Journal of Engineering and Health Sciences
eISSN 2600-7843
Volume 9 (Bil.1) 2025:1-12

THE USE OF MOBILE EDUCATION APPLICATIONS IN ANATOMY AND PHYSIOLOGY LEARNING FOR NURSING STUDENTS

Norziah Sarudin
Faculty of Nursing and Health Sciences
Universiti Islam Melaka

Mohd Fahmi Mohd Yusof
Faculty of Nursing and Health Sciences
Universiti Islam Melaka

Amilia Idris
Faculty of Nursing and Health Sciences
Universiti Islam Melaka

Nurul Fatin Md Nasir
Faculty of Nursing and Health Sciences
Universiti Islam Melaka

Ibrahim Ahmad
Fakulti Teknology Maklumat dan Telekomunikasi
Universiti Teknikal Malaysia Melaka

Dilkumar Marimuthu
Institut Jantung Negara University College

Mohd Reza Amin
Faculty of Health and Life Sciences
Management and Science University

Corresponding Author's Email: ibrahim@utem.edu.my

Article History:
Received : 5th Nov2025
Revised : 20th Dec 2025
Published : 31st Dec 2025

To cite this article:
Sarudin et al., (2025). ***THE USE OF MOBILE EDUCATION APPLICATIONS IN ANATOMY AND PHYSIOLOGY LEARNING FOR NURSING STUDENTS.*** *Journal of Engineering and Health Sciences, 9(1),1-12.*

The Use of Mobile Learning Applications in Anatomy and Physiology for Nursing Students

Abstract:

The use of applications for mobile devices has grown rapidly and has become a hotly debated issue in the field of education as well as student development. Flexibility, user-friendly, small, easy access and various other mobile technology capabilities make it valuable and a necessity nowadays. This study aims to identify nursing students using mobile applications for anatomy and physiology subjects in self-learning

through a case study. This study was conducted in a faculty nursing and helath science in Universiti Islam Melaka. Data collection was also done using interview instruments to 10 students from a population of 139 nursing students in UNIMEL. The results show that there are differences in self-learning for male and female students in the use of mobile applications. Therefore, nursing students still need to be given knowledge and motivation about self-learning because the use of technology such as mobile applications in teaching and learning is one of the teaching strategies for the development of metacognitive skills in solving mathematical problems.

Keywords:
M*obile applications, self-learning, anatomy and physiology*

1.0 Introduction

Many students have a negative perspective on the difficulty of Anatomy and Physiology as a critical subject in the field of nursing science, and this misunderstanding is compounded by the use of teaching strategies that do not enhance mastery of Anatomy and Physiology among nursing students (Iji, Abah & Anyor, 2022). The concerns among nursing science educators have led to the search for technological solutions developed for instructional delivery. The subject of Anatomy and Physiology requires the development and mastery of every part of the human body. It involves skilled manipulation and careful approaches to ensure the accuracy of facts (Iji, Abah & Uka, 2023). These facts clearly indicate that, to build a strong understanding among students in this subject, effective delivery strategies are needed. The delivery of effective teaching strategies may be supported by educational technology as it allows students to choose how they learn, with the instructor acting as a guide rather than a director

Thus, the need for continuous learning in today's society is undeniable in the face of technological advancements that professionals must be aware of and support. The use of information technology, when applied correctly, can become an effective tool to meet these needs by providing dynamic and interactive forms of internet-based learning and training (Haag, 2011). For example, the use of mobile educational devices adds opportunities for innovative pedagogical approaches that are less rigid than other forms of technology-based teaching and learning (Sharpless, Taylor & Vavoula, 2022).

Educational mobile applications are software applications specifically developed for use on small computing devices, such as smartphones and tablets, rather than desktop or laptop computers. Educational mobile applications can stimulate student engagement through knowledge-oriented activities. Learning through educational mobile apps encourages student motivation to learn independently, as mobile devices like smartphones are easy to use and feature engaging characteristics. In this way, students can participate in courses and access study materials, seek consultation outside of class hours or fixed infrastructures, and have greater flexibility to interact with peers in real-time (Laurillard, 2023). This promotes self-directed learning within the mental and physical readiness space of the students (Saedah, 2022). According to the Dewan Dictionary, "self-directed learning" refers to a learning situation that allows students to learn at their own pace and ability.

