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Innovative Mobile Application for Self-Directed Learning in Massage Therapy: Development and Usability Study

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ABSTRACT

Mobile health education applications for parents are emerging as powerful tools to support self-directed learning and improve skills such as infant massage for better child health outcomes. The usability and availability of a smartphone app in Indonesia for improving body weight among children with low birth weights are being under-investigated due to the growing interest in self-directed learning of mobile application tools. This research aimed to document a mobile application's development and usability testing stages on self-directed learning of massage therapy. The methodology, developed using a server–client architecture with the HyperText Transfer Protocol and Web API, was evaluated during the prototype phase using the Think-Aloud method and the Smartphone Usability Questionnaire. The result showed that the agreement of the content reported 95%, indicating good validity. Thirteen out of the fifteen participants used the notification page to limit their time on social media. The mean IMI score was 4.34 (SD=0.45) out of 7. The App had a SUS score of 68.16 (SD = 9.34). The participants gave the app an average of 18.45 (SD = 1.76). The test revealed that the app prototype was designed with the end user in mind, ensuring high usability. The app provides health education and serves as a foundation for future mobile applications for parents to prevent low-birth weight.

Keywords: Development, Usability, Mobile Application, Self-Directed Learning, Baby Massage

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1. INTRODUCTION

Mobile applications have revolutionized education by transforming how individuals acquire knowledge and skills, offering flexible and adaptive self-learning opportunities. The boundless digital access to information has fostered inclusive learning environments for the general public (Buyannemekh et al., 2024), enabling individuals to independently enhance their educational competencies anytime and anywhere (Haleem et al., 2022). In the context of health education, mobile-based educational applications have been shown to empower parents by equipping them with the necessary knowledge to optimally care for their children (Virani et al., 2021). A significant example is the use of mobile applications for infant massage education. This form of education provides parents with evidence-based knowledge and practical skills to support infant health and development (Andria et al., 2021), particularly for vulnerable populations such as low birth weight (LBW) infants. Through application-based education, parents can independently learn and apply appropriate massage techniques to promote their child's growth and development without constant reliance on healthcare professionals.

Learning through mobile applications offers interactive modules, tutorial videos, and evidence-based guidance that support users in acquiring knowledge and skills (Errabo & Ongoco, 2024; Johnson et al., 2021; Verville et al., 2021). In the context of community health education, particularly in infant care,

educational applications have significant implications for improving parents' ability to implement optimal caregiving practices, enhance infant health, and reduce the risk of potential health complications. Educating parents about infant massage therapy via mobile applications may serve as an effective solution to promote infant well-being, particularly among LBW infants. According to Singh et al. (2021), LBW infants require specialized care to support immune system development and motor growth.

Application-based self-learning constitutes an integral component of the self-directed learning concept, which has become increasingly relevant in the digital era (Jeong, 2022; Lee & Chang, 2025). According to Criollo-C et al. (2021) and Hattie (2023), in contrast to traditional methods that often rely heavily on direct instruction, mobile educational applications enable users to learn rapidly and adaptively in accordance with their individual needs. Bdair (2021) and Hinze et al. (2023) further emphasize that the flexibility of mobile applications affords individuals the freedom to independently access the educational materials they require. Mobile applications thus function not only as learning platforms but also as empowering tools that encourage individuals to take initiative in developing their skills and knowledge.

Previous studies have demonstrated that the use of mobile applications as learning media can enhance effectiveness compared to conventional methods. Research conducted by Yu et al. (2022) involving 101 participants revealed that mobile applications can improve both the emotional and cognitive aspects of learners. Similarly, Al-Said et al. (2023) examined 662 students and found that mobile applications positively influence motivation and knowledge sharing. In addition, the study by B. Chen et al. (2021) indicated that mobile applications can enhance skills in the context of health education. These findings suggest that mobile applications not only improve learners' comprehension of the subject matter but also motivate them to engage more actively in the learning process.

