

The Effect of Integrated Simulation Experiential Learning Disaster Nursing for Enhancing Learning Outcomes Among Undergraduate Nursing Students: A Quasi-Experimental Study

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Background: Traditional classroom-based learning often lacks the depth of experience to develop the practical skills and decision-making abilities needed in disaster situations. Integrated Simulation Experiential Learning Disaster Nursing (ISEL-DN) is an innovative approach that combines simulation technology with experiential learning, providing a more immersive and interactive learning experience for students.

Purpose: This study aimed to explore the effectiveness of the ISEL-DN model in enhancing knowledge, attitudes, satisfaction, and self-confidence among undergraduate nursing students.

Methods: A quasi-experimental study with a control group was conducted on 94 undergraduate nursing students (Intervention group: 47 and control group: 47). Samples were recruited using convenience sampling by inclusion and exclusion criteria. The intervention group was given learning based on ISEL-DN. The data were analyzed univariately by displaying the frequency distribution and central tendency, and comparisons were made using the Wilcoxon rank and Mann-Whitney *U*-tests.

Results: Significant improvements were observed in the control group across variables: knowledge ($p < 0.001$), attitude ($p = 0.042$), satisfaction ($p = 0.001$), and overall self-confidence ($p = 0.009$). In the intervention group, all variables and subcomponents showed significant improvements ($p < 0.05$). The ISEL-DN model significantly increased knowledge and satisfaction, much greater than traditional learning ($p < 0.05$).

Conclusion: This study showed that the ISEL-DN model significantly improved nursing students' knowledge and satisfaction, attitudes, and self-confidence compared to traditional learning. The knowledge and satisfaction variables observed the most significant improvement, indicating that the ISEL-DN model provided a more interactive and in-depth learning experience. This model can be innovative in disaster nursing education to improve students' preparedness to deal with emergency situations effectively.

Keywords: attitude, disaster nursing, knowledge, satisfaction, self-confidence, nursing student

Introduction

Indonesia is prone to earthquakes, tsunamis, and volcanic eruptions. Indonesia's topographical conditions and geographical location cause this country to experience various disasters that continue to increase yearly. Disaster events that occurred throughout 2018 were 4051 events and showed an increase in 2023 to 4,940 events consisting of 18 earthquakes, 41 droughts, 2,048 forest and land fires, 427 landslides, 322 tornadoes, and 351 floods. Disaster events in West Java Province in 2023 were landslides (6 times) and tornadoes (2 times), which caused casualties, injuries, and refugees.¹ Victims in disaster conditions have not been entirely appropriately handled due to the lack of coordination and inadequate health service data, resulting in untreated victims.² Therefore, it is important to increase the competence of health professionals, including nurses, in providing health services in disaster conditions.

The nursing profession has many members across various areas, including urban, rural, and remote hamlets.³ As the largest group of healthcare providers, nurses are essential in dealing with casualties, injuries, and refugees in disaster conditions. Nurses must be able to identify, advocate for, and treat the impact in all phases of disaster, including active participation in disaster planning and preparedness.⁴ The International Council of Nurses developed competencies for disaster nurses at each stage of the disaster cycle by increasing the capacity of nurses within a framework. All of these competencies are needed to reduce the impact caused by disasters, it is necessary to have integrated and interdisciplinary disaster preparedness and response.^{5,6} Besides nurses, nursing students also have an important role in disaster conditions.

