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RESEARCH **Open Access**

Learning Endotracheal Tube and Laryngeal Mask Airway Intubation with Android Applications for Nursing Students

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Abstract
E-learning in anesthesiology nursing faces challenges like finding practice materials, mastering ETT and LMA techniques, and tool damage. This research aims to develop an android application model to support valid and effective learning for endotracheal tube and laryngeal mask airway intubation for nursing students.This research uses Research and Development (R&D) method with the 4D model by Thiagarajan and just untill a limited group trial. Quantitative method of data collection techniques using a questionnaire. Questionnaire given to material experts and media experts to test product eligibility and use of knowledge questionnaires as well and also System Usability Scale for students to test the effectiveness and acceptance. Result of this research show that the material experts assessment was 92.00% which was classified as very feasible and media experts was 98.52% which was classified as very feasible. Results of pretest and posttest analyzed by wilcoxon test from 34 students obtained results of 0.000 which were significant as well. System Usability Scale result was 85.66 classified acceptable with adjective rating B or good. This Android- based application is very feasible and can be used as a support for learning on the topic or material for ETT intubation and LMA intubation.

Keywords: Mobile Learning, Anesthesiology Nursing, Competence, Endotracheal Tube Intubation, Laryngeal Mask Airway Intubation.

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1. INTRODUCTION

The learning process is very crucial in education. One of the elements of the learning process is the learning media used to achieve the learning objectives needed to convey information to students. Learning media in Indonesia continues to experience development from time to time ranging from direct communication, textbooks, blackboards, chalk, and wooden rulers, as well as visual media such as books. In the 2000s, the learning media that developed was the blackboard, whiteboard, Liquid Crystal Display (LCD) projector, smartphone, tablets, laptops, and print media (Shoffa et al., 2021). In 2023 Indonesia is in era society 5.0 which is required to overcome everything and face challenges with technological innovation. According to BPS in 2021, the percentage of the Indonesian population who own & control cellular phones is around 65.87% (BPS Statistics, 2023). In addition, colleges now set self-directed learning which emphasizes learning focuses on students in meeting their learning needs in tertiary institutions.

In 2020, the number of study programs in the health sector ranks fourth that show 3,640 study programs according to PDDIKTI in 2020. In this era, the use of internet-based electronic learning media or e-learning been used in the learning process (Shoffa et al., 2021). However, use e-learning still not optimal because e-learning still limited to learning theory and tends to be monotonous even though it can be accessed via a laptop or computer and also smartphone. Recent research evidence demonstrates that mobile learning significantly enhances nursing students' knowledge and skills compared to traditional teaching methods (Kılıç et al., 2021). In 2024, studies have shown that nursing students who underwent mobile application educational programs possessed enhanced general knowledge and heightened awareness compared to those in traditional teaching groups, with success rates improving from 80% to 100% in simulation-based intubation training (Alkhazali et al., 2024; Maurya, Ahmed, & Garg, 2024; Vadivoo et al., 2024).

With widespread smartphone adoption, learning can be accessed anytime and anywhere that allows interactive learning and encourages student satisfaction (Essfadi et al., 2024). According to recent surveys conducted in medical institutions, it was found that 96% of students own smartphones, and 84% of them use various health applications for information, with 71.6% agreeing that medical apps are beneficial and allow faster access to medical information. This indicates that the use of mobile applications is very effective for study programs in the health sector (Alkhazali et al., 2024; Nava et al., 2024).

One of the study programs in health sector is anesthesiology nursing, a study program in Indonesia that has only in 14 institutions. According to KMK RI No. HK.01.07/Menkes/722/2020 this study program is required to have clinical skills. One of the competencies that must be achieved is general anesthesia which includes endotracheal tube (ETT) intubation and laryngeal mask airway (LMA) intubation. Endotracheal tube and laryngeal mask airway (LMA) intubation competence for anesthesiology nursing students is very important to understand and hone in depth to apply in hospital practice (Park et al., 2019).

