

# MOBILE LEARNING USAGE AND ITS IMPACT ON INCREASING STUDENTS' COGNITIVE ACHIEVEMENT IN NURSING CLINICAL LEARNING IN PALEMBANG CITY, INDONESIA: RANDOMIZED CONTROLLED TRIAL

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## Abstract

**Background:** The cognitive abilities of nursing students are crucial for ensuring the quality of clinical learning and nursing services in the future. Therefore, innovation in clinical learning media is essential. Currently, mobile learning is a popular educational tool, as it offers real-time access without the constraints of time and location, serving as both an information and communication medium. However, in Indonesia, mobile learning is yet to be fully developed for clinical nursing education. **Objective:** This study aims to assess the effectiveness of mobile learning in enhancing the cognitive abilities of nursing students during clinical training. **Methods:** A Randomized Controlled Trial was conducted from December 2022 to May 2023. The study included a sample of nursing students, who were divided into an experimental group (n = 40) and a control group (n = 40). Data analysis was performed using the Wilcoxon Signed-Rank Test and the N-Gain Score Test. **Results:** The study results demonstrated a significant and effective improvement in the cognitive abilities of nursing students in the clinical learning environment. The experimental group, which utilized mobile learning features such as a guidebook, Gantt chart, verification, assignments, assessments, group chat, and learning outcomes, showed greater improvement compared to the control group. This was measured through various assessments, including Pre-test, Post-test, Direct Observation of Procedural Skills (DOPS), Structured Oral Case Analysis (SOCA), Mini-Clinical Evaluation Exercise (Mini-CEX), and Case Presentation. **Conclusion:** Mobile learning in clinical education is effective and efficient in achieving cognitive learning targets, offering flexible access to information, communication, and evaluation without time or place limitations.

**Keywords:** Cognitive Abilities, Clinical Learning, Mobile Learning, Nursing Students.

## INTRODUCTION

The quality of clinical learning is heavily influenced by the success of nursing students in acquiring skills, knowledge, and developing a professional spirit within a clinical environment. The primary objective of clinical learning in nursing education is to equip students with the knowledge, attitudes, skills, satisfaction, and experience necessary to achieve clinical competence. Clinical competence, in turn, is closely linked to the successful attainment of cognitive ability targets in the clinical learning setting (Amaral & Figueiredo, 2021; Bouchlaghem & Mansouri, 2018; Nejad et al., 2019; Mathisen, 2023).

Cognitive skills play a critical role in the development of psychomotor skills and the ability to deliver safe, high-quality patient care in real clinical situations. These skills are evaluated against established cognitive standards (Yoshida et al., 2022; Nordquist et al., 2019; Arpanantikul & Pratoomwan, 2017).

According to the Association of Indonesian Nurse Education Centre (2020), the evaluation of cognitive abilities in the nursing clinical learning area includes assessments such as Direct Observation of Procedural Skills (DOPS), Student Oral Case Analysis (SOCA), Critical Incident Reports, Objective Structured Clinical Examination (OSCE), Problem-Solving Skills, and comprehensive case assessments.

However, several studies have identified challenges in achieving cognitive learning outcomes in clinical settings. These challenges include a lack of integration in clinical learning, differing perceptions of target learning outcomes, including cognitive competence, limited availability of preceptor time for guidance, unclear cognitive evaluation domains, and the absence of an integrated, real-time assessment system (Rohendi, Ujeng & Mulyati, 2020; Harjanto & Sumunar, 2018; Murdhiono & Siswanto, 2019; Na & Roh, 2021).

Given these challenges, there is a pressing need to develop instructional media that can serve as tools for communication, coordination, and monitoring, particularly in clinical learning environments fully implemented in hospitals, health centers, and communities. The growing demand for efficient and flexible learning methods in the digital era necessitates the development of digital learning platforms, such as E-Learning or Learning Management Systems (LMS) based on mobile learning. These platforms consistently produce superior outcomes, enhance interaction, and improve the acquisition of cognitive and practical skills compared to traditional learning methods (Mituhu, Dwiantoro & Kristina, 2021; Mousavizadeh, 2022).

