The Effects of Blended Learning Using Virtual Reality Simulation in Pediatrics-adolescent Nursing Clinical Practice

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Abstract

This study was to compare the effects of blended learning that integrates child-adolescent nursing clinical practice and virtual reality simulation. The aim of this study was to evaluate the effectiveness of blended learning in parallel clinical practice of child-adolescent nursing and virtual reality simulation of child-adolescent nursing by comparison of critical thinking, problem-solving processes, and clinical performance in both education groups before and after the educational intervention. The participants were 48 nursing college students. The experimental group (n=22) exposed a blended learning using virtual reality simulation, combining child-adolescent nursing clinical practice education, while the control group (n=26) received only child-adolescent nursing clinical practice curriculum course. The data collection period was from March 8 to November 26, 2021. The general characteristics of subject's were analyzed by number, percentage, mean and standard deviation. And clinical practice fused with virtual reality simulation, that is, homogeneity verification of the blended learning education group was analyzed by x^2 test and independent t-test. Whether there is a differences between pretest and posttest critical thinking tendency, problem-solving process, and clinical performance ability of the blended learning and the clinical practice education group was analyzed by independent t-test. The pretest & posttest results of each group showed statistically significant improvements in critical thinking, problem-solving processes, and clinical performance. In a comparison of the results of the two groups, the only statistically significant difference was found for critical thinking. Furthermore blended learning, combining a v-sim and a clinical nursing practice, into the nursing curriculum may contribute to the further development of nursing education.

Keywords: pediatrics nursing care, nursing students, blended learning, virtual reality, clinical practice

1. Introduction

Nursing science is developing educational content to experience digital-based healthcare fields following the 4th Industrial Revolution, and the global era of "untact" continues in the face of the COVID-19 outbreak, increasing demands for an optimized educational environment for non-face-to-face education (Yu & Ryu, 2017; Han, 2020) (clinicjournal, 2020). In particular, the necessity is more urgent in nursing education that trains nurses, who are professionals who provide nursing and medical services to humans (Hasala et al., 2020).

In the pandemic caused by COVID-19, face-to-face education has been limited in nursing care education, and many college of nursing in South Korea have not been able to conduct clinical practice in various health care fields, so clinical practice has been replaced with minimal face-to-face or non-face-to-face practice (Han, 2020). In addition, clinical practice, which is indispensable in nursing education, faces various problems such as a lack of clinical practice environment and a reduction in actual nursing practical treatment and intervention opportunities through observing clinical practice rather than actual clinical practice.

Therefore, nursing colleges have been paid for continued teaching and learning methods using VR simulations as an alternative to clinical practice education so that nursing students can experience and learn nursing in actual nursing clinical practice (Lim & Yeom 2020). Therefore, nursing education is preemptively responding through the introduction and operation of educational media such as AI and VR in order to flexibly and efficiently operates a non-face-to-face class in nursing college (Ahn & Lee., 2021).

Nursing college students were limited to perform direct contact with patients or nursing techniques directly due to problems with the patient's safety at the clinical practice site (Kang et al., 2020; Ewalt, 2018). Virtual reality simulation, an educational method to supplement this, is growing as one of learning modalities nursing education to improve clinical adaptability by reproducing the clinical environment and providing new learning experiences to nursing students (Regan & Onello, 2013). The KABONE defines simulation practice as 'a practice that can screen out situations that may occur in clinical area to perform nursing to solve problems using simulators or standardized patients, and to acquire clinical knowledge and nursing skills and promote critical thinking through debriefing on the process (Korean Accreditation Board of Nursing Education 2020). In addition, since simulation nursing education is allowed as some practical education when evaluating nursing education certification, many nursing colleges use a high-fidelity simulator to conduct simulation education (Lim & Yeom, 2020; Kim et al., 2019; LeFlore & Thomas, 2016).

In recent nursing college education, virtual reality allows learners to experience situations in a three-dimensional alternative learning environment (Ewalt), and is mainly applied as a technology using v-sim. VR simulation provides learners with innovative learning condition opportunities to provide safe and qualitative nursing in a complex clinical practice environment of the health care system (Kim et al., 2019; LeFlore & Thomas, 2016), and is in the spotlight as an educational medium that can be used continuously. In particular, virtual reality simulation is used for online remote education because it repeatedly allows virtual reality experiences in a nursing practice environment without time constraints, allow learners to practice learning situations or contexts at any time, easily accessible, and provide sufficient time for students to master the skills required by them (Ha et al., 2016). Therefore, it is the best educational method suitable for non-face-to-face practical education appropriate for the nursing education environment in the recent "untact" era (Hayden et al., 2014).

