

## EFFECT OF VIRTUAL REALITY IN 360 DEGREES VIDEO TO IMPROVE STANDARD PRECAUTIONS COMPLIANCE AMONGST NURSING STUDENTS

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### ABSTRACT

Nursing students need effective learning methods to improve their abilities and skills in achieving competency. Virtual care reality in 360° videos is an alternative solution to a real and concrete learning method. This study aims to determine the effect of virtual care reality in 360° (VCR 360°) videos on compliance with standard precautions in nursing professional students. The study used a randomized control trial with the sample of 32 students for each group was obtained through a random sampling technique. This research was conducted at two state universities in Indonesia in 2022 and provided an intervention in the form of a 360° VCR for 17 minutes at least three times in each video containing material on standard precautions. A standard precautions compliance questionnaire was employed to investigate the main variable with a further analysis using paired t-test and independent t-test. The results of the study showed that there was a significant effect of the VCR 360° on increasing standard precautions compliance among students ( $p = 0.004$ ). The research results are expected to be applied in the learning process of nurses in tertiary institutions and other learning topics.

Keywords: *Compliance; virtual care reality; 360° videos; standard precautions*



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### INTRODUCTION

COVID-19 brought some adjustment throughout daily lives including education. With the previous measures to combat the transmission with the social distancing, we aligned to a different path of remote education (Shorey et al., 2022). Thus, continuing education after COVID-19 pandemic becomes a

constant, challenging endeavor for many nursing education institutions. One of many alternatives is modifying the learning methods. In-person instruction was replaced with virtual remote learning (Agu et al., 2021), and clinical rotations were halted (Leaver et al., 2022). Reportedly, these circumstances have several negative effects, including insufficient planning, a deficiency in learning chances, and

subpar skill development (Kaveh et al., 2022). Another study also highlighted a variety of difficulties that nursing students faced during this time of transition, including difficulties with technology and the classroom (Sulastri et al., 2022).

Furthermore, during the COVID-19 pandemic, students who were pursuing higher education in nursing certainly had needs that needed to be met to gain an authentic learning experience, as well as improve skills relevant to their profession (Ilmy et al., 2020). Another study had unequivocally shown how fresh graduates evaluate their clinical shortcomings; hence, young nurses may believe their situation is more unstable than that of their forebears (Martin et al., 2023). Now that the pandemic is over, post-pandemic education can use adaptive and dynamic learning methods that focus on resilience with the use of new digital technologies that offer a more interactive experience (Ratten, 2023). Therefore, it is very important to develop authentic learning methods and media to improve students' skills in achieving competence as professional nurses. One of the skills that is very crucial for nursing students who are undergoing a nurse professional education program is action *standard precautions*.

Preventive procedures *and precautions* must be implemented strictly in all health service facilities, including emergency rooms, action rooms, triage rooms, observation rooms, and laboratories (Wu et al., 2020). There are several methods used in patient care, both involving invasive and non-invasive procedures. This can pose a risk for nurses to be exposed to various types of germs originating from patients (Hillier, 2020). Every nurse must comply with the action procedure *universal precautions* consistently and precisely every time they perform nursing actions on all patients. The implementation of standard precautions includes washing hands, using personal protective equipment, managing needles and sharps, treating equipment in a sterile manner, and managing waste and cleanliness. Implementation of standard precautions is part of the nurse's efforts to create an environment free from infection and protect themselves and patients from the spread of disease. The application of standard precautions can train and introduce practices that always prioritize safety and infection control in hospitals for all patients. Therefore, an effective learning effort is needed.

Learning methods have a significant impact on the quality of learning in higher education in nursing (Sismulyanto & Putra, 2018). Practice in the laboratory is the main way that can help in the nursing learning process covering cognitive, affective, and psychomotor aspects (Juniarti et al., 2017). The application of the perfect practicum method requires the help of learning media with a real picture and an effective instructional layout (Maduramente et al., 2019). According to Permana et al (2019) good learning media can provide authentic learning experiences that are almost the same as the real environment.

The recommended method for applying clinical nursing skills is the use of Virtual Care Reality (VCR 360°) in the form of 360°-spherical video. VCR 360° is a device that can produce images and objects that look real and can be rotated 360 degrees. This device uses stereo images to create an immersive experience, which makes us feel as if we are in a simulated environment. VCR 360° service offers opportunities for users to interact with patients and clinically virtual resources, and access practice content as needed.

Overall, the use of Virtual Reality Simulation (VRS) is a practical way of learning that can visually show the practical experience of providing nursing care in situations that are almost the same as real situations (Permana et al., 2020).