As a student-centered learning method, mobile learning offers numerous advantages, allowing nursing students to access information anytime and anywhere via portable devices such as Personal Digital Assistants (PDAs). Several studies have demonstrated the effectiveness of mobile learning in enhancing the knowledge and skills of nursing students (Yalcinkaya & Yucel, 2023; Kim & Suh, 2018; Kenny et al., 2020). Mobile learning applications with well-structured, engaging, and user-friendly content can facilitate the development of clinical problem-solving skills, improve learning performance, and reduce cognitive load. These applications also have the potential to significantly enhance nursing students' knowledge in pre-clinical education and serve as a medium for interaction and communication between preceptors and students (Sari & Sari, 2023; Kim & Suh, 2018; Kim & Park, 2019). Additionally, mobile learning is valuable as an information and communication technology tool in the teaching and learning process, improving cognitive abilities and developing students' skills (Lee et al., 2016; Shuja et al., 2019).

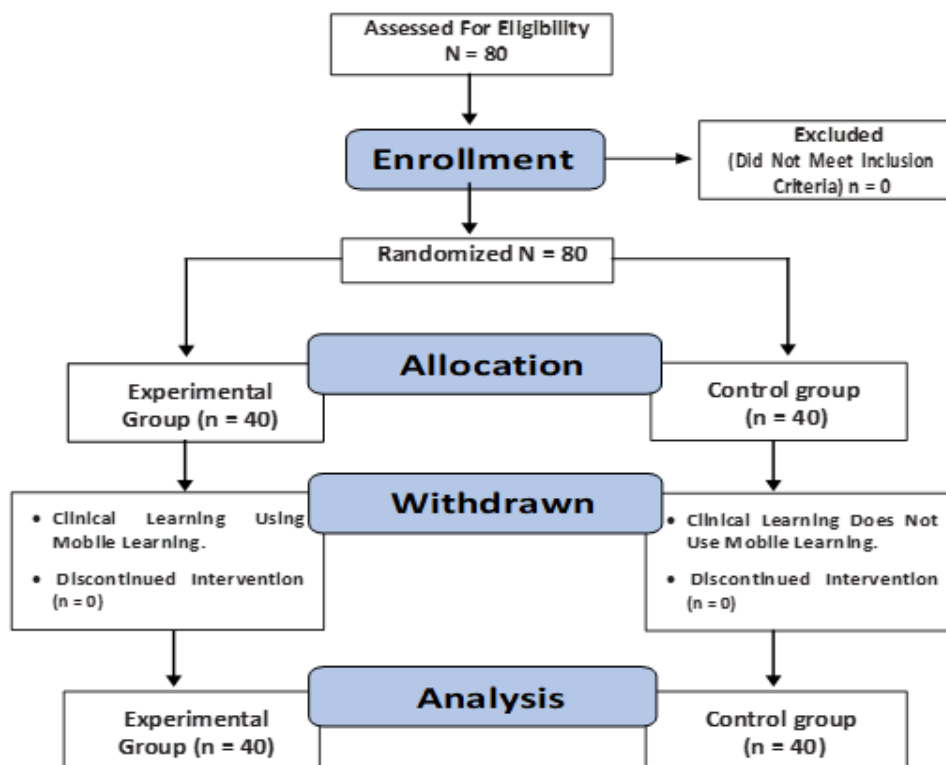
Despite these advantages, the implementation of LMS or E-learning based on mobile learning in Indonesian nursing clinics remains limited. For example, Harjanto & Sumunar (2018) developed the Learning Management System: Open for Knowledge Sharing (OFKS), a flexible clinical education platform with a website-based or desktop-based interface that still needs adaptation for mobile learning. The I'M SMART application, developed for assessing nursing clinical learning, is similarly limited, focusing only on the assessment process during learning. Neither of these platforms fully integrates mobile learning, nor are they based on the specific needs of learning outcomes, highlighting the need for further research.

In light of the above, the development of mobile learning-based clinical learning media is crucial for providing an effective medium for information, communication, and evaluation to achieve cognitive ability targets in clinical learning.

However, the use of online-based learning media remains limited in clinical learning. Despite this, students prefer online-based learning due to its flexibility, cost-effectiveness, time efficiency, and ability to foster student independence (Ponamon et al., 2022). Therefore, there is a significant opportunity and need for researchers to develop and study integrated, real-time clinical learning tools, especially for the nursing clinical learning process in hospitals, health centers, and communities. Such research will also analyze the effectiveness of mobile learning in enhancing cognitive abilities in clinical settings.

