

# An Integrative Review on Augmented Reality/Virtual Reality Simulation Programs in the Mental Health Area for Health Professionals

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## ABSTRACT

*This is an integrative review paper of Augmented Reality (AR)/Virtual Reality (VR) simulation programs in the mental health area including the analysis of the general characteristics, contents, and the impact of the interventions studies. The keywords used to search the studies were "AR/VR" and "medical/nursing students". The author and a postdoctoral research fellow searched four electronic databases: Web of Science, PubMed, EmBase, and CINHA, and as a result nine studies met the inclusion criteria. Among the selected studies AR/VR simulation programs in the mental health area for healthcare professionals were found to be effective in clinical skills as well as for the interpersonal relationship and the stigma of mentally ill patients. Providing an opportunity to experience a safe and effective tool is important when educating health professionals and AR/VR simulation programs are safe and effective. Thus, standardized AR/VR simulation programs are needed to be developed for health professionals.*

**Keywords:** Augmented Reality, Virtual Reality, Integrative Review, Mental Health.

## 1. INTRODUCTION

### 1.1 Background

Simulation has become a standard education method in healthcare education and a variety of simulation-based education (SBE) and training methods are developed and used [1]. It can be performed by role-plays of standardized patients and using variety of technologies using virtual reality or augmented reality programs with variety of devices. Due to the limitations in learning within the real clinical settings, such as restricting nursing students' approaches to the patients, hospital policies, and increased patient safety, SBE helps students to overcome the difficulties of learning the clinical fields [2]. Also, SBE provides a safer and student-centered environment with reflections of real-life practice and supports from the experts [3].

Application of simulation education among healthcare professionals have been over 40 years, starting from with investigations with laparoscopic surgery simulation in 1969 [4]. Also standardized patients [5] with role-plays in the early days of the simulation education. Over the years due to the development of technologies and changes in the environment, simulation started using devices, called as technology-enhanced simulation (TEM) [6]. This allowed to adopt the simulation settings more complex and more similar to the real setting in the present hospitals. Also by using virtual technology,

dangerous activities can be performed in a safe way [7]. Virtual reality (VR) and augmented reality (AR) started implemented in the simulation technologies as TEM developed. VR is an artificial environment created by computer and users can sense as if they are in the real world, but it is actually formed by the computer [8]. Similar to VR, AR is also an artificial environment made by computer, but with AR, users can see and sense with the real environment [9]. In other words, the computerized world is within the real world. Most of the studies of TEM were on invasive procedures and were actively published from 2008 [6]. At the beginning studies related with not only physicians but also other departments of healthcare professionals [2], [6].

The benefits of simulation in the healthcare education are numerous. It allows the students to practice medical skill or nursing skills without harming patients or preventing from the high risk situations [3], [10]-[12] and can apply and practice the theories learned in the classroom [13]. Also all levels of users can use to practice and develop skills and knowledge without fear and encourages healthcare professionals to acquire through experiences [14]. In addition, it allows the teachers to give feedbacks on practice within a safe, controlled environment [2]. The other advantage of the simulation is that scenarios can be renewed or can be created due to the needs of the learners [15]. It means that levels of difficulty, complexity and challenge can be tailored to the levels of the learners to suit the context, learning or assessment objectives and the experience of the learner [16].

Since simulation education provides learners to learn in the safe environment [2], [3], [10]-[12], simulation offers many

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opportunities for the development of skills, knowledge and behaviors for students and clinicians working in the mental health settings. Also simulations in educating the mental health professionals in both medicine and nursing were proved to be effective [17]-[19]. Due to the unfamiliarity and the stigma of the mental illness, it is more beneficial compared to the other area of healthcare [2], [20].

Although acknowledging the importance of developing and implementing AR/VR simulation programs in the mental health area for the healthcare professionals, there are no standardized programs developed. It is assumed that it is provided as a pilot test in few universities or used as an additional education tool in the curriculums. Studies related to AR/VR simulation program in the mental health area and evaluating after applying to the healthcare professionals are rare. In this study, previous studies on AR/VR simulation program in the mental health area for healthcare professionals were reviewed. Therefore, AR/VR simulation programs in the mental health area for healthcare professionals were searched and the interventions that were implemented were analyzed. Using the studies found, the approaches, effects, contents of the interventions were reviewed and analyzed. Through this, basic information to develop AR/VR simulation program in the mental health area for healthcare professionals can be obtained.

