore, the average score of 3.00 ± 1.20 points for 'The virtual reality based educational contents are practical' turned out to be low. Hence, in order to develop and disseminate the virtual reality based oral health education contents, it is considered that the related education and training are needed to ensure that the manpower who perform the oral health education can use them effectively, and it seems necessary to have the practicality to ensure that they may be easily applied for the public.

Table 3. Perception of the virtual reality based oral health education contents

Unit: Mean±SD

Classification	Clinical DH*	Public health DH*	Dentist	Total
The virtual reality based educational contents need to be developed.	3.00±0.00	4.40±0.55	3.83±0.75	3.80±0.77
The education using the virtual reality based educational contents is necessary.	3.00±0.82	4.40±0.89	3.83±0.75	3.80±0.94
I have the intention to use the virtual reality based educational contents.	4.00±0.82	4.60±0.55	3.50±0.84	4.00±0.85
I have a pressure on the use of the virtual reality based educational contents.	1.75±1.50	3.40±1.14	2.33±1.51	2.53±1.46
The virtual reality based educational contents are practical.	3.50±0.58	3.60±0.89	2.17±1.33	3.00±1.20
The education using the virtual reality based educational contents is effective.	3.25±0.50	4.40±0.55	3.83±0.75	3.87±0.74
Mean±SD	3.08±0.70	4.13±0.76	3.25±0.99	3.50±1.13

*DH: Dental hygienist

3.2 Derivation of the topics related to the dental care manpower's perception of the virtual reality based educational contents

The results of deriving the topics related to the perception and actual conditions related to the virtual reality based educational contents are as illustrated in Table 4. A total of 65 meanings were formed based on the original data, and based on which, 17 topics and 11 central topics were derived, and 5 core categories were derived based on the systematic conceptualization.

The 5 core categories were derived based on the media requiring adaptation, value of the VR based educational contents, appropriate type, environment required for the contents utilization, and the factors of obstruction, etc. The central topics were derived based on the experience using the VR based contents, considerations, necessity of training, expected effect, effective class content, appropriate type for production, manpower, preparation for performance, improvement in awareness of the subject, difficulty of use, and the pressure, etc.

Table 4. Derivation of the topics related to the perception of oral health education contents based on the virtual reality of dental care manpower

Category	Primary subject	Secondary subject
Medium requiring adaptation	Experiences of using the VR based contents	Experiences of using the VR based contents
		Feedbacks on using the VR based contents
	Considerations	Age for which the VR based contents may be used
Value of the VR based educational contents	Need for training	Need for the VR based educational contents
		Practicality of the VR based educational contents
	Expected outcome	Educational effect using the VR based educational contents
Appropriate type	Effective learning contents	Classes and contents appropriate for the virtual reality based education
	Type appropriate for production	Type appropriate for the virtual reality utilized education
Environment needed for the content utilization	Manpower for performance	Need for the training of education performing manpower
		Active intention of the performing manpower
	Factors of preparation for performance	Appropriate treatment fees
		Equipments and tools needed for the contents utilization
	Enhanced perception of the subjects	Publicity and education
		Enhanced perception of subjects
Factors of obstruction	Difficulty of utilization	Negative perception of the VR based educational contents
		Difficulties of utilizing the VR based educational contents
	Pressure	Pressure

3.3 Description of the meaning of the dental care manpower's perception of the virtual reality based oral health education contents

3.3.1 Topic 1. Media requiring adaptation

The dental care manpower demonstrated a positive perception of the development of the virtual reality based educational contents, which was similar to the research results of Kim & Han (2021), which investigated the perception of special education teachers in 2021. Most of the clinical dental hygienists responded that they used the virtual reality based contents and felt that they were so much real, and the public health dental hygienists had little experiences using the virtual reality based contents, yet they demonstrated the perception that there would be fewer problems using them if they were developed. Dentists had little experiences in using the virtual reality based media, yet they perceived the need for the production of educational contents that applied such. In this connection, Lee (2015) claimed that the extent of remembering what was learned after 2 weeks is very different depending on the learning method, and in general, people remember only about 10% when they read only, yet when they actually experience or simulate, 90 % may be remembered. Hence, it is considered that the use of the virtual reality based technology when producing oral health education contents can contribute to increasing the effectiveness of education.