Interactive features in technology-based learning applications play a pivotal role in enhancing a more personalized and responsive learning experience (Balalle, 2024; Zhang, 2022). In the context of learning infant massage therapy, features such as reminders can assist users in consistently applying infant massage techniques according to the recommended schedule, while diary functions enable parents to record their baby's developmental progress and independently evaluate the effectiveness of the therapy. Furthermore, according to Dai et al. (2024), consultation services with midwives or other healthcare professionals embedded within the application provide direct access to essential guidance, allowing parents to obtain more accurate and context-specific information for their baby's condition. With these features, the application serves not merely as an educational tool but as an interactive companion capable of adapting to the unique needs of its users.

Beyond enhancing individual experiences, mobile applications can also strengthen family engagement (Booton et al., 2023; Shin et al., 2023), particularly that of parents, in supporting infant growth and development. Through information-sharing and notification features, both parents can collaborate in implementing infant massage therapy, ensuring that the practice is carried out consistently and optimally. Community-based features further connect parents with other users, fostering an environment of shared experiences and social support. Consequently, mobile applications not only improve individual understanding of infant massage therapy but also help build a broader learning ecosystem in which families and communities actively contribute to providing the best possible care for infants, particularly those with LBW. In the context of infant massage therapy education, mobile digital applications not only facilitate the learning process but also enhance its practical application in daily life. Both parents and healthcare professionals can consistently improve their skills in caring for infants, especially those with LBW.

LBW is a major health concern in Indonesia, since it is the leading cause of newborn death (Sampurna et al., 2023). The prevalence of LBW in Indonesia was 12% (Oktriyanto et al., 2022). LBW is characterized by a birth weight that falls below 2500 grams, as defined by Lewandowska (2021). The main factors contributing to LBW include intrauterine growth retardation (IUGR), being small for gestational age (SGA), or a combination of both (Liu et al., 2022; Martín-Calvo et al., 2022). LBW increases the vulnerability to long-term chronic conditions like cardiovascular disease and diabetes later in life (Grillo et al., 2022; Jańczewska et al., 2023). Additionally, LBW is recognized as a multifaceted health problem in infants, associated with hindered physical growth and impaired cognitive development (Jana et al., 2023; Sangwan et al., 2025).

Baby massage enhances body weight, growth, endurance, concentration, sleep, fosters affection, and boosts milk production, promoting sound sleep and healthy bonding between parents and children (Lestari et al., 2021). Infant massage has been shown to have numerous benefits, including weight gain promotion (Lu et al., 2020; Mrljak et al., 2022), reduced jaundice (Jazayeri et al., 2021), pain alleviation (Gholami et al., 2021), enhanced alertness, and prevention of post-partum depression in mothers (Hendy et al., 2022). Quantitative studies worldwide have found that these effects are primarily beneficial (Mrljak et al., 2022). Infant massage also increases the mental well-being of mothers and reduces feelings of worry, despair, and stress (Garmy, 2012). Research has shown that mothers who continue to massage their children after discharge from the hospital show consistent reductions in worry and stress (Hwu et al., 2023). Parents report reduced stress with their children after attending infant massage classes (Ruan et al., 2023). The hormone oxytocin, secreted through physical touch, may be responsible for these effects (Y. Chen et al., 2020). Baby massage is a form of affectionate touch between parents and their children, involving the use of their skin

(Field, 2019). These findings highlight the potential benefits of infant massage and its potential to improve maternal and child health.

To enhance parents' baby massage skills, appropriate learning media such as baby doll media, leaflets, modules, and videos can be provided (Harun et al., 2023). However, the current videos are based on compact discs, making it difficult for parents to learn gradually. Medical personnel, including midwives and nurses, still use module media, dolls, and pamphlets in addition to videos (Harun et al., 2021). Video media has advantages as a learning medium, such as attention, affective function, and cognitive and compensatory functions (Lange & Costley, 2020) Attention is attracted by video media, which directs the audience's concentration on the material. Arousing emotions and attitudes are another effective function of video media. Cognitive function accelerates the achievement of learning objectives by understanding and remembering messages or information contained in images or symbols in the learning video (Noerr, 2021).