Virtual Reality (VR) is becoming more affordable financially and can be used easily so that students can access it wherever and whenever they want to learn (Permana et al., 2020). VR has the potential to transform health professions education. VR with higher interactivity showed more effectiveness compared with less interactive VR for post intervention knowledge and skill outcomes (Kyaw, 2019). Even so, the use of VCR 360° in the world of nursing higher education in Indonesia is still limited and there is no VCR 360° technology specifically designed for higher education in nursing. Thus, it is important to carry out studies and innovations on the VCR 360° specifically designed for the healthcare sector in Indonesia. The hope, the use of VCR 360° can meet the deficiencies of learning methods, especially in the practice of standard precautions which are more effective, safe, and support direct learning. This study aims to analyze the effect of using virtual reality technology in video 360° on the level of standard precautions compliance (SPC) among nursing students.

## METHOD

### Study design

We conducted a randomized control trial. The design of this study was to measure the effect of the 360° VCR intervention on SPC in nursing students.

### Sample

The population of this study were students at the State University in Purwokerto dan Depok, with as many as 164 respondents. The sampling technique used a random sampling technique through a random draws process. The number of samples in this study was 38 students in the intervention group and 32 students in the control group. The inclusion criteria were students of the Nursing Profession, the Department of Nursing, the Faculty of Health Sciences, Jenderal Soedirman University, and the University of Indonesia. Exclusion criteria were students who did not take part in nursing professional practice at the hospital.

### Instrument

This study used a questionnaire for SPC that had been tested by (Valim et al., 2015) consisting of 20 statement items with the answer choices always, often, sometimes, and never. The validity test value is 0.76-0.83 and the reliability value is 0.8. An instrument also explored respondent characteristics are gender, experience as a nurse, experience studying infection control, receiving Hepatitis B vaccine, and report needlestick incidents.

### Intervention

VCR 360° intervention was applied to the intervention group for 17 minutes (Permana et al., 2020) at least three times in each video. VCR 360° videos contain material about *standard precautions* consisting of proper and proper hand washing, use of Personal Protective Equipment (PPE), safe injection practices, and handling of potentially contaminated equipment or surfaces in the patient's environment.

### Data Collection

The research subjects were divided into two groups, namely the intervention group and the control group. Measurements were made twice, namely before and after the intervention in

both groups. Researchers provide research explanations to prospective respondents. Prospective respondents who are willing to be respondents fill out the consent form. Measurement *post-test* was performed two weeks after the VCR 360° intervention for the internalization phase first (Kusumawardani et al., 2018). The control group was given a VCR 360° after the posttest to pay attention to research ethics. This research was conducted at the Nursing Professional Study Program, Department of Nursing, Faculty of Health Sciences, Jenderal Soedirman University, and the University of Indonesia. This research was conducted for four months.

### Data Analysis

Data analysis consisted of univariate and bivariate. Univariate analysis describes the characteristics of students and SPC. The age variable is interpreted in terms of median, minimum, and maximum. Variables of gender, experience as a nurse, studied infection control, received hepatitis B vaccine, and reported incidents of needle sticks were interpreted in terms of frequency and percentage. SPC was interpreted in terms of mean and SD.

Bivariate analysis was used to identify differences in the average standard precaution's compliance in each group and to analyze the effect of the intervention on SPC. Analysis of differences in the average standard precaution's compliance before and after the VCR 360° intervention in each intervention and control group using the pooled t-test. Analysis of the effect of the VCR 360° intervention on SPC using paired t-test. The normality test was carried out first using the Saphiro Wilk test with the results of  $p > 0.05$ .

### Ethical Consideration

This research has been declared to have passed an ethical review from the Ethics Commission of the Faculty of Health Sciences, Jenderal Soedirman University with decision letter number 788/EC/KEPK/VII/2022.

## RESULT

In this study, the characteristics of students by age reveal that the median age of the students is 22 years, with an age range between 21 and 31 years. This table reflects the age variation among the sample of 70 students.

