

# Developing a mobile learning virtual nursing diagnosis (VND) media for medical surgical nursing course



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## ABSTRACT

**Introduction:** The development of innovative and technology-aligned learning media is a necessary solution for nursing students. Students require access to interactive, practical, and easily accessible learning resources. An application that can facilitate students' learning in nursing diagnosis for surgical nursing, such as Virtual Nursing Diagnosis (VND), is needed. This study focuses on the development of the VND application specifically designed for the Surgical Nursing Care course.

**Methods:** The research is a Research and Development (R&D) study involving 253 nursing students from Aceh Health Polytechnic. A needs analysis was conducted to identify the difficulties faced by students in applying nursing diagnoses to topics related to surgical nursing, particularly the cardiovascular system. Based on the findings of the needs analysis, it was discovered that students face difficulties in determining nursing problems. Therefore, the VND application was developed with features such as assessment forms, assessment tools, disease pathology, and nursing diagnoses. Additionally, the application is equipped with competency tests on interesting nursing cases that are user-friendly for students.

**Results:** The research results indicate that the VND application has received positive feedback from 253 students who have used it in real classroom environments. The application is user-friendly, efficient in performing nursing diagnoses, and provides available nursing case questions. VND application provides an interactive, innovative, and effective learning tool for understanding nursing diagnoses while enhancing accessibility and flexibility through mobile-based learning. The application equips students with the necessary skills to apply nursing diagnoses in real-world surgical medical practice.

**Conclusion:** the VND application significantly contributes to the development of nursing education which provides an understanding of nursing diagnoses and also an engaging and interactive learning experience. It is hoped that the use of the VND application in surgical nursing education can be an effective and innovative solution to enhance competency in applying nursing diagnoses in clinical practice.

**Keywords:** Mobile Learning, nursing diagnosis, surgical nursing, VND application.

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## INTRODUCTION

Nursing education has become an important process involving theoretical and practical learning in various domains, including cognitive, affective, and psychomotor aspects.<sup>1</sup> However, with the dynamic development of learning methods, the trend has shifted from face-to-face instruction towards flexible learning that can be conducted both online and offline, encompassing theory and practice.<sup>2</sup> In this context, the role of instructional media is crucial in facilitating clear message delivery, enhancing learning motivation, and improving learning outcomes.<sup>3</sup> The use of smartphones as learning tools has

become increasingly common due to their convenience and user-friendly features.<sup>4</sup>

Beyond being a substitute for traditional teaching methods, the use of smartphones in education provides innovation, interaction, and attractive features with a comprehensive display.<sup>5</sup> Especially in situations like the COVID-19 pandemic, where face-to-face learning is limited, educational institutions have increasingly adopted virtual media and computers in their curricula. In the context of nursing education, the use of smartphones in instructional media is also known as mobile learning (m-learning).<sup>6</sup> M-learning offers several significant benefits, such as the accessibility of

learning materials anytime and anywhere. Additionally, m-learning can enhance literacy and numeracy skills, proficiency in using information and communication technology, customization of learning according to students' needs, and learning motivation.<sup>7</sup>

The use of mobile technology and virtual reality in Medical-Surgical Nursing courses has been proven to provide a profound understanding of complex nursing diagnoses and patient care.<sup>8</sup> Conventional teaching methods may have limitations in comprehending and honing the required skills. Therefore, the use of mobile learning media and virtual reality offers advantages in instruction.<sup>9</sup> Through

mobile applications, students can access learning materials flexibly and interact with the presented content. Meanwhile, virtual reality enables students to engage in interactive simulations that create real-life experiences in clinical settings.<sup>10</sup> Several studies have also shown that the use of mobile technology and virtual reality in nursing education can enhance students' knowledge, attendance, self-confidence, and clinical abilities.<sup>11,12</sup>

Currently, several nursing applications have been developed, such as NersDiag, SDKI, SLKI, and SIKI, aiming to facilitate the nursing diagnosis process. However, there is a lack of availability of specialized learning media applications for nursing students, especially in the context of Medical-Surgical Nursing (MSN) courses. One example of an application that has been developed for this course is the Medical Surgical Nursing II (MSN II) Application, which provides learning materials, quizzes, and instructional videos. To address this issue, the development of a Virtual Nursing Diagnosis (VND) Application specifically designed for the MSN course is needed. This application includes various features, such as learning materials, instructional videos, quizzes, assessment forms, assessment tools, disease pathology, nursing diagnoses, and competency testing for nursing cases.