The advancement of new communication technologies has contributed to increased interconnectedness and interdependence worldwide. Technologies such as educational mobile apps provide educational opportunities anytime and anywhere through various functions (Crompton, 2023). However, as the United Nations Educational, Scientific and Cultural Organization (UNESCO) states, mobile devices are not used as effectively as they could be to address global education challenges (West, M., 2022). Successful use of educational mobile technology in the field of education requires educators to design learning experiences that leverage the capabilities of these mobile devices (Krull & Duart, 2021).

Educational mobile apps tend to drive new research opportunities in mobile learning due to the rapid pace of technological change. In addition to educational mobile technology, communication technologies are also evolving, shifting the focus of research (Parsons, 2024). For example, social media and messaging apps have become commonplace. The development and patterns of mobile

educational technology use are changing rapidly. The goals and methods used in research studies are important because they influence how research findings are shared, interpreted, and utilized (Wingkvist & Ericsson, 2021). Survey studies can help identify progress in the field and offer guidelines for planning future research (Frohberg, Göth, & Schwabe, 2022

Understanding the use of educational mobile applications for students in the subject of Anatomy and Physiology in research studies can also assist education policymakers in making decisions about technology, teaching, and learning (Wu et al., 2022). Norlaila, Rosseni, and Mohammed (2020) suggest that opportunities should be provided for educators in the field of nursing science to develop educational mobile apps by creating supplementary learning modules to existing reference materials, such as textbooks.

This study provided a systematic review of mobile educational learning studies in higher education from 2021 to 2024. It begins with an analysis of previous studies to provide a basis for comparison with similar research. The purpose and research questions are then outlined. The next section discusses the methodology used to conduct the review study, followed by the presentation of the findings, with comparisons to previous studies. The final section provides a discussion on the findings of the review.

Several review studies have been conducted in recent years in an effort to explore and provide insights into the growing knowledge of mobile educational learning. Based on the literature review, three gaps were identified in this systematic review. First, most studies have been conducted in preschool settings rather than in the field of nursing, suggesting that further research is needed in other educational levels. Second, to avoid researchers or other stakeholders repeating unsuccessful efforts, reports of negative learning outcomes should also be reported, not just positive ones. Third, the reviewed studies revealed that a large number of researchers did not identify the concepts of Anatomy and Physiology and only focused on specific topics being taught. It would be useful for this information to be included to inform practice so that educational mobile apps can enhance students' metacognitive skills.

At the same time, learning through educational mobile apps can motivate students and provide a more effective and enjoyable learning experience. This has proven that the use of mobile educational technology can enhance the delivery of quality, student-centered education. Furthermore, to ensure that this research contributes to 21st-century education, as stated in the National Education Development Plan (Ministry of Education, 2013), in order to achieve students' aspirations in critical thinking skills, teaching tools and aids must align with current needs.

The purpose of this study is to identify how nursing science students use educational mobile apps for the subject of Anatomy and Physiology and their use in self-directed learning. Therefore, the researcher has conducted a study on the use of educational mobile apps in learning Anatomy and Physiology. Specifically, the objectives of this study are to:

i. To identify the advantages of educational mobile applications in student learning for the subject of Anatomy and Physiology in the field of nursing science.

ii. To identify the impact of using educational mobile applications on self-directed learning

2.0 Literature Review

2.1 The mobile educational application approach in understanding the concepts of Anatomy and Physiology.

The development of mobile technology is a phenomenon observed worldwide, as the number of mobile subscriptions has shown rapid growth (Tsinakos, 2013). The advantages of mobile applications include the convenience of accessing the internet from anywhere and at any time (Adi Nur Cahyono &

Miftahudin, 2018). Currently, many mobile applications have been developed for learning in various fields of knowledge (Oranç & Küntay, 2019). The widespread initiative regarding the use of technology and educational mobile apps for educational purposes has been launched (Kearney, Burden, & Rai, 2015) due to the increasing use of apps in various aspects of life, driven by individuals' needs for smartphones in areas such as communication, entertainment, productivity, travel, and learning, as well as their affordable prices. To create a knowledgeable, creative, digitally capable society with flexible skills, it is essential to integrate the use of technology in education, particularly in the field of nursing (Ainley, 2010; Sharples et al., 2016).