The previous study developed a baby massage training app for parents, collaborating with midwives. The app, accessible via smartphones, features six features: 1) a video tutorial on every step of baby massage, aiming to improve parents' skills. 2) Benefits of baby massage are provided to make it easier for parents to understand the benefits, motivating them to practice. 3) The massage instructions feature provides practical instructions for starting and preparing the baby for massage. 4) A reminder system is included to remind parents to practice twice a day, promoting obedience to the practice. 5) A diary feature allows parents to take notes after a massage, which can be monitored and evaluated by the midwife. 6) The midwife contact feature provides a parental consultation service with a competent midwife to address any obstacles experienced during the massage. Overall, the app aims to improve parents' understanding and practice of baby massage, ultimately promoting positive growth and development for their baby (Harun et al., 2023; Shorey et al., 2021). However, development and novelty are needed to make it easier and more efficient for parents to learn, as each media has varying effectiveness in increasing knowledge. This research aimed to document the development and usability testing stages of a mobile application on self-directed learning of massage therapy

2. METHOD

2.1. Apps development

The Web API and HTTP (Hypertext Transfer Protocol) were used to build the server/client design that the app's system is based on. MySQL was used to set up the site. The client setup was done by an Android app that used the Android SDK. Developers can quickly make changes to designs before trying them on a wide range of mobile devices with the Kodular companion platform, which lets them debug apps in web browsers. With "hot reloading," which changes the browser's document layout regardless of the state of the application, the app's code was changed right away. Object-oriented programming is used to make the apps that work with Kodular. Some browsers have tools that let you test at different screen sizes. This program tested the app on both low-resolution and high-resolution devices to make sure it looked good on most Android phones.Both the device and the server keep track of users' sessions, which are needed for the apps to work. The system stops a user's session after a certain amount of time, like ten minutes on a mobile app. The Keychain feature built into the Android programming platform can help you keep track of a user's passwords for a certain app. Smartphone operating systems today have very limited rights that make it hard for apps to access user data. This means that apps can't share local data. If hackers use a fake copy of the development software, they are more likely to add code that does harm to a program.

2.2. Study Design

A hybrid app called "a mobile application on self-directed learning of massage therapy" is described, along with its heuristics and usability, in this research. Users assessed the ease of use of the app's prototype. The effectiveness of this software was evaluated sequentially. Publication of the next phases of the research has coincided with the app's trademark and software registration processes. Ensuring app quality is our top priority. Two approaches include doing informal evaluations and usability tests with members of the user class (Lewis & Sauro, 2021). Errors, productivity, and safety are all improved by human-system interaction. In February of 2025, researchers in Cirebon, Indonesia, carried out the investigation.

2.3. Content

A Java-based Android application using an asynchronous interface was developed for the App. Prior to accessing the content of the application, users are required to establish an account. The application's homepage is tailored to the user's designated role (parent or children), enabling them to conveniently browse all the listed websites. The site displays often updated content for users. The content of the mobile application includes health education, newborn growth and development, stimulation practice, monitoring of child growth and development, infant massage, quizzes, case studies, and online consultations. The user interface of the application (Figure 1) presents a role-based homepage with intuitive navigation, offering users streamlined access to diverse, regularly updated health education resources and interactive features.

