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User-Centered Design for Enhancing the Usability of Mobile Applications: A Review of the Literature

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Abstract

The implementation of User-Centered Design (UCD) in mobile application development has a significant impact on user satisfaction. Based on a review of 30 scholarly articles, UCD has been shown to enhance satisfaction through a deep understanding of user needs, iterative design based on user feedback, and improvements in both functionality and intuitive user interface design. The evaluation methods commonly used to measure usability within the UCD approach include usability testing, heuristic evaluation, surveys and questionnaires, A/B testing, application usage data analysis, and cognitive walkthroughs. The findings indicate that applications developed using UCD principles tend to achieve higher adoption rates, more positive user reviews, and better overall usability. Therefore, the application of UCD is strongly recommended as an effective strategy for achieving optimal user satisfaction in mobile application development.

Keywords: Mobile Applications; Application Usability; Usability Testing; User-Centered Design

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1. Introduction

The rapid advancement of technology and the widespread use of smartphones have transformed how people interact with digital information and services, making mobile applications a primary medium for daily activities such as communication, shopping, education, and healthcare [1]. As mobile application usage continues to increase, greater emphasis has been placed on user experience and usability as key factors determining whether an application is easy, efficient, and satisfying to use [2]. Usability is a core component of user experience that reflects how effectively

users can achieve their goals with a product, and applications that fail to meet usability standards are likely to be abandoned by users [3]. Consequently, User-Centered Design (UCD) has become an essential approach in mobile application development.

User-Centered Design places end users at the center of the design process, ensuring that system functionality and interfaces are shaped by users' needs, behaviors, and expectations [4]. This approach is guided by principles such as user focus, integrated and iterative design, continuous user involvement, and usability evaluation [5], and it emphasizes aligning system design with how users think, work, and interact with technology [6]. UCD incorporates techniques such as user research, persona development, wireframing, prototyping, and usability testing to ensure that design decisions are evidence-based and user-driven. Numerous studies have demonstrated that applying UCD significantly improves mobile application usability and user satisfaction [7].

Usability comprises key components including learnability, efficiency, memorability, error reduction, and satisfaction [8], all of which are especially critical in mobile contexts where users often interact briefly and under varying conditions. Prior research has identified efficiency, satisfaction, and effectiveness as the most frequently examined usability attributes [9], and the System Usability Scale (SUS) as the most commonly used usability evaluation method [10]. Empirical studies across domains such as agriculture, healthcare, and education further show that UCD-based mobile applications achieve higher usability scores and higher levels of user satisfaction [11]–[15]. However, despite the growing body of research, there is still a lack of comprehensive literature reviews that systematically examine usability evaluation methods and the overall impact of UCD on user satisfaction in mobile application development. Therefore, this study aims to synthesize existing findings to identify best practices, research gaps, and effective evaluation strategies for implementing UCD to enhance the usability and user satisfaction of mobile applications.

2. Methods

This study is a literature-based research using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method. The PRISMA framework provides a systematic and transparent approach to identifying, selecting, and evaluating relevant studies in a literature review.

The stages of this research follow the standard PRISMA flow, which consists of identification, screening, eligibility, and inclusion. Each stage is designed to ensure that only high-quality and relevant articles are retained for analysis.

These are illustrated in **Figure 1**, which presents the PRISMA flow diagram used in this study [16].