## 1.2 Purpose

The purpose of this integrative review is to describe AR/VR simulation program in the mental health area for healthcare professionals and examine the contents and approaches of these programs. The findings of this study can provide the basic information to AR/VR simulation program in the mental health area for healthcare professionals. The specific purposes are as follows.

- 1) Describe the research studies about AR/VR simulation program in the mental health area for healthcare professionals.
- 2) Analyze the contents and approaches of these AR/VR simulation programs in the mental health area for healthcare professionals.
- 3) Analyze the effect of these AR/VR simulation programs in the mental health area for healthcare professionals.

## 2. METHODS

### 1.1 Design

An integrative review was used to analyze the AR/VR simulation programs in the mental health area for healthcare professionals research written in English from 1994 to 2019.

### 1.2 Procedure

**1.2.1 Stages of Review:** The methodology for integrative review recommended by Whittemore and Knafl [1] that involves 5 stages was used. The first stage is about identifying the problem. The second stage is searching the literature related to the research problems and specifying the inclusion criteria. The third stage is evaluating data among researchers and determining and evaluating the suitability of each study. The

fourth stage is analyzing data through interpretation without bias. The last stage is presenting the concept and attributing into a diagram or a table. Each stage of the process is as follows.

**1.2.2 Problem Identification:** At the initial stage of the research meeting, the researchers agreed on the purpose and the boundaries of the study. Due to limited conditions, healthcare professionals and students do not have many chances to practice of caring those patients. Since interactions and accurate decisions among mental health patients is critical when treating the patients, it is important to get prepared before meeting mentally ill patients. However, becoming prepared before meeting the real mentally ill patients is not easy. Although there are many AR/VR simulation programs for clinical skills especially for surgeries or laparoscopies, but there are no standard AR/VR simulation programs in the mental health area for healthcare professionals. Therefore, the research problems are as follows: "What is known about AR/VR simulation program in the mental health area?" and "What kinds of AR/VR simulation programs in the mental health area are present?". The study aimed to identify the core components and the limitations of the programs in order to provide a guide for future studies and programs to improve the ability to give appropriate medical care to mentally ill patients.

**1.2.3 Literature Search:** The literature search was performed by the author and the Postdoctoral research fellow independently. A computerized search using Web of Science, PubMed, EmBase, and CINHALL were undertaken. Key words used to search for relevant literature included AR or VR AND medical student or nursing student.

#### (1) Inclusion criteria

Studies published until March 8<sup>th</sup>, 2019

All AR/VR programs related to simulation programs on mental health

Participants of the studies are health care professionals, medical students or nursing students

#### (2) Search outcomes

A total number of 1,654 studies were searched. Based on the inclusion criteria, and after eliminating overlaps and screening of title, abstract and keywords, 9 publications were retained (Fig. 1).

**1.2.4 Data Evaluation:** According to Whittemore and Knafl [1], applying one specific assessment tool to the quality of the study may not be appropriate. When the evaluation criteria are too broad, the specialty of the study cannot be retained. However, when criteria differ from one study to another, the data analysis will be complex. Therefore, applying clear inclusion and exclusion criteria is important. In this study the author, a Registered Nurse who has doctoral degree on Psychiatric Mental Health Nursing, and a Postdoctoral Research Fellow in School of Computer Science, checked the date of the publication, name of the journal, research design, intervention method and type, duration, and tools used in the study to fill out a matrix and evaluated the quality of each study. The evaluation of the studies was performed independently. Through active discussion between the author

and a Postdoctoral Research Fellow, discrepancies were resolved. As a result of the quality evaluation, 9 studies were

selected as appropriated and analyzed for the final review.

