



(REVIEW ARTICLE)



The impact of using health apps as a source of information and health education in the medical field

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International Journal of Science and Research Archive, 2024, 13(02), 3499-3509

Publication history: Received on 12 November 2024; revised on 21 December 2024; accepted on 23 December 2024

Article DOI: <https://doi.org/10.30574/ijrsra.2024.13.2.2555>

Abstract

Introduction: Medical training transcends the formal curriculum, involving the construction of a professional identity shaped by interaction with professors and professionals in the field. In response to contemporary demands, medical education has undergone adaptations, driven by the advancement of digital technologies, which offer greater flexibility and accessibility to learning. Mobile applications have gained prominence for facilitating access to medical knowledge, although they raise concerns about the quality of teaching and the technological literacy of students.

Objective: This study aims to review the literature on the impact of health applications on medical education, by evaluating their contributions to the learning of students and health professionals, as well as the advantages and disadvantages associated with their use.

Methods: This is an integrative literature review, carried out using the PubMed, LILACS and SciELO databases, with articles published from 2019 to July 2024, which addressed the impact of health applications in the medical field. The initial search resulted in 75 articles, of which 20 were selected according to the established criteria.

Conclusion: Health applications offer flexibility, dynamism and convenient access to information, complementing medical training with a diversity of resources, especially in contexts restricted to the clinical environment. However, issues such as language interpretation and possible barriers to accessing technology can affect its effectiveness and the quality of learning. Therefore, the integration of these applications must be done critically to ensure that they do not compromise medical training and practice.

Keywords: Mobile applications; Medical education; Medical Informatics; Health Technology Assessment

1. Introduction

The teaching process is the set of successive steps through which the student becomes a doctor (García, 2022). This set of steps transcends the formal curricula of medical schools, encompassing a process that not only adds the technical element of medical knowledge to aspirants, but also constitutes a unique identity, that of the medical professional. This identity is constructed from the sharing of diverse ideas and ideals within a specific group, composed of medical professionals and teachers (Sassi *et al.*, 2020).

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In this sense, the training of medical professionals is considered a determining factor for the quality of health, being a significant concern for institutions such as the World Health Organization (WHO) and the Pan American Health Organization (PAHO) (Meireles; Fernandes; Silva, 2019). Thus, since the mid-20th century, there has been a growing need to restructure the methodological approaches used by medical professionals globally. This effort aims to provide students with training that is generalist, humanistic, critical, and problem-solving (Paiva *et al.*, 2019). In a historical paradigm, transformations in medical education are often guided by a logic of adaptation to contemporary social demands, reflecting the characteristics of a specific context (Rocha, 2018). In recent years, the advent of digital technology has caused drastic changes in various sectors of society, consolidating itself as a potentializing tool in medical education and in the health area (Silva *et al.*, 2022). Digital resources offer significant flexibility and convenience for accessing educational content, enabling learning anywhere and at any time. The use of mobile devices, which easily adapt to students' busy routines, maximizes the efficiency of study time. In this way, even brief breaks throughout the day can be used to review important concepts (Navarro, 2024). Currently, there are dozens of educational applications aimed at the medical field, available both free and paid. These applications cover a wide spectrum of categories and are adapted to specific medical disciplines, such as Medscape, Whitebook, Gray's Virtual Atlas of Anatomy, MediApp, iGyno, and Harrison's Manual of Medicine, among others. These resources represent a combination of information and technology, facilitating the integration of knowledge with practicality in the routine of medical students (Morgado; Ames; Silvestre, 2019).

However, the main concerns related to the adoption of technology in medical education include the possibility of reducing the quality of teaching, the possible disadvantage of students with low technological literacy, and the possible compromise of relationships between students and specialists, as well as between students and patients (Teixeira, 2020). Thus, when critically approaching technological innovation, it is essential to understand the contexts that allow educational institutions to develop innovative practices with social, cultural, and ethical responsibilities, aiming at excellence in the quality of teaching (Wiebusch; Lima, 2019).

Therefore, this study aims to conduct a literature review on how health applications contribute to the learning of medical students and health professionals. In addition, it aims to investigate the advantages and disadvantages of using these applications, and examine whether the way of learning through these technologies complements or compromises medical training.