The development of this application is based on the current needs of nursing students, as indicated by the questionnaire results that have been distributed to them. The researchers recognized the importance of mobile technology in education and identified the need for interactive and accessible learning tools in the nursing curriculum.<sup>13</sup> The study focuses on the development and evaluation of a mobile learning application specifically designed to address the limitations of existing learning media and provide an innovative solution. The research and development of the Mobile Learning Virtual Nursing Diagnosis (VND) Media in the Medical-Surgical Nursing course aims to achieve several objectives. Firstly, this study aims to develop a specific VND application for the course. This application will provide an interactive, innovative, and effective learning tool for studying nursing diagnosis materials. Additionally, the

research aims to enhance accessibility and flexibility in learning for students.

By utilizing mobile learning media, students can access learning materials anytime and anywhere through their smartphones, enabling self-paced and independent learning according to their schedules. Furthermore, the research aims to increase student engagement and active participation in the learning process. Through interactive features in the VND application, such as instructional videos, quizzes, and assessment tools, it is expected that students will be more engaged and stimulated in understanding and applying nursing diagnoses.

Moreover, the research also aims to improve students' skills in applying nursing diagnoses in medical-surgical nursing practice. Lastly, the research will evaluate the effectiveness and student satisfaction with the use of the VND application by collecting data and feedback on their experiences and perceptions regarding the benefits and usefulness of the application. By achieving these objectives, this research is expected to make a significant contribution to enhancing the quality of learning in the Medical-Surgical Nursing course and improving students' competency in applying nursing diagnoses in medical-surgical nursing practice.

## METHOD

In the realm of research and development, the present study embraces the utilization of the ADDIE model.<sup>14</sup> Commencing with a meticulous needs analysis accomplished through a thoughtfully designed questionnaire, vital information was acquired. To validate the resultant product, an engaging and insightful Focus Group Discussion (FGD) was skillfully orchestrated, assembling a diverse panel of participants including a proficient Medical-Surgical Nursing (MSN) expert, three esteemed MSN course lecturers, a knowledgeable application specialist, a trusted Research Partner (PPNI), and a dynamic group of six aspiring nursing students. With the product's viability confirmed, the research journey progressed to the stage of conducting application analysis trials, involving an extensive cohort of 253 students from the esteemed Aceh Ministry of Health

Poltekkes Nursing Department.

To gather precise and meaningful data, a meticulously crafted questionnaire containing 15 carefully tailored questions was ingeniously developed using the versatile platform of Google Forms. This comprehensive approach reinforces the robustness and validity of the research, meticulously considering the insights and perspectives of esteemed stakeholders encompassing experts and students alike, who are integral to the dynamic realm of nursing education. Through the implementation of a rigorous and meticulous methodology coupled with the active engagement of key stakeholders, the paramount objective of this study crystallizes: to create a remarkable mobile learning application of exceptional quality and effectiveness for the Medical-Surgical Nursing course, ultimately enriching the landscape of nursing education while fostering the development of students' competencies within the realm of medical surgical care.

## Research Instrument

To gauge students' perspectives and requirements regarding the utilization of Virtual Nursing Diagnosis (VND), a well-crafted research instrument comprising 15 thought-provoking questions was devised. This meticulously designed questionnaire is a powerful tool for in-depth analysis and evaluation of the applications, enabling a comprehensive understanding of users' needs and preferences. Through the systematic assessment of these 15 questions, the research aims to uncover valuable insights and ensure that the development of VND aligns perfectly with the expectations and requirements of its intended users.

To ensure rigorous data analysis, a frequency test was employed as the statistical analysis method in this study. The data collected was meticulously processed and analyzed using IBM SPSS Statistics ver. 25, a powerful and widely recognized analysis software. This enabled a comprehensive examination of the collected data, providing valuable insights and facilitating the interpretation of research findings. Moreover, it is worth noting that this research adheres to the highest ethical standards.

