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Correlation between cognitive load, vividness and cyber sickness for 360-degree education video

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Abstract

This study attempted to investigate cognitive load, vividness, and cybersickness in nursing students, in the last year of nursing college, who used a 360-degree video content for studying intravenous fluid infusion, one of the core fundamental nursing skills. The aim was to determine the correlation between the variables, and to decide whether the 360-degree video content can be used as an effective supplementary educational material in the regular curricula. This study, a descriptive research, was conducted from October 31, 2019 to November 14, 2019. The participants in this study were 64 students in the 4th year of nursing college at a university located in B City, South Korea. They were instructed to watch a 360-degree video content for intravenous infusion using a Samsung Head Mounted Display (HMD) while ensuring the safety of the students. The results showed that the scores, out of 7 points, for material design, self-evaluation, and physical effort for cognitive load in nursing students were 5.93±0.71, 5.92±0.71, and 5.64±0.74 points, respectively. In addition, the scores, out of 7 points, for mental effort and task difficulty were 2.55±1.08 and 1.94±0.75 points, respectively, and the scores for vividness and cybersickness in the participants were 5.82±0.84, and 2.57±0.98 points, respectively. Physical effort, self-evaluation, and material design for cognitive load in the participants were positively correlated with vividness (r=.379, r=.458, r=.507). In addition, mental effort for cognitive load was positively correlated with cybersickness (r=.684), whereas self-evaluation and material design were negatively correlated with cybersickness (r=-.388, r=-.343). Based on the results of this study, we believe that the 360-degree video content for intravenous fluid infusion can be used as an educational medium in regular and non-regular curricula. In addition, future studies are needed to specifically develop and verify teaching and learning methods on how to apply 360-degree video contents..

Keywords: *Nursing student, Cognitive load, Vividness, Cybersickness, Intravenous fluid infusion*

1. INTRODUCTION

What new nurses feel they lack the most while starting nursing practice in hospitals is the professional kno wledge and skills [1]. Nursing students in the last year of nursing college, who will become new nurses, must have the professional knowledge and expertise relating to core fundamental nursing skills that have a high p erformance frequency and importance in nursing practice, and should be fully provided with related educatio

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nal opportunities. Core fundamental nursing skills include 20 items of core nursing skills that nursing student s must essentially learn and achieve in nursing practicum while training [2], and are essential items that they must learn and be skilled in before starting practice as new nurses because they are a very important part of nursing practice and patient nursing care [3]. Among the core fundamental nursing skills, intravenous fluid infusion has a high difficulty level, and occupies a large part of nursing practice.

Nursing students have expressed that it was difficult to memorize the sequence of basic nursing skills, and to acquire skills [4]. Education on intravenous infusion so far is mostly offered in the forms of theoretical education using eBooks and textbooks, and practice education using internet videos and educational DVDs. Due to the limitations of such classical education methods, smart device-based educational contents have been developed, and digital content development models are thus recommended [4].

The simulator runs for the right for patients to receive safer treatment and can contribute in the dimension of more appropriate practical effect of education, acquisition of new medical knowledge, medical education, patient safety, medical cost reduction, etc. [5]. Virtual reality simulation allows medical personnel to be trained through devices instead of practicing as a patient [6]. The general definition of virtual reality (VR) is to implement an artificial virtual world through a computer or other device to provide a real-like experience for the user to feel. Therefore, if the intravenous injection education is applied as a VR simulation, nursing students can practice safely and can expect results in reducing the cost of laboratory training materials that need to be continuously purchased as consumables.

The modern students live in the digital age, have no resistance to electronic devices, and are familiar with the use of devices, therefore, they prefer educational materials delivered through electronic devices [4]. In particular, the smartphone usage rate in South Korea is ahead of the computer usage rate [5], and new technologies equipped with smart learning are introduced constantlyre, and the development of digital educational contents such as 360-degree virtual reality (VR) videos is increasing. Education using such smart devices will be able to present a new paradigm for new education methods tailored for learners' preferences.

Therefore, this study aims to investigate cognitive load, vividness, and cybersickness in the 4th year nursing college students who used 360-degree video content to learn intravenous fluid infusion, and to determine the correlation between the variables and provide basic data for developing educational methods for core fundamental nursing skills, which will help improve nursing skill competency in nursing students before graduation.