## MATERIALS AND METHODS

This study employed a randomized controlled trial with a pre-test and post-test design. The writing of this study was guided by the CONSORT (Consolidated Standards of Reporting Trials) 2010 checklist. The sample consisted of nursing students in the clinical learning area at a nursing education institution in Palembang, Indonesia. A random sampling technique was used with the following inclusion criteria: (1) willingness to participate; (2) nursing students currently enrolled in the nursing clinic learning process for the 2022-2023 academic year; and (3) possession of an Android or iOS smartphone. The research sample was divided into an experimental group (n=40), which used mobile learning as the nursing clinic learning medium, and a control group (n=40), which relied solely on conventional learning methods, including the use of WhatsApp Groups (WAG) (Figure 1).



**Figures 1: CONSORT Flow Chart of Participation through the Trial**

The mobile learning application used in clinical learning underwent a validation process conducted by both technologists and subject matter experts. According to Widoyoko (2017), learning media should be validated by technologists and material experts through a questionnaire. The results of this validation serve as a foundation

for analyzing and revising the developed media and are essential for conducting product trials with students.

The validation test results for the mobile learning application in clinical learning, conducted by technology and material experts, yielded the following outcomes: The technology experts assessed the application based on device engineering and visual display aspects, resulting in a score of 87.90%, categorizing it as highly feasible. The material experts evaluated the application on aspects such as self-instruction, self-contained, stand-alone, adaptive, and user-friendliness, resulting in a score of 88.52%, also categorizing it as highly feasible. Additionally, a practicality test conducted by students assessed identification, visual appearance, application menu, application content, ease of use, usefulness, and overall feasibility, resulting in a score of 85.05%, categorizing it as practical.

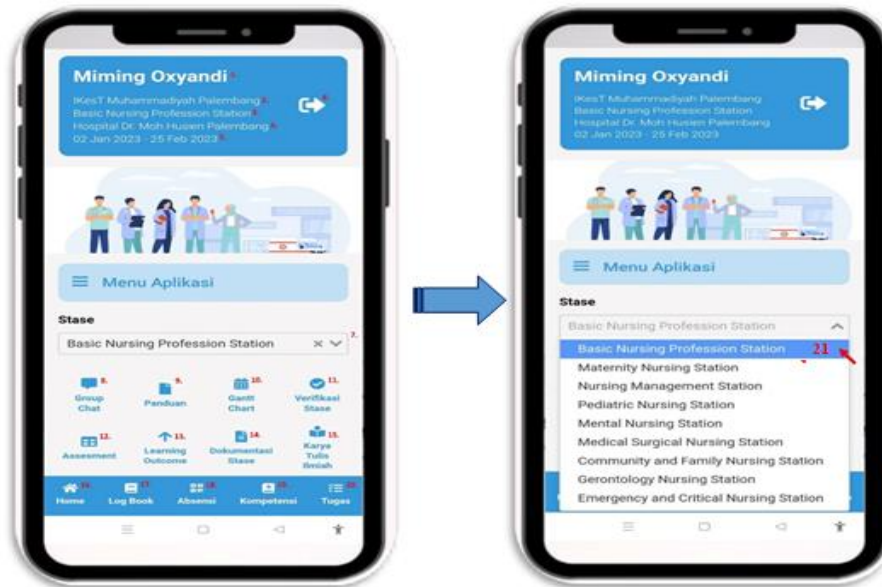
Data collection was carried out through interviews and questionnaires/questionnaires to obtain data on the evaluation of students' cognitive ability achievement in nursing clinic learning. The research data collection process began with the signing of informed consent as proof of consent to become a respondent. The collection of data results from the evaluation of students' cognitive ability achievement in nursing clinic learning through the learning outcome feature with the data collection process using the Assessment feature with assessment aspects: Pre Conference, Post Conference, DOPS, SOCA, Mini Cex and Case Percentage (Association of Indonesian Nurse Education Center, 2020; Indonesia Higher Education Standards, 2022).