Virtual simulation is an emerging technology that has been suggested to be effective in teaching various skills in nursing education (National League of Nursing, 2012) (Foronda et al., 2014a; Foronda et al., 2014b; McCallum et al., 2011). Virtual simulation for nursing employs a web-based platform to simulate nursing scenarios whereby students have the opportunity to interact with patients and receive direct feedback on their performance. Scenarios allow students to apply knowledge, make decisions, perform interventions, receive feedback on actions, and repeat the experience as desired.

Previous studies on virtual reality simulation are currently being actively conducted at home and abroad, and research on nursing students reported an increase in confidence, communication skills, knowledge, and clinical performance, and it is suitable for educating non-technical skills (Forneris & Scroggs, 2014; Peddle et al., 2016). Previous studies in the 'Adult Nursing Care' area in South Korea have been reported on the development of 'Acute Gastrointestinal Bleeding' virtual reality simulation programs (Park, 2018), internet-based high-fidelity education for acute heart disease nursing (Chu & Hwang, 2017), and the effect of virtual reality simulation and blended simulation education for asthma child nursing education (Kik et al., 2018).

Therefore, this study was to compare the effects of hands-on education through blended learning that integrates child-adolescent nursing clinical practice and virtual reality simulation, and through this, it is intended to provide basic data for more efficient operation of child-adolescent nursing practical education.

The purpose of this study is to evaluate the effectiveness of blended learning by combining clinical practice of child-adolescent nursing and virtual reality simulation of child-adolescent nursing and the specific purpose is as follows.

First, the critical thinking tendency, problem-solving process, and clinical performance ability of the child-adolescent nursing clinical practice education group before and after education are identified.

Second, it identifies the critical thinking tendency, problem-solving process, and clinical performance ability of the education group pre and post an education that combines child-adolescent nursing clinical practice and VR simulation.

Third, the critical thinking tendency, problem-solving process, and clinical performance ability before and after education of the child-adolescent nursing clinical practice education group and the blended simulation education group were compared.

2. Method

2.1 Research Design

This study is a quasi-experimental study with a non-equivalent control group pretest-posttest designs to confirm the effect of blended education in combination with clinical practice of child-adolescent nursing and virtual simulation of child-adolescent nursing for nursing students (Table. 1).

Table 1. Research Design

Control group	Experimental group
$X_1 Y_{c2}$	$X_2 Y_{e2}$

X_1= clinical practice of child-adolescent nursing;

X_2=Blended learning by combing clinical practice of child-adolescent nursing and virtual reality simulation

Y_{c2}=Data collection (critical thinking tendency, problem-solving process, and clinical performance ability)

Y_{e2}=Data collection (critical thinking tendency, problem-solving process, and clinical performance ability)

2.2 Participants

The subjects of this study were 4th-grade nursing college students of the department of nursing science at CNC, who previously agreed to participate in the study among students who had no experience in child-adolescent nursing virtual reality simulation education. When the number of subjects for independent t-test was set to effect size .80, significance level (α), and power ($1-\beta$).80 using the G*Power 3.1.9 for WIN program, the minimum number of subjects required was calculated as a total of 42.

In consideration of poor responses, data were collected from a total of 50 people, and the final 48 people were used for the final analysis, with 22 in the blended education and 26 in the child-adolescent nursing clinical education.
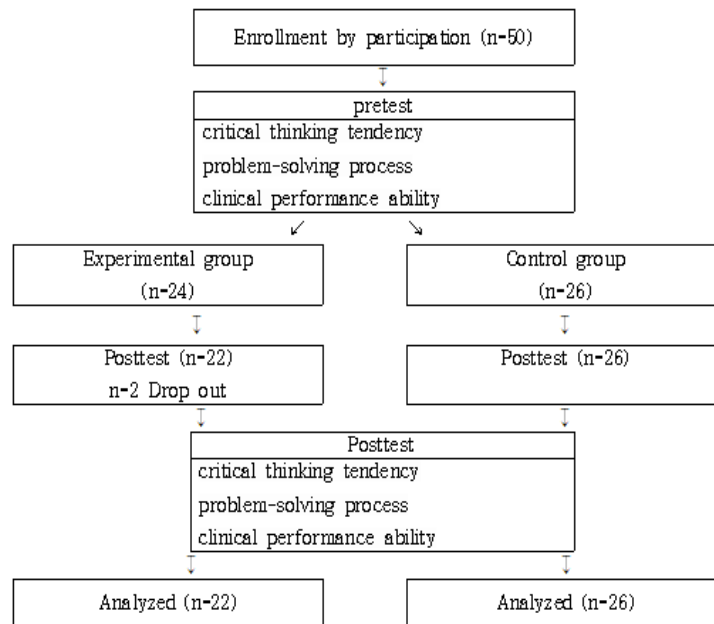
3. Data Collection

