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Comparison of Students' Satisfaction in Intramuscular Injection Education: Model versus Simulation-Based Learning

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Abstract

Purpose: Although simulation-based learning (SBL) has been using in nursing education, there is few studies evaluating students' satisfaction on SBL. Thus, the purpose of the current study was to compare the satisfaction of nursing students in Intramuscular injection education between using model based learning (MBL) and SBL. Methods: Randomly assigned two group cross-over design was used. The participants were a total of 88 female nursing students. Descriptive statistics and t-test were conducted using SPSS 20.0. Carry-over effect was examined using Grizzle model. Satisfaction of students was measured in terms of student participation, satisfaction on learning type and contents, appropriateness of contents and objectives, and goal attainment. Results: There was no carry-over effect in all satisfation scores. No significant differences in all satisfaction scores between MBL and SBL were found. Conclusion: Compare to MBL, SBL did not bring higher satisfaction of nursing students in terms of student participation, satisfaction on learning type and contents, appropriateness of contents and objectives, and goal attainment. In spite of no better satisfaction, the effectiveness of SBL is required to be evaluated in every aspect in future studies.

Keywords: *Intramuscular Injection, Model-Based Learning, Simulation-Based Learning, Nursing Students, Nursing Education.*

Introduction

Clinical skills education is very important in nursing education. In the case of clinical skills education, if it is taught using actual patients, the educational effect will be great, but there are bound to be legal and ethical restrictions [1]. Therefore, clinical skills education is mainly conducted based on observation [2], and various forms of education are being used to overcome the limitations of limited skills education. One of them is model-based education, and recently, simulation education using computers is also becoming more widespread [3- 5].

Practical training in intramuscular injection, a crucial core skill among clinical skills, is currently being implemented in most schools using either low-fidelity simulators or high-fidelity simulations. Model-based training has been the most traditional method, while simulations are increasingly being introduced to enhance student proficiency. herefore, it is thought that providing simulation education that integrates information such as computer-based pictures, photos, sounds, and videos to students will motivate and arouse their interest [6]. However, before utilizing it in nursing education, it is necessary to comprehensively compare the educational effects that traditional visual aids, such as model-based education, and simulation education, can bring to learners and seriously consider which method to utilize in nursing education. Therefore, this study aimed to compare the differences in learner satisfaction among the educational effects of model education and simulation education methods in intramuscular injection education.

Furthermore, this study went one step further and attempted to compare the effects using a crossover design, which has not been attempted much in domestic nursing research. A crossover design is a design method that administers different treatments to each group of subjects, allows a washout period for a certain period of time, then applies the treatments crosswise again and compares the effects of the different treatments [7]. When using a crossover design, selection bias can be reduced by applying both treatments to the same subjects, and in particular, since each subject becomes his or

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her own control group, interference from confounding variables can be avoided [8], and thus results with much higher validity can be obtained than any other experimental design.

To achieve this, this study developed learning protocols for simulation-based and model-based intramuscular injection training for nursing students, based on protocols presented in Fundamentals of Nursing. Using a crossover design, these protocols were applied and specific learner satisfaction levels were compared between the two training methods. Through this, we aimed to provide basic data that will enable nursing educators in the field to select more appropriate teaching methods for intramuscular injection training in the future.

Materials and Methods

Research Design

This study used a crossover design with random assignment to compare learner satisfaction with model and simulation training methods for intramuscular injection. To this end, nursing students who consented to the study were divided into two groups based on their grades in the "Simulation Practice" course in the previous semester, and each group was randomly assigned to receive model training or simulation training first. Treatment A was model training and Treatment B was simulation training. As the first treatment (period 1), group AB received model training (A) and group BA received computer simulation training (B). After that, learner satisfaction was measured first. To prevent the effects of the first treatment from affecting the effects of the second treatment, i.e., to exclude the carryover effect, a two-week washout period was provided (Figure 1). Afterwards, in the second treatment (period 2), the first treatment was reversed, with group AB receiving computer simulation training (B) and group BA receiving model training (A). After the training, learner satisfaction was measured again for the second time.