A previous study stated that students need to be given provisions related to disaster preparedness.⁷ Then, this is stated in the disaster learning guidelines for university students to carry out the disaster learning process. The reason is to increase the students' knowledge, capacity, and skills to build self-awareness and community awareness of hazards and reduce disaster risk.⁷ Nursing students have more roles in disaster conditions, and they can be placed in public service areas under the supervision of nurses.⁸ Few literatures have explored the role and function of nursing students in disaster conditions.^{9,10} Several studies concluded that many methods can be used to provide disaster education. Several of these journals showed significant differences between the results before and after the intervention was given.¹¹

In carrying out their role, students need to get supportive learning in disaster nursing education to improve student preparedness in dealing with disasters. In the learning process, disaster nursing can increase the student's knowledge, attitudes, satisfaction, and confidence in dealing with disasters. A previous study found that disaster nursing learning can increase nursing students' knowledge, self-confidence, and preparedness in dealing with disaster events.¹² In-depth knowledge of disaster nursing allows nursing students to understand aspects of the disaster management process, including risk mitigation, triage, and post-disaster management.¹³ The research also showed that disaster nursing can improve nursing students' knowledge, attitudes, and satisfaction regarding disasters.^{14,15} Student satisfaction is essential to learning effectiveness. This satisfaction creates a positive learning environment and encourages active engagement in the teaching and learning process. Improving students' knowledge, attitudes, satisfaction, and self-confidence requires continuous learning of disaster nursing with appropriate learning methods.

Courses in disaster nursing within undergraduate nursing programs should cover core competencies such as critical thinking, assessment, technical skills, communication, and foundational knowledge.¹⁶ These competencies are outlined in the learning outcomes for undergraduate programs. Research on undergraduate nursing education in Australia identified specific learning outcomes for nursing students, including the ability to (1) recognize, assess, and implement initial responses for victims of acute illness or injury and take appropriate action; (2) understand roles and provide first aid; (3) apply clinical problem-solving processes based on theory, practical skills, and clinical competence in emergencies; and (4) identify pathways for rehabilitation. Learning outcomes (1–4) can be achieved through case studies while learning outcome (5) focuses on understanding various health sector responses to mass casualty incidents and collaborating in disaster management through planning activities and simulations. In addition, learning outcomes (6) involve working collaboratively within an integrated emergency health system at the initial response level, and (7) emphasize recognizing patient and family reactions to acute, life-threatening conditions in culturally diverse communities. Outcomes 6 and 7 are often addressed through reflective writing on technical and non-technical skills gained during mass casualty simulations.^{17,18}

The learning outcomes that must be achieved in disaster nursing courses in these countries seem different from those in Indonesia. Only a small amount of literature explores the role and function of nursing students in disaster conditions, especially the readiness of undergraduate nursing students, which consists of students' knowledge, attitudes, satisfaction and self-confidence. Therefore, a learning model that can cover the aspects needed in a disaster is required. This study was conducted to identify the effectiveness of the learning model prepared previously in increasing the knowledge, attitudes, satisfaction, and confidence of nursing students.

Material and Methods

Study Design

This study is a quasi-experimental study with a pre-post-test control group. Quasi-experiments are research that aims to evaluate an intervention without using randomization.¹⁹ Similar to randomized trials, quasi-experiments aim to show a cause-

and-effect relationship between an intervention and an outcome. These studies may use measurements before and after the intervention and involve a non-randomly selected control group.²⁰ This research is part of the first author's dissertation and is a trial of the learning model at stage III.

Setting and Sample

This study was conducted on fifth-semester undergraduate students at the Faculty of Nursing, Padjadjaran University, Indonesia, which is an institution that organizes higher education in nursing. The research sample was 94 students divided into 47 in the control group and 47 in the intervention group. In a quasi-experimental design with a pretest-posttest control group design, ideally, each group (experimental and control) consists of at least 15–30 subjects. Hence, the data is sufficient for statistical analysis.²¹ The sample was recruited for each group at convenience, with several inclusion criteria, such as completing the fifth semester, passing prerequisite courses, following the entire disaster nursing learning process, and being willing to participate in the research process. Meanwhile, the exclusion criteria were students with an E grade (<46) in the range of the lecture period up to the fifth semester and/or some courses had not been completed administratively.