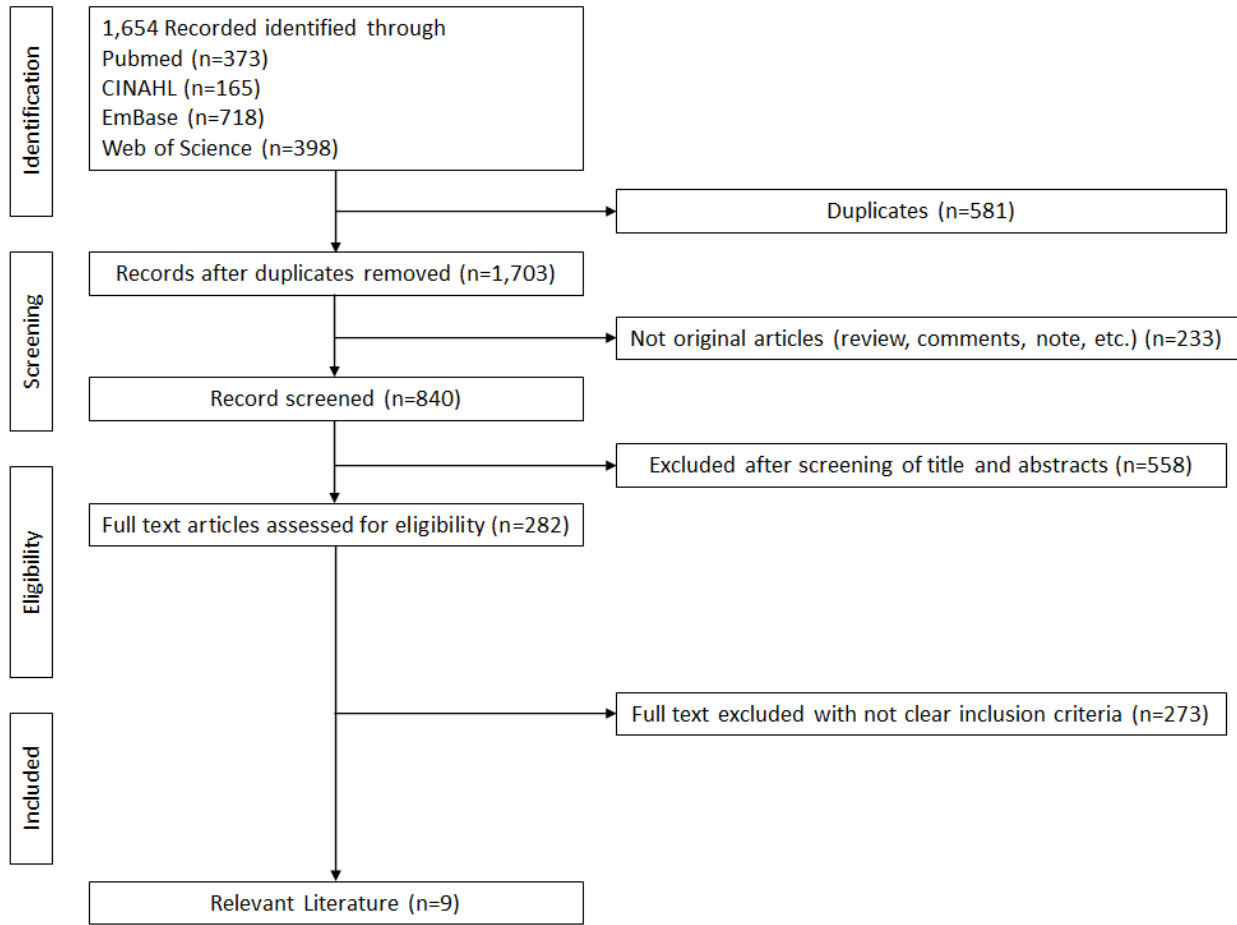


Fig. 1. Result of search strategy

**1.2.5 Data Analysis:** To reach an integrated result, Whitemore and Knafl [1] mentioned that providing a matrix is needed to see what categories apply to each study. The collected data were categorized according to the analysis method or the research design, characteristics, etc. Since not only quantity data but also qualitative data can be included in this review method, the data analysis can include more information than other review methods. In the matrix, all the information in the categories must be mentioned and must allow repeated comparisons. For the intervention studies, it is important to distinguish the differences and similarities, describe the

variables, and find intervention factors to make logical connections. Therefore, this study mentioned the matrix of the research, as shown in Table 1.

**1.2.6 Presentation:** To promote better understanding of the effects and the contents of the AR/VR simulation programs in the mental health area for healthcare professionals, the integrative review were performed as is shown in Table 1 and Table 2.