**Table 1. Characteristics of students based on gender, experience as a nurse, studied infection control, hepatitis B vaccination, and reported incidents of needle sticks (n=70)**

Characteristics	f	%
Gender		
1. Man	4	54,7
2. Woman	66	94,3

**Table 4. Analysis of changes in SPC among nursing students before and after the intervention (n = 70)**

Variable	Intervention Group				Mean Different	p-value
	Before		After			
	Mean	SD	Mean	SD		
SPC	64,18	6,035	65,92	5,440	1,74	0,002
Variable	Control Group				Mean Different	p-value
	Before		After			
	Mean	SD	Mean	SD		
SPC	64,38	5,729	64,84	6,284	0,46	0,129

Characteristics	f	%
Experience as a nurse		
1. Once	4	54,7
2. Never	66	94,3
Experience studying infection control		
1. Once	69	98,6
2. Never	1	1,4
Receiving Hepatitis B vaccine		
1. Once	9	12,9
2. Never	61	87,1
Report needlestick incidents		
1. Once	28	40
2. Never	42	60

Table 1 shows that most students are female, namely 66 students (94.3%), 66 students (94.3%) have never been nurses, 69 students (98.6%) have studied infection control, 61 students (87.1%) never receive Hepatitis B vaccine, and 42 students (60%) had never reported needlestick incidents.

**Table 2. SPC before and after intervention (n=70)**

SPC	Group	Mean	SD
Before	Intervention	64,18	6,035
	Control	64,38	5,729
After	Intervention	65,92	5,440
	Control	64,84	6,284

The average of SPC among students in the intervention group was different before and after the intervention was carried out. The mean SPC before the intervention was 64,18 with a standard deviation of 6,035. [MOU1] The mean SPC after the intervention increased to 65,92 with a standard deviation of 5,440. The average SPC in the control group was not much different between before and after the intervention. The mean of SPC before the intervention was 64.38 with a standard deviation of 5.729. After the intervention, the mean of SPC was not much different, namely 64.84 with a standard deviation of 6.284.

**Table 3. Respondents' SPC homogeneity test (n = 70)**

Variable	Group	Mean	SD	p - value*
SPC	Intervention	64,18	6,035	0,893
	Control	64,38	5,729	

\*Homogeneous population variance (equivalent) at  $p \text{ value} > 0.05$

Based on the results of the homogeneity test, it was found that the variance of SPC between the intervention group and the control group was homogeneous ( $p > 0.05$ ). After knowing the variance of the two homogeneous groups, an analysis of the differences in respondent's SPC before and after the intervention was carried out in the intervention group and the control group.

**Table 5. Analysis of differences in SPC among students after intervention between the intervention group and the control group (n = 70)**

Variable	Group	Mean	SD	p-value*
Obedience	Intervention	65,92	5,440	0,004
	Control	64,84	6,284	

The analysis results showed a difference in the mean SPC Obedience scores between the intervention group and the control group of 1,08. The results of further statistical tests also obtained significant changes in adherence after the intervention ( $p\text{-value} < 0.05$ ). The mean of SPC also increased by 0.46 in the control group. The results of further analysis obtained insignificant changes in SPC before and after the intervention in the control group ( $p\text{-value} > 0,05$ ).

After analyzing the differences in SPC before and after the intervention in the two groups, then analyzing the differences in SPC after the intervention between the intervention group and the control group using a statistical test *pooled t-test*. The results of the analysis showed that the mean SPC of respondents after the intervention was carried out in the intervention group was 65.92 with a standard deviation of 5.440. The mean SPC in the control group without intervention was 64.84 with a standard deviation of 6.284. The results of the further analysis showed that there were significant differences in SPC after the intervention between the intervention group and the control group ( $p\text{-value} < 0,05$ ).

## DISCUSSION

The study's findings indicate that the respondents were in their late teens, with an SD of 1.378 and an average age of 22 years. Early adolescence is a developmental stage that marks the beginning of becoming a more responsible adult (Bonnie & Backes, 2019). A person's cognitive capacities are at their peak during the late adolescence stage, making it simpler for them to learn, understand, and think creatively. There is also no deterioration in memory capacity currently (Potter et al., 2013). The level of awareness and adherence to the usage of PPE among dental students at RSGM Unsoed is influenced by adolescence (Dewi et al., 2020).

VCR 360° intervention affects student compliance in the form of student perception changes. VCR 360° intervention is useful for improving new knowledge and skills (Alammary, 2023), so that students can easily understand the basic principles and standard practices of SPC as well as it consistently applies that positive perception will be formed. Positive perception on VCR 360° intervention is shaped by their knowledge, which also serves as a foundation for decision making and impacts on changes in students' perception on standard precautions practice, it is also confirmed in a study by Angeloni et. al (2023) that an improvement in the students score on SPC shows the educational intervention is successful, the improvement may be attributable to the fact that the students are able to absorb and process new information on the intervention. These results indicate that the learning method using a VCR 360° effectively increases student knowledge about *standard precaution*.