**Table 1. Student Response Questionnaire on VND Application User Needs Analysis**

No	Questions
1	Are you an Android smartphone user?
2	How long do you use your smartphone in a day?
3	Besides communication, the majority of you use smartphones as a means.
4	Is your institution equipped with Wifi?
5	Are you interested in using a smartphone as a learning medium?
6	Should nursing diagnoses be made in the form of an application?
7	Have you ever used an application to learn nursing diagnoses?
8	If so, how often do you use the application in learning nursing diagnoses
9	Sources/references that you use in nursing diagnoses
10	So far you have studied the types of nursing diagnoses in the Medical-Surgical Nursing Course
11	Types of nursing diagnoses that you have studied in the Medical Bedan Nursing Course
12	Obstacles faced when studying Nursing Diagnosis in the Medical-Surgical Nursing Course
13	Do you experience difficulties in applying nursing diagnoses to MSN subject topics?
14	MSN learning topics that are difficult to apply to nursing diagnoses, according to you, are difficult to learn
15	In your opinion, which is easier to understand nursing diagnoses using a textbook or an application?

systems. Additionally, the application incorporates three MSN Competency Test menus, presenting exam-style case questions related to the Medical Surgical Nursing course. Once the VND application features were meticulously developed, they underwent rigorous testing to ensure optimal functionality and user experience.

**VND Application Trial**

The VND application trials that have been carried out obtained the following results:

The outcomes of the trials conducted through the impactful Focus Group Discussion (FGD) approach shed light on valuable insights shared by multiple informants regarding the VND (Virtual Nursing Diagnosis) application. Through collaborative discussions, participants exchanged their perspectives, resulting in the following key findings and observations:

**VND Application Revision and Development**

The culmination of diligent revision and development efforts for the VND application is reflected in the remarkable alignment between the outcomes and the valuable input gathered from user trials. These findings are visually represented in Figure 2, providing a comprehensive overview of the successful integration of user feedback into the application's enhancements.

**Analysis of Needs: Demographics and characteristics of respondents**

The analysis of needs encompassed a thorough examination of the demographics and characteristics of the respondents. By scrutinizing these essential aspects, a comprehensive understanding of the target population was gained, enabling insights into their diverse backgrounds, experiences, and perspectives. This in-depth analysis serves as a foundation for tailoring the research findings and developing effective strategies that address the specific needs and requirements of the respondents. In an extensive application development needs analysis stage, a total of 253 students from six diverse campus locations actively participated. Leveraging the convenience and accessibility of digital platforms, the questionnaire was



**Figure 1.** VND prototype.

**RESULT**

**Building a VND Prototype**

The VCND (Virtual Nursing Diagnosis) application was specifically developed to enhance the learning journey for students, specifically those undertaking the Medical-Surgical Nursing Care Course. By integrating virtual media into the application, a more immersive and holistic learning experience is created. VCND encompasses a range of essential learning features that empower students in their educational pursuits. These features include:

The VND (Virtual Nursing Diagnosis) application offers an intuitive initial menu interface comprising three main sections, each catering to specific learning needs. The Disease Pathophysiology menu serves as a comprehensive resource, providing access to in-depth learning materials on crucial topics such as the cardiovascular system, respiratory system, digestive system, elimination system, and nervous system. To further enhance students' diagnostic skills, the Nursing Diagnosis menus present detailed diagnostic information for each of the aforementioned bodily

**Table 2. User trials (Drive Mocking-up)**

No	Aspect	Input Minutes from Users
1	Display and System	<i>Display colors to be brighter Can be used anytime The capacity is not too heavy Very useful to facilitate the learning process</i>
2	Features/ Menu	<i>The use of symbols to make it more interesting Nursing Diagnosis The distribution of MSN topics according to the body system Learning Videos according to disease diagnosis MSN case questions are available</i>
3	Learning needs	<i>Diagnosis of the disease to be more specific Even better in giving the case method Easier to understand in determining nursing diagnoses Completeness of MSN learning materials Additional details about the occurrence of a disease Creating an application about nursing diagnoses, such as how to determine nursing diagnoses, sample questions, and explanatory videos like other learning applications An application that can be used as a guide in MSN courses Determine and classify so many diagnoses, especially in cases of medical-surgical nursing Can quickly understand the diagnosis taken from a problem NANDA IDHS Diagnostics and others are available Significant data grouping Define nursing problems Determine Etiology</i>

#### Questions to students about making nursing diagnoses

“...To establish a nursing diagnosis, we need some assessment data so that we can make a nursing diagnosis. If we have a new diagnosis, we can plan and implement a solution to the problem.”