Recent studies on anesthesia education have shown that simulation-based training significantly improves intubation success rates and reduces procedure time (Maurya, Ahmed, & Garg, 2024). A 2024 study demonstrated that simulation-based endotracheal intubation training using high-fidelity manikins increased success rates from 68.42% to 100%, with substantial improvements in identifying standard intubation equipment (from 42.0% to 87.5%) and verification of tube placement (from 39.6% to 98.8%) (Alton, 2024).

Based on the pre-survey that researchers did through google form by adapting the questions from previous studies , there were 76.78% of grade 3 students who stated that they had difficulty finding material to support practice, then 60.72% had not mastered the flow and material for ETT intubation, and 65.21% had not mastered the flow and material for LMA intubation (Yalcinkaya & Yucel, 2023). In addition, in the process of learning skill labs, students are not very familiar with the tools and their use procedurally which can allow damage

to laboratory equipment, especially anesthesia machines, phantoms, and intubation tools (Owrangi et al., 2025). Furthermore, recent research has indicated that LMA insertion skills among healthcare providers are often inadequate, with studies showing higher failure rates compared to endotracheal intubation, emphasizing the need for improved training methods (Mani & Rawat, 2020).

Contemporary evidence supports the effectiveness of mobile applications in medical education. A 2024 systematic review found that mobile-assisted teaching significantly improved nursing students' learning outcomes, with post-test scores being significantly higher in mobile application groups compared to traditional lecture groups across all assessed competencies (Vadivoo et al., 2024). Mobile learning applications have been shown to enhance self-directed learning, with 69.8% of students agreeing that smartphone apps improved access to their courses and 66% stating that medical apps helped them study independently (Alkhazali et al., 2024). The purpose of this research is to obtain an android application development model to support intubation learning endotracheal tube and laryngeal mask airway valid and effective for anesthesiology nursing students.

2. RESEARCH METHOD

The method used in this study is research and development (R&D) with 4D models. This model includes a series of development step: Define, Design, Develop, and Disseminate (Indaryanti et al., 2025). Recent systematic reviews of the 4D model implementation have shown its widespread adoption in educational contexts, with 70% of studies employing the 4D model concentrated in educational settings, particularly in instructional material development (Appelboam et al., 2025). This study was conducted until limited trials to measure knowledge and acceptance and usability of the application. The trial research was conducted at Polytechnic Health of Ministry Yogyakarta involving 34 students of Bachelor Applied of Anesthesiology Nursing in April 2023 with the inclusion criteria are bachelor Applied of Anesthesiology students at least 4 term, have android mobile phone, and have already taken the course on the theory of intubation.

The instrument used for the assessment of material experts and media experts is a questionnaire adapted from The Attributes of Instructional Materials by Mc Alpine & Weston in 1994 and adapted by Chaeruman in 2015 (Chen et al., 2021). While the instrument of knowledge questions was developed in the third stage of the study, development and obtained 16 valid and reliable questions (Prasastin et al., 2024). For the acceptance instrument used instrument System Usability Scale which was developed by Brooke in 1996 and has been declared valid and reliable (Persson et al., 2025; Ghorayeb et al., 2023). Recent validation studies of the System Usability Scale have confirmed its continued reliability and validity for evaluating digital health applications, with studies showing satisfactory psychometric properties across diverse contexts (Persson et al., 2025; Natrio et al., 2024).

This research has received an ethically proper statement from the Health Research Committee of the Polytechnic Health of Ministry Yogyakarta with letter number No.DP.04.03/e-KEPK.1/532/2023 and research permit No.DP.04.03/I/2985/2023.

3. RESULTS AND DISCUSSION

Front end Analysis or initial analysis

Based on the pre-survey that the researchers conducted onundergraduate students in bachelor applied anesthesiology nursing at the Polytechnic Health of Ministry Yogyakarta third year through google form, there were 76.78% students who stated that they had difficulty finding material to support practice. In addition, as many as 60.72% of students stated that they had not mastered the ETT intubation step and material. Meanwhile, 65.21% of students stated that they had not mastered the step and material of LMA intubation

(Yalcinkaya & Yucel, 2023). Futhermore, in the learning skill labs process, students are not very familiar with the tools or equipment and how to use procedurally which can allow damage to laboratory equipment, especially anesthesia machines, phantoms, and intubation tools (Owrangi et al., 2025).