In a critical and comprehensive manner, it also seeks to understand the impact of the use of health applications as a source of information in medical education.

2. Methodology

In view of the study proposal and in order to achieve the objective of investigating the impact of the use of health applications as a source of information and health education in the medical field, an integrative literature review was used as the method for this investigation.

Regarding this methodological procedure, it is observed that it is a broad methodological approach that allows the inclusion of various types of studies, such as the analysis of experimental and non-experimental studies to have a greater understanding of the topic addressed (Souza; Silva; Carvalho, 2010).

The articles included in this work were identified through searches in the following electronic databases: PubMed, LILACS and SciELO. The research was conducted to identify articles relevant to the topic, using the following descriptors: "Mobile Applications", "Medical Education" and "Telemedicine", joined by the Boolean operators "AND" and "NOT". The inclusion criteria used to select the articles were articles written in Portuguese and English, with full text available free of charge, that addressed the study question "what is the impact of the use of health applications as a source of information in the medical field?", in addition to articles published between 2019 and July 2024. Incomplete, duplicate articles and those that did not fit the scope of the study were excluded, as well as those related to Telemedicine, to ensure that the focus remained on mobile applications and their application in medical education. The search resulted in 75 articles, of which 20 were selected to compose this review, meeting the established criteria and selecting the most relevant ones.

Table 1 Search strategy in the PubMed, Scielo and LILACS databases, published between 2019 and July 2024

Database	Search strategy	Article Found	Selected article
PubMed	"Mobile Applications" AND "Medical Education" NOT "Telemedicine"	75	20
LILACS	"Mobile Applications" AND "Medical Education" NOT "Telemedicine"	0	0
SciELO	"Mobile Applications" AND "Medical Education" NOT "Telemedicine"	0	0
total		75	20

Source: Author's own (2024)

3. Results

Table 2 Summary of information obtained from eligible articles in the investigation regarding the impact of the use of health applications as a source of information and health education in the medical field

Title	Author/ Year	Objective/Method	Results/Conclusion
"Mobile applications in medical education: A systematic review and meta-analysis"	Chandran <i>et al.</i> (2022)	To evaluate the effectiveness of smartphone applications in improving academic performance and clinical practice among health professionals and students. Systematic review and meta-analysis.	The study suggests that learning through mobile applications is important in improving knowledge and skills, promoting conversation, communication and cooperation, in participant-centered learning.
"Smartphone Apps in Graduate Medical Education Virtual Recruitment During the COVID-19 Pandemic"	Xá <i>et al.</i> (2021)	To evaluate the incorporation of a smartphone application into the virtual interview season for gastroenterology fellowships, aiming to provide detailed information to candidates and improve the recruitment experience. Descriptive and analytical study.	The study suggests that the use of smartphone apps can improve the recruitment experience and that a combination of virtual and face-to-face interviews is likely to be the future of recruitment in postgraduate medical education.
"How can WhatsApp facilitate the future of medical education and clinical practice"	Salam <i>et al.</i> (2021)	To investigate how WhatsApp can be effectively integrated into medical education and clinical care delivery. Literature review.	The study shows that WhatsApp facilitates communication between students and tutors, promotes collaborative learning, improves flexibility in clinical teaching, and enables rapid implementation of health measures, such as during the COVID-19 pandemic.
"Integrating Bayesian reasoning using smartphone apps"	Kinnear <i>et al.</i> (2019)	Equip clinical educators with effective tools to teach and utilize Bayesian reasoning in clinical settings. Interactive workshop to teach Bayesian concepts to participants.	The workshop utilizing visual models, clinical cases, and smartphone apps was well received by residency leaders as an effective way to learn and teach Bayesian reasoning. Continued integration of Bayesian reasoning into medical and residency curricula is recommended, with future outcome measures focused on improving diagnostic accuracy and clinical behavior of clinicians.
"Usage and attitude of medical students towards mobile medical applications during and after COVID-19 lockdown: repeated cross-sectional study"	Alsharif <i>et al.</i> (2024)	To assess the percentage of use of medical applications by medical students during and after the COVID-19 pandemic, as well as students' attitudes and perceptions towards these applications. Cross-sectional study.	There has been a significant increase in the use of medical apps following the COVID-19 pandemic, with overall positive attitudes and perceptions towards the use of these apps in medical education.