The findings indicated that most pupils had read readings on infection prevention. Following the completion of their nursing undergraduate degree, individuals pursue nursing professional education. When they reach the Bachelor of Nursing education level, this indicates that students have been exposed to basic infection control information. The skills

course in undergraduate level includes information on fundamental infection control (AIPNI, 2021). The ability of the students to apply the principles and practices of infection control and patient safety is one of the learning successes in this course.

To assist the implementation of high-quality and competent healthcare services, including infection prevention and control initiatives in healthcare facilities, the Ministry of Health of the Republic of Indonesia has established guidelines for infection prevention and control in healthcare facilities. The goal of Infection Prevention and Control (IPC) is to prevent and reduce the frequency of illnesses in patients, employees, visitors, and the neighborhood surrounding healthcare facilities. Standard cautious principles based on transmission, prudent antibiotic use, and safeguards are used to execute IPC. Through advocacy, outreach, technical counseling, training and capacity building of human resources, monitoring, and evaluation, the process of nurturing and supervising IPC is carried out based on Health Minister Regulation No. 27 Concerning Guidelines for Infection Prevention and Control in Health Facilities (Health Minister Regulation, 2017)

Students, who make up one of the resources in question, must get instruction and technical advice about IPC to reduce the incidence of infections linked to healthcare. The work of hospital healthcare professionals and healthcare professionals involved in the delivery of healthcare services in healthcare facilities is to blame for this infection. Every hospital has a policy requiring the implementation of fundamental IPC training for all healthcare professionals, including students working as practitioners there. There was 1 (one) student who had not received basic IPC training when the pretest measurement was carried out, because the student was sick at the beginning of practical implementation. Pretest data was taken before the student was scheduled to take part in the follow-up activities for basic IPC training organized by the Hospital Training Agency.

The hepatitis B vaccine has not been administered to nearly all kids. It is important to make efforts to prevent, control, and treat viral hepatitis since it is an infectious disease and a public health concern. By doing so, the impact on morbidity, mortality, and socioeconomic concerns will be reduced. Through vaccination campaigns, viral hepatitis can be managed. Newborns must receive an active hepatitis B vaccination as soon as possible after birth. Newborns of hepatitis B-positive mothers receive passive hepatitis B vaccine shortly after birth based on Health Minister Regulation No. 53 Concerning Viral Hepatitis Management (Health Minister Regulation, 2015).

Based on the results of basic health research in 2018, the number of hepatitis cases in Indonesia is quite high, both in the adult to adolescent age range (Ministry of Health, 2019). However, currently there are no regulations that require health workers in Indonesia to undergo hepatitis B vaccination before starting work in health care settings.

Many health workers have received complete hepatitis vaccination, although there are still a small number who have an incomplete vaccination history and have never been vaccinated (basic health research, 2018). According to Bastiangga & Hapsari (2019) there are still few health professionals who have protective anti-HB titers against hepatitis B.

Most pupils haven't ever reported experiencing a needle stick. According to Mallapiang et al (2019) a needle stick injury is an accident brought on by being pricked by a needle when receiving an injection, closing the needle, drawing blood, inserting the infusion, or disposing of it and there is a chance that the wound will get contaminated with blood or bodily fluids. The likelihood of infection may be impacted by this. Training in the proper use of needles and established work standards are factors that affect the frequency of needle sticks (Herlinawati et al., 2021).

According to earlier studies, nurses frequently get needle sticks in their fingers while recapping and pay little attention to properly disposing of sharp materials. The ability to increase one's self-awareness in terms of adhering to specified work standards, using PPE, and reporting any work-related incidents is expected of nurses (Sari et al., 2021). According to research findings, the lack of complaints of needle stick events during practice may be attributable to students' improved ability to implement basic IPC when taking the prior level of education and training offered by the hospital.

Students are encouraged to examine an undesired incident when teachers are well informed about them. The work standards established by healthcare institutions act as a manual for attaining practical and time-saving objectives so that they can consistently and safely achieve the required criteria. When performing invasive operations on patients, training can help reduce the likelihood of needle sticking (Herlinawati et al., 2021).

The results showed that the mean compliance of respondents in the intervention group was different before and after the intervention was carried out. The mean compliance score in the intervention group after the intervention also increased by 1.74 compared to before the intervention. The results of further statistical tests also obtained significant changes in respondents' compliance after the intervention ( $p$ -value  $<0.05$ ). The mean compliance of respondents in the control group was not much different before and after the intervention. The mean compliance before the intervention was 64.38 with a standard deviation of 5.729. After the intervention, the mean knowledge was not much different, namely 64.84 with a standard deviation of 6.284.