The data analysis used in this study is Kolmogorov-Smirnov to evaluate the normality of data, which aims to assess the distribution of data in a group of data or whether the distribution is distributed normally. Meanwhile, two types of data analysis are used to test the effectiveness of mobile learning, namely the Wilcoxon Sign Rank Test with  $Asymp. Sig \leq 0.005$ , which means significant, and N-Gain Score Test with the decision that if the N-Gain value is in the range 56% - 75%, then it can be said to be quite effective, and if it is in the range  $> 76\%$ , then the model used is effective.

## RESULTS

### Mobile Learning in Clinical Nursing Learning

Mobile Learning in nursing clinical learning is a Learning Management System (LMS) used at all stages of clinical learning and has 12 features with student users, academic preceptors, and clinical preceptors. This mobile learning aims to make it easier for all parties to manage the learning process. Interact and access information in an integrated and real-time manner in the nursing clinical learning process, which includes all stages with a design that adapts to the needs of learning outcomes consisting of Cognitive Ability, Psychomotor Ability, and Affective Ability (Figure 2).



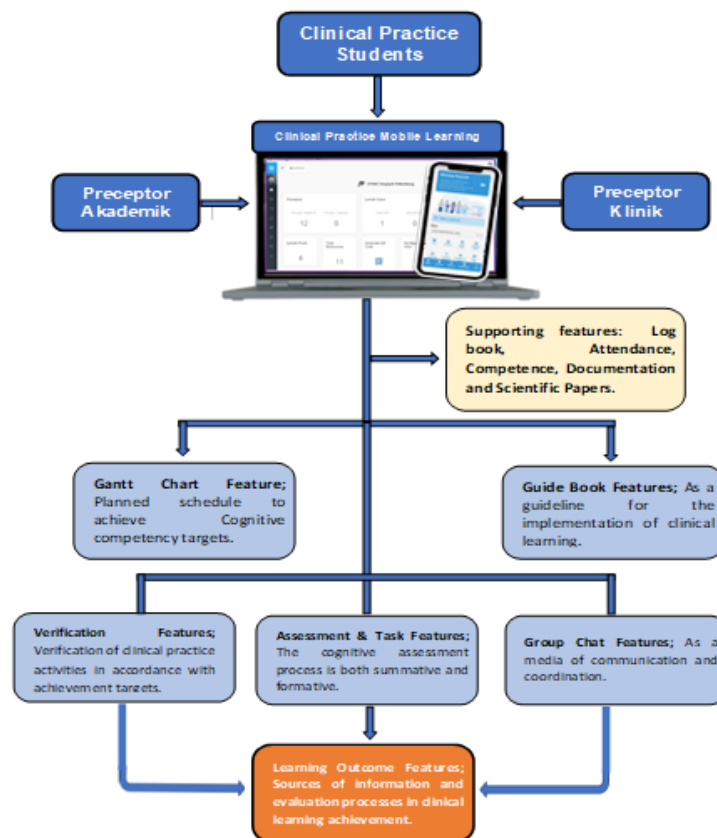
**Figure 2: Mobile Learning in Nursing Clinical Learning.**

Figure 2. Providing information:

- 1) Name of student,
- 2) Name of Educational Institution,
- 3) Practice Stage Name nursing clinic,
- 4) Practice rides nursing clinic,
- 5) Log Out,
- 6) Execution time clinical practice of nursing,
- 7) Select button stage,
- 8) Group Chat feature,
- 9) Guide,
- 10) Gantt chart,
- 11) Verification Stage,
- 12) Assessment,
- 13) Learning Outcomes,
- 14) Documentation Station,
- 15) Scientific Writing,
- 16) Home,
- 17) Logbook,
- 18) Absence,
- 19) Competence,
- 20) Task,
- 21) Choice Stage.

## The Process of Using Mobile Learning to Increase the Achievement of Cognitive Abilities of Nursing Students In Clinical Learning

The process of improving the cognitive abilities of nursing students in the clinical learning area using mobile learning is explained in the form of user flow involving the role of academic and clinical preceptors. Nursing students, academic preceptors, and preceptors begin by accessing guidebooks and Gantt charts of the clinical nursing learning process. In this feature, nursing students can find the targets for achieving cognitive abilities in clinical learning. Nursing students can see instructions and information about the assessment process and assignments, both summative and formative, in the task and assessment features. As a medium of communication and coordination between students, academic preceptors, and clinical preceptors, mobile learning for nursing clinical learning is equipped with a group chat feature to assist the process of achieving cognitive abilities in learning. Furthermore, nursing students can see and access the learning outcomes through the Learning Outcome feature. Learning outcome features are a source of information and an evaluation process for achieving clinical learning by academic and clinical preceptors for nursing students (Figure 3).