Table 1. Chronological Summary of Reviewed Papers

(N=9)

Author (year)	Design / Subject	Intervention	Outcome Measures	Findings
Verkuy et al. (2018)	Quasi-experimental study / Nursing students and nursing faculty	Virtual Gaming Simulation(VGS)	<ul style="list-style-type: none"> <li>Perceived ease of use</li> <li>Perceived usefulness</li> </ul>	<ul style="list-style-type: none"> <li>Total mean score: 81/90</li> <li>Useful addition to clinical experience for students and staff</li> <li>Advantage over written case studies</li> <li>Useful to nurses working in mental health or assessing suicide risk</li> </ul>

				<ul style="list-style-type: none"> <li>•Provide chances which cannot be exposed in reality</li> <li>•Felt safe practicing in virtual environment</li> </ul>
Gilmartin-Thomas et al. (2018)	Quasi-experimental study / Medical and pharmacy student	Virtual Dementia Experience	<ul style="list-style-type: none"> <li>•Dementia Attitudes Scale (DAS)</li> </ul>	<ul style="list-style-type: none"> <li>•Total DAS score and subdomains of comfort and knowledge has improved</li> </ul>
Silva et al. (2017)	Quantitative study / Medical student	Schizophrenia Simulator	<ul style="list-style-type: none"> <li>•Stigma related to schizophrenia</li> <li>•The efficiency and effectiveness of the tool</li> <li>•Stigma after simulation</li> </ul>	<ul style="list-style-type: none"> <li>•Increased stigma score which means increase in possibility of giving help, statistical significance in pity, fear, and segregation</li> <li>•Educational for health professionals</li> <li>•Suitable place rendering realistic effects</li> <li>•Helps to understand psychotic patient's mind</li> <li>•Reduces stigma and prejudice</li> </ul>
Sunnqvist et al. (2016)	Mixed methodology / Nursing students	Virtual Patients (VPs)	<ul style="list-style-type: none"> <li>•Written and oral examination</li> <li>•Visual Analogue Scale</li> </ul>	<ul style="list-style-type: none"> <li>•Independent to work on one's own</li> <li>•Useful to train communication</li> <li>•Exam pass rate: 77.8% (experimental group), 61.1% (control group)</li> </ul>
Saunders & Berridge (2015)	Qualitative study / Nursing students and lecturers	Shareville	<ul style="list-style-type: none"> <li>•Expectations, experiences and reflection on using Shareville</li> <li>•Shareville's usability and acceptability, and the application/transfer of learning</li> </ul>	<ul style="list-style-type: none"> <li>•Learning: helpful in promoting understanding</li> <li>•Clinical practice: helpful to reflect on the decision making</li> <li>•Fidelity: simulation is realistic</li> <li>•Pedagogy: Helpful format, given full opportunity to fully discuss the scenarios and approaches</li> </ul>
Vallance et al. (2014)	Mixed methodology / Medical student	Second Life Viewer (version v.3.3.4)	<ul style="list-style-type: none"> <li>•Psychiatric assessment, management, communication and professional skills</li> </ul>	<ul style="list-style-type: none"> <li>•Improvements in psychiatric skills/knowledge, expressing less anxiety and more enjoyment</li> </ul>
Lambert & Lucy (2013)	Cohort study / Nursing students	Mohammed	<ul style="list-style-type: none"> <li>•Knowledge and performance</li> </ul>	<ul style="list-style-type: none"> <li>•Higher level of learning</li> <li>•Management of emotions</li> </ul>
Kidd, Knisley, & Morgan (2012)	Quantitative study / Nursing students	Second Life® (SL)	<ul style="list-style-type: none"> <li>•SL Simulation Evaluation Survey</li> </ul>	<ul style="list-style-type: none"> <li>•Effective in teaching strategy</li> <li>•Opportunity to conduct home health assessment without potential safety risks</li> <li>•Enjoyable, requiring quick thinking</li> <li>•Focus on communication skill</li> </ul>
Fleming et al. (2009)	A randomized controlled educational trial / Physician, physician assistants or nurse practitioners, medical students, pharmacy, physician assistant, or nurse practitioner students	SIM simulation technology	<ul style="list-style-type: none"> <li>•Alcohol screening skill score</li> <li>•Alcohol intervention skill</li> </ul>	<ul style="list-style-type: none"> <li>•Alcohol screening: 14.4% increase</li> <li>•Brief intervention skill: 5.7% increase</li> </ul>

Table 2. Analysis of Intervention Papers

(N=9)