“.....now it is difficult to determine a nursing diagnosis either when studying theory or in the field because you have to use a lot of references, so the last one makes us confused”

“.....we want a method or application that we can access anywhere and anytime to determine the nursing diagnosis”

#### Questions about the appearance and system of the VND application

“...to display the application to make it brighter to be able to attract students to use it”

“...the capacity of the application is adjusted, if possible not too big so that all types of smartphones can be used”

#### Questions for menus/features in the VND application

“...For the division of MSN subject topics, they are made according to the body system or sequentially”

“.....the use of symbols in the application must be more attractive and colorful”

“...The use of video should be by the diagnosis of the disease”

“....It's good because there are case questions in this application, so that it helps students to be better trained with case questions”

#### Questions for learning needs in the VND application

“...This application is needed because it is easier to determine nursing diagnoses for students”

“.....This application is useful for learning media for students because everything is available in one application”

administered online through a dedicated WhatsApp group established exclusively for research purposes. This inclusive approach allowed for widespread student engagement and ensured a comprehensive data collection process

The dynamic and insightful [Figure 3](#) presents a visual representation of the respondents' demographics and characteristics. Among the 253 participating students, a significant majority of 149 individuals (58.9%) were Level II students, while an equally

noteworthy group of 105 individuals (41.5%) represented Level III students from the esteemed Nursing Study Program at Poltekkes Kemenkes Aceh. This data not only provides valuable insights into the composition of the respondent group but also underscores the significance of their



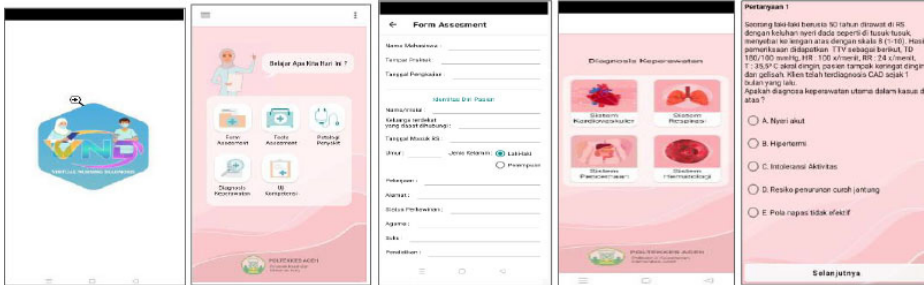


Figure 2. VND Application Revision and Development.

Table 3. Number of respondents from five different campuses in the location of the midwifery study program at the Aceh Health Polytechnic

No	Campus Location	Number of Respondents (N)
1	Langsa Nursing Study Program	26
2	Melaboh Nursing Study Program	38
3	North Aceh Nursing Study Program	36
4	Banda Aceh Nursing Study Program	94
5	South Aceh Nursing Study Program	43
6	Southeast Aceh Nursing Study Program	16

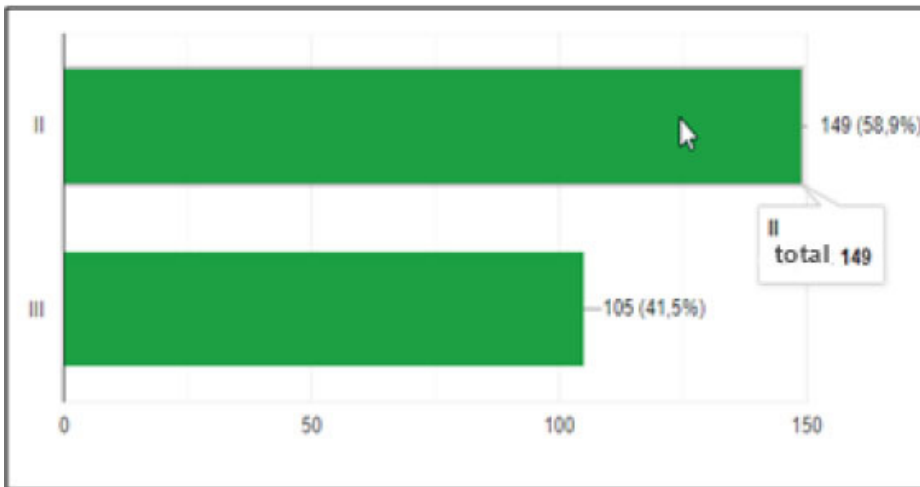


Figure 3. Demographics and Characteristics of Respondents by Class.

perspectives and experiences in shaping the research outcomes.