Concept Analysis or concept analysis

The contents of the material menu are based on the Decree of the Minister of Health of the Republic of Indonesia or it called KMK RI No. HK.01.07/Menkes/722/2020 and the terms of reference for basic anesthesia clinical practice include: general anesthesia equipment, general anesthetic drugs, inhalation agents, triple airway maneuvers, ASA physical status, ETT and LMA intubation preoxygenation, and tidal volume. Whereas the questions are made based on the material taken and a validation test is carried out on 2 expert, lecturer in anesthesiology nursing as a team for compiling the national anesthesiologist competency test in Indonesia and an anesthesiologist nurse in Muhammadiyah Yogyakarta Hospital, Indonesia. In the step menu and games the Standard Operating Procedure (SOP) reference was used for ETT intubation and LMA intubation at the Polytechnic Health of Ministry Yogyakarta which consulted to 3 material experts, which is anesthesiologist, an anesthesiology nursing lecturer, and an anesthesiologist nursing.

Design

This stage begins with finding appropriate ui/ux design inspiration, the next step is choosing colors and themes. In designing the menu and application design will be carried out by researchers using the CorelDRAWx7 application. The next step is making an application that is done with programmer assist.

Material expert validation assessment

Table 1. Assessment of the first round of material expert validation

No	Indicator	Percentage (%)	Category
1.	Truth content	86.67%	Very worthy
2.	Error free concept	73.33%	Worthy
3.	Contemporary and up to date material	73.33%	Worthy
4.	Coverage and depth of material	86.67%	Very worthy
5.	Adequacy of the reference used	86.67%	Very Worthy

Table 2. Assessment of the second round of material expert validation

No	Indicator	Percentage (%)	Category
1.	Truth content	86.67%	Very worthy
2.	Error free concept	80%	Worthy
3.	Contemporary and up to date material	100%	Very worthy
4.	Coverage and depth of material	100%	Very worthy
5.	Adequacy of the reference used	93.33%	Very Worthy

Based on the first round of assessment in table 1, an average percentage of 81.33% is obtained so that it is included in the very worthy or very feasible category (Latifah, 2020). After making improvements from suggestions and input expert, among others: necessary update material, so that the material is adjusted to the theory in the hospital field clinic, and the anesthetic drug menu has not been added to aminophylline and antidotes, as well as adding contraindications to the inhalation agent menu.

Then a second round of assessment was carried out in table 2 and an average score of 92% was obtained so that it was included in the very feasible category. In addition, the

assessment of each panelist on each assessed indicator shows an assessment of ≥ 3 with a value range of 1-5 and can be said to be feasible. This shows that the material, content, and concepts contained in this android application are in accordance with the topic discussed, namely intubation endotracheal tube dan laryngeal mask airway.

Table 3. First round media expert validation assessment.

No	Indicator	Percentage (%)	Category
1.	Narrative clarity with audience characteristics	86.67%	Very worthy
2.	The clarity of the animation with the characteristics of the audience	73.33%	Worthy
3.	Simulated clarity with audience characteristics	80%	Worthy
4.	Clarity of style of language and communication with the characteristics of the audience	86.67%	Very worthy
5.	The accuracy of the selection of narrative with the purpose and content of the material	86.67%	Very Worthy
6.	The accuracy of the selection of animation with the purpose and content of the material	73.33%	Worthy
7.	The accuracy of selecting the simulation with the purpose and content of the material	86.67%	Very worthy
8.	The attractiveness of learning multimedia packaging	86.67%	Very Worthy
9.	The accuracy and overall attractiveness of the media	80%	Worthy

Table 4. Second round media expert validation assessment.