Authors (year)	Approach	Intervention period	Contents
Verkuy et al. (2018)	Virtual Reality	•30-40 minutes per simulation •More than one simulation	•Technology Acceptance Model •‘Think aloud’ method with recorded participants' comments and progression through the game
Gilmartin-Thomas et al. (2018)	Virtual Reality	•1.5 hours	•Multisensory, virtual simulation of light, sound, color, and visual content •Cognitive and perceptual difficulties faced by people with dementia
Silva et al. (2017)	Augmented Reality	•3 minutes	•Simulating the psychotic symptoms typical of schizophrenia •Simulates sense perception changes in order to create an immense experience capable of generating pathological experiences of patient with schizophrenia •Audio and visual effect
Sunnqvist et al. (2016)	Virtual Reality	•5 VP cases •10 weeks	•Assessment in Mental Health •Assessment in Ill-health •5 VP Cases: Major depressive disorder, psychotic behavior, substance abuse, bipolar in a manic states, and schizoaffective disorder
Saunders & Berridge (2015)	Virtual Reality	•1 hour	•Problem-based scenarios •Scenarios on persons with learning disabilities, coping with challenging behavior, seizure, and role modelling positive behavior •Children with Down’s syndrome, autism and attention deficit hyperactivity disorder
Vallance et al. (2014)	Virtual Reality	•2 consecutive 90 minutes teaching session	•Briefing, role play, reflective and debriefing stages •Depressed teenager avatar
Lambert & Lucy (2013)	Virtual Reality	•2 weeks	•Decision making, critical thinking and the application of clinical reasoning •Practice clinical and communication skill
Kidd, Knisley, & Morgan (2012)	Virtual Reality	•45 – 60 minute	•Interactions with virtual patient •Debriefing with instructor and students
Fleming et al. (2009)	Virtual Reality	•10 sessions, 6 weeks	•Basic background on alcohol screening and intervention •Asking the simulated patient to conduct counseling or make a referral to a treatment center •Response development for the simulated patient •Displays hand and body signals to indicated good or not-so-good questions posed by the learner •Instant replay feature •Scoring and feedback about learner’s performance

Table 3. General Analysis of Reviewed Papers

(N=9)

Variables	Content	n (%)
Published years	2016 ~ 2019	4 (44.4)
	2010 ~ 2015	4 (44.4)
	2006 ~ 2009	1 (11.1)
Research design	Cohort study	1 (11.1)
	Mixed methodology	2 (22.2)
	Qualitative study	1 (11.1)
	Quantitative study	2 (22.2)
	Quasi-experimental study	2 (22.2)
	Randomized Control Study	1 (11.1)
Research subjects	Nursing students	6 (66.7)
	Medical students	4 (44.4)
	Other health professionals	4 (44.4)
Approach	Augmented reality	1 (11.1)

	Virtual reality	8 (88.9)
Outcome Measure	Effectiveness/efficiency of the simulation tool	4 (44.4)
	Clinical skills (assessment, diagnosis, knowledge, and performance)	8 (88.9)
	Communication skill	3 (33.3)
	Emotion/feeling	3 (33.3)
	Understanding of patient	2 (22.2)

### 3. RESULTS

#### 3.1 Study Setting and Samples

Among the studies searched, 9 studies met the inclusion criteria. AR/VR simulation programs have been studied for a long time, but not many studies have been done in the mental health area. Recently AR/VR simulation programs in the mental health area for healthcare professionals have been actively studied and published. However, of those, only 1 study (11.1%) was randomized control test. Also, only 2 studies (22.2%) used mixed methodology even though mental health training cannot be evaluated mere questionnaires.

Among 9 studies, 6 studies' (66.7%) participants were nursing students, 4 studies' (44.4%) participants were medical students. There were 8 studies (88.9%) using VR approach and 1 study (11.1%) used AR approach. The duration of interventions provided were varied from 3 minutes to 90 minutes. When the AR/VR simulation programs were conducted as a part of the curriculum of nursing and medical students, it took about 10 sessions or at least 6 weeks. However, in most studies it was just one-time simulation. A summary of these findings is given in Table 3.

#### 3.2 Contents and Approaches

The interventions included effectiveness or efficiency of the AR/VR simulation tool, clinical skills, communication skills, and the experience of mentally ill people. The common contents of AR/VR simulation programs in the mental health area for healthcare professionals are learning more clinical skills like diagnosing, assessing, and providing interventions for patients, communication skills, and experiencing how mental diseases, and etc. Only 3 studies targeted specific disease such as dementia, schizophrenia, and alcohol abuse [21]-[23]. Other studies focused on general knowledge and interactions with patients in the mental health area.

The AR/VR simulation programs not only included teaching how to assess the patients and use screening tools but also included how the mentally ill patients feels like. Therefore, it allowed to sense more broader understanding of the patients.