The clinical dental hygienists perceived that the repetitive education was necessary to apply for the elderly, and the dentists considered that it would be good to apply primarily for the groups of younger age. This was similar to the results of a study by Yoo et al. (2018), based on which they reported that the educational effects of the virtual reality based educational contents could vary depending on the characteristics of the learners. Hence, it would seem to be necessary to consider the age specific characteristics of the learners when creating the virtual reality based educational contents.

3.3.1.1 Clinical dental hygienists

“I’ve also played games before. It was a bit like crossing a bridge, yet even though I know it's not actually there, I'm afraid of heights, and so I can't cross it effectively, yet I couldn't cross it effectively in the game.”

“Once I have it in my possession, I think I would use it often...but I think I would try a little more to think about as to whether this is helpful medically. It's the issues of time and whether it's directly helpful for the patients.”

“For the elderly to use, they need to be trained like this repeatedly for a long period of time to be effective.”

3.3.1.2 Public health dental hygienists

“In fact, I have unclear expectations, yet I don’t think I have come across any practical information or programs.”

“If we have education developed and conducted in a virtual reality method appropriate for the era of the 4th industrial revolution, people will increasingly be able to access it even more easily, and it would be an effective education method.”

"I think the elderly can do it now if we keep telling them repeatedly. There was a time where we simply put a video into a QR code and educated them, yet we explained the method three or four times and repeatedly told them to try it once, and thereafter, we saw how they remembered it effectively."

"I think the effect will be different depending on the age and environment of the beneficiaries. It may be very effective, yet I think it may be restrictive under some circumstances."

3.3.1.3 Dentists

"Virtual reality? What is it?"

"I know what virtual reality is. It's fun, yet it's also difficult to adapt to."

"I felt that VR was a very good tool from an educational point of view. Since it is not real and virtual, nothing happens (there is no risk of causing side effects or accidents to the patients). If it is made like a game, you can induce interest, yield a high educational effect, and I think it is unconditionally good for education, except for causing the eyesight to deteriorate."

"I think it would be appropriate for the young curious patients. I would like to know what oral hygiene education for the pediatric patients is like."

"The older they get, the more they look for things of familiarity. It's hard to explain face-to-face in front of them and ask them to try doing it, yet I don't know if it will work if you offer them a VR experience for the first time and ask you to do it. It's not so familiar... and there are many old people who only use their smartphones to text messages or place calls, and so for them, the VR may be difficult."

3.3.2 Topic 2. Value of VR based educational contents

The clinical dental hygienists demonstrated the perception that the production of the virtual reality based educational contents is necessary, effective in education, and that the consumption of manpower may be reduced. A lot of the public health dental hygienists perceived that the virtual reality based educational contents are useful because they help motivate the learners and allow them to learn about and understand the results and the implementation process of the contactless implementation. This resembled the previous studies (So, 2016; Shim et al., 2013; García et al., 2016) which claimed that the virtual reality based educational contents help improve the learners' motivation and concentration, enable the analysis of learning effects, and improve the immersion in learning. However, while the currently available virtual reality based educational contents offer various possibilities for the public health education, it is also true that there are still many technically challenging tasks. Hence, it is also important to improve the quality of educational contents through the continuous research and development. Dentists also demonstrated the concerns about the costs required for use, which was similar to what Lee (2019) proposed as a negative aspect of the virtual reality based educational contents. Currently, the virtual reality based technology is developing each day, and the price is growing cheaper, and the possibility of implementing it at a reasonable price is increasing. However, it is expected that it may be used even more efficiently if the cost aspect is improved, as the cost of purchasing equipment or the contents utilization may still act as a pressure. Furthermore, recently,

the high quality contents that can experience the virtual reality with just a smartphone are undergoing development (Lee, 2019), and hence, it is expected that the virtual reality based education will be an alternative for the new experiential education in the future.

3.3.2.1 Clinical dental hygienists

"Currently, many things besides dentistry are changing a lot based on the virtual reality and artificial intelligence, and someday, they will become commonplace. The effect of creating the educational contents based on the virtual reality in dentistry will come."

"Using the virtual reality is expected to have a much better educational effect than in paper or watching videos, and since it does not consume manpower, I think there will be no pressure on us to implement it in terms of the clinical practice."

"I think the advantage is that there is no consumption of manpower. We also introduced a new technology when promoting for the patients. Such promotion would be helpful."