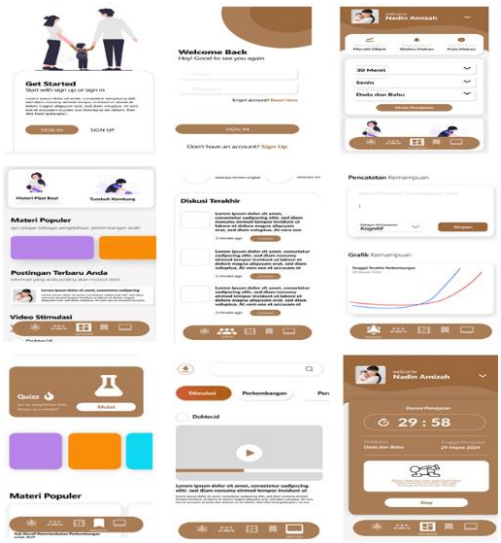

Figure 1. User interface

2.4. Sample

Participation is contingent upon the following: the participant's willingness to participate, the presence of a child between the ages of 0 and 12 months, legal custody of the child, the participant's weight at birth being less than 2500 grams, and the absence of the following medical conditions: cleft lip or cleft palate, neurocutaneous syndromes, trisomy, cerebral palsy, failed hearing tests, sensorineural hearing loss disorders, TORCH infection, head bleeds, intraventricular hemorrhage, or previous tracheal intubation. People who do not have access to a mobile phone are not included in the research. Researchers will arrange for eligible individuals to visit a baseline clinic. A small number of evaluators, ranging from three to five, is recommended for interface accuracy and assessment utilizing the given heuristics (Benaida, 2023). Preliminary plans called for comparing three groups' usefulness, but no statistical significance could be reached. They were 18 or older, they had an active health center account, they had their own mobile device, they knew their way around applications, and all the other requirements were satisfied. The outcomes of the test were dependent on how well the prototype performed in a maneuverability assessment. No one was taken into consideration if they had a significant mental or physical disability that would have made any kind of management effort impossible. The participants were chosen using a convenience sampling method.

2.5. Study protocol

Researcher contacted mothers when they were at the clinic. Interested parties were taken to a separate room where they reviewed the study's purpose, saw a PowerPoint presentation outlining the app's features made on a tablet, and finally got a sneak peek at the app itself. Everyone was informed about the research. After giving their permission to take part in the research, participants signed the Free and Informed Consent Term. They started by giving out think-aloud (TA) tasks that were meant to be useful. The research project was given the go-ahead by the Ethical and Research Committee (023/A.1/ETIK/2025). The permission form was signed by each participant once they had received information about the research. During the course of the inquiry, participants were only identified by their alphanumeric numbers in order to protect their anonymity.

2.6. Data Analysis

The TA sessions that were recorded on video were transcribed and examined. In the transcripts of TA sessions, not only should the actual words said by the participant be included, but also the amount of time that has passed and the amount of time that is required to complete each assignment. To investigate the broad concepts, we used the iterative three-cycle model (Babo et al., 2021). We began by doing a comprehensive analysis of two TA sessions and generating a report on the usability issues that were brought up by the participants. For the purpose of locating the underlying concepts, we arranged the codes into categories. Through the process of assigning codes to the verbalizations, the dependability of the assertions was evaluated. After a new issue has been identified, it is analyzed to see if it can be classified into any of the pre-existing categories or whether it is something completely novel. Displaying the data, which is subsequently compared and contrasted within the context of the relevant literature, is accomplished via the use of tables. For the purpose of analyzing the variables, descriptive statistics such as frequency, percentage, mean, standard deviation, and test mean were used. A comparison was made between the findings of the usability test and the adopted scores of the SURE instrument. The reliability of the data is assured by the fact that each rater's response to an item shows the likelihood as a function of the item's characteristics and ability (Avinç & Doğan, 2024). This is because the IRT serves as the basis for the dependability of the data.

3. RESULTS AND DISCUSSION

3.1. Results

The content of this application evaluated by five specialists from various fields. The expert examined the module's content, including its applicability, relevance, and depth of content. CVI scores for content suitability, content relevance, and content richness. The CVI range from 0.80 to 1.0 indicating the content of the module was applicable, relevance, and rich. The participants were given access to both the entirety of the Delphi procedure as well as the final statement produced by the consensus. The result of Table 1 showed that the agreement of the content reported 95%, indicating good validity.

Table 1. Kappa Agreement

	Value	Standardized error	Approximate	Approximate significant
Kappa agreement N valid case	0.95	0.111	5.543	0.001

The Think Aloud (TA) report identified 14 usability issues, eight of which were considered legitimate but minor issues, and four of which were classified as major issues. A total of approximately 9 specific bugs were discovered in this mobile application. The most serious usability issues are summarized in Table 2. The lengthy completion time to download the app appeared to be related to the numerous usability issues and limited internet access available in Indonesia. Approximately 8 participants experienced severe usability issues when attempting to interpret the terminology.

To evaluate the application's usability, participants were asked to complete a series of predefined tasks, with their completion rates and time recorded. These tasks were designed to represent key user interactions within the app, such as downloading and installing the application, navigating to different sections, and locating specific features. The results indicated a consistently high completion rate across most tasks, suggesting that the application's basic navigation and functionality were generally straightforward for users. However, minor variations in task completion time hint at certain features requiring more effort to locate, particularly pages that were less prominently displayed within the interface (Table 2).