Figure 1. Flow Diagram of the Study Participants

The data were collected by dividing the participants into a control group with 26 fourth-grade nursing college students who conducted a clinical practice in child-adolescent nursing in the first semester of 2021 (March 8, 2021 to June 25, 2021), and 22 fourth-grade nursing college students were conducted as experimental groups in the second

semester (September 6, 2021 to November 26th, 2021). Both groups consist of students who had no previous experience in child-adolescent nursing virtual reality simulation education in the same grade.

Prior to data collection, the contents of the study were explained to the participants, and the study was conducted on students who voluntarily agreed to take part in the research, and the participating students were not required to know whether it was an experimental group or a control group. Both groups were handled by the same researcher. Before child-adolescent nursing clinical practice, two groups of experimental and control groups were given a general questionnaire.

General characteristics, critical thinking propensity, problem-solving process, and clinical performance were measured. In the case of the experimental group, the clinical practice for 5 days (45 hours) was conducted at the clinical practice institution, and 5 days (45 hours) also for the virtual reality simulation of child-adolescent nursing conducted in the computer room. In the case of the control group, child-adolescent nursing clinical practice was conducted at a clinical practice institution for 10 days (90 hours). After the end of child-adolescent nursing clinical practice, critical thinking tendency, problem-solving process, and clinical performance ability were measured again in the two groups (Fig. 1).

4. Ethical Considerations

In this study, to protect subjects, a medical report was attached, and the contents of the consent form included voluntary participation in the study, guaranteeing anonymity, and the scope of use of the survey contents, considering the ethical aspects of the study. The consent form also assured the participants that they could withdraw at any time during the course process of the data collection, and the collected data were encrypted and stored to protect the subject's personal information, and the personal information management file was thoroughly managed to ensure confidentiality.

5. Research Procedures

The process of this study is as follows. First, the experimental group conducted clinical practice at a medical institution for 5 days and virtual reality simulation on campus for 5 days. The control group conducted clinical practice at a medical institution for 10 days.

Second, the virtual simulation for nursing scenario was selected. The scenario was about a 5 years old girl named Sabina Vasquez, who shows asthma symptoms. Here, the nursing student must perform respiratory system assessment for the child in the emergency room, and perform medication by recognizing minor respiratory difficulties. If a scenario was already selected, you have to step 6 where the suggested reading, pre-simulation quiz, v-Sim, post-simulation quiz, documentation assignments, and guide reflection questions are given. Lastly, after the operation simulation of the two groups, a survey was conducted again on the critical thinking tendency, problem-solving process, and clinical performance ability of the experimental group and the control group.

6. Research Tools

6.1 Critical Thinking Tendency

Critical thinking tendency is a tool developed by Yoon (2008) for nursing students, and consists of 27 questions in total, including 7 sub-areas: 4 questions for prudence, 5 questions for intellectual passion and curiosity, 4 questions for intellectual fairness, 3 questions for being systematic, 4 questions for sound skepticism, and 3 questions for objectivity. The tool is a 5-point Likert scale from 1 = very rarely to 5 = very often. The possible range of score from lowest to highest is 27 to 135 points. The higher the score, the higher the critical thinking tendency. The Cronbach's α value of the tool was .80 in Yoon's (2008), and .81 in this study.

6.2 Problem-solving Process

A tool developed by Lee, Park, and Choi (2008) was used to measure the problem solving process, and this tool consists of 30 questions in 5 areas: 6 clarification questions, 6 solution seeking questions, 6 decision applying questions, and 6 evaluation and reflection questions. The tool is a 5-point Likert scale from 1 = very yes to 5 = not at all. The possible range of score from lowest to highest is 30 to 150 points, and the higher the score, the higher the problem-solving ability. The Cronbach's α value of the tool was .90 in the study of Lee et al. [28], and .92 in this study.

6.3 Clinical Performance Ability

Clinical performance is a tool developed by Lee et al. (1990) and modified and supplemented by Choi [30] and consists of 45 questions (11 for nursing courses, 11 for nursing skills, 8 for education/cooperation relationships, 6 for interpersonal/communication questions, and 9 for professional development questions). The tool is a 5-point Likert scale with 1 = not at all and 5 = very yes. The possible score range from lowest to highest is 45 to 225 points, and the higher the score, the higher the clinical performance. The Cronbach's α value of the tool was .93 at the time of development and .90 in the studies of Lee et al., (1990) and Choi (2005). In this study, Cronbach's α value was .96.