**Figure 3: Flow Chart of the Use of Mobile Learning in Improving Student Cognitive**

### Demographic Characteristics

Demographic data of respondents in this study: most of the students in the experimental group were 22 years old (70%), and the control group were 23 years old (65%). Meanwhile, the gender of most of the students in the experimental group was female, 35 people (87.5%), while the majority of students in the control group were



female, 30 people (75%) (Table 1).

**Table 1: Frequency Distribution of Respondents' Characteristics**

Variable	Group Experiments (n = 40)		Group (n = 40)	
	f	%	f	%
Age				
Median & years	22	70	23	65
Sex				
Male	5	12.5	10	25
Female	35	87.5	30	75
Education				
Reguler	38	95	38	95
Non Reguler	2	5	2	5

### Test the Effectiveness of Mobile Learning on Increasing the Cognitive Ability of Nursing Students in Clinical Learning

The results of testing the effectiveness of mobile learning on increasing the cognitive ability of nursing students in the clinical learning area in this study used the Wilcoxon Sign Rank Test. Tests were carried out before and after the implementation of mobile learning with the assessment elements of Pre-test, Post-test, DOPS, SOCA, Mini CEx, and Case Percentage (Table 2).

**Table 2: Wilcoxon Sign Rank Test Results Against The Use of Mobile Learning in Clinical Learning**

Variable		N	Mean Ranking	Asymp. Sig (2-tailed)
<b>Pre-Test</b>				
Group Experiment	Negative Ranks	11 <sup>a</sup>	12.18	0.003
	Positive Ranks	24 <sup>b</sup>	20.67	
Group Control	Negative Ranks	13 <sup>a</sup>	14.15	0.208
	Positive Ranks	18 <sup>b</sup>	17.33	
<b>Post-Test</b>				
Group Experiment	Negative Ranks	13 <sup>a</sup>	11.50	0.011
	Positive Ranks	21 <sup>b</sup>	21.21	
Group Control	Negative Ranks	13 <sup>a</sup>	15.73	0.173
	Positive Ranks	20 <sup>b</sup>	17.82	
<b>Direct Observational Procedure Skill (DOPS)</b>				
Group Experiment	Negative Ranks	10 <sup>a</sup>	13.55	0.005
	Positive Ranks	24 <sup>b</sup>	19.15	
Group Control	Negative Ranks	13 <sup>a</sup>	12.81	0.109
	Positive Ranks	18 <sup>b</sup>	18.31	
<b>Student Oral Case Analysis (SOCA)</b>				
Group Experiment	Negative Ranks	10 <sup>a</sup>	13.55	0.002
	Positive Ranks	24 <sup>b</sup>	19.15	
Group Control	Negative Ranks	10 <sup>a</sup>	15.07	0.143
	Positive Ranks	5 <sup>b</sup>	20.20	
<b>Mini CEX</b>				
Group Experiment	Negative Ranks	11 <sup>a</sup>	12.18	0.009
	Positive Ranks	25 <sup>b</sup>	21.28	
Group Control	Negative Ranks	13 <sup>a</sup>	14.81	0.066
	Positive Ranks	18 <sup>b</sup>	18.31	
<b>Case Percentage</b>				
Group Experiment	Negative Ranks	11 <sup>a</sup>	9.23	0.004
	Positive Ranks	20 <sup>b</sup>	19.72	
Group Control	Negative Ranks	12 <sup>a</sup>	14.62	0.097
	Positive Ranks	20 <sup>b</sup>	17.62	

Table 2 shows the results of the Wilcoxon Sign Rank Test, namely Pre-test (Asymp. Sig 0.003 vs. 0.208), Post-test (Asymp. Sig 0.011 vs. 0.173), DOPS (Asymp. Sig 0.005 vs 0.109), SOCA (Asymp. Sig 0.002 vs 0.143), Mini Cex (Asymp. Sig 0.009 vs 0.066), Case Presentation (Asymp. Sig 0.004 vs 0.097). The results of the Wilcoxon Sign Rank Test showed that the experimental group was significantly able to improve students' cognitive abilities by using mobile learning in the clinical learning area compared to the control group. While the results of the N-Gain Score Test obtained the results of the N-Gain Score Test, namely Pre-test 78% (Effective), Post-test 76% (Effective), DOPS 78% (Effective), SOCA 78% (Effective), Mini Cex 79 % (Effective), Case Presentation 78% (Effective). These results indicate that mobile learning can effectively increase the achievement of the cognitive abilities of nursing students in the clinical learning area (Table 3).