<p>“A Pilot Study on the Feasibility of Developing and Implementing a Mobile App for the Acquisition of Clinical Knowledge and Competencies by Medical Students Transitioning from Preclinical to Clinical Years”</p>	<p>Prados- Carmona <i>et al.</i> (2022)</p>	<p>To offer students a new tool to complement remote learning, ideally improving skills and knowledge acquisition outside the clinical setting, and to assess whether student satisfaction would increase in the future if the application were maintained as a complement to traditional teaching following a blended learning scheme. Cohort study.</p>	<p>The study concludes that the mobile application is an effective tool to complement remote learning for medical students, especially in times of limited access to the clinical environment.</p>
<p>“Mobile application as a complementary tool for differential diagnosis in Neuro- ophthalmology: A multicenter cross- sectional study”</p>	<p>Vinny <i>et al.</i> (2021)</p>	<p>To evaluate the effectiveness and applicability of the application in aiding diagnosis in complex neuro-ophthalmological cases. This is a qualitative study that uses interviews and thematic analysis to collect and interpret data.</p>	<p>The study concluded that the mobile application can be a useful and effective tool as a complement to differential diagnosis in Neuro-ophthalmology, especially in environments with limited access to specialists. However, the importance of the interpretation of the results by the physician is emphasized, since the application does not replace clinical judgment. The integration of digital technology into clinical practice can improve diagnostic accuracy, as long as it is used with discretion and adequate professional monitoring.</p>
<p>“Students' perceptions on how e-learning platform in universities should be improved to increase the Quality of educational services”</p>	<p>Petrescu <i>et al.</i> (2022)</p>	<p>To identify students' perceptions on how e-learning platforms should be refined to increase the quality of online educational services. Cross-sectional study.</p>	<p>The study concludes that e-learning platforms play a crucial role in the educational environment, especially during the COVID-19 pandemic. Students' suggestions for improvements include adding blogs, forums, animations, and access to a digital library, which can significantly enhance the quality of online learning.</p>
<p>“Effect of Smartphone App-Based Education on Clinician Prescribing Habits in a Learning Health Care System: A Randomized Cluster Crossover Trial”</p>	<p>McEvoy <i>et al.</i> (2022)</p>	<p>To determine whether a smartphone-based application that uses spaced instruction with retrieval practice is an effective method for increasing evidence-based practice. Randomized controlled trial.</p>	<p>Smartphone app-based education is a feasible and effective approach to improving clinicians' prescribing practices in a learning health system. This study highlights the importance of ongoing interventions and periodic reinforcement to sustain positive changes in clinical practices.</p>
<p>“Use of smartphones and mobile applications among physicians in clinical practice: a scoping review”</p>	<p>Lee <i>et al.</i> (2023)</p>	<p>Describe how physicians use these technologies in their clinical practices. Scoping review.</p>	<p>Although no statistically significant differences were observed in knowledge retention, knowledge acquisition, or self-efficacy between the groups that used the app and those that did not, the study</p>