7. Data Analysis Method

The data collected in this study were analyzed using the SPSS/WIN 25.0. The subjects' general characteristics were analyzed by number, percentages, means, and standard deviation. And clinical practice fused with virtual reality simulation, that is, homogeneity verification of the blended learning education group was analyzed by x^2 test and independent t-test. Whether there is a difference in the pre- and post-critical thinking tendency, problem-solving process, and clinical performance ability of the blended learning education group and the clinical practice education group was analyzed by independent t-test.

8. Results

8.1 Verifying the General Characteristics and Homogeneity of the Subjects

Table 2 shows the general characteristics and homogeneity verification results of this research. Of the total 48 participants, 100% (22 students) in the experimental group and 100.0% (26 students) in the control group were female, and the average age was 21.2 years in the experimental group and 21.8 years in the control group, showing no significant difference between the two groups. For religion, 50.0% (11 people) of the experimental group, and 26.9% (7 people) of the control group stated their religion. Neither of the members from each group had experienced previous simulation education and asthma education. As a result of the homogeneity test between the experimental group and the control group before the simulation education operation, it was confirmed that there was no significant statistical difference in homogeneity.

Table 2. General Characteristics of the Participants (N=48)

Characteristics	Categories	Blended simulation (n=22)	Clinical practice (n=26)	x^2 or t	p
		n(%) or M±SD	n(%) or M±SD		
Gender	Female	22 (100.0)	26 (84.6)	3.69	.055
	Male	0 (0.0)	0 (0.0)		
Age (year)		21.2±1.03	21.8±1.87	0.32	.560
Religion	Yes	11 (50.0)	7 (26.9)	11.28	.027
	No	11 (50.0)	19 (73.1)		
Simulation experience	Yes	0 (0.0)	0 (0.0)		
	No	22 (100.0)	26 (100.0)		
VR education experience	Yes	0 (0.0)	0 (0.0)		
	No	22 (100.0)	26 (100.0)		
Critical thinking disposition		97.62±9.18	97.51±6.24	0.69	.324
Problem-solving process		108.89±18.98	104.28±27.48	0.98	.319
Critical performance		154.14±18.99	153.87±11.14	3.09	.205

8.2 Critical Thinking, Problem Solving Process, and Clinical Performance Degree before and after Education of Blended Learning Using Virtual Reality Simulation Group Propensity

Table 3 shows the comparison effects before and after education of blended learning using virtual reality simulation group. Critical thinking tendency is 95.69 points before education and 104.49 points after education. Therefore, the increase in scores was statistically significant (t=2.98, p=.003). In case of the problem-solving process, the increase

in post-training scores was statistically significant from 114.31 points before education to 120.46 points after education (t=2.99, p=.005). Clinical performance was also statistically significant from 149.27 points before training to 158.09 points after training (t=3.99, p<.001).

Table 3. Comparison of Dependent Variables for the Clinical Practice Education Group between Pretest and Posttest (N=26)

Variables	Pretest	Posttest	Difference	x^2 or t	p
	M±SD	M±SD	M±SD		
Critical thinking disposition	95.69±7.08	104.49±8.67	-8.24±5.65	2.98	.003
Problem-solving process	113.98±12.53	120.46±11.48	-6.47±1.68	2.99	.005
Critical performance	149.27±18.47	158.09±12.26	-8.81±9.88	3.99	< .001

8.3 Critical thinking, Problem Solving Process, and Clinical Performance Degree before and after Education of Blended Learning using Virtual Reality Simulation Group Predisposition

Table 4 present the comparison results before and after education of blended learning using virtual reality simulation group. The critical thinking tendency was statistically significant from 95.69 points before education to 106.42 points after education (t=6.25, p<.001). In the case of the problem-solving process, there was a significant statistical difference in the scores pre and post implementation from 118.62 points before education to 123.32 points after education (t=3.45, p=.008). And the clinical performance ability was 142.27 points before education to 178.67 points after education, and the difference in scores before and after education was statistically significant (t=6.20, p<.001), in the lower areas, the increase in post-education scores was significant statistical results such as nursing process, nursing technology, education and cooperative relations, interpersonal relations and communication, and professional development.