**Table 3: N-Gain Score Test Results**

Variable	Percentage N-Gain Score (%)	Interpretation
Pre-test	78	Effective
Post-test	76	Effective
DOPS	78	Effective
SOCA	78	Effective
Mini Cex	79	Effective
Case Percentage	78	Effective

## DISCUSSION

### **The Process of Using Mobile Learning to Improve the Achievement of Nursing Student Cognitive Abilities in Clinical Learning.**

The process of using mobile learning to improve the cognitive abilities of nursing students in the clinical learning area is through which students can interact and communicate in an integrated and real-time manner, and students can access or download guidebooks and Gantt charts on mobile learning. The Gantt chart in clinical nursing learning is a planned schedule to achieve targets for achieving student cognitive abilities in the Gantt chart feature. The Gantt Chart method is the easiest and most effective way to ensure activities have been planned, work sequences or activities have been documented, activity durations have been recorded and estimated, and have developed the duration of an activity so that it helps the process of achieving the cognitive abilities of nursing students (Munadia & Gani, 2019; Chasan, Fauji & Purnomo, 2022).

Furthermore, nursing students can see the verification feature as a process of verifying documents and targets for achieving cognitive abilities in clinical learning with fulfilled information. Verification is a process of checking, confirming, and ensuring the truth. Verification methods in information systems can simplify verifying the completeness of documents and activity by avoiding file loss and reducing errors (Gunawan, Suherman & Wibowo, 2022). Therefore, document verification and activity targets for achieving cognitive abilities in clinical learning so that they are more accurate and effective. After students know the process of achieving targets for achieving their mental skills in the verification feature, students can see information about the assessment process and assignments, both summative and formative, in the task features and assessment features. In this feature, participants in clinical practice upload files or documents related to the implementation of the assessment.



The assessment feature contains instructions and the assessment process carried out by the academic and clinical preceptors.

As a media of communication and coordination between students, academic preceptors, and clinical preceptors, mobile learning for clinical nursing practice is equipped with a group chat feature so that it can assist the process of achieving cognitive abilities in clinical learning because the learning media used is not limited by time and space. Group chat as a learning media has proven effective because the learning process can be implemented without being limited by space and time. It means that learning is still being carried out not only limited to face-to-face meetings but learning can also be carried out outside the hours of the learning process (Pustikayasa, 2019; Budiyantri, Ganggi & Herlambang, 2021). So, the learning media offered is flexible. Furthermore, nursing students can see and access the learning outcomes through the Learning Outcome feature. As a source of information and evaluation process in clinical learning achievement, the Learning Outcome feature is carried out by academic and clinical preceptors for nursing students. It includes assessments with an information management system for measuring student achievement in real time.

### **The Effectiveness of Mobile Learning to Increase the Achievement of Nursing Student Cognitive Ability in Clinical Learning**

Clinical learning is a crucial component of nursing education, as it enables nursing students to develop and apply various skills, including cognitive abilities (Abdulrahman, 2024). The assessment of cognitive abilities in the clinical learning environment involves several key components. According to the Association of Indonesian Nurse Education Center (2020), the evaluation standards for cognitive abilities in nursing clinical education include Direct Observation of Procedural Skills (DOPS), Student Oral Case Analysis (SOCA), Critical Incident Reports, Objective Structured Clinical Examination (OSCE), Problem-Solving Skills, and comprehensive case assessments.

In this study, the cognitive abilities of nursing students were evaluated using pre-tests, post-tests, DOPS, SOCA, Mini-CEX, and case presentations for both the experimental and control groups. The OSCE was not conducted as it is typically administered at the end of the clinical learning stage to assess the cumulative cognitive abilities of nursing students. The cognitive abilities of nursing students in the clinical learning environment significantly impact the development of clinical competence. Assessing cognitive skills in clinical learning is essential for measuring students' mastery of knowledge, which influences the development of psychomotor skills and provides opportunities for enhancing self-confidence and cognitive abilities (Kleinpell, 2022; Yoshida et al., 2022; Qodir, 2018).