Research Instrument

This research instrument consists of four primary variables: knowledge, attitude, student satisfaction with learning, and self-confidence. The three instruments were reviewed by experts in the field of disaster management to examine the instruments that were prepared. The preparation of this instrument used the content validity index (CVI). The process of preparing and developing the content of this instrument was carried out in stage II of this research. The instrument was then subjected to content validity for four disaster nursing experts, including one hospital expert and three nursing faculty lecturers. All experts have doctoral qualifications, volunteer in humanitarian activities, especially in disaster conditions, and are active in emergency and disaster nursing training. The CVI results obtained all variables have a mean value of $I-CVI = 1$ and $S-CVI / UA = 1$. This is higher than the minimum value for the I-CVI results, which is 0.78 or higher for three or more experts and is considered evidence of good content validity.²²

Knowledge and Attitude

The knowledge and attitude instrument was developed by researchers based on empirical data from previous research and input from relevant experts, with reference to literature studies. The development process involved discussions with experts, including lecturers, students, volunteers, and stakeholders, and was based on research results and the curriculum of the Indonesian Nursing Education Institution Association. This step was taken to ensure that all aspects of the construct of each instrument item were represented.

Knowledge assessment was conducted using 30 multiple-choice questions covering the topics of preparedness, emergency response, and post-disaster, with five answer choices for each question. In addition, the attitude scale, which includes preparedness, mitigation, emergency response, and post-disaster, was assessed through 21 questions using a 5-point Likert scale, focusing on the aspects of preparedness, emergency response, and post-disaster. Responses were calculated as correct scores, total scores for attitudes scale, and presented with the mean and standard deviation.

Student Satisfaction and Self-Confidence

Student satisfaction was measured using five questions from the Student Satisfaction and Self-Confidence in Learning (SSS) questionnaire, with a 5-point Likert scale evaluating satisfaction with disaster simulations. Student confidence was also assessed using the SSS questionnaire, with eight questions on a 5-point Likert scale measuring confidence in conducting disaster simulations. Responses were calculated as total scores and presented with the mean and standard deviation. The difference in pretest and posttest scores for each variable determined the effectiveness of the learning model.

Validity and Reliability of Instruments

All instruments used have good validity and reliability. Based on the validity test results, all items in the knowledge aspect are declared valid with a correlation range of -0.831 to 0.830 . All items are also valid for the attitude aspect, with

a correlation range of 0.400 to 0.899. Likewise, all items are valid in the satisfaction and self-confidence aspects, with a correlation range of 0.682 to 0.820.

Meanwhile, the reliability test results showed a very high level of internal consistency in all instruments. The knowledge instrument has a Cronbach's alpha value of 0.903, while the attitude instrument has a value of 0.910. The instrument measuring satisfaction and self-confidence showed the highest reliability value with a Cronbach's alpha of 0.945. These results indicate that the instruments used are valid and reliable to measure the research variables.

Data Collection and Intervention Procedure

Data collection was done through pretests and posttests to evaluate learning outcomes. The pretest was conducted before students received online learning. At the same time, the posttest was taken after students completed the entire learning process, including modules and practicums that had been designed according to their respective groups.

The intervention group received Integrated Simulation Enhanced Learning for Disaster Nursing (ISEL-DN)-based learning, where concepts were taught online before the offline practicum. Students were given special modules, including four main topics: (1) Introduction to Disaster Nursing and Integrated Emergency Management System, (2) Disaster Assessment and Surveillance, (3) Disaster Management Planning and Community Empowerment, and (4) Earthquake Disaster Risk Analysis Practicum. In addition, respondents in the intervention group participated in a website-based simulation called Natural Disaster Practice, designed to improve disaster preparedness skills. In this simulation, students carried out various tasks, such as rapid health assessment, determining disaster zones, identifying health and public facilities in affected areas, triaging disaster victims, tabletop exercises, and understanding the referral system. Meanwhile, the control group only received concept-based learning online with the same module concept as the intervention group and carried out offline practicum. However, the control group did not receive the fifth module, the natural disaster nursing website simulation, before the offline practicum.