Figure 4 depicts the prevalence of smartphone use among students. The majority of students have smartphones, and only a small percentage do not. Smartphones are important and necessary for everyone because they allow students to access learning materials and videos more quickly than a laptop. Most students use smartphones less than 12 hours a day. For students, having a smartphone is very important for learning media because it allows them to easily access what they need to learn.

The intriguing findings presented in Table 2 shed light on students'

perspectives and preferences regarding the use of technology in their learning journey. A staggering 72.2% of campuses were reported to have accessible WiFi, providing students with the opportunity to utilize online resources conveniently. Remarkably, an overwhelming 98.4% of students expressed keen interest in utilizing smartphones as a medium for learning. Moreover, the data highlighted a strong demand for a dedicated nursing diagnosis application, with 89.3% of students recognizing its importance. It is worth noting that a significant proportion (64.4%) of students had already experienced using nursing diagnosis applications as part of their learning

process. These statistics emphasize the significance of incorporating technology-enhanced learning tools to meet students' needs and enhance their educational experiences.

Figure 5 provides an intriguing depiction of the sources and references utilized by students when studying nursing diagnoses. Surprisingly, the majority of students (180 individuals) relied on traditional written sources such as magazines and journals, while only a fraction of students (41 individuals) utilized nursing diagnosis applications. Interestingly, despite their current reliance on written sources, students expressed a strong desire for digital nursing diagnosis references. This indicates the potential benefits of virtual nursing diagnosis in facilitating students' diagnostic processes, as it eliminates the need for an extensive array of written reference sources. By embracing digital platforms, students can experience a more streamlined and efficient approach to diagnosing, thereby optimizing their learning experience in the field of nursing.

Figure 6 provides a fascinating insight into the applications frequently utilized by students during the Medical-Surgical Nursing (MSN) Course for nursing diagnoses. The data reveals that a significant number of students, 174 in total, relied on the North American Nursing Diagnosis Association (NANDA) application, while 146 students utilized the Indonesian Nursing Diagnosis Standards (IDHS) application. However, it is important to note that students encountered various challenges in their nursing diagnosis learning journey. The most common hurdles reported by students include difficulties in determining nursing problems, as experienced by 145 students, followed by challenges in grouping significant data, as indicated by 100 students. Moreover, students expressed struggles in applying nursing diagnoses to the specific topics covered in the Medical-Surgical Nursing Course. These findings highlight the need for effective strategies and supportive resources to enhance students' proficiency in nursing diagnoses, ensuring their successful application in real-world healthcare settings.

Based on Figure 7, interesting insights

about challenging topics in the MSN course within the nursing diagnosis application are revealed. The analysis results indicate that the cardiovascular system is the most difficult topic for the majority of students, with 139 individuals, or approximately 54.9% struggling with it. This is followed by the neurological system with 132 individuals (52.2%), the musculoskeletal system with 112 individuals (44.3%), and the hematological system with 110 individuals (43.5%). On the other hand, topics such as the sensory system are challenging for only 42 individuals (16.6%), the digestive system for 35 individuals (13.8%), and the respiratory system for 46 individuals (18.2%). These data highlight the challenges faced by students in understanding several topics in the MSN course. Educators and nursing education institutions must provide specific attention and appropriate support to help students overcome difficulties in studying these topics.

## DISCUSSION

The development of Virtual Nursing Diagnosis (VND) Mobile Learning Media in the Medical Surgical Nursing course aims to create an effective and innovative learning application in the field of surgical medical nursing. The important steps

in this development process include problem identification, investigation, design, realization/construction, testing, evaluation, revision, and implementation. The ADDIE model is used as a foundation for the development of VND. The investigative phase involves literature review, observation, and interviews with students from the D III Nursing Program at Melaboh Poltekkes Aceh to gather the foundation for VND application development.