No.	Indicator	Percentage (%)	Category
1.	Narrative clarity with audience characteristics	100%	Very worthy
2.	The clarity of the animation with the characteristics of the audience	93.33%	Very worthy
3.	Simulated clarity with audience characteristics	100%	Very worthy
4.	Clarity of style of language and communication with the characteristics of the audience	100%	Very worthy
5.	The accuracy of the selection of narrative with the purpose and content of the material	100%	Very worthy
6.	The accuracy of the selection of animation with the purpose and content of the material	100%	Very worthy
7.	The accuracy of selecting the simulation with the purpose and content of the material	93.33%	Very worthy
8.	The attractiveness of learning multimedia packaging	100%	Very worthy
9.	The accuracy and overall attractiveness of the media	100%	Very worthy

Based on the assessment of the first round of media experts in table 3, an average percentage of 82.22% is obtained so that it is included in the very worthy or very feasible

category. After making improvements from expert suggestions and input, including: Adding information about the application, improving image and text display proportions on mobile devices, enhancing games according to learning objectives, ensuring consistent menu style, improving font differentiation for headers and body text, and adding scoring or assessment features to the game menu (Gizicki et al., 2023).

Then a second round of assessment was carried out in table 4 and an average score of 98.52% was obtained included in the very feasible category. Recent studies on mobile application development have confirmed the importance of user interface design and multimedia elements in educational applications, with properly designed interfaces showing significant positive impacts on learning outcomes (Hyzy et al., 2022; Kusumastuti et al., 2022; Roncal-Belzunce et al., 2025)

Development of knowledge instruments

The developed instrument consisted of 20 multiple choice questions which were assessed through expert judgement by anesthesiology nursing lecturer and anesthesiology nurse. Assessment is done with expert judgment in the form of a score obtained from giving an assessment sheet then calculated to determine the validity of the contents of the item instrument using the Aiken validity index formula, in this study only questions that had moderate validity were used $0.4<V<0.8$ and high validity $V\geq0.8$ (Stone et al., 2020). Then obtained 16 valid questions and tested their reliability using alpha cronbach. The results of the reliability of the 16 items show a value of 0.949 so that 16 items of the knowledge item instrument are declared reliable.

Dessiminate

The deployment stage was carried out by researchers with limited trials in second grade students of the Undergraduate in Bachelor Applied of Anesthesiology Nursing Study Program, Poltekkes Kemenkes Yogyakarta. With a total 34 students of 4 semester or second grade students.

Limited Knowledge Trials

The instrument used is a question that has been developed in the development step, as many as 16 multiple choice questions. Obtained pretest score of 34 students with a total score of 1815 while the posttest score with a total score of 3100. The data obtained from 34 students was tested for normality of the data with shapirowilk test because the number of respondents <50. The normality test results show the value <0.05 so that the data is not normally distributed, then proceed with a different test using a Wilcoxon non-parametric test and obtained p value 0.000, so it's means p value <0.05 and this android application had an effect of using on the level of student knowledge.

These findings are consistent with recent systematic reviews showing that mobile applications significantly improve nursing students' knowledge acquisition, with studies reporting similar improvements in post-test scores compared to traditional teaching methods (Alkhazali et al., 2024; Vadivoo et al., 2024)

Acceptance or Use Limited Trial

Test results of System Usability Scale for 34 students obtained a total score of 2912.5 with an average of 85.66. From these results it can be classified according to acceptable rating and classified as acceptable. Meanwhile according to adjective rating can be classified into good or with a B level.

This SUS score aligns with recent benchmarking studies for digital health applications, which confirm that scores above 80 indicate good usability and user acceptance (Persson et al., 2025). Recent validation studies of the SUS have demonstrated its continued reliability for evaluating educational mobile applications, with studies

showing satisfactory psychometric properties across diverse healthcare education contexts (Hyzy et al., 2022; Roncal-Belzunce et al., 2025).