Data Analysis

Data analysis in this study aims to evaluate the effect of learning methods on dependent variables between the control and intervention groups. The analysis process was carried out in two main stages: descriptive analysis and inferential statistics. The control and intervention groups' average value (mean) and standard deviation for each dependent variable (knowledge, attitudes, satisfaction and self-confidence) are calculated at the descriptive analysis stage.

Furthermore, before inferential analysis, a normality test was carried out using the Shapiro–Wilk Test and Z-Score analysis of skewness and kurtosis. The normality test results showed that the data was not normally distributed ($p < 0,05$), so a non-parametric approach was applied. The Wilcoxon Rank Test was used to test the difference in pretest and posttest scores in the same group (control or intervention). Meanwhile, the Mann–Whitney *U*-Test was applied to identify significant differences between the control and intervention groups in the pretest and posttest results.

Ethical Considerations

Ethical approval for this study was obtained from the Research Ethics Commission of Padjadjaran University Bandung (894/UN6.KEP/EC/2023) on July 13, 2023. The study adhered to the ethical principles outlined in the Declaration of Helsinki, ensuring respect for participants' autonomy, safety, and well-being throughout the research process. Informed consent was obtained from all respondents, clearly explaining the study's purpose, benefits, procedures, and data confidentiality. Participants were assured that their involvement was entirely voluntary, with no coercion or undue influence, and they had the right to withdraw from the study at any point without any negative consequences. This ethical commitment underscores the researchers' dedication to maintaining high standards of integrity and respect for human subjects in research.

Results

Characteristics of Respondents

Table 1 showed that most respondents in both groups were female, with similar percentages (95.7% in the intervention group and 89.4% in the control group). Most respondents had experience as disaster volunteers (100% in the intervention group and 95.7% in the control group), with minor differences in distribution. The percentage of students involved in

Table 1 Homogeneity of Respondent Characteristics

Respondent Characteristics	Intervention n (%) (n=47)	Control n (%) (n=47)	p-Value
Gender			0.241
Male	2 (4.3)	5 (10.6)	
Female	45 (95.7)	42 (89.4)	
The experience involved as a disaster volunteer			0.155
Yes	47 (100)	45 (95.7)	
No	0 (0)	2 (4.3)	
Students involved in Unique Humanitarian/Disaster Activities			0.513
Yes	14 (29.8)	17 (36.2)	
No	33 (70.2)	30 (63.8)	

student activity units was also nearly identical between the groups. Overall, the characteristics of respondents between the intervention and control groups were similar or homogeneous, with no significant differences in gender, experience as disaster volunteers, or involvement in humanitarian/disaster student activity units ($p>0.05$).

Study Outcomes

Differences in Pretest and Posttest Scores of Control Group

Table 2 shows that several variables in the control group show significant differences between pretest and posttest scores. In the knowledge variable, all subvariables (preparedness and emergency response) have a significant increase ($p<0.001$),

Table 2 Differences in Pretest and Posttest Scores of Control Group

Variable	Pretest	Posttest	Change Value	p-Value
Knowledge	16.83	28.32	11.49	<0.001**
- Preparedness	3.70	6.19	2.49	<0.001**
- Emergency Response	11.21	19.21	8.0	<0.001**
- Post-disaster	1.89	2.94	1.05	0.074
Attitude	94.62	97.51	2.89	0.042*
- Preparedness	28.45	28.81	0.36	0.379
- Emergency Response	38.89	40.00	1.11	0.186
- Post-disaster	27.28	28.70	1.42	0.004*
Satisfaction	20.53	22.89	2.36	<0.001**
- Lecturer	8.17	9.00	0.83	0.008*
- Methods	12.36	13.89	1.53	<0.001**
Self-Confidence	35.17	37.26	2.09	0.009*
- Lecturer	8.87	9.40	0.53	0.013*
- Methods	26.29	27.85	1.55	0.009*

Notes: * $p<0.05$, ** $p<0.001$.

except for the post-disaster subvariable ($p=0.074$). Although most sub-variables are not significant in the attitude variable, the overall score significantly increases ($p=0.042$).