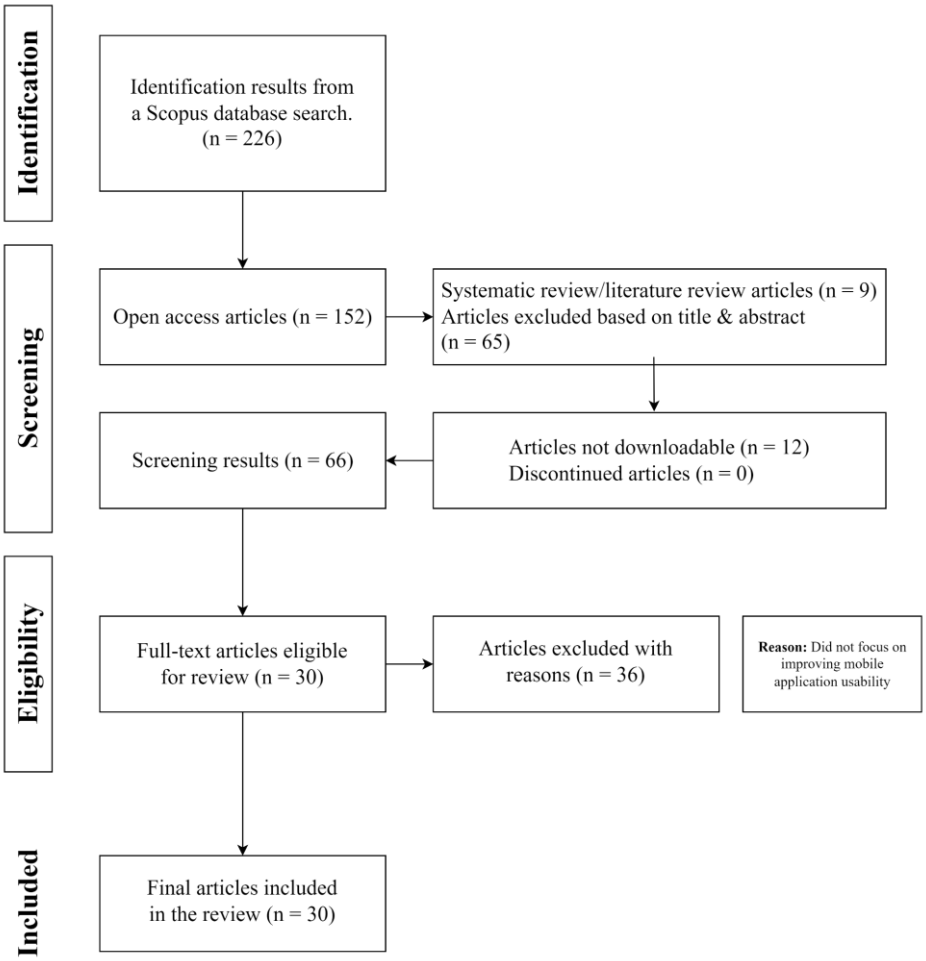

Figure 1. Research methods

2.1 Identification

At this stage, the researchers conducted a comprehensive search to collect studies relevant to the topic of this review, as summarized in **Table 1**. The online database used to retrieve the articles was Scopus, which was selected for its wide coverage of peer-reviewed and high-quality publications.

Keywords were identified based on the research topic and combined using the Boolean operator "AND" to link different concepts and "OR" to include synonymous or closely related terms. "User-Centered Design" and "mobile applications" were defined as the core keywords and were emphasized during the search process by incorporating alternative terms with similar meanings.

This strategy was intended to ensure that all relevant aspects of the topic were captured and that the search results represented a broad yet focused body of literature suitable for systematic analysis.

Table 1. Literature Selection Process

Keywords	***("user-centered design " OR "UCD") AND ("mobile apps" OR " mobile applications") AND ("usability")***
Database	Scopus
Article Type	Conference Article, Journals
Language	English
Year Range	2020 – June 2024
Inclusion Criteria	Articles discussing the UCD method in mobile application development
Exclusion Criteria	Articles not mentioning the UCD method in

2.2 Screening

Based on the predefined search strategy, a total of 226 articles were retrieved from the Scopus database. These records were then screened to remove duplicates and inaccessible papers, resulting in 152 articles available for further review.

During the next screening phase, titles and abstracts were examined to assess relevance to the core keywords, such as User-Centered Design and mobile applications. As a result, 9 articles identified as systematic reviews or literature reviews and 65 articles that were not aligned with the research scope were excluded.

In addition, 12 articles could not be downloaded in full text and were therefore removed from the dataset. After completing the screening process, a total of 66 articles remained for the subsequent eligibility stage.

2.3 Systematic Review Method Using PRISMA

The eligibility assessment resulted in 30 articles that were reviewed in full text. At this stage, 36 articles were excluded because they did not primarily focus on improving the usability of mobile applications or did not explicitly address the implementation of User-Centered Design in mobile app development. The remaining studies were then evaluated for methodological rigor, relevance to the research questions, and the clarity of their usability evaluation outcomes.

Following this process, a total of 30 articles were deemed eligible and included in the final analysis. This review focuses on examining the effectiveness of User-Centered Design in enhancing the usability of mobile applications. Accordingly, a systematic literature review was conducted to synthesize evidence on how UCD principles, methods, and evaluation techniques contribute to improved usability and higher levels of user satisfaction in mobile application development.