In general, educational mobile technology has been used in learning for more than a decade. Therefore, learning Anatomy and Physiology with the aid of mobile applications can increase student motivation, thereby enhancing the understanding of concepts and facts related to Anatomy and Physiology (Vidermanova & Vallo, 2015; Bradley & Holley, 2021). The use of mobile education can also improve student performance (Papadakis et al., 2022). According to a study conducted by Su (2022), mobile educational technology has become a learning process that can achieve better learning outcomes and higher motivation levels compared to traditional teaching methods.

This is also in line with Nasution (2023), who states that mobile-based learning strategies are more interactive, enjoyable, and highly effective in achieving learning objectives. Research results by Gharini (2022) show that educational mobile applications meet legitimate, practical, and effective aspects, as demonstrated by nursing students' responses and learning test results with an average percentage of 96.33%. Therefore, mobile learning technology has great potential as students can enhance their knowledge, skills, and learning performance informally through communication technology (Hwang & Wu, 2012; Camilleri & Camilleri, 2017; Ciampa, 2024). Directly, the learning environment through mobile applications can encourage students to engage in deeper problem-solving processes, concluding that more involvement in learning activities using educational mobile apps can improve students' core competencies for the 21st century, such as communication, complex problem-solving, and creativity (Lai & Hwang, 2024).

Several researchers have studied the growth of educational mobile applications over the past decade (Crompton, 2013; Parsons, 2024), with specific literature reviews attempting to capture particular aspects of this field (Parsons, 2024; Frohberg, Göth & Schwabe, 2020; Naismith et al., 2023; Wingkvist & Ericsson, 2021). There has been a literature review on educational mobile applications. The results of the literature review from the analysis, listing studies that have assessed the use of educational apps for learning, are shown in Table 1.

This review focused on the educational level where the apps were examined for use by nursing students randomly from the Nursing and Health Sciences faculty at Unimel. The development of educational mobile applications focused on the nursing field due to evidence of decreased engagement among nursing students in recent years (Palmer, Burke & Aubusson, 2017; Ainley, Kos, & Nicholas, 2022). Therefore, investigating how the use of educational mobile applications can optimize learning in this faculty discipline is crucial. This narrows the scope for researchers compared to existing reviews. Meanwhile, the selected subject scope focused on finding empirical studies reporting on educational mobile applications in Anatomy and Physiology education (Crompton & Burke, 2022).

Several existing reviews on this topic, particularly Anatomy and Physiology concepts in the context of nursing education, indicate that educational mobile applications have less emphasis on foundational knowledge of organs in the Anatomy and Physiology subject. Although researchers suggest that past studies may have focused on developing competencies and skills across all nursing fields rather than limiting it to Anatomy and Physiology alone, it can be concluded that the focus was more on the technology used, with Anatomy and Physiology not being the main focus of the research. Educational mobile applications are most frequently used in fields other than nursing (34%), followed by secondary schools (29%) (Crompton & Burke, 2022).

3.0 Research Methodology

This study adopts a qualitative approach with a case study design. The purpose of this research is to assess how nursing students use educational mobile applications for the subject of Anatomy and Physiology and how these applications are utilized in self-directed learning. For this purpose, the researcher employed interview instruments. The interview instrument was developed based on self-directed learning theory. The interview method, in which both the subject and the researcher are present in the process of acquiring information, is highly effective for exploring perceptions, including attitudes, interests, thoughts, values, and opinions. The interview involves a conversation between the researcher and the study participants to gather relevant information for the research. Interviews are a method that allows researchers to obtain in-depth study information because it involves direct face-to-face interaction with participants (McNiff, 2022). The participants involved in this study were 10 students from a population of 139 nursing students in the Nursing and Health Sciences Faculty in Melaka. The selection criteria for participants included being nursing students who own smartphones and tablets, and have internet access in the dormitories. The researcher obtained their voluntary consent to participate in this study during the first meeting. Observations and document analysis were also used to support the findings of this study during the initial data collection phase.