3.3.2.2 Public health dental hygienists

"When I educated children, I allowed them to experience each person with Dentiform. Observing that the children were very happy with that alone and follow it effectively, I think it would be much better to learn if it is made into a virtual reality. Even more so when it comes to the young people."

"Currently, there is a lack of educational media, and if the virtual reality may be used to provide education as if it were real, the effect of education would be very significant."

"I think it could help increase the immersion of learners, it may be interesting, and hence, it could motivate learning, and it seems that the repeated education would be possible."

"I think it is effective because it is not face-to-face, yet it is possible to know the results and implementation process executed in a contactless manner."

3.3.2.3 Dentists

"The more the educational tools, the better. Since the characteristics of the people who are educated are different, the education method that suits them effectively may be different. And so if there are various types of educational tools, you can choose and use them."

"First, I think that in order to train something, the contents must be properly developed and easily accessible before doing anything, or it would be difficult. In particular, if you educate the general public on the oral health related contents, it would really be difficult to inform on the need and induce them to participate. It would be wonderful if simple, difficult, and fun contents was created effectively and expanded. Just train them with phrases since it won't work at all."

"You can encourage active participation from and by the patients. If there is a virtual reality program, I think we could reduce our dependence on the dental care manpower to provide education."

"Virtual reality requires machines, and the machines are very expensive. Wouldn't it lead to a problem of practicality that such machine is difficult to expand widely? I think the problem of cost effectiveness will be serious."

3.3.3 Topic 3. Appropriate type

The clinical dental hygienists responded that the contents required for education for the patients were appropriate several times, such as those on the treatment process and oral exercises, for the production purposes as the virtual reality based oral health education contents, and the dentists responded similarly to the study of Park et al. (2018) which claimed that anatomy, which is difficult to observe directly with the naked eye, may provide an alternative to building a system to enable the actual clinical situations. Furthermore, the clinical dental hygienists demonstrated the perception that the contents that may be used at community welfare centers or community centers would be good, and the public health dental hygienists expressed the perception that it would be nice if the educational contents for oral health education for the local residents were produced. Learning by using the virtual reality has been known to increase the efficiency of learning since the extent of perception of the learning contents is linked to physical activities and learning occurs based on the interaction with the virtual environment, and hence, the related memories remain for a long time and are used not only in terms of sight and hearing but also the motor nerves (Kim, 2021; Wong et al., 2018). Hence, it is determined that the effectiveness of education may be enhanced by developing the oral health education contents based on the virtual reality and by using them at and by the dental care institutions or community institutions.

3.3.3.1 Clinical dental hygienists

"Oral exercises and mouth exercises do not entail large movements, and hence, you would need to tell them very small movements in significant details, and I think you can approach them in more detail when I think that a patient or a subject ought to practice them together."

"It seems that there will be some difficult areas to proceed at the clinical dental clinic, and various programs are operated at senior universities, welfare centers, local government programs, and community centers, and hence, it would be better to contact them and utilize them."

"Those who wear dentures for the first time experience much difficulty with undergoing the denture procedures. Otherwise, it would be even more effective if such education was provided because the process of adapting for the first time is very difficult, and it is combined with mouth exercises to ensure that the process could be adapted."

3.3.3.2 Public health dental hygienists

"It would be nice if the areas such as oral exercise, voice exercise, diet control, post implant care, and post surgical care were produced."

"The correct brushing method for infants and adults, education on the oral hygiene behavior and perception for infants, education to directly experience the treatment process for adults, and the education on the correct three-dimensional shape method for the elderly are among the things I can think about now."

"It would be nice to show the anatomical position of muscles and the movements of muscles during the oral exercises in the virtual reality, which we cannot actually observe with the naked eyes."

3.3.3.3 Dentists

"There are many areas of the oral cavity and teeth which could not be seen directly, and especially the oral muscles, which cannot be seen directly. Such thing can also be demonstrated in virtual reality, and hence, it would help to understand the contents. Motivation would also be bettered."

"Since this is the field of dentistry, I think it would be nice to be able to practice in virtual reality rather than performing the procedure directly on a patient in an unfamiliar condition. It would depend on the extent of completion of the virtual reality program, yet it would be better to develop it under the assumption that the technology will be further developed. Virtual reality is also possible in the form of a game, isn't it?"