DISCUSSION

The results of android based learning media in the form of this application can be accessed via Android, at least Android version 8.0 and a minimum screen size of 5.5 inches. This application can be downloaded via file, without the need for a fee. The application views are as follows: (1) Opening screen, (2) Main Menu, (3) Materials Menu, (4) Steps Menu, (5) Games ETT intubation menu, and (6) Games LMA intubation menu, (7) Quiz menu, (8) About Me menu, and (9) Reference Menu. Each of these menus can be accessed by students anytime and anywhere, even though there is no internet connection it can still be accessed. Application details can be seen in the following figure.

This android application can be accepted by students and gets a positive response from students. One of the advantages of this application is that it has been validated by expert which can be relied on for validity, in the current era many students are looking for learning resources via the internet whose truth is uncertain (Annisa et al., 2025; Pan & Rong, 2021). The discussion in the application is also stated to be very feasible by expert because it contains material that is suitable for reference for carrying out clinical anesthesia practice, including anesthetic drugs which are summarized according to current evidence-based references and selected based on medications commonly encountered in contemporary hospital practice (Shosha et al., 2019).

Figure 1. Opening Display

Figure 2. Main Menu

Figure 3. Material Menu

Figure 4. Step Menu

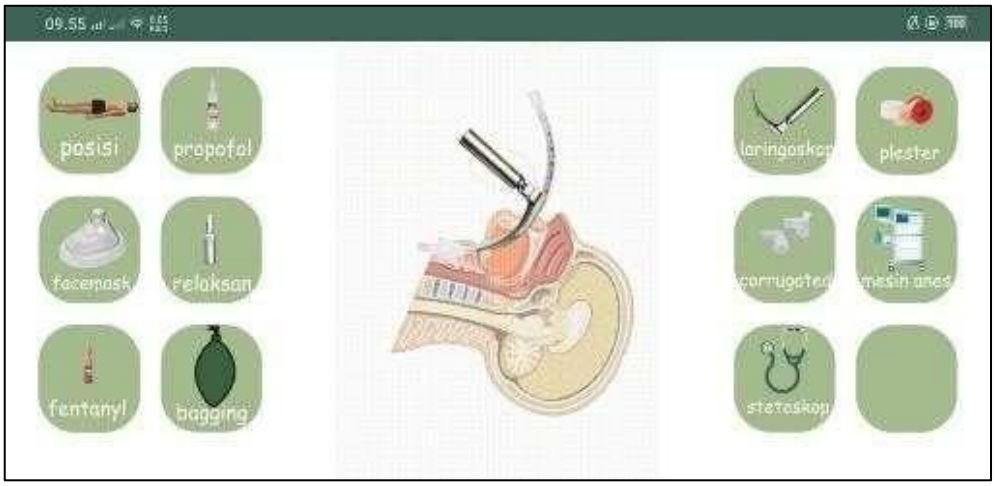

Figure 5. Games ETT intubation

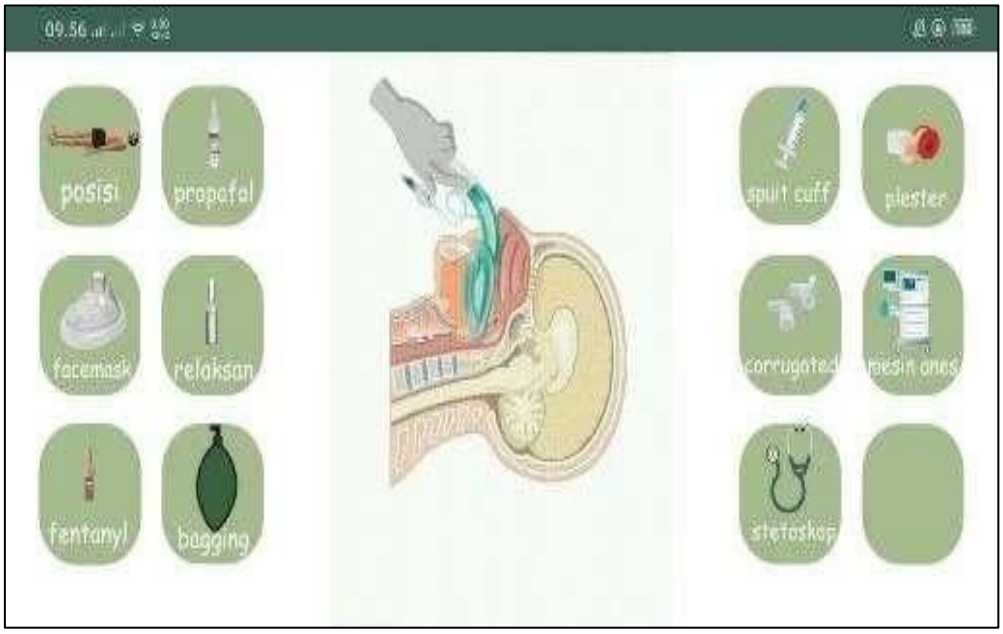

Figure 6. Games LMA intubation

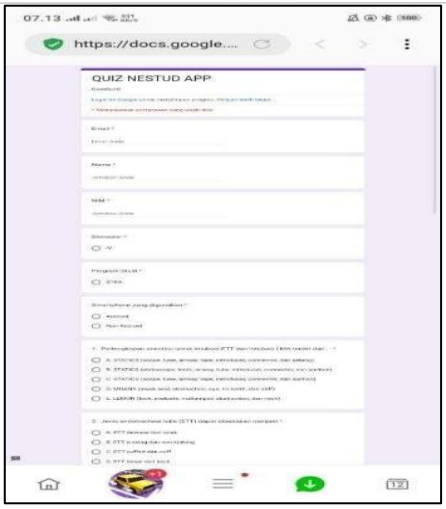

Figure 7. Quiz Menu

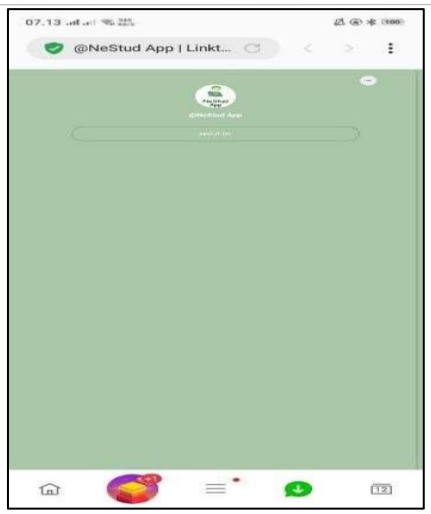

Figure 8. About Me

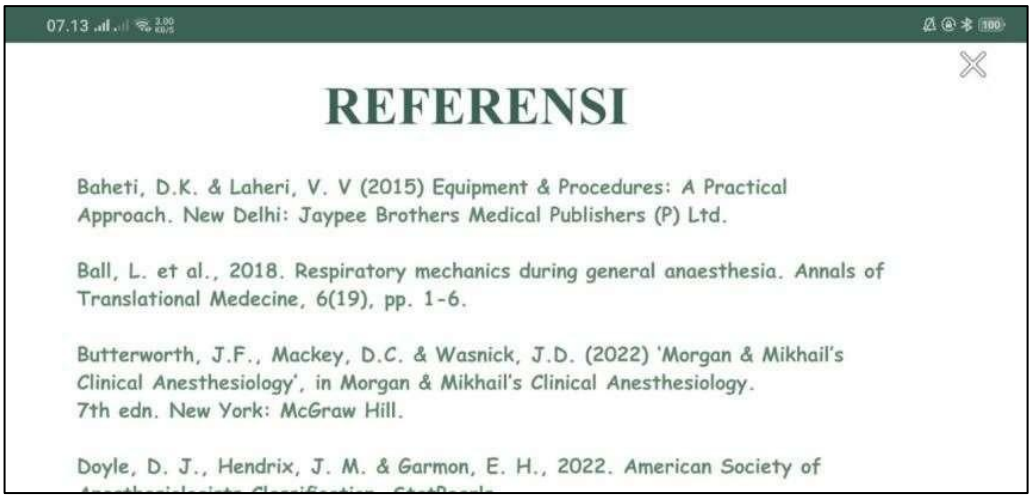

Figure 9. Reference Menu

In the opening display menu, the user can enter a name then login. On the main menu there are various menu options: material menu, steps, games, quiz, references, and information or about me. In the material menu there are statics options, selected anesthetic drugs, inhalation agents, triple maneuvers, and other menus (intubation pre-oxygenation, tidal volume, and ASA physical status). Whereas on the step menu there are ETT and LMA intubation procedures that