In the satisfaction variable, both in the lecturer subvariable ($p = 0.008$) and methods ($p<0.001$), there was a significant increase. In addition, in the self-confidence variable, the increase in the overall score was also significant ($p=0.009$), with the lecturer subvariable ($p=0.013$) and methods ($p = 0.009$) showing similar results. These results significantly impact several dimensions of learning in the control group.

Differences in Pretest and Posttest Scores of Intervention Group

Table 3 showed a significant increase in almost all variables and sub-variables in the intervention group. In the knowledge variable, all sub-variables, including preparedness ($p = 0.001$), emergency response ($p<0.001$), and post-disaster ($p<0.001$), showed a significant increase between the pretest and posttest scores. In addition, In the attitude variable, the overall score increased significantly ($p<0.001$), with the preparedness sub-variables ($p=0.025$), emergency response ($p<0.001$), and post-disaster ($p=0.008$) also showing significant differences. Then, the satisfaction variable also increased significantly ($p<0.001$), both in the lecturer subvariable and methods. Likewise, in the self-confidence variable, a significant increase occurred overall ($p<0.001$) and in the lecturer subvariable ($p=0.001$) and methods ($p<0.001$). These results indicate that the intervention significantly impacted increasing participants' knowledge, attitudes, satisfaction, and self-confidence.

Differences in Change Values Between Groups

Based on Table 4, several variables show significant differences. In the knowledge variable, the change in scores in the intervention group (13.17) was significantly greater than the control group (11.49), with all sub-variables (preparedness, emergency response, and post-disaster) showing significant differences ($p<0.001$ for preparedness and emergency response, and $p = 0.006$ for post-disaster). In the satisfaction variable, the change in scores in the intervention group

Table 3 Differences in Pretest and Posttest Scores of Intervention Group

Variable	Pretest	Posttest	Change Value	p-Value
Knowledge	16.74	29.91	13.17	<0.001**
- Preparedness	3.77	6.96	3.19	0.001**
- Emergency Response	10.79	19.96	9.17	<0.001**
- Post-disaster	2.19	2.98	0.79	<0.001**
Attitude	96.36	100.79	4.43	<0.001**
- Preparedness	28.83	29.28	0.45	0.025*
- Emergency Response	39.55	42.26	2.71	<0.001**
- Post-disaster	27.98	29.26	1.28	0.008*
Satisfaction	19.70	23.87	4.17	<0.001**
- Lecturer	7.72	9.57	1.85	<0.001**
- Methods	11.97	14.29	2.32	<0.001**
Self-Confidence	34.74	37.85	3.11	<0.001**
- Lecturer	8.83	9.59	0.77	0.001**
- Methods	25.91	28.25	2.34	<0.001**

Notes: * $p<0.05$, ** $p<0.001$.

Table 4 Differences in Change Values Between Groups

Variable	Control Group Change Value	Intervention Group Change Value	p-Value Between Variables
Knowledge	11.49	13.17	<0.001**
- Preparedness	2.49	3.19	<0.001**
- Emergency Response	8	9.17	<0.001**
- Post-disaster	1.05	0.79	0.006*
Attitude	2.89	4.43	0.183
- Preparedness	0.36	0.45	0.462
- Emergency Response	1.11	2.71	0.071
- Post-disaster	1.42	1.28	0.445
Satisfaction	2.36	4.17	0.026*
- Lecturer	0.83	1.85	0.013*
- Methods	1.53	2.32	0.020*
Self-Confidence	2.09	3.11	0.429
- Lecturer	0.53	0.77	0.462
- Methods	1.55	2.34	0.398

Notes: * $p < 0.05$, ** $p < 0.001$.

(4.17) was also greater than in the control group (2.36), with a significant difference ($p = 0.026$). The lecturer ($p = 0.013$) and methods ($p = 0.020$) subvariables also showed significant differences.