The interview results indicate that students face difficulties in determining nursing diagnoses and require an effective and efficient learning method. In the product design phase, technical aspects are prepared with the assistance of media experts. Subsequently, the realization phase produces the product based on the prepared design. The testing, evaluation, and revision phase involves validation and product testing by experts, who provide valuable feedback for improvement. The product is then tested with students in the MSN course, who respond positively to the VND learning media. The result of this research is the VND learning media that can be used as an alternative learning tool in the MSN course. This media has advantages in terms of ease of use, accessibility, comprehensive features, and visual appeal. In the process of developing

VND, it was found that students face difficulties in determining nursing diagnoses and have a high interest in using smartphones as a learning medium. This indicates a great potential for leveraging mobile learning technology to enhance nursing education.

Through group discussions, valuable input from nursing experts and students has been provided for the validation and improvement of the VND product. The application was tested with a group of students, resulting in revisions and improvements that align with user needs. Feedback from validators and application users has played a crucial role in enhancing the quality of VND learning media. In addressing the challenges of understanding the topics in the MSN course, the development of VND offers a potential solution to enhance students' understanding and competence in surgical medical nursing. Overall, the development of VND demonstrates significant benefits in nursing education, including ease of access, learning effectiveness, and the superiority of the features offered. As a result of the research, the VND learning media has been proven to be valid and effective through testing with students. In a survey conducted with 253 respondents, the VND learning media was rated as engaging and effective in MSN learning.

The advantages of this media include user-friendliness, unrestricted accessibility in terms of space and time, and features such as assessment, disease pathology, nursing diagnoses, and competency testing for nursing cases. Overall, the development of Mobile Learning Virtual Nursing Diagnosis (VND) in the Medical Surgical Nursing course represents an important innovation in enhancing the quality of nursing education. The use of effective technology and learning applications can help students overcome difficulties in learning nursing diagnoses, improve their understanding of the subject matter,

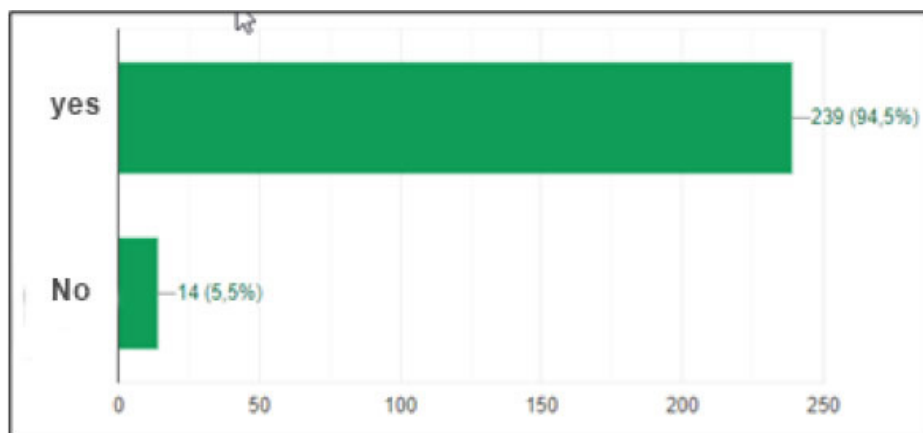


Figure 4. Amount of Smartphone Usage.

Table 4. Needs analysis questions related to internet facilities, smartphones, and digital preferences

No	Questions	Yes		No	
		f	%	f	%
1	Is your institution equipped with a WiFi facility?	184	72.7	69	27.3
2	Are you interested in using a smartphone as a learning medium?	249	98.4	4	1.6
3	Is it appropriate to make a nursing diagnosis in the form of an application?	226	89.3	27	10.7
4	Have you ever used an application to learn nursing diagnoses?	163	64.4	90	35.6

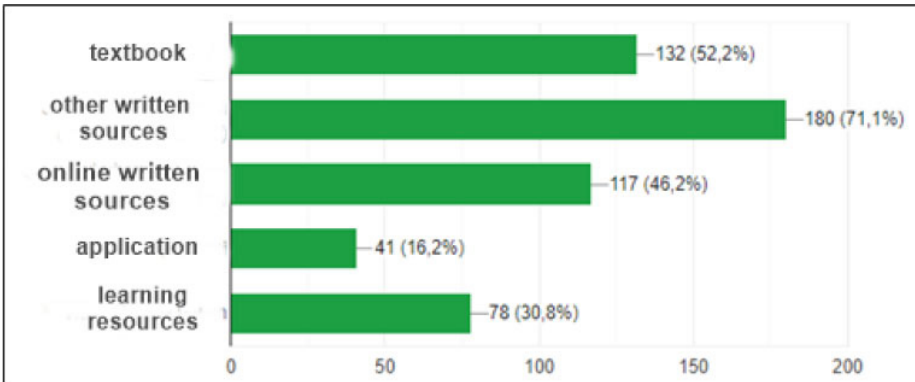


Figure 5. Nursing Diagnosis Sources/References.