Table 2. Completion Rates and Time Taken per Task (N=20) by Participants

Tasks	Completion rate	Times (Minutes/Seconds)
Download and install application	20/20	4/15
Create account	20/20	2/10
Find your rights homepage	19/20	0/20
Find content	20/20	0/50
Find notification page	19/20	0/45
Find account/profile page	19/20	0/57

Thirteen out of the fifteen participants used the notification page to limit their time on social media. The mean IMI score was 4.34 (SD=0.45) out of 7. The App had a SUS score of 68.16 (SD = 9.34). The participants gave the app an average of 18.45 (SD = 1.76). While task performance metrics highlight strong usability in basic functions, further analysis was conducted to identify specific areas where users encountered significant challenges. These severe usability problems were categorized into main problem types, each assessed for frequency and severity. The findings show that issues such as confusing button placement, unclear terminology, and difficulty in locating or understanding guidance were among the most frequent and impactful barriers to optimal user experience. Notably, problems related to helping users find and comprehend guidance emerged as the most severe, with a severity rating of 3, indicating the need for targeted design improvements (Table 3).

Table 3. Overview of Severe Usability Problems Per Main Problem Type

Usability problem	Frequency	Severity
Confusing buttons	7	2 to 3
Usability in relation to design	6	2 to 3
Difficulty in understanding terminology	8	2 to 3
Helping people find and comprehend guidance	10	3

The severity and frequency of these usability issues underscore the importance of refining navigation structures, simplifying language, and providing more intuitive visual cues. Addressing these concerns will

not only enhance task efficiency but also improve user satisfaction and engagement, ultimately increasing the app's overall effectiveness in supporting self-directed learning.

3.2. Discussion

An agreement about the definition of usability was achieved by the users. Their perception of the product as useful stems from its ability to streamline data entering and editing processes. All of the capabilities are equivalent to those found on existing devices available on the market, and it includes an engaging interface, easily comprehensible content, and straightforward written language. All users of the application unanimously agree that it is very effective in providing assistance and guidance. This offers substantiation that the program is easily comprehensible and practical for usage in daily scenarios. Certain participants expressed that the app's presentation and design had a substantial impact on their degree of passion and commitment towards its use. According to Iqbal & Campbell (2023) and Rui et al. (2024), the combination of intuitive navigation and appealing visual elements not only boosts motivation but also enhances user engagement, which is a crucial factor in the success of self-directed learning, especially in health education contexts.

Notwithstanding the perception of most users that they had accomplished it, the primary objective of the app was not attained. Existing research on digital health and mHealth that employed the Technology Acceptance Model (TAM) as its foundation have shown comparable findings (Adnan et al., 2025; Philippi et al., 2021). In study by Alshehhi et al. (2023) and Chang et al. (2024), found that despite the reported ease of use, a significant number of users had difficulties in comprehending the data presented on an online application. In the present study, the application's ease of use and accessible content demonstrate potential to enhance acceptance of self-learning methods for health-related skills, such as infant massage, by increasing user trust and willingness to engage. An envisioned future mobile application for self-directed massage therapy might include animations and interactive games, which could further improve user motivation and comprehension while enriching the learning process.

There has been a significant focus in the field of human-computer interaction on the usability of mobile applications (Gurcan et al., 2021; Said, 2023). Consequently, several methodologies for assessing usability have been included into scholarly papers. The complexity of these models and the lack of explicit standards for defining usability measures, dimensions, and criteria make it uncertain if they will be effective for any specific mobile application (Muro-Culebras et al., 2021; Weichbroth, 2024). Additional considerations include the rapid proliferation of applications, the widespread availability of substandard applications, the diversification of app categories, and the existence of several platforms. According to Habibullah et al. (2023), due to the diverse range of functional and non-functional requirements, usability testing approaches are not universally suitable for all app kinds. Feroz & Ahmad (2024) suggest that it may be essential to use distinct usability models for each of these applications. In the context of health education, particularly for infant massage skills, a more dynamic and user-centered usability framework is recommended to align with the unique needs of parents, caregivers, and healthcare providers.