However, although the change in scores was higher in the intervention group compared to the control group in the attitude and self-confidence variables, the difference was not statistically significant ($p > 0.05$). These results indicate that the intervention method had a greater impact on increasing participants' knowledge and satisfaction compared to the control group, especially in the aspects of preparedness, emergency response, and satisfaction with teachers and learning methods.

Discussion

The ISEL-DN model is a development of a disaster nursing learning model that uses various learning methods. The results of this study, the ISEL-DN model can improve disaster knowledge and student satisfaction in methods and teaching. As a development of disaster nursing learning methods, ISEL-DN integrates online and offline approaches through learning modules and practicums. This model can hone critical thinking and decision-making skills by considering ethical and legal principles, attitudes, and general and specific skills established in disaster nursing courses. Experiential training, such as integrated simulation, can play an important role in developing emotional skills and enhancing nursing students' preparedness for disaster situations.²³

The study results showed that the ISEL-DN model had a much greater influence in improving students' knowledge. The change in scores obtained in the intervention group (mean = 13.17) was significantly greater than the control group (mean = 11.49). Knowledge is a fundamental component of disaster preparedness. It equips students with the ability to understand disaster scenarios, identify risks, and implement appropriate responses effectively.^{16,24} The ISEL-DN model ensures that nursing students are better prepared to handle real-world disaster scenarios confidently and competently by focusing on knowledge improvement.

Several previous studies also produced similar findings where disaster-related training interventions were more effective in the intervention group.^{16,24} The same results were also found in the research of Ghezjeljeh et al (2018)

regarding the effects of providing disaster preparedness education with a social virtual model, which showed significant differences between the intervention and control groups.²⁵ This finding confirms that the ISEL-DN model has a better effect in improving students' knowledge compared to the approach applied to the control group.

The interesting thing about the results of this study is that in the pretest, the control group had a better level of knowledge regarding emergency response information than the intervention group. This is inversely proportional to the attitude variable, which shows that the intervention group's attitude toward disaster emergency response is better than that of the control group. In the posttest series, both variables show that the intervention group has a higher average value than the control group. This indicates that the intervention given effectively improves the knowledge and attitudes of the intervention group regarding disaster emergency response. In other words, the intervention overcame initial weaknesses (low knowledge) while strengthening existing strengths (positive attitudes). Emergency response is an important health protection skill and competency to protect the health and well-being of the community at critical times.²⁶ The role of nurses is key in the emergency response phase, from general to specific roles, media task assignments, and coordination with other health professionals.²⁷

Apart from knowledge, the ISEL-DN model also increased nursing student satisfaction to a greater extent in the intervention group. This indicates that the ISEL-DN model has been proven not only to increase the knowledge of nursing students but also to increase their satisfaction in the learning process. This satisfaction is important because it is closely related to learning motivation, active participation, and achieving optimal results in learning.²⁸ When students feel satisfied with the learning process, they tend to be more motivated to learn, more active in participating, and more easily absorb the material being taught.^{29,30} Previous studies have shown that simulation-based learning improves nursing students' competence, self-efficacy, and satisfaction.³¹ In addition, nursing students who underwent simulation-based learning showed increased knowledge and confidence, satisfaction, critical thinking, judgment and psychomotor skills.³²

However, although the change in scores on the attitude and self-confidence variables was higher in the intervention group than in the control group, the difference was not statistically significant ($p > 0.05$). This indicates that the ISEL-DN model has not been able to impact the dimensions of students' attitudes and self-confidence significantly. In particular, the relatively short duration of the intervention may not be sufficient to create lasting impacts on these dimensions. Furthermore, the ISEL-DN model may have limitations in addressing the complex factors that influence attitudes and self-confidence, which require a longer, multifaceted approach. Other factors, such as the learning environment, curriculum, social interaction, individual experience, and duration of intervention, may influence these results.^{30,33}