are adjusted to the SOP of the Yogyakarta Ministry of Health Poltekkes and suitable with field conditions or clinical conditions. Next on the games menu, users can perform ETT and LMA intubation simulations. On quiz menu, users can explore the ability of the material that has been studied. To find out which references are used as references in the application, users can select the reference menu. In addition, for more information, users can select features about me.

Recent evidence from 2024 demonstrates that mobile learning applications specifically designed for anesthesia education can significantly enhance learning outcomes (Alton, 2024). Studies have shown that simulation-based training combined with mobile applications improves procedural competency, with success rates in intubation procedures improving dramatically when mobile learning is integrated into the curriculum (Basnet et al., 2024). In addition, learning through android applications or mobile learning can make it easier for students because it can be used anywhere and anytime. Students do not need to carry heavy books, laptops, and other burden items to learn about ETT and LMA

intubation because of the use of this mobile learning (Basnet et al., 2024; Natrio et al., 2024).

Contemporary research in nursing education has consistently demonstrated the superiority of mobile applications over traditional teaching methods. A 2024 randomized controlled study involving nursing students showed that mobile application groups achieved significantly higher mean scores across all learning themes compared to traditional lecture groups, with particular improvements in knowledge retention and practical skill application. Furthermore, studies have shown that 85% of nursing students highlight advantages of mobile applications including improvements in knowledge and skills, enhanced self-confidence, and stimulation of learning motivation (Alkhazali et al., 2024; Ghorayeb et al., 2023).

The integration of mobile technology in anesthesia nursing education aligns with current trends in healthcare education (Annisa et al., 2025). Recent systematic reviews have identified mobile learning as an essential educational approach with profound implications for healthcare education and patient care quality improvement (Vadivoo et al., 2024). The widespread incorporation of mobile applications into educational frameworks provides flexible teaching paradigms that support continuous lifelong learning, which is particularly crucial in the rapidly evolving field of anesthesia nursing (Alkhazali et al., 2024).