3.Results and Discussion

3.1 Results

The findings of this study are derived from a review of 30 selected articles. To facilitate systematic comparison, the key information from each study is summarized in a table that includes the article title, year of publication, research methodology, and main findings, as presented in **Table 2**.

Table 2. Literature Review Results

Title	year	Methods	Insight	Ref
Design and evaluation of a mobile application for enhancing farm management and performance assessment in fattening beef cattle	2024	Group discussions and interviews.	An average System Usability Scale (SUS) score of 75.17 indicates good usability. User satisfaction assessment revealed that the average satisfaction score across all participants was 4.26, indicating a high level of satisfaction and a favorable perception of the application.	[11]
Acceptability and Usability of a Wearable Device for Sleep Health Among English- and Spanish-Speaking Patients in a Safety Net Clinic: Qualitative Analysis	2023	Semi-structured qualitative interviews.	Participants found SomnoRing comfortable to wear over seven nights, indicating high usability. SomnoRing was perceived as easier to use than other sleep-monitoring devices or traditional testing methods, such as polysomnography.	[12]
A Mobile App for Children With Asthma to Monitor Indoor Air Quality (AirBuddy): Development and Usability Stud	2022	Field deployment involved seven pediatric asthma patients and weekly semi-structured interviews.	All participants responded positively to the usability of AirBuddy, indicating high acceptance and user satisfaction. This study demonstrates that a user-centered design process can lead to the development of digital tools that effectively meet the usability and relevance needs of children with asthma.	[13]
An Electronic Patient-Reported Outcome Mobile App for Data Collection in Type A	2021	Focus group (FG), conducted 2 exploratory FGs.	Usability testing participants demonstrated a positive trend, with increasing overall MAUQ scores across successive design revisions.	[17]

Hemophilia: Design and Usability Study			At the end of the design process, the application was considered easy to use with an attractive layout, which is important for sustained user engagement.	
A Personalized Physical Activity Coaching App for Breast Cancer Survivors: Design Process and Early Prototype Testing	2020	Literature review and interview.	The System Usability Scale, Mobile Application Rating Scale, and App Behavior Change Scale scores were 95/100, 4.6/5, and 15/21, respectively. Users reported high satisfaction and perceived effectiveness of the personalized training application.	[18]
Applying User-Centered Design in the Development of a Supportive mHealth App for Women in Substance Use Recovery	2023	Focus groups	Features such as positive messaging, peer chat, and expert advice were found to be important for usability. Participants preferred the 'daily challenge' concept to point-based learning modules, supporting usability and user engagement.	[19]
A User-Centered Approach to an Evidence-Based Electronic Health Pain Management Intervention for People With Chronic Pain: Design and Development of EPIO	2020	Iterative approach.	An average SUS score of 81.25 (grade A) indicates high usability and user satisfaction. Users reported that the intervention was easy to use and required no assistance during interaction.	[20]
Mobile application to support oncology patients during treatment on patient outcomes: Evidence from a randomized controlled trial	2022	Survey questions	Participants used the application an average of 11.7 times, reflecting consistent usage throughout the study period.	[21]
Chemo assist for children mobile health application to manage chemotherapy-related symptoms in acute leukemia in Indonesia: a user-centered design approach	2023	Action, Behavior, and Comment (ABC) observation method, satisfaction questionnaires, and observation.	The usability evaluation indicated that the CAC mHealth application was well accepted by the target users and effectively supported the identification and management of chemotherapy-related symptoms.	[22]