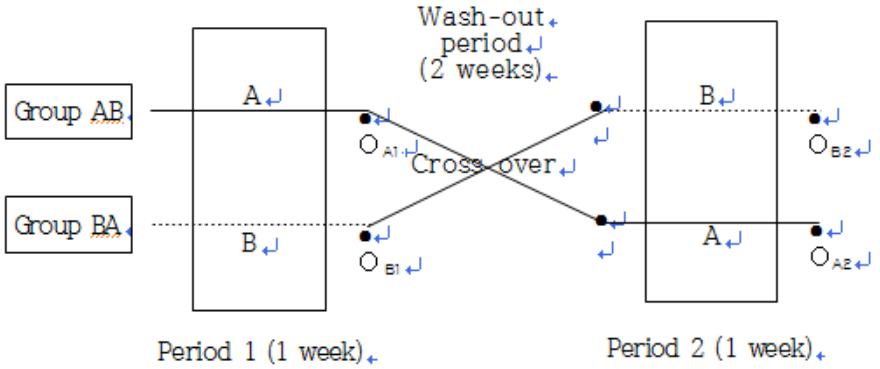

Figure 1. Research Design: Cross-Over Design

A= model based learning; B=simulation-based learning

O_A=observation after treatment A(model-based learning); O_B=observation after treatment B(simulation-based learning)

O_1= first observation; O_2= Second observation

Data Collection Period and Research Subjects

This study was conducted on third-year nursing students taking a simulation class at K University from March to May 2025. Using the G power program 3.1.2, the number of subjects required for the t-test was calculated with a significance level of .05, an effect size of .5, and a power of .7. As a result, 39 subjects were needed for each group. Considering a 20% dropout rate, 48 subjects were recruited for each group, for a total of 96 subjects. Ultimately, 8 subjects did not respond to the questionnaire, resulting in a total of 88 subjects included in the analysis in this study, with 41 subjects in group AB and 47 subjects in group BA.

Development of a Learning Protocol

The learning time for this study consisted of 6 hours, including 2 hours of lectures on intramuscular injection, 2 hours of model training, and 2 hours of computer simulation training. The lectures provided identical content to both groups. A model (LM027, Koken, Japan) was used [9], and the simulation used Sim Baby (Laerdal, Norway) [10]. The learning objectives for the simulation learning objectives for intramuscular injection were set to be to follow the safety rules for administration, prepare accurately, find a safe intravenous injection site, and perform the correct intramuscular injection procedure.

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The simulation training protocol was developed based on the Simbaby (Laerdal, Norway) user manual. The researcher received two hours of training from Laerdal's trainers, and focused on a pediatric nursing scenario. The training included video viewing, understanding medication safety guidelines, preparing for intramuscular injections, patient identification, intramuscular injection, and cleanup. The training time was identical to that of the model training. The appropriateness and validity of the developed protocol were finalized with the advice of three nursing professors and one experienced nurse.

Data Analysis

The collected data were analyzed using SPSS Version 20.0. The general characteristics of the subjects were analyzed using descriptive statistics, and the homogeneity of general characteristics between the two groups was verified using the $\chi 2$ test and t-test. The Grizzle model was used to analyze the carryover effect [11], and according to this model, the significance level (p) was determined to be 0.1 or less. If the carryover effect was not significant, the scores of group AB (O_{A1}-O_{B2}) and group BA (O_{B1}-O_{A}) were calculated, and the two scores were compared using a t-test to verify the verification. The significance level for all analyses except the carryover effect analysis was set at 0.05.

Results and Discussion

Homogeneity Test for General Characteristics

There were no significant differences between the AB and BA groups in terms of age, satisfaction with the nursing major, or 'simulation practice' grades, indicating that the two groups were homogeneous (Table 1). The mean age of the AB group was 20.00±0.74 years, and that of the BA group was 20.32±1.22 years. The satisfaction with the nursing major was 6.07±1.63 points for the AB group and 6.49±1.50 points for the BA group. The 'Basic Nursing and Practice' grades in the previous semester were 82.68±8.05 points for the AB group and 84.02±6.57 points for the BA group, showing no significant difference.

Table 1. General Characteristics of Subjects (N = 88)

Characteristics	AB (n=41)	BA (n=47)	χ^2 or t	*p*
	n(%) or M±SD	n(%) or M±SD		
Age (yrs)	20.00±0.74	20.32±1.22	-1.50	.136
Satisfaction with major	6.07±1.63	6.49±1.50	-1.24	.217
Grade Point Average	82.68±8.05	84.02±6.57	0.93	.350

Comparison of Students' Satisfaction between Model and Simulation Based Learning

There was no difference in the scores for active participation in model education and simulation education, satisfaction with learning format and content, and suitability of content and objectives. (Table

2). There was also no difference in academic achievement scores. As a result of the test, the (O_{A1}-O_{B2}) score of group AB was -0.11±0.70, which was slightly higher in academic achievement scores during treatment B, simulation education, and the (O_{B1}-O_{A2}) score of group BA was -0.02±0.51, which was slightly higher in scores during treatment A, model education, but the difference between the two scores was not statistically significant (p=.535).