In fact, attitude and self-confidence are important components in clinical decision-making and are essential for disaster simulation practice.³⁴ In addition, self-confidence will affect a person's psychomotor skills in dealing with disaster victims.^{35,36} This differs from previous research, which reported that learning models using simulation effectively increased self-confidence.^{31,32} The same study conducted in Indonesia reported a significant relationship between the disaster simulation learning process and student satisfaction and self-confidence in 140 nursing students.³⁶ A nurse or prospective nurse must have a high level of self-confidence in his or her competence.³⁷

Overall, these results confirm that the ISEL-DN model is superior in improving participants' knowledge and satisfaction compared to traditional learning methods. The significant impact on knowledge variables, especially on the sub-variables of preparedness, emergency response, and post-disaster, indicates the effectiveness of the intervention in preparing participants to face various stages of disaster management. In addition, the increase in participants' satisfaction with the instructor and learning method also reflects the success of this approach in creating a more positive learning experience. However, the limitations in influencing attitudes and self-confidence highlight the need for further development to ensure a more holistic impact on all aspects of disaster learning.

Implication for Practice

The practical implications of implementing the ISEL-DN learning model show great potential in improving nursing students' readiness and competence in disaster situations. This model significantly improves students' knowledge and creates a more satisfying learning experience. The knowledge gained through ISEL-DN becomes an important foundation in understanding disaster scenarios, identifying risks, and responding effectively. This provides recommendations for universities in Indonesia to adopt this learning model in disaster nursing courses to improve the quality of nursing education.

However, implementing this intervention requires stronger support regarding facilities and tools that support disaster nursing learning. Currently, many universities in Indonesia still face limitations in providing adequate facilities and infrastructure, such as disaster simulation tools, interactive educational technology, and standardized practicum rooms. Without adequate facilities, the effectiveness of interventions such as ISEL-DN will be difficult to optimize. Therefore, universities need to invest strategically in procuring disaster nursing learning support tools so that students can develop practical skills, including critical thinking, decision making, and emergency preparedness. Support from the government, educational institutions, and other stakeholders is also needed to create a more holistic and comprehensive educational ecosystem in disaster nursing.

Strength and Limitations

The limitations of this study lie in the development of website features that are not yet fully optimized. The website that was developed still needs improvement, especially in distinguishing information between people's homes and health facilities in the affected areas. In addition, the storage features, tabletop exercise creation, and disaster zone determination still need further development in order to meet user needs more effectively. These limitations are expected to be evaluation materials for future research so that the resulting solutions can be more comprehensive and applicable in supporting disaster preparedness.

This study has a significant strength in developing a website as an innovative platform to support disaster preparedness. This website offers a technology-based approach to improve access to information and integrates interactive features such as tabletop exercises and relevant disaster zone mapping. Another strength is its design approach that focuses on the needs of the community and health facilities, making this platform a potential solution to strengthen coordination and response in emergencies. In addition, this study significantly contributes to utilizing digital technology to improve nursing students' awareness and preparedness in facing disasters.

Conclusion

The ISEL-DN model is a practical educational approach to improve the knowledge and satisfaction of undergraduate nursing students. Statistical analysis showed significant increases in knowledge ($p < 0.001$) and satisfaction ($p < 0.05$) in the intervention group compared to the control group. However, the differences in attitude ($p > 0.05$) and self-confidence ($p > 0.05$) between the groups were not statistically significant, indicating areas for further refinement. Therefore, further research is needed to explore additional approaches or combinations of methods to enhance changes in attitude and self-confidence in this study.

Integrating web-based simulations provides a more immersive learning experience, overcoming the limitations of traditional classroom methods. Future research should evaluate the long-term effects of ISEL-DN and investigate the specific mechanisms that drive its success. Practical implications suggest incorporating simulation-based experiential learning into nursing curricula can enhance students' disaster preparedness and readiness for real-world scenarios. Developing strategies to expand and refine the ISEL-DN approach may further strengthen its impact on nursing education, especially in disaster learning.

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Disclosure

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