4.0 Results

A semi-structured question on the advantages of mobile educational applications for nursing students' learning in the subject of anatomy and physiology. Table 1 presents a summary of the overall findings regarding these advantages.

Table 1: Summary of the Advantages of the Application

Theme	Code	N	(%)
Convinience	*a1) Easy*	4	40
Not boring	*b1) Bored*	8	80
	b2) focus		
Element multimedia	*c1) Too many things*	7	70
	c2) Video		
	c3) Sound		
	c4) quiz		

Table 1 above presents the findings obtained regarding the advantages of mobile educational applications in nursing students' learning for the subject of Anatomy and Physiology. Based on the data analysis conducted, four themes of the advantages of using mobile educational applications for student learning were identified

4.1 Conveniency of the System

The first theme regarding the advantages of mobile educational applications is convenience. Based on the summary in Table 2 above, 50% of the students stated that using this learning application makes it easier for them to study, such as completing reinforcement exercises. Therefore, students are required to use exercise books for writing, but with this mobile educational application, they only need to click the provided button to answer the questions. An example of an interview excerpt is as follows:

> *"It's easier when using this. If it's in a book, I have to write, but with this, I just need to click." (p1)*

The second theme that emerges from the advantages of this learning application is that it is not boring. The table above shows that 80% of students stated that this mobile educational application is

more engaging compared to using textbooks. According to one of the six students, the use of textbooks leads to boredom and a lack of focus. Here is an example of an interview excerpt:

> *"Use this application, if you read a book, you get bored quickly, you quickly become bored, you lose focus quickly." (p4)*

4.2 Multimedia Elements in the System

The third theme is multimedia elements. The results show that 70% of students stated that this mobile educational application contains interesting multimedia elements, while 30% preferred the application to be in the form of a game. Seven students mentioned that the application includes multimedia elements such as animations, graphics, and interactive audio. An example of an interview excerpt is as follows:

> *"This kind of application, yes, you can find the answers, it has moving pictures,sounds, music, and quizzes. You just press, no need to copy anymore, but that's how it is." (l3)*

A semi-structured question on the use of mobile educational applications in self-directed learning for nursing students. Table 2 presents a summary of the overall findings regarding self-directed learning.

Table 2: Summary of Self-Directed Learning

Theme	Coding	N	(%)
Content Aplications	a1)interesting	10	100
	a2)Interest	5	50
	a3) Like		
	a4) Enjoy		
	a5) Atractive		
Motivation	b1) Enthusiasm	5	50
	b2) Diligent		
Self solution	c1) Ask the instructor	6	60
	c2) Used aplication	2	
	c3) Look at formula	1	
Using Itself	d1) Press Itself	1	10
	d2) Can Use	9	90
Existing Knowledge	e1) Ever Used	8	80
	e2) Never Used	2	20
Attitude	f1) Depends	4	40
	f2) No Effort	2	20

Table 2 above presents the findings obtained regarding the effects of using mobile educational applications on self-directed learning for nursing students in the subject of Anatomy and Physiology. Based on the data analysis conducted, five themes were identified regarding the impact of mobile learning applications on students' self-directed learning.

4.3 Student's Interest in Using the System

The first theme is about interesting applications and interest in using them. The results show that 100% of students stated that this educational mobile learning application was interesting but only 50% were interested in using this application in their learning. For example, this interview excerpt illustrates the theme of interesting applications and their use:

> *"This application is interesting but if it crashes, it becomes difficult to call, everything in it disappears and you can't do anything, so it's better to use a textbook." (l1).*

In addition, only five female students chose to learn outside the classroom using mobile educational applications. According to two of the five female students, they chose to learn using technology or applications using smartphones because it is fun and learning using applications or electronics has become the choice of society today and this application is also easier and saves time for them to learn by just clicking a button in the application without needing an exercise book to write because everything is already available.