The use of mobile learning to improve the cognitive abilities of nursing students in the clinical learning area is influenced by the demographics of the respondents shown in Table 1. It was found that most of the students were, on average, 22 years old, female, and came from regular education programs. Based on the demographics of the respondents, the respondents in this study are in their late teens and fall into the category of Perceived usefulness or perceived usefulness, which is a level where a person believes that using a system can improve performance, which will have an impact on increasing a person's productivity and effectiveness (Alifah & Rochana, 2017). Whereas based on Table 2 and Table 3 regarding the results of the Wilcoxon

Sign Rank Test and N-Gain Score Test, this study proves that mobile learning can significantly increase the achievement of cognitive abilities of nursing students in clinical learning areas with assessment components, namely Pre-test, Post-test, DOPS, SOCA, Mini Cex and Case Presentations. The Mobile Learning feature supports the implementation process of improving students' cognitive abilities, including the group chat feature as a discussion medium in the cognitive evaluation process. Gantt chart features planned activities to achieve learning outcomes in the clinical learning process. The verification feature for the monitoring process of station activities is based on the targets for achieving cognitive abilities of nursing students so that the achievement targets for summative and formative assessments are very effective and efficient. According to Mousavi et al. (2024), Elvira (2024), Ponamon, Tambingon & Rotty (2022), and Chandran et al. (2022), they revealed that an effective clinical learning model and the availability of learning process facilities using mobile learning have proven to be very effective in producing an exciting learning atmosphere and influencing student learning outcomes and improving academic abilities and clinical practice.

In addition, the application of mobile learning in nursing clinical learning makes the learning media offered more attractive, not limited by space and time. It can be accessed anytime and anywhere because they are Charms of Digital Assistants (PDAs). Mobile learning-based learning has a positive impact because the technology does not limit learning to face-to-face schedules. It can facilitate the process of implementing supervision, monitoring, and decision-making quickly and precisely, which affects the achievement of the target cognitive ability of nursing students in the clinical learning area (Rahmat et al., 2019). However, this research has several obstacles, namely the unstable internet network when using mobile learning and the limitation that the research sample only specifies one nursing college. Therefore, it cannot guarantee that the findings of this study are representative of other universities, thereby limiting the generalization of the findings of this study.

## CONCLUSION

Mobile learning as a learning media for clinical nursing has been proven to significantly and effectively improve the cognitive abilities of nursing students with assessment components, namely pre-test, post-test, DOPS, SOCA, bedside teaching, mini-sex, and percentage of cases. The use of mobile learning has features that are by the needs of clinical learning that can be used without time and place restrictions as a medium of information, communication, and evaluation by involving the role of academic preceptors and preceptors and has features that are by clinical learning needs including; Features of guidebooks and Gantt charts as guidelines and determining planned schedules to achieve targets for achieving cognitive abilities, Verification features as a document verification process and activity targets for achieving cognitive abilities, Assignment features and assessment features as a summative and formative assessment process, Group chat features as media of communication and coordination between students, academic preceptors, and clinical preceptors, Learning outcome features as a source of information and an evaluation process in clinical learning achievements. In the future, mobile learning as a nursing clinical learning medium will be integrated with the theoretical learning process in the classroom and skills lab as a learning medium based on mobile learning.

## Limitations

This research has limitations, namely, the research sample in analyzing the use of mobile learning in improving nursing students' cognitive ability in clinical learning is only set in nursing academics. So, it can not be guaranteed that this study's findings will be representative of colleges and other high nursing academics.

**Conflicts of Interest:** The author declares that there are no conflicts of interest associated with this study.

**Ethical Statement:** The ethical clearance process for this study was conducted on December 2, 2022, by the Health Ethics Commission of Sriwijaya University, Palembang, Indonesia. The study was granted exempt status, with the protocol certificate number 287-2022.

**Authors' Contributions:** All authors of this article contributed to conducting the literature review, preliminary study, research design, data collection, data analysis, manuscript preparation, and critical revision of the article.

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