A usability assessment of mobile health applications was conducted using the recommendations provided by the HealthCare Information and Management Systems Society (Li et al., 2021; Nimmanterdwong et al., 2022). Notwithstanding the incorporation of usability engineering elements to measure efficiency, effectiveness, user satisfaction, and platform optimization, the criteria were extensive and did not provide any indication of quality according to the Likert scale used for classification. Before this research, there was no established framework for assessing the usability of mobile health apps. Although usability models for mobile apps do exist, their effectiveness has been generally discredited and they have not undergone thorough rigorous study. According to Ayada & Hammad (2023) and Ahmad Faudzi et al. (2023), due to the distinctive characteristics and dynamic application environment, current usability criteria are insufficient for constructing effective app interfaces. The present study recommends refining these criteria by incorporating field testing with the intended user group, such as parents of infants, to ensure the app meets their learning needs and practical challenges.

By assigning a numerical value ranging from 1 to 5 to each category on a Likert scale, we successfully computed the comprehensive usability rating. The majority of programs had ratings ranging from 3.0 to 4.0, indicating that they are satisfactory at most and have restricted functionalities in comparison to other competing options. In the context of infant massage education, higher usability scores suggest a greater potential to effectively support skill acquisition through self-learning. Supported by Ntoa (2024) and Almusharraf (2024), usability referred to three key aspects: the ease of locating desired actions, the prompt and unambiguous provision of feedback, and the intuitiveness of the interface. These aspects not only enhance learning efficiency but also contribute to better health outcomes for infants and emotional well-being for parents.

In the context of health education, self-directed learning plays a crucial role in empowering individuals to acquire skills at their own pace and according to their personal schedules (Murniati et al., 2023; Sadeghi et al., 2024). The integration of mobile technology into this process addresses common barriers in conventional training, such as limited access to qualified instructors, geographical constraints, and time limitations. By offering an intuitive interface, structured content, and clear instructional materials, the

application supports independent learners in mastering massage therapy techniques without the need for continuous face-to-face supervision. This aligns with adult learning theories (Bin Abdulrahman & Hosny, 2025; Hansen et al., 2021) , which emphasize autonomy, self-motivation, and the application of knowledge in real-life contexts, thereby enhancing both skill retention and practical competence.

From a pedagogical perspective, the application embodies principles of blended learning by complementing traditional instructional methods with digital resources that encourage active engagement. Features such as visual demonstrations, step-by-step guidance, and interactive feedback mechanisms transform passive content consumption into an experiential learning process. In the specific case of infant massage therapy, enables learners to immediately apply newly acquired techniques in real settings while simultaneously reinforcing their understanding through repeated practice and review. Supported by Verkooijen et al. (2024) and Noorbhai & Ojo (2023), the application not only serves as a training medium but also as a sustainable educational tool that supports lifelong learning and continuous skill improvement in healthcare-related practices.

4. CONCLUSION

The Android operating system or later software was used in the development of the mobile application that addresses the concept of self-directed learning of massage treatment. Based on the results of the usability test, it was determined that the prototype application was very user-friendly, providing high levels of effectiveness, efficiency, and satisfaction. Mobile health technology has the potential to improve the efficacy of clinical therapy for the prevention of low birth weight. This technology also enables nurses to better manage their health by providing them with more access to information and reducing the amount of paperwork they have to do. The purpose of this application is to provide a new source of health education and to provide the groundwork for the development of enhanced mobile apps for parents to use in the prevention of low birth weight. In addition to this, it offers parents a fresh opportunity to learn about health issues through flexible and self-paced training.

The application also has broader implications for healthcare delivery, as it helps reduce the time and resources required for parent training, allowing healthcare professionals to focus more on direct clinical interventions that require immediate attention. By streamlining the educational process and minimizing logistical constraints, the app supports more efficient allocation of healthcare resources while ensuring that parents still receive comprehensive and accessible guidance. The research had several limitations, one of which was the relatively small sample size. Additionally, we lacked a mechanism to ensure that each respondent carefully read and evaluated every item while completing the questionnaire, leaving us unable to confirm the accuracy of their responses.

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