2. METHODS

2.1 Study Design

This study is a descriptive research aimed at investigating cognitive load, vividness, and cybersickness, and in the 4th year nursing college students who used 360-degree video contents for intravenousinfusion, and determining the correlations between the variables.

2.2 Participants and Data Collection

The participants in this study are the 4th year nursing college students at a university located in B City, South Korea who were informed of the purpose and methods of this study, and all agreed to voluntarily participate in the study. The participants were informed that they would not be forced to participate in this study or to answer the questionnaires, and that they would be able to voluntarily stop participating in this study. Then, the researchers explained them about the purpose and methods of this study. In addition, the participants were fully informed of the consent to voluntarily participate in this study, and the advantages, and inconveniences of participation in this study, and were also explained that they would have no disadvantages even if they did not participate in this study.

The data collection period was from October 31, 2019 to November 14, 2019. Before starting this study, the researchers provided the participants with a brief introduction about the 360-degree video and how to use the Head Mounted Display (HMD) for watching the video. A total of 65 nursing college students participated in this study, and watched the 360-degree video content for intravenous fluid infusion for about 7 minutes. A total of 64 copies of questionnaires, except for one questionnaire with incomplete information, were finally used for analysis

2.3 Instruments

Cognitive load. Cognitive load was measured using the cognitive load tool used in Rye's study [8]. The tool consists of five categories: physical effort, mental effort, task difficulty, self-evaluation, and material design. The five categories consisted of a total of 20 items with 4 items for each category. Each item is rated on a 7-point scale, ranging from 1 point for 'Strongly disagreel', 2 points for 'disagree', 3 points for 'slightly disagree', 4 points for 'usually agree', 5 points for 'slightly disagree', 6 points for 'agree', and 7 points for 'strongly agree'.

The reliability of the tool in a study by Rye [8] was Cronbach's α=.88 for physical effort, Cronbach's α=.85 for mental effort, Cronbach's α=.89 for task difficulty, Cronbach's α=.79 for self-evaluation, and Cronbach's α=.72 for material design. Its reliability in this study was Cronbach's α = .89 for physical effort, Cronbach's α=.78 for mental effort, Cronbach's α=.89 for task difficulty, Cronbach's α=.84 for self-evaluation, and Cronbach's α=.85 for material design.

Vividness. Vividness was measured using a vividness tool which was modified for this study from a vividness measurement tool used in a study by Lee [9]. The tool consists of a total of three items. Each item is rated on a 7-point Likert scale, ranging from '(1) strongly disagree' to '(7) strongly agree'. The reliability of the tool was Cronbach's α=.91 in a study by Lee, and Cronbach's α=.89 in this study.

Cybersickness. Cybersickness was measured using a tool which was modified for this study from the Simulator Sickness Questionnaire used in a study by Kennedy et al [10]. The tool consists of items regarding fatigue, dizziness, and nausea. Each item was measured on a 7-point Likert scale, ranging from '(1) strongly disagree' to '(7) strongly agree'. The reliability of the tool was Cronbach's α=.77 in the study by Kennedy et al. [10], and Cronbach's α=.81 in this study

2.4 Data Analysis

The statistical analysis of the data was performed using the SPSS 24 WIN program. The significance level w as set at .05. Frequency, percentage, minimum value, maximum value, mean, standard deviation, and Pearso n correlation for the variables were calculated.

3. RESULTS AND DISCUSSION

3.1 General Characteristics

The participants in this study were 3 men (4.7%) and 61 women (95.3%). A total of 62 (96.9%) participants had intention to use the VR content, and 61 (95.3%) had intention to recommend the VR content. In addition, 25 (39.1%) reported their intention to use the VR content as a post-class material, 21 (32.8%) reported their intention to use the VR content as a pre-class material, and 18 (28.1%) reported their intention to use the VR content as a self-study material [Table 1].