"I think it would be nice to have the contents on the implant procedures and the implant surgery process. Otherwise, it would be nice for the root canal treatment practice, and the virtual reality could be used for the overall dental procedures. Or, it would be nice to use the virtual reality for the contents that explain the progress of periodontitis or the stages of oral disease from occurrence to intensification."

3.3.4 Topic 4. Environment need for the contents utilization

The clinical dental hygienists demonstrated the perception that the willingness of the person who runs the hospital is important, and that the infection control must be possible and convenient to use in order to be used for and by the dental care institutions. The dentists also perceived that manpower was needed and that appropriate treatment fees ought to be guaranteed in order to be used in clinical practice. Hence, in order for the virtual reality based educational contents to be highly and effectively utilized at and by the dental care institutions, it is determined that the oral health education ought to be perceived as part of the medical service, and the appropriate compensation such as health insurance reimbursement ought to be provided. Furthermore, the public health dental hygienists perceived the need to prepare for the smooth operation of the program, such as the equipment costs and safety issues, training manpower's proficiency, and perception enhancement of the target audiences through the contents related publicity and education among the opinions expressed such that the equipments needed for the contents utilization ought to be built. In this connection, Kang et al. (2020) also claimed that, in order to utilize the virtual reality based educational contents, the wireless Internet environment establishment, related contents development, and training preparation time ought to be considered. Hence, in order to utilize the virtual reality based educational contents effectively, it seems necessary not only to simply develop the related educational contents, yet provide the financial support at the national level to ensure that the conditions to utilize them effectively will be in place.

3.3.4.1 Clinical dental hygienists

"I think we need a little more activeness from the directors of clinics and hospitals. If there is a program, I'm willing to use it, yet if some directors are active, or if there is really a fee for treatment when this kind of education is provided, the directors will naturally recommend it, won't they?"

"I think it would be nice if it were set up in a manner convenient for the infection control.

Hospitals are sensitive to infection control, and a lot of aerosol splashes, and hence, it would be more convenient to use the equipments which could be managed with facility."

"In the clinical practice, I think it would be difficult for us to do so. If possible, I think it would be nice to use the mobile phone utilized contents for the clinical practice."

3.3.4.2 Public health dental hygienists

"No matter what, it seems to me that a lot of preparation is needed for the costs of equipments and others, safety issues, and for the smooth program operation."

"I think it would be necessary to replace it with the equipments that can directly perceive it rather than the computer currently in use."

"I think the person in charge of education needs to have an in-depth understanding of the virtual reality based educational contents."

"I think we need to publicize various things on the virtual reality and explain the effects of education effectively."

"I think the users might simply perceive it as a game."

3.3.4.3 Dentists

"There are some difficulties in reality. If I'm too busy to care even for the scheduled patients, they might say, "The dentist does not have to train himself. He or she just needs to train other employees and conduct the training." However, it is not at all easy to find such employees. It is difficult to find the manpower, and hence, the reality is that one has to treat on his or her own."

"I think whether such contents may be used for the clinical dentistry will be determined by how much time it takes to do so at a reasonable cost, and how much support from the insurance corporation will be extended."

"You must have the equipments to use the VR, yet the initial cost of setting up the equipments is an issue. The initial cost is also a problem, yet I have to maintain the equipments, and I think there will be many problems to upgrade the hardwares later. And I wonder if there will be actual demand from and among the patients. Even if the dentists have such equipments or programs, the patients may not know about them."

3.3.5 Topic 5. Factors of obstruction

The clinical dental hygienists demonstrated the cases of having the pressure to learn new media and the perception that there was no problem, etc. The public health dental hygienists demonstrated the perception that, while it is an unfamiliar medium, they ought to make efforts to utilize it even when they uncomfortable when using the virtual reality based educational contents, and that skilled also felt pressured by unfamiliar media. This resembled the research results of Han (2020), who presented that the factors of obstruction to the virtual reality based education include the lack of teaching time, fear of new teaching methods, unskilled instructor skills, and the inadequate number of instructors compared to the number of trainees. Hence, to revitalize the virtual reality based education, it would be necessary to systematically disseminate the educational methods and technologies