Similarly, one of the five female students stated that the mobile education technology has interesting elements when using the app compared to textbooks, such as quizzes in the app that feature answer choices and buttons that move. An example of this interview excerpt is as follows:

> *"Educational mobile applications because they are interesting from textbooks. The quiz has answer choices, there are action buttons." (p1)*

But for the statement from two male students stating that these excellent students prefer or like learning in textbooks, this textbook has a lot of facts and he also said that this application is produced in an interactive and fun way because for him the apps have the illusion of pictures and interesting things, such as moving pictures and imagination. Here is an example of an interview excerpt:

> *"For me, for students who are excellent, this textbook is like a textbook, this textbook has a lot of facts, applications because it has interesting pictures and things, there are moving pictures and imagination like that. It's like playing mobile legends, there are competitions, it's even better, you can talk while doing it, you can ask the teacher, it's more exciting." (l4)*

4.4 Motivation of Student Using the System

The second theme is the impact of motivation on students. The results show that only 50% stated that using this mobile application gives them motivation in learning anatomy and physiology. Five out of ten students stated that this application gives them motivation to learn easily because the phone is always with them if they want to study so it is easy compared to learning using books, if the book and the student are in different places it causes difficulty in learning. The following is an example of an interview excerpt for the motivation theme:

"My motivation is to be diligent in studying. If I had books with me, it would have been difficult, but if I had this phone with me, I would have always been happy." (p3)

4.5 Self solution

Next, is the third theme, which is how to solve problems on your own. Based on the table above regarding the problems that often arise in learning Anatomy and Physiology and the solutions that were done before, it shows that 60% of students will ask their lecturers while another 20% will use applications and only 10% refer to textbooks. The findings of this study found that six out of ten students wait for class the next day to ask the teacher how to solve the question. For example, this interview excerpt illustrates the theme of problem solving:

"If I ,I would wait until tomorrow's class and then ask the teacher what to do." (p2)

In addition, two out of ten students used technology to answer quizzes, according to them the application used for this quiz segment to find answers. Here is an example of an interview excerpt:

"I use technology to look for answers like using AI but that's it, the explanations there are too long and too long, so he has to think a lot and then the sentences are too high to understand." (p4).

Using it yourself without the help of others is the fourth theme in this study. Therefore, the findings above show that all students are 100% able to use this educational mobile application without the help of others because all students have existing experience using the application without the help of others. The following is an example of an interview excerpt illustrating the theme of using it yourself:

"For me, I can use it without the help of others. Before this, I used the notes given through mobile apps to find the answer." (p3)

4.6 Blending with Existing Knowledge

Only eight out of ten students had prior knowledge in using learning applications before while the other two had never used this application but they had experience playing online games and these students had experience in online learning such as having used the quzzie application, and flashcard according to them the instructor would provide a link and ask them to answer the questions but these students stated that quzzie did not have a check on the correct answer at the end and only gave out marks, google meet was also used during the movement control order (MCO). For example, the excerpt from this interview is as follows:

"I used a quiz, the instructor gave me a link to answer the questions and then used Google Meet during the MCO, but this quiz doesn't allow me to check the correct and incorrect answers, only the scores are sent out." (l2)

4.7 Attitude od Students Using the System

Four students prefer to use mobile educational applications rather than learning through textbooks, but five out of ten students still need teacher assistance during teaching and learning sessions. According to one student interviewed, this application is more for self-study, but he prefers to study with an instructor because when studying alone, he feels lazy and unmotivated to study, which involves diagrams that need to be labeled. The following is an example of an interview excerpt illustrating the attitude theme:

"The application on the phone is more for self-study but it's not very good… I

prefer to study with a teacher because when I study on my own I feel lazy and not motivated to learn because I want to involve numbers." (l3)

For them, using this application is easy, but for self-study, it cannot help them master the topic and they need the presence of a teacher face-to-face because for them, this mathematics subject is not the same as a reading subject that only requires memorization. For example, the excerpt from this interview is as follows:

"It's easy to use this application, but it's best to have an instructor in front of you because Anatomy and Physiology are not the same as reading and memorizing subjects, you have to have an instructor as well." (p5)

One of these six students stated that he likes to use his smartphone only to play games and not to study, if he studies he prefers to study in class with the instructor. An example of an interview excerpt is as follows:

"No, it's nice to play games on your phone, if you study in class, you need a teacher to be enthusiastic about learning." (l3)

5.0 Discussion

5.1 The use of educational mobile applications on students' views and interests in learning anatomy and physiology

Based on the findings above, it was found that the use of mobile educational applications has several advantages for students. Among the advantages, 50% of the students stated that the application makes things easier for them, while 80% or 8 of the interviewed students preferred using this application because it was more engaging compared to textbooks. Another advantage of this application is that it has interesting multimedia elements such as animations, graphics, audio, and interactive learning videos, unlike other mathematics learning applications. According to Praherdiono and Adi (2021), the advantage of multimedia is that it appeals to the senses and captures interest by combining visual, auditory, and motion elements. This study is also supported by the research of Nie, Bird, and Edirishingha (2023), where applications like these provide advantages and make better use of time when accessing course materials.