Recent developments in anesthesia education emphasize the importance of simulation-based training. Studies have shown that different airway simulators improve intubation skills, with high-fidelity manikins demonstrating significant improvements in success rates and reduced procedure times (Basnet et al., 2024; Yu et al., 2025). The incorporation of mobile applications enhances these traditional simulation methods by providing accessible, standardized training materials that can be accessed repeatedly for skill reinforcement (Yu et al., 2025).

Thus, this application can be applied, accepted, or used on the topic of ETT and LMA intubation for anesthesiology nursing students, supporting current evidence that mobile learning represents the future of medical education technology (Feng et al., 2025; Pan & Rong, 2021).

4. CONCLUSION

This research focuses on developing an Android-based application for intubation learning, specifically for endotracheal tube and laryngeal mask airway. The application includes material, steps, games, and quizzes, covering topics such as anesthetic equipment, anesthetic drugs, inhalation agents, triple airway maneuvers, intubation preoxygenation, tidal volume, ASA classification, ETT and LMA intubation procedures, simulations, and knowledge quizzes. The first round of material expert assessment was 81.33%, the second round was 92%, and the media expert assessment was 82.22% in the first round and 98.52% in the second round. The application's System Usability Scale score was 85.66, indicating its acceptable category and received a B or good rating. The limited trial demonstrates the app's effectiveness in improving learning outcomes, with statistically significant improvements in knowledge scores ($p<0.001$). This Android-based application is very feasible and can be used as an effective support for learning ETT intubation and LMA intubation, aligning with current evidence that mobile learning applications significantly enhance nursing education outcomes compared to traditional teaching methods.

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