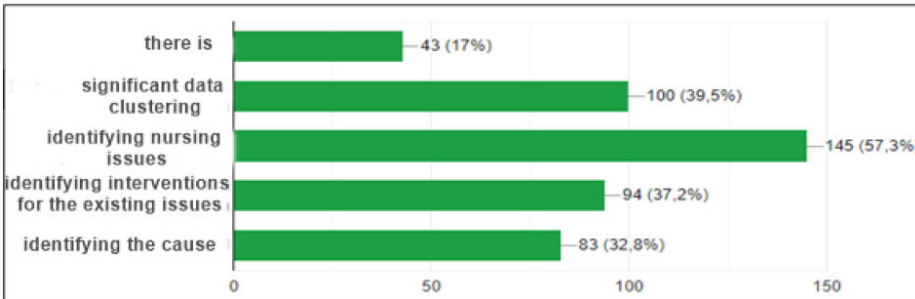
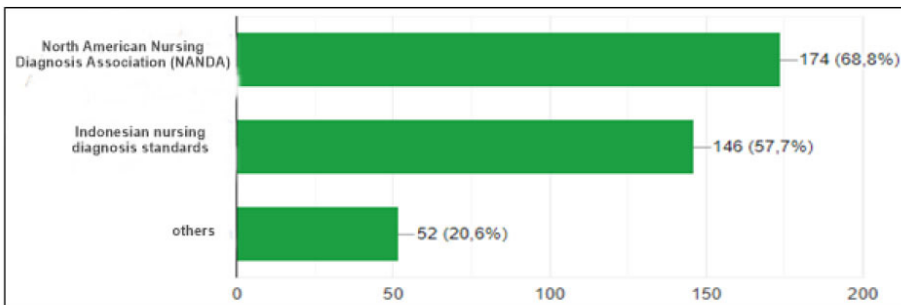


Figure 6. Types of Nursing Diagnosis Applications Learned (a) and Obstacles to Learning It (b).

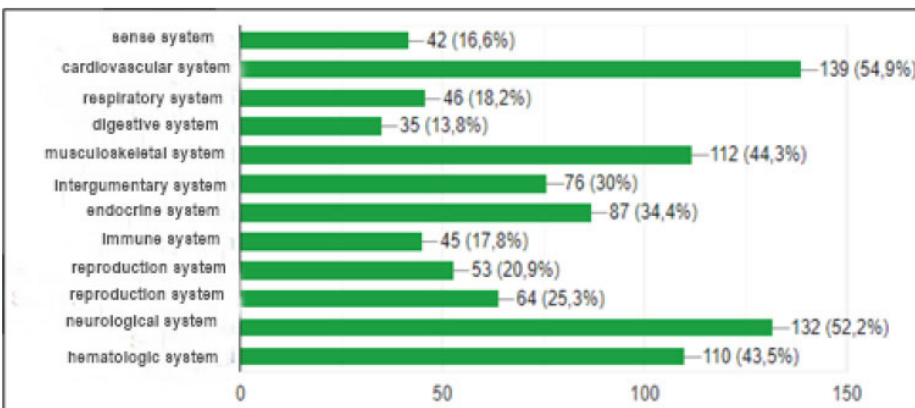


Figure 7. Difficult MSN Subject Topics in Nursing Diagnosis Applications.

and prepare the necessary competencies in surgical medical nursing. There have been previous studies on the development and evaluation of mobile learning virtual nursing diagnosis applications for nursing students.