Table 2. Comparison of Students' Satisfaction between Model- and Simulation- Based Learning (N = 88)

Category	Details	Group AB (n=41)	Group BA (n=47)	Comparison of effectiveness between 2 treatments	
		(O_{A1}-O_{B1}) M±SD	(O_{B1}-O_{A2}) M±SD	t	*p*
	Total	-0.07±0.58	-0.01±0.42	-0.48	.626
Active participation	**Subtotal**	-0.15±0.73	-0.06±0.57	-0.59	.552
Satisfaction on learning type and contents	**Subtotal**	-0.01±0.55	0.02±0.54	-0.25	.800
	I had an intention to recommend this learning type to other practice education	-0.15±0.79	-0.15±0.66	0.01	.987
	I was satisfied with this learning type	-0.05±0.92	0.06±0.73	-0.63	.525
	I was satisfied with learning contents	0.17±0.63	0.15±0.75	0.14	.884
Suitability of objectives and contents	**Subtotal**	-0.03±0.72	-0.01±0.57	-0.14	.886
	Contents were matched with objectives	0.07±0.82	0.04±0.72	0.18	.852
	Contents met my expectation	0.02±0.88	-0.06±0.76	0.50	.616
	Contents were organized logically	-0.15±0.94	-0.06±0.57	-0.50	.614
	Objectives were presented properly	-0.07±0.75	0.04±0.72	-0.73	.464
Achievement of learning	**Subtotal**	-0.11±0.70	-0.02±0.51	-0.62	.535
	Objectives were achieved	0.15±0.91	0.04±0.62	0.63	.530
	I learned logical thinking process	-0.27±0.95	-0.21±0.95	-0.27	.786
	I learned new knowledge	0.17±0.67	0.17±0.70	0.00	.997
	I acquired nursing practice ability	-0.24±0.89	-0.02±0.87	-1.18	.240
	I acquired ability to identify problems	-0.15±1.20	-0.15±0.86	0.01	.991

	I acquired communication skills	-0.29±1.10	0.02±0.82	-1.49	.138

O_1=first observation; O_2= Second observation;

O_A=observation after treatment A(model-based learning); O_B=observation after treatment B(simulation-based learning)

Discussion

This study compared student satisfaction with model training, a key clinical skill in nursing education, and simulation training, a more recent and increasingly popular method, in terms of active participation, satisfaction with learning format and content, satisfaction with the appropriateness of learning content and objectives, and satisfaction with academic achievement. The goal was to identify the differences in student satisfaction between the two methods and provide nursing educators with basic data for selecting the appropriate teaching method.

The results of the study showed that there was no significant difference in the level of active participation, satisfaction with the learning format and content, satisfaction with the appropriateness of the learning content and objectives, and satisfaction with the level of academic achievement after model education and simulation education. These results are compared with the following domestic previous studies. Although it was not the same intramuscular injection, this result is different from that in which the level of student participation (class attitude score) was significantly higher after simulation-based emergency nursing education [12]. However, because this study conducted simulation education on one group without a control group and observed attitude scores, a direct comparison with the results of this study is difficult. Another previous study compared learner satisfaction after model education and computer simulation education using a quasi-experimental design in intravenous injection education and reported that there was no difference [12], which is consistent with the results of this study.

Given the conflicting opinions in previous studies regarding satisfaction with model and simulation education, it's difficult to draw any conclusions. However, unlike previous studies, this study utilized a crossover experimental design. Furthermore, the subjects experienced both simulation and model education before comparing their satisfaction levels, making this study significantly more valid. Therefore, the conclusion that student satisfaction with model and simulation education methods does not significantly differ is supported.

In addition, a study reported that the factors that affect the satisfaction of nursing college students when using computer simulation education are clear goal setting and appropriate achievement motivation [13]. Considering that the satisfaction of students regarding the appropriateness of learning content, format, and goals did not differ when simulation education was conducted and model education was conducted in this study, it can be inferred that the satisfaction of students according to the two educational methods did not differ because clear goals and appropriate learning content were presented even though the educational methods were different. As mentioned earlier, model education and simulation education each have their own shortcomings. Model education has been reported to not provide students with sufficient experience [14], and computer simulation education often provides limited experience by not utilizing diverse scenarios in intramuscular injection training. Furthermore, simulations are often inconvenient to utilize [15], and particularly, simulations can be difficult to operate. Therefore, research has shown that model-based training provides better educational outcomes [16]. Furthermore, they are reported to be very expensive, require pre- and post-training procedures in addition to hands-on practice, and have limited durability [16]. However, the results of this study confirm that student satisfaction with education does not significantly change, regardless of the educational method used, as long as learning objectives and content are appropriately presented.

The significance of this study lies in its ability to examine learner satisfaction with model training and simulation training in intramuscular injection training in more specific areas. Furthermore, its use of a crossover design ensures greater validity. A limitation of this study is that it did not compare the effectiveness of model training and computer simulation training in terms of outcomes (intramuscular injection success rates), the ultimate goal of intramuscular injection training. This suggests the need for further comparison in future research.

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