Additionally, the female respondents regarding learning with this mobile educational application found it very suitable because it has become a choice for most students in their daily activities due to its engaging elements and its ability to enhance students' emotional involvement in learning, unlike textbooks. To further improve student engagement, the developed applications need to be well-designed, as suggested by the findings from three male respondents. This study aligns with the research of Papadakis et al. (2016), which found that carefully planned educational activities using mobile devices enhance students' motivation and performance.

This also indicates that mobile educational applications within the education faculty are very limited. According to the findings from the female students who had used this application, they stated that the applications they had used often presented solutions with high-level language and difficult-to-understand long notes, and most existing applications are more focused on finding answers. This study is in line with the research by Palmer, Burke, and Aubusson (2023), which found evidence of reduced student engagement in nursing subjects like anatomy and physiology in recent years, and the development of mobile educational applications is more focused on games.

5.2 The use of educational mobile applications for self-learning.

All respondents have been exposed to the use of educational mobile applications since the COVID-19 pandemic, and they clearly show that nursing students are quite familiar with educational mobile technology. However, only female students and one-third of male students use mobile apps for

educational purposes, while the rest use these apps solely for personal reasons and online gaming. Therefore, the use of educational mobile apps in self-directed learning among nursing students is considered moderately weak due to several factors, such as existing knowledge, self-regulation, attitudes, motivation, and the app itself.

Overall, students state that these apps are appealing because they are fun, easy to use, cost-effective, and learning through these electronic apps has become a popular choice across all age groups, offering flexibility in terms of location and time. The findings of this study support Tsinakos (2023), which states that the development of mobile educational technology has become a global phenomenon, as mobile subscriptions have shown rapid growth. Similarly, Crompton (2023) states that mobile educational technology can provide educational opportunities anytime and anywhere through various functions. However, only some students are interested in using these mobile educational apps in their learning, as they believe that anatomy and physiology are better learned face-to-face with instructors.

Thus, students' attitudes play an important role in self-directed learning. This is because of their reliance on instructors and their lack of effort to study on their own, even without using technology. They do not review lessons at home except with exercises provided by instructors. Similarly, two respondents' attitudes towards problems in understanding anatomy concepts were to simply leave them unresolved. An individual's actions are influenced by their own attitude towards the matter because self-directed learning requires positive self-initiative. Therefore, we need to train students to use educational technology in an era without boundaries so that both teachers and students do not fall behind.

This study has similarities with the research by Mohd Najib, Noor Raudhiah Abu Bakar, and Norziah (2022) regarding the idea that a positive attitude always leads to positive behavior, while a negative attitude leads to negative behavior. The individual's attitude is what makes the use of the app either important or not. Learning through educational mobile apps requires self-motivation, dedication, and discipline because the use of mobile apps is self-guided (Shiun, 2007; Najib et al., 2022).

However, all female students interviewed responded positively about the use of mobile learning apps. They had previously used other learning apps to assist them in learning anatomy and physiology without the help of instructors or peers, and they had prior knowledge. This finding is based on their statements regarding the use of the Quzzie app as an exercise given by the instructor. However, according to them, after completing the questions, they could not check if their answers were correct or wrong and only saw their score, while in the Quzzie app, students can check their answers and access other functions.

Considering that the respondents were teenagers aged 13 to 15 years, it can be observed that many of them have a good level of knowledge, but it is not perfect. On the other hand, many others lack knowledge in information literacy (Kosta Dolenc & Andrej Šorgo, 2020). This finding is also in line with the OECD (2019) study, which states that only one in ten 15-year-old students can distinguish between facts and opinions, even though they spend a significant amount of time online.