#### 3.3 Outcomes

The effects for the programs were evaluated through the outcome measures. The outcome measures include, effectiveness/efficiency of the simulation tool, clinical skills (assessment, diagnosis, knowledge, and performance), communication skill, emotion/feeling, and understanding of patients. Among the factors, outcome measures were mostly clinical skills (assessment, diagnosis, knowledge, and

performance) (88.9%) and effectiveness/efficiency of the simulation tool (44.4%).

All of the AR/VR simulation programs were helpful in understanding or taking care of mentally ill patients. Although there was only one study that used AR simulation program, it showed both audio and visual effect [21], which helped to experience how the schizophrenia patients sense. Compared to AR simulation program, VR simulation programs more focused on abilities on interacting with patients and learning the clinical skill in mental health [22]-[29]. VR simulation programs also included multisensory technology with longer duration and longer sessions of the program. Since the AR/VR simulation programs can be repeated, it helped students to learn and practice more and this helped them to prepare for the clinic setting.

### 4. DISCUSSION

This paper analyzes the characteristics, contents, and effects of AR/VR simulation program in the mental health area for healthcare professionals as an integrative review paper. By gathering the information according to the results, this review could provide guidance for developing AR/VR simulation program on mental health in the future.

One of the first characteristics of this paper is that most of the studies' participants were nursing or medical students. For physicians or nurses, most interventions were provided to evaluated the contents and the effectiveness of the AR/VR simulation programs in mental health [22], [26], [29]. A wider variety of types of interventions were provided to nursing and medical students. When AR/VR simulation program in the mental health area for healthcare professionals is develop, it enables health professionals to practice interacting with patients and providing medical care to the patients in a safe, protected environment. Therefore, it is suitable to prepare health professionals before work and get trained. It can be used as education for nursing and medical students which can replace clinical experience and also for ongoing education for health professionals. Although the number of AR/VR simulation program in mental health has been recently increased, more AR/VR simulation programs in the mental health area for healthcare professionals are recommended in the future.

Second, the intervention duration was not clearly mentioned. Moreover, the intervention period varied and the number of sessions ranged from one-time session to 10 sessions. Since the unit of the intervention period sessions was mentioned in different ways, the period could not be compared accurately. When assuming one semester as a 12 to 16-week intervention, only 2 studies delivered the intervention for 10 weeks. Additionally, most studies did not describe the specific

contents of the intervention [24], [25], [27], [29]. Therefore, these interventions leave the questions about how to perform the same intervention in other situations.

Third, the contents were clearly mentioned. In most of the studies, the contents of the intervention were not described clearly. Moreover, only about half of the studies mentioned the type of devices used in the intervention. Among the studies reviewed, not all of the approaches satisfied the participants of using and experiencing the AR/VR simulation programs. Some participants complained about difficulties in focusing or using the devices and it did not help them to focus on the programs. Therefore, the contents and the approaches of the intervention needs more clarification for the future studies and applications to the health professionals.

The outcome measures to assess the effects of the interventions were varied. The common factors were effectiveness/efficiency of the simulation tool, clinical skills (assessment, diagnosis, knowledge, and performance), communication skill, emotion/feeling, and understanding of patients. Among these factors, clinical skills (assessment, diagnosis, knowledge, and performance) were mostly evaluated. Although clinical skills (assessment, diagnosis, knowledge, and performance) are not the only skills required for health professionals in the mental health area, factors affecting interpersonal relationship were not much focused. Since relationship between patient and the health professionals is important in the mental health area, the outcome measure of the future studies are recommended to include more factors when evaluating the effects of AR/VR simulation programs in the mental health area.

This paper has certain limitations. The studies included only AR/VR simulation programs using more than two sensory systems. Additionally, by limiting papers to those published in English, the studies included in this paper are limited. It is recommended that future research includes AR/VR simulation programs in more diverse technology and paper published in other languages.

## 5. CONCLUSION

Although the importance and effectiveness of AR/VR simulation in the mental health area, studies on AR/VR simulation program on mental health for health professionals are in a primitive stage. Therefore, this study will help to develop concrete contents and program periods for AR/VR simulation program on mental health for health professionals through an integrative review. Finally, the review helps to identify a future research agenda. Although most of the studies revealed that AR/VR simulation programs on mental health for health professionals enhanced the clinical skills and interpersonal skills like communication, controlling emotions and feelings, advanced research designs need to be implemented since the study designs are very primitive. Furthermore, when developing interventions, it is suggested that multisensory technique be included. The multisensory technique allows participants learned and experienced better than those with one sensory technology.

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