Table 4. Comparison of Dependent Variables for the Blended Learning using Virtual Reality Simulation between Pretest and Posttest (N=22)

Variables	Pretest	Posttest	Difference	x^2 or t	p
	M±SD	M±SD	M±SD		
Critical thinking disposition	95.69±8.17	106.42±21.49	-10.69±15.46	6.25	<.001
Problem-solving process	118.62±42.45	123.32±15.26	-4.65±14.55	3.45	.008
Critical performance	142.27±22.11	178.67±20.98	-36.40±24.42	6.20	<.001

8.4 Differences in Critical Thinking Tendency, Problem-Solving Process, and Clinical Performance between the Blended Learning using Virtual Reality Simulation

Table 5 shows the comparison results before and after blended learning using virtual reality simulation of the two groups. The critical thinking tendency was 10 points in the comparative group and 3.79 points in the control group, and the difference in scores between the two groups was statistically significant (t=2.40, and p=.006).

The problem-solving process was 6.82 points for the experimental group and 5.92 points for the control group, but the score difference was not statistically significant, and the lower region also showed no statistically significant difference. Clinical performance was 24.69 points in the comparative group and 12.78 points in the control group, and the difference in scores between the two groups was not statistically significant, but there was a statistically significant difference in education and cooperation among the lower areas.

Table 5. Comparison of Changes in the Dependent Variables between Pretest and Posttest for Both Groups (N=48)

Variables	Blended learning(n=22)	Clinical practice(n=26)	x^2 or t	p
	Difference M±SD	Difference M±SD		
Critical thinking disposition	10.98±9.84	3.79±5.19	2.40	.006
Problem-solving process	6.82±6.54	5.92±17.92	1.77	.082
Critical performance	24.69±4.68	12.78±2.11	4.78	.065

9. Discussion

This study attempted to provide basic data for the development and operation of effective and standardized virtual reality education in simulation-based nursing education by confirming the educational effect of blended teaching and learning methods that combines clinical practice and virtual reality simulation.

As a result of the study, in the case of the control group, the difference in scores before and after education was statistically significant in all areas of critical thinking tendency, problem-solving ability, and clinical performance ability. This is believed to have improved problem-solving skills through the process of exploring various solutions in the clinical situation of virtual reality of child nursing.

Various and innovative nursing education methods are being developed in accordance with the era of the 4th industrial revolution. As the demand for advanced technology use increases in clinical practice training in medical institutions, virtual reality simulation education is on the rise as a means of practical education. As a study applying virtual reality simulation, it was reported that nursing students were highly satisfied with learning child nursing skills through virtual games in the case of development and effective study of child nursing skills using virtual games (Ryoo et al., 2013).

In this study, when comparing the effects of the two education groups before and after education, the group applying blended learning significantly improved its critical thinking tendency compared to the group applying only clinical practice (Lim & Yeom 2020). This is believed to have led to a more positive effect on learning in parallel with the two types of education. And in the comparison of the effects before and after education, there was a significant statistical difference in score of clinical performance each group. This shows that the cooperative relationship capability with colleagues has increased through blended learning, and it is believed that self-learning has also improved somewhat in the cooperative relationship (Foronda et al., 2014b; McCallum et al., 2011).

And in the comparison of the effects before and after education, there was a significant statistical difference in clinical performance between the two groups. This shows that the cooperative relationship capability with colleagues has increased through blended learning, and it is believed that self-learning has also improved somewhat in the cooperative relationship. In addition, it was reported that clinical performance after simulation education had a correlation with critical thinking tendency (Lim & Yeom, 2020; Park, 2018).

Since the limitation of the study is a study targeting nursing students at a college, there is a limit to generalizing the research results, so it is suggested to try continuous repeated studies. In addition, virtual reality simulations of various clinical situations have been developed, and research that measures the effectiveness of education after applying the simulation is needed.

10. Conclusion

This study confirmed the critical thinking tendency, problem-solving ability, and clinical performance before and after an education that combines clinical practice and virtual reality simulation for nursing college students who have no exposed in virtual reality simulation education. Both groups improved their scores after training, and showed statistically significant differences, especially in critical thinking tendencies.

In child nursing practice, virtual reality-based education is an innovative way to enable blended learning. To enable such virtual reality-based education, scenarios will be developed and implemented under various topics to maximize the research area by measuring various variables as well as nursing students' critical thinking tendency, problem-solving ability, and clinical performance ability.

Based on the above research results, the following recommendations are advance. It is suggested to develop virtual reality simulations in the future for core basic nursing training in clinical practice in child nursing. In addition, effect research is proposed by applying blended learning that combines virtual reality simulation in various practical subjects.

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Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data sharing statement

No additional data are available.

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