The utilization of mobile learning virtual nursing diagnosis applications has shown improvements in the ability to accurately and comprehensively determine nursing diagnoses. The use of mobile learning applications has also had

a positive impact on increasing students' confidence and engagement in the nursing diagnosis process.<sup>15</sup> The implementation of these applications significantly enhances students' capabilities in diagnosing health problems, identifying signs and symptoms, and formulating appropriate nursing diagnoses. Several studies have shown the positive impact of mobile learning virtual nursing diagnosis (VND) media on students' diagnostic skills. For example, a study by Johnson et al. (2019) conducted in a nursing education setting demonstrated that the use of a mobile learning VND application improved students' ability to analyze and interpret clinical data, leading to more accurate nursing diagnoses.<sup>15</sup>

Furthermore, the use of these applications significantly improves the accuracy of nursing diagnoses and provides valuable resources, including comprehensive information about diagnoses, step-by-step guidelines, and relevant case studies. Research conducted by Bertocchi et al found that students who used a mobile learning VND media platform had a higher rate of correct nursing diagnoses compared to those who relied solely on traditional methods.<sup>16</sup> Students have reported that these applications enrich their learning experiences and effectively support the enhancement of their diagnostic abilities. Another study explored students' perceptions of using a mobile learning VND application and found that the majority of participants reported a positive learning experience. They found the application to be interactive, engaging, and helpful in developing their diagnostic skills. The findings of this study align with the research conducted in Vietnam, indicating that the introduction of mobile technology in the country's continuing medical education program has a positive impact on healthcare professionals.<sup>17</sup> The study revealed an improvement in understanding and application of medical concepts among healthcare professionals after they utilized the mobile learning platform.

In addition, it is crucial to involve nursing educators, instructional designers, and technology experts in the development process to ensure the effectiveness and



usability of the Mobile Learning VND media.<sup>18,19</sup> Regular evaluation and assessment should be conducted to measure the impact and effectiveness of the media in improving students' learning outcomes and diagnostic abilities.<sup>20</sup> Feedback from students and faculty members should also be sought to continuously improve and refine the Mobile Learning VND media. By implementing these recommendations, the development of Mobile Learning Virtual Nursing Diagnosis (VND) media for the Medical-Surgical Nursing Course can greatly enhance the educational experience and knowledge acquisition of nursing students, ultimately leading to improved diagnostic skills and better patient care outcomes. The integration of mobile technology and interactive learning approaches in nursing education has the potential to revolutionize the way students learn and apply nursing diagnoses in their clinical practice.<sup>21</sup> Therefore, investing in the development and implementation of Mobile Learning VND media is crucial for advancing nursing education and preparing future nurses for the evolving healthcare landscape.<sup>15</sup>

## CONCLUSION

The development of the Mobile Learning Virtual Nursing Diagnosis (VND) Media for the Medical-Surgical Nursing Course promises to enhance the learning experience for nursing students. The VND application, specifically designed for this course, addresses the limitations of available learning media applications that meet the needs of nursing students. The application has received positive feedback from 253 students who have used it in a real classroom setting. Students have shown a high interest in using the application due to its user-friendly interface, efficient nursing diagnosis capabilities, and the availability of nursing case questions. The VND application offers interactive, innovative, and effective learning tools to understand nursing diagnoses while improving accessibility and flexibility through mobile learning. This encourages greater student engagement and active participation in the nursing diagnosis process, thereby enhancing confidence and clinical skills. Furthermore, the VND application

equips students with the skills to apply nursing diagnoses in real-world medical-surgical practice. Through evaluating the effectiveness and satisfaction of students using the VND application, this research aims to make a significant contribution to improving the quality of Medical-Surgical Nursing education and enhancing students' competence in applying nursing diagnoses in clinical practice.

## CONFLICT OF INTEREST

The present study has been conducted in a manner that ensures the absence of any conflicts of interest that could potentially bias the results or interpretations. To uphold the scientific integrity of the research, measures were taken to ensure that the study design, data collection, analysis, and reporting were carried out objectively and impartially. No external influences or financial interests were involved that could compromise the objectivity and validity of the findings. By maintaining this strict adherence to scientific principles and ethical standards, the research findings can be considered unbiased and reliable.

## ETHICAL STATEMENT

Ethical clearance and approval were obtained from the Research Ethics Commission of the Faculty of Nursing, University of North Sumatra, with a designated reference number of 2565/VII/SP/2022. This ethical clearance ensures that the study was conducted by ethical guidelines, safeguarding the rights and well-being of all participants involved in the research process.

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## AUTHOR CONTRIBUTION

All authors contributed equally in this study.

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