The findings also reveal a difference between male and female students regarding the use of educational mobile apps in learning. Female students are more open-minded about using mobile apps and are able to learn independently without assistance, whereas male students still rely on their instructors. However, they need to be trained in information literacy skills to help them use these apps more effectively in the future.

In summary, the use of educational mobile apps in anatomy and physiology can help students train themselves in self-directed learning, requiring self-motivation, dedication, and discipline. There is also a need to develop more educational mobile apps for the nursing field, as these apps can make the teaching and learning process more engaging and flexible. Norlaila, Rosseni, and Mohammed (2020) also suggest providing opportunities for educators in nursing faculties to create mobile apps by developing supplementary learning modules to complement existing reference materials, such as textbooks.

Summary

According to the research discussed, the researchers found that educational mobile apps for Anatomy and Physiology are tools that help make the teaching and learning process more flexible and effective. Therefore, nursing students still need to be provided with information literacy knowledge and motivation regarding self-directed learning. The use of technology, such as mobile apps in teaching and learning, is one of the teaching strategies for the development of metacognitive skills in solving problems and understanding anatomy concepts. However, these apps need to be improved in the future to keep up with current trends and needs.

References

Ainley, J., Kos, J., & Nicholas, M. (2021). Participation in science, mathematics and technology in Australian education. *ACER Research Monographs, 4*.

Ainley, J. (2021). Monitoring and assessing the use of ICT in education. *Educational Research and Innovation*, 67–88.

Bradley, C. and Holley, D. (2021). Empirical research into students' mobile phones and their use for learning. *International Journal of Mobile and Blended Learning (IJMBL), 3*(4), 38–53.

Cahyono, A. N., & Ludwig, M. (2018). Exploring mathematics outside the classroom with the help of GPS- enabled mobile phone application. *Journal of Physics: Conference Series, 983*, 1–7.

Camilleri, M.A. and Camilleri, A.C. (2022). Digital learning resources and ubiquitous technologies in education. *Tech..Knowl. and Learning, 22*(1), 65-82.

Ciampa, K. 2014. Learning in a mobile age: an investigation of student motivation. *J. of Comp. Assisted Learning, 30*(1), 82-96.

C. N, Din, R. & Alias, M. H. (2020). Kesediaan pelajar tingkatan 6 menggunakan aplikasi mudah alih pendidikan. *Journal of Personalized Learning, 3*(1): 79-86.

Crompton, H. (2023). A historical overview of mobile learning: Toward learner-centered education. Handbook of Mobile Learning.

Crompton, H., & Burke, D. (2024). Research trends in the use of mobile learning in mathematics. *International Journal of Mobile and Blended Learning (IJMBL), 7*(4),1–15.

Cahyono, Adi Nur. (2018). Learning Mathematics in a Mobile App-Supported Math Trail Environment. In SpringerBriefs in Education.

Frohberg, D., Göth, C., & Schwabe, G. (2021). Mobile learning projects–a critical analysis of the state of the art. *Journal of Computer Assisted Learning, 25*(4), 307–331.

Gharini, I. & Khabibah, S. (2021). Pengembangan Aplikasi Mobile Learning sebagai Media Pembelajaran Matematika untuk Materi Peluang. Jurnal Pendidikan Matematika FPMIPA UNNES.

Hwang, G.J. & Wu, P.H. (2022). Advancements and trends in digital game-based learning research: a review of publications in selected journals from 2001 to 2010. *Brit. J. of Educ. Tech. 43*(1), E6-E10.

Iji, C. O., Abah, J. A. & Uka, N. K. (2023). Attaining the Millenium Development Goals (MDGs) through Effective Mathematics Education. Proceedings of the 54th Annual Conference of Science Teachers Association of Nigeria, 99-107.

Iji, C.O., Abah, J.A. & Anyor, J.W. (2022). Impact of cloud services on students' attitude towards mathematics education in public universities in Benue State, Nigeria. *International Journal of Research in Education and Science (IJRES), 3*(1), 228-244.

Kosta Dolenc & Andrej Šorgo (2020): Information literacy capabilities of lower secondary school students in Slovenia. *The Journal of Educational Research*,

Kearney, M., Burden, K., & Rai, T. (2021). Investigating teachers' adoption of signature mobile pedagogies. *Computers & Education, 80*, 48–57.