Table 1. General characteristics (N=64)

Item		n(%)
Gender	Male	3 (4.7)
	Female	61 (95.3)
Intention to use VR content	Yes	62 (96.9)
	No	2 (3.1)
Intention to recommend VR contents	Yes	61 (95.3)
	No	3 (4.7)
How to use VR content	Pre-class materials	21 (32.8)
	Post-lass materials	25 (39.1)
	Self-tudy materials	18 (28.1)

3.2 Cognitive Load, Vividness, and Cybersickness in the Participants

The scores for cognitive load, vividness, and cybersickness in the participants are shown in Table 2. With regard to cognitive load, the scores for material design, self-evaluation, and physical effort were, out of 7 points, 5.93±0.71, 5.92±0.71, and 5.64±0.74 points, respectively. The scores for mental effort, and task difficulty were 2.55±1.08 points, and 1.94±0.75 points, respectivelyOut of 7 points, the score for vividness and cyber sickness in the participants were 5.82±0.84 out of 7 and 2.57±0.98 points, respectively.

Table 2. Variable results (N=64)

Items	Min	Max	M ± SD
Mental effort	1	5.75	2.55±1.08
Physical effort	4	7	5.64±0.74
Task difficulty	1	4	1.94±0.75
Self-evaluation	3.75	7	5.92±0.71
Material design	4	7	5.93±0.71
Vividness	3	7	5.82±0.84
Cybersickness	1	4.57	2.57±0.98

3.3 Correlation between Cognitive Load, Vividness, and Cybersickness

The correlation between cognitive load, vividness, and cybersickness in the participants are shown in Table 3. Physical effort, self-evaluation, and material design among the cognitive load in the participants were positively correlated with vividness (r=.379, r=.458, r=.507). In addition, mental effort among the cognitive load in the participants was positively correlated with cybersickness (r=.684), whereas self-evaluation and material design were negatively correlated with cybersickness (r=-.388, r=-.343).

Table 3. Correlations between the variables (N=64)

	Mental effort	Physical effort	Task difficulty	Self-evaluation	Material design	Vividness	Cybersickness
Mental effort	1						
Physical effort	-.227	1					
Task difficulty	.299*	-.377**	1				
Self-evaluation	-.473**	.481**	-.324**	1			
Material design	-.380**	.632**	-.336**	.647**	1		
Vividness	-.149	.379**	-.091	.458**	.507**	1	
Cybersickness	.684**	-.167	.213	-.388**	-.343**	-.044	1

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed)

4. CONCLUSION AND SUGGESTIONS

This study investigated cognitive load, vividness, and cybersickness in nursing college students who watched a 360-degree video content of intravenous fluid infusion installed on a smartphone using an HMD device. The aim was to determine the correlations between the variables, and provide basic data for the use of 360-degree video contents as supplementary educational materials in the future. The study found that, with regard to cognitive load in the participants, material design, self-valuation, and physical effort were at the upper middle level, whereas mental effort, and task difficulty were at the lower level. Vividness in the participants was at the upper middle level, and cybersickness was at the low level. Physical effort, self-assessment, and material design for cognitive load in the participants were positively correlated with vividness. In addition, mental effort was positively correlated with cybersickness, whereas self-evaluation and materials design were negatively correlated with cybersickness. The results of this study confirmed the possibility of using the 360-degree video content for intravenous infusion as a supplementary education method. In previous research, the same intravenous injection simulator that applied virtual reality and haptic technology. When practicing by merging with the existing intravenous arm model in practice time, It is believed that venipuncture execution time is reduced and satisfaction with equipment is improved. Education using virtual reality is for repetitive practice until the trainee becomes proficient. It is efficient not only because it provides an opportunity, but also because it allows you to learn special issues that are needed at any time in the current state[12] . However, there is a possibility that the training effect may not be properly reflected due to not having enough time to practice for the intravenous injection simulator using virtual reality. In addition, there are studies that show that the traditional method brings a greater improvement than the simulator[6]. Therefore, it is necessary to carry out practical evaluation such as measuring the success of intravenous injection after applying the contents of this study in future studies. In addition, training using a simulator is in the spotlight as a useful method to improve clinical performance as a practical and interactive teaching-learning method [13]. We need a way to select and apply it. There is a limitation in not being able to confirm the effect size due to insufficient previous thesis on the number of subjects. Since this study was conducted using students' self-report questionnaires, it is difficult to generalize the results of this study. Based on this study, the following are suggested for further studies in the future. First, studies extensively involving subjects from various regions can increase the possibility of generalizing study results. Second, future studies are needed to comprehensively investigate cognitive load by adding physiological measurements to the cognitive load for 360-degree video contents. Third, comparative and repetitive studies are suggested to determine the effects of 360-degree video contents for the use of video materials in class.

5. ACKNOWLEDGEMENT

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