			identified several barriers that limit the effectiveness of the app. Issues such as accessibility (such as lack of smartphones), technical problems (such as outdated operating systems), and language barriers were highlighted as significant obstacles. In addition, the lack of guidance for definitive management in referral hospitals was highlighted as a limitation of the app.
"Mobile learning in clinical settings: unraveling the paradox"	Lee <i>et al.</i> (2021)	To investigate the perception and use of mobile devices for learning in clinical settings. Exploratory research design, using a combination of questionnaire survey and semi-structured interviews.	Most medical students used mobile devices to find information about medications and practice guidelines. Students primarily accessed UpToDate and Google for medical resources. The main barriers students encountered were internet connectivity, reliability of information, and technical issues.
"Mobile application to complement the WHO basic emergency care course: a mixed methods study"	Tenner <i>et al.</i> (2022)	To investigate whether the use of the app could influence knowledge acquisition and retention, work experience and user perceptions compared to the traditional course alone. The study is classified as a mixed methods study	The study's conclusion highlights the importance of a careful approach when exploring mHealth interventions, considering specific contexts and user needs. The research highlights the need to overcome practical and operational challenges to maximize the potential of mobile apps as health coaching tools.
"WeChat application combined CBL in oral medicine clinical training: a review"	He <i>et al.</i> (2023)	To evaluate the impact of using WeChat CBL on participants' performance in discussions, daily assessments and final exams, compared to traditional teaching methods. Randomized clinical trial.	Combining WeChat CBL with oral medicine clinical training resulted in increased student participation in discussions, improving their enthusiasm, knowledge and clinical skills. The study concludes that WeChat CBL not only facilitated access to multidisciplinary materials, but also fostered positive relationships between students, teachers, physicians and patients, and emphasized the development of emotional intelligence and humanity in medical practice.
"Usefulness of Mobile Devices in Learning Process for Residents of Pediatric Surgical Specialties"	Bracho <i>et al.</i> (2023)	To investigate the use of mobile devices among pediatric surgery residents to better understand their advantages/disadvantages. Quantitative and qualitative study.	The present study showed that mobile devices are a necessary learning tool used daily by pediatric surgery residents to facilitate learning, help communicate in the context of clinical care, and ensure teamwork and speed in the provision of medical care.
"Augmented reality and mixed reality for healthcare"	Gerup; Soerensen; Dieckmann (2020)	To investigate the current research and state of augmented reality (AR) and mixed reality (MR)-	All included studies suggested several health education benefits of display technologies that

education beyond surgery: an integrative review”		based applications for health education beyond surgery, providing an overview of the findings, strengths, and weaknesses of the reported studies. Integrative review.	significantly outperformed traditional learning approaches in 11 studies, specifically with regard to the acquisition of anatomy knowledge and needling skills. However, there are few studies reporting the influence of AR and MRI on medical practice, and this knowledge needs to be improved over the years.
“Design, Dissemination, and Assessment of NephSIM: A Mobile-Optimized Nephrology Teaching Tool”	Farouk; Hilburg; Sparks (2019)	To promote learning for students in the field of nephrology through NephSIM, also perceiving feedback on the use of this digital resource. Longitudinal study, based on an online questionnaire.	NephSIM offers content that caters to different learning styles. The Learning Styles Index describes 4 domains: active versus reflective, sensing versus intuitive, visual versus verbal, and sequential versus global. Users were presented with infographics and illustrations, actively participated as the case unfolded sequentially, completed differential diagnoses, and received positive and negative iterative feedback.
“Digital Health Professions Education in the Field of Pediatrics: Systematic Review and Meta-Analysis by the Digital Health Education Collaboration”	Brusamento <i>et al.</i> (2019)	To evaluate the effectiveness of different modalities of digital education for post-registration pediatric healthcare professionals compared to traditional learning or other forms of digital education. To also evaluate the impact of digital education on knowledge, skills, attitudes, clinical practice and satisfaction of participants compared to other forms of learning.	Digital education for post-registration healthcare professionals in paediatrics is at least as effective as traditional learning and more effective than no learning. Computer-based offline/online digital education was better than no intervention for knowledge and skills outcomes and as good as traditional face-to-face learning.
“Exploring the features of mobile phone application of anatomy in basic medical sciences: a qualitative study”	Mansouri <i>et al.</i> (2020)	The main objective is to explore what features an anatomy app should have to meet the educational needs of medical students. This is a qualitative study, which uses focus groups (FG) and an expert panel (EP) to collect and analyze data.	The research concludes that an effective anatomy app should combine rich visuals, comprehensive and reliable scientific content, ease of use and interactivity, and should be affordable. These features are essential to meet the educational needs of medical students and improve their learning in anatomy.
“The Use of Mobile Devices to Enhance Engagement and Integration with Curricular Content”	Leydona; Schwartzb (2020)	The aim of the study was to investigate the effectiveness of these devices in improving students' learning and interaction with teaching materials. This was a multicenter, cross-sectional study that included multiple educational institutions.	Mobile anatomy apps have a positive impact on teaching basic medical sciences by improving accessibility and understanding of anatomical concepts. However, continued development and integration with traditional teaching methods are needed to maximize their benefits.
“Introduction of case-based learning aided by	Grover; Sood (2020)	The main objective of the study was to compare the effectiveness of WhatsApp-assisted CBL with	The study concluded that WhatsApp-assisted CBL helped students acquire knowledge, discuss and