In this study, VR applications are called *Virtual Care Reality* in 360° video (VCR 360°). VCR 360° are real-looking images and objects projecting a three-dimensional (3-D) view that can be rotated 360 degrees and uses a stereo image to give it a real feel. This is what causes the VCR 360° to become a practical learning method capable of providing learning experiences in increasing knowledge (Permana et al., 2019). Notoatmodjo (2018) explains that a person's knowledge occurs after sensing certain objects. Sensing can be through the senses such as the senses of sight, hearing, smell, taste, and touch.

Kang et al (2020) showed the highest scores for the level of knowledge, confidence, and performance after using VR applications with conventional learning procedures compared to the control group (Kang et al., 2020). Another study by Padilha et al., (2019) stated that clinical virtual simulations increase knowledge retention and clinical reasoning and increase student satisfaction in learning. This is due to the VCR 360° technology functions to reconstruct information into a digital visualization combined with the real world so that it becomes easy for students to imagine the information conveyed. In addition, the learning method uses a VCR 360° which makes it easy for anyone to use (Indrawan et al., 2021).

Ashari et al (2021) in his research uses *virtual fieldwork* to show that result *virtual fieldwork* is a form of innovation that can be an alternative in providing learning experiences based on field studies and practicum. In this system, online learning does not limit opportunities to hone skills and experience learning physical geography contextually. This is what can increase student knowledge, even though they experience limitations in the learning process during the pandemic. Other research conducted by Nurdiana, (2020) shows the effectiveness of the development of *reality* as an educational medium can increase public knowledge about the natural disaster of Mount Merapi. This is because this media presents an image that when highlighted using a cellphone camera will produce an effect that combines the real world with the virtual world, so that it can be a choice in increasing public knowledge of natural disasters.

Rambing et al (2017) in their research related to application *Virtual Reality* (VR) based on 360° video on the traditional dances of the Minahasa tribe show the results that VR media can help preserve cultural values and provide information so that it can increase one's knowledge in studying culture in North Sulawesi. This is caused by *the virtual Reality* 360° video based on the Maengket Dance in the form of an interactive application featuring the Maengket Dance with a total of 3 rounds where in each round scene there is an information button about the meaning of the dance movements displayed.

A meta-analysis study reveals the role of VR in student academic achievement, the results of which are known to have a positive impact on improving cognitive abilities, affective and psychomotor skills, satisfaction, self-confidence, and performance time in addition to creating a perception of a real atmosphere and a feeling of being present immediately (*presence*) (Akgün & Atici, 2022; Wu et al., 2020). In nursing studies, the results of this study validate the positive impact on student knowledge as is the case in Jung & Park (2022) who designed a similar study in a group of 30 nursing students on surgical nursing ( $p=0.001$ ). Compared to the use of traditional methods in nursing learning, the use of VR in practical learning has been extensively researched and has had positive results in increasing student knowledge and skills (Wu et al., 2020). Although several other studies have results that tend to show the same or contradictory results in two different treatment groups (Ezenwa et al., 2022; William et al., 2016) a literature study shows that the use of VR is one of the most effective learning methods in increasing student knowledge (compared to affective and psychomotor abilities) (Shorey et al., 2021). This can be explained by a study that shows that the interest of nursing students in the VR method and the success of their studies is based on the motivation and perceived benefits of using VR (Uymaz & Uymaz, 2022). However, some research also indicates the need for an

assessment of the suitability of the VR method with the skills being taught.

The various studies above show the effectiveness of *Virtual Reality (VR)* as a technology that places images or videos situationally and broadens the viewing power, captures, and analyzes virtual data significantly to increase knowledge. Besides that, *Virtual Reality* can increase compliance because it allows users to interact in cyberspace with an environment that is simulated by a technology from the actual environment and that exists in the imagination. The strength of this study focuses on the effect of virtual care reality in 360° videos (VCR 360°) on compliance with standard precautions in nursing students and the limitation relates to the sample of study which is clearly still insufficient to describe the actual situation.

## CONCLUSION AND RECOMMENDATION

The research results show that virtual reality in 360° video can increase nursing students' compliance in implementing universal precautions. The research results are expected to be applied in the learning process of nurses in tertiary institutions. This method integrates the latest information technology in the clinical learning process so that one of the learning competency outcomes for nurse graduates can be achieved. The learning outcomes and competencies referred to are being able to utilize information technology in the process of providing nursing care. Universal precautions are a very crucial basic competency for nurses because if they are ignored, nurses will violate the principles of patient safety in healthcare facilities. Patient safety is one of the nine life-saving patient safety solutions that all health and support workers in health service facilities need to pay attention to. In addition, the VCR 360° method is expected to be applied to other Nurse learning themes.

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