Krull, G., & Duart, J. M. (2017). Research trends in mobile learning in higher education: A systematic review of articles (2011 – 2015). *International Review of Research in Open and Distributed Learning, 18*(7).

Lai, C-L. and Hwang, G-J. (2014) 'Effects of mobile learning time on students' conception of collaboration, communication, complex problem-solving, meta-cognitive awareness and creativity', *International Journal of Mobile Learning and Organisation*, *8*(3–4), 276–291.

Laurillard, D. (2022) 'Pedagogical forms of mobile learning: Framing research questions.' In Pachler, N. (ed.) Mobile learning: Towards a research agenda. London, WLE Centre, Institute of Education, pp. 153-176.

Li, Y. (2023). Cultivating student global competence: A pilot experimental study. *Decision Sciences Journal of Innovative Education, 11*(1).

Mike Sharples, Josie Taylor, Giasemi Vavoula. A Theory of Learning for the Mobile Age. The Sage Handbook of Elearning Research, Sage publications, pp.221- 247, 2006.

Nasution, M. I, P. (2021). Strategi Pembelajaran Efektif Berbasis Mobile Learning Pada Sekolah Dasar. *Jurnal Iqra', 1*(1), 1-14.

Najib, H. M., Bakar, N. R. A., & Othman, N. (2021). E-Pembelajaran Dalam Kalangan Pelajar di Sebuah Institusi Pengajian Tinggi Selangor. *Attarbawiy: Malaysian Online Journal of Education, 1*(1), 74-82.

Nie, M., Bird, T., & Edirisingha, P. (2023). E-book readers and PDAs for work-based learners. In Z. L. Berge & L. Y. Muilenburg (Eds.), The handbook of mobile learning (pp. 209–223). New York: Routledge.

Oranç, C., & Küntay, A. C. (2019). Learning from the real and the virtual worlds: Educational use of augmented reality in early childhood. *International Journal of Child-Computer Interaction*, 21, 104-111.

OECD. (2019). PISA 2018 results (volume I): What students know and can do. PISA, OECD Publishing.

Palmer, T.-A., Burke, P. F., & Aubusson, P. (2021). Why school students choose and reject science: A study of the factors that students consider when selecting subjects. *International Journal of Science Education, 39*(6), 645–662.

Praherdiono, H & Adi, Pramono Eka. 2008. Panduan Praktikum Multimedia. Malang: Fakultas Ilmu Pendidikan Universitas Negeri Malang

Poushter, J. (2021) Smartphone ownership and internet usage continues to climb in emerging economies. The Pew Research Center. Retrieved from

Papadakis, S., Kalogiannakis, M. and Zaranis, N. (2016c). Developing fundamental programming concepts and computational thinking with ScratchJr in preschool education: a case study. *International Journal of Mobile Learning and Organisation, 10*(3), 187–202.

Su, C. (2022). A Mobile Gamification Learning System For Improving The Learning MotivationAnd Achievements. *Journal of Computer Assisted Learning 31*(2).

Siraj, S. (2004). Pembelajaran Mobile dalam Kurikulum Masa Depan [Mobile learning in future curriculum]. *Masalah pendidikan, 27*, 128-142.

Shiun, T. K. (2022). Kajian Mengenai Penggunaan E-Pembelajaran (E-Learning).

Tsinakos, A. (2013). State of mobile learning around the world. *Global Mobile Learning Implementations and Trends*, 4–44.

Vidermanova, K., & Vallo, D. (2020). Practical Geometry Tasks as a Method for Teaching Active Learning in Geometry. *Procedia - Social and Behavioral Sciences, 191*, 1796–1800.

Wingkvist, A., & Ericsson, M. (2021). A survey of research methods and purposes in mobile learning. *International Journal of Mobile and Blended Learning, 3*(1), 1–17.

Wu, W. H., Jim Wu, Y. C., Chen, C. Y., Kao, H. Y., Lin, C. H., & Huang, S. H. (2022). Review of trends from mobile learning studies: A meta-analysis. *Computers and Education, 59*(2), 817–827.