by using the related technologies targeting the training manpower. Furthermore, the dentists presented the opinion on the dizziness felt when using the VR equipments and the limitations of the technology. This could also be related to the fact that dizziness and motion sickness accounted for the largest percentage of the inconveniences when using contents in a survey of learners by using the virtual reality based educational contents (Lee, 2019). Accordingly, when creating the virtual reality based educational contents, it would seem necessary to come up with a plan to alleviate such user's inconvenience to the extent possible. This study has limitations in that the research participants were limited to the dental hygienists and dentists of some regions according to the non-probability sampling method, and there is a lack of previous domestic and foreign studies that investigated the perception of dental care manpower on the virtual reality based oral health education contents, demonstrating the difficulty of making a direct comparison of the results. Notwithstanding which, from a qualitative research point of view, it is meaningful that the dental care manpower's perception of the virtual reality based oral health education contents was investigated to examine what to consider when creating the virtual reality (VR) based oral health education contents. Furthermore, in the follow-up studies, it is considered that the perception and usage status of learners who will use virtual reality based educational contents ought to be closely investigated.

3.3.5.1 Clinical dental hygienists

"I would have to learn new things anyway, and I don't have that kind of fear of machines. And so I don't think it will be too difficult if you just learn it at first as you explained earlier."

"It was entirely different from becoming skilled like the young people. These days, they use a cad cam and intraoral camera at the dental clinic a lot, and naturally we undergo training together now, yet I do feel that I'm falling in terms of quality further."

"Because I'm not skilled with machines, I think it will be difficult for me to adapt in the first place.. Patients would not know as much as I do, and I wonder if I can answer their questions if presented. And that's what concerns me.

3.3.5.2 Public health dental hygienist

"It's honestly a pressure since I've never encountered it before. I think I lack a prior knowledge on the virtual reality contents."

"I think the contents are still unfamiliar for many."

"I think you need professional knowledge to use it. I also think you ought to have some time to spare so you can try it out over a long period of time."

3.3.5.3 Dentists

"I used a VR equipment once before, yet I felt quite dizzy. If you're not familiar with the VR, it may be difficult for you to get used to. And I think the virtual reality technology still needs to be further developed."

"I think it would be impossible to have a program that is perfect in terms of implementing reality. No matter how advanced the VR technology is, if it is the same as the procedures performed on a real patient, it will not be the same, and I don't think you can skip the step of performing

it on a patient just because you have practiced the VR."

"I've never used the virtual reality before, and hence, it's a pressure. Even I'm not used to it, and hence, I feel a barrier to using it for education."

4. Conclusion

In order to examine and understand the perception of the dental care manpower related to the virtual reality based educational contents, this study collected the data based on the focus group interviews with the clinical dental hygienists, public health dental hygienists, and the dentists from June through July 2022, and the following results were obtained.

1. Examining the perception of dental care manpower on the virtual reality based educational contents, the clinical dental hygienists and the public health dental hygienists scored an average of 4.00±0.82 points and 4.60±0.55 points, each respectively, for 'I'm willing to use the virtual reality based educational contents,' demonstrating the highest perception. The dentists scored an average of 3.83 ± 0.75 points for 'The development of the virtual reality based educational contents is necessary', 'Education by using the virtual reality based educational contents is necessary', and 'Education by using the virtual reality based educational contents is effective,' demonstrating a high perception.

2. Based on the in-depth interviews with the dental care manpower, the five criteria were derived including 'media requiring adaptation', 'value of the VR based educational contents', 'appropriate type', 'environment required for the contents utilization', and 'interference factors.' The central topic was derived from the experience using the VR based contents, considerations, necessity of training, expected effect, effective class contents, appropriate type for production, manpower, preparation for performance, improvement in perception of the subject, difficulty of use, and pressure, etc.

3. The clinical dental hygienists demonstrated the perception that the will of the head of the affiliated medical institution is most important for the virtual reality based educational contents to be utilized, while the public health dental hygienists demonstrated the perception that the understanding and proficiency of those performing education were important. The dentists expressed their opinion that the appropriate treatment fees ought to be guaranteed in order for the virtual reality based educational contents to be used for the clinical practice, and expressed concerns about the costs involved.

As a result of conducting this study, when producing the VR based oral health education contents, it would be necessary to consider as to whether they may be used without building equipments, and it would be necessary to prepare a plan to increase the convenience of their use. Furthermore, it would be necessary to consider the working environment and the purpose of use of the dental care manpower.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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