WhatsApp messenger in pathology teaching for medical students”		traditional DL in pathology education and to assess students’ perception of the use of WhatsApp as an educational tool. The study is a comparative experimental research involving the analysis of learning outcomes and students’ perception.	learn actively, achieve better scores, and retain knowledge more effectively than traditional DL. The use of WhatsApp as a platform facilitated student interaction, enabling them to seek guidance from their mentors without resistance and hesitation.
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4. Discussion

The results presented by this study brought different points of view on the use of health applications as a source of information and health education in the medical field. In this sense, as discussed in the study by Farouk, Hilburg and Sparks (2019), these digital resources presented advantages and disadvantages when applied in real medical experience.

In general, the applications were analyzed mostly in the routine of students in the health field, thus, this resource presented an interaction that brought teachers closer to their students, as discussed in the research by He *et al.* (2023) and Grover and Sood (2020).

In addition, as discussed by Kinnear *et al.* (2019), digital platforms proved to be excellent learning resources using the Bayesian method, according to teachers' reports, in addition to presenting a teaching performance equivalent to the face-to-face method, as observed in the research by Brusamento *et al.* (2019). In the approach of Gerup, Soerensen and Dieckmann (2020), there was also evidence of virtual applications (such as augmented realities and mixed realities) surpassing the teaching experience of traditional methods, due to the diversity of information present.

As studied by Chandran *et al.* (2022), Bracho *et al.* (2023) and Prados-Carmona *et al.* (2022), the introduction of these instruments in the healthcare environment promoted more dynamism in the information worked on in this environment, adding more case discussions among colleagues and speeding up consultations due to this optimization of dialogues and flexibility of performance. The idea also became quite convenient, as presented in the study by Salam *et al.* (2021), in the scenario of the COVID-19 pandemic, since it required more social distancing from the subjects and more contact with the digital world.

However, several challenges were still observed in the studies by Lee *et al.* (2021) and Lee *et al.* (2023) on the limitations of using digital platforms, since they require personal smartphones (accessibility), interpretation of the language used, reliability of information, and internet connectivity in the practical environment (hospitals and outpatient clinics). In addition, the article by Vinny *et al.* (2021) showed that, even though they present reliable data, these applications still require medical interpretation.

As studied by Alsharif *et al.* (2024), health professionals and students increased their use of health applications even more after the pandemic, given the need and optimization that this resource provides. In this vein, the article by Xá *et al.* (2021) demonstrated interest in the job market in using applications to conduct job interviews, which reached a larger audience with this strategy.

According to the work of Petrescu *et al.* (2022) and Massouri *et al.* (2020), students not only use digital platforms, but also claim that many of them could further optimize learning if they changed some aspects. These changes could include: improving audiovisual resources, providing quick access to the library, offering a discussion forum, offering blogs, and several other resources.

In this sense, the article by McEvoy *et al.* (2022) and Leydona and Schwartzb (2020) states that, for the impact of health applications to be well observed, users must maintain constant use of these tools in order to improve them even further. Furthermore, as analyzed in the studies by Tenner *et al.* (2022), virtual resources will progress in medical practice, as was studied in pediatric emergency settings, maximizing users' learning potential.

5. Conclusion

Based on the literature review, it can be seen that the use of health applications in medical education provides significant benefits to learning, such as flexibility and convenience in accessing information. These applications have shown potential to complement medical training, especially in times of restricted access to the clinical environment, offering support for remote learning and clinical practice. However, concerns also arise regarding inequality of access and potential technological barriers, which may affect the effectiveness of these tools. In addition, the quality of human interactions and the depth of learning may be compromised if the use of these technologies is not adequately mediated. Therefore, while mobile applications offer new possibilities for medical education, it is essential that they are integrated critically and responsibly into the curriculum, to ensure that they fulfill their role without compromising the comprehensive training of the medical professional.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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