Designing and Developing a Mobile App for Management and Treatment of Gestational Diabetes in Nepal:User-Centered Design Study	2024	Focus groups and interviews	The application achieved an average task usability score of 3.50/5, with task completion rates ranging from 55.6% to 94.4%.	[23]
Design of a Self-Measuring Device Based on Bioelectrical Impedance Analysis for Regular Monitoring of Rheumatoid Arthritis	2024	Heuristic evaluation.	The usability assessment identified specific areas for improvement to enhance the user experience of the self-measuring rheumatoid arthritis monitoring device.	[24]
Development of an mHealth Platform for Adolescent Obesity Prevention: User-Centered Design Approach	2022	PSSUQ and interviews	The results showed a 100% task completion rate among participants, indicating high usability and user satisfaction with the developed application.	[25]
Evaluation of the usability of the Quali+ mobile application for people with high blood pressure	2024	Descriptive cross-sectional study and heuristic evaluation.	All participants achieved a SURE score of level 80, indicating full agreement on the usability of the provided assistance and tips. Scores ranging from 83 to 113 indicated consistent application performance across various usability aspects, ensuring a reliable user experience.	[14]
Evaluation of usability and user feedback to guide telepharmacy application development in Indonesia: a mixed-methods study	2024	Questionnaires and open-ended qualitative questions.	The application reached the usability acceptability threshold, with average scores of 63.4 for the general population and 64.1 for pharmacists.	[26]
Design, Development, and Evaluation of an mHealth App for Reporting of Side Effects During Cytostatic Treatment: Usability Test and Interview Study	2023	Questionnaires and semi-structured interviews.	The obtained SUS score was 92.5, indicating high usability and user satisfaction from the application testing. Participants had a mean age of 56.5 years, with an average task completion time of 240.15 seconds, indicating efficient usability.	[27]
Design and usability evaluation of a mobile-based-self management application for caregivers of children with severe burns	2023	Questionnaire for User Interaction Satisfaction (QUIS) and Cognitive	The usability evaluation of the Burn application involved installation on the smartphones of caregivers, IT professionals, and general users, resulting in good usability scores ranging from 7.92 to 8.10 out of 10.	[28]

		Walkthrough (CW).	A high-fidelity prototype was reviewed by specialists to ensure that functional requirements were met.	
Mobile health application for Thai women: investigation and model	2022	Interviews and questionnaires.	End users rated usability more favorably, giving the first version an average score of 4.440 out of 5, indicating a positive user experience without statistical significance. The second version received a higher average score from end users, with a focus on usability (mean = 4.494 out of 5), indicating consistently positive user feedback. IT experts rated functionality lower (mean = 4.034/5), highlighting differences in perspectives between end users and experts.	[29]
Mobile health platform based on user-centered design to promote exercise for patients with peripheral artery disease	2022	Questionnaires and open-ended questions.	The platform scored 67.86/100, indicating good usability among nurses and PAD patients.	[15]
MyPEEPS Mobile App for HIV Prevention Among Transmasculine Youth: Adaptation Through Community-Based Feedback and Usability Evaluation	2024	PSSUQ and Heuristic Evaluation.	MyPeeps Mobile achieved an overall usability score of 1.63 (SD = 0.65), indicating strong acceptance among young transgender men. The application scored 4.50 (SD = 0.24) on the Health-ITUES, above the 4.32 usability threshold for health IT tools	[30]
Passive Mobile Self-tracking of Mental Health by Veterans With Serious Mental Illness: Protocol for a User-Centered Design and Prospective Cohort Study	2022	Interviews and Focus Groups	Usability testing participants found the mobile app user-friendly and effective, offering valuable feedback for enhancements.	[31]
Usability Testing of a Patient-Centered Mobile Health App for Supporting and Guiding the Pediatric Emergency Department	2022	Think-Aloud and Questionnaires.	Pengguna melaporkan efektivitas yang baik, dengan tugas berhasil diselesaikan dalam 88,2% kasus, menunjukkan pemahaman menyeluruh tentang fitur aplikasi	[32]

Patient Journey: Mixed Methods Study			Participants completed nine goal-oriented tasks, from account creation to receiving the diagnostic sheet after the emergency care episode.	
Mixed-methods study of development and design needs for CommitFit, an adolescent mHealth App	2023	Semi-structured Interviews and Surveys.	The modified SUS score of 78.5 indicates that adolescents found the application easy to use and highly usable	[33]
Prototyping Mobile Storytelling Applications for People with Aphasia	2022	Questionnaires, informative discussions, and interactive collaborative evaluations were used.	Usability testing with individuals with aphasia showed successful task completion with researcher support, demonstrating the app's effectiveness in supporting communication and daily experience sharing.	[34]
Reviewing the User-Centered Design Process for a Comprehensive Gastroesophageal Reflux Disease (GERD) App	2022	Data collection using a combination of surveys, think-aloud protocol, and interviews.	Post-interview survey participants from Design Stage 3 rated the GERD app as fairly easy to use, with some considering it very easy. Design Stage 4 survey results showed users rated the application as slightly to fairly easy to use.	[35]
Usability-Focused Development and Usage of NeoTree-Beta, an App for Newborn Care in a Low-Resource Neonatal Unit, Malawi	2022	Questionnaires and Interviews.	Usability evaluation results, including System Usability Scale (SUS) scores, were above average, with scores of 88.1 and 89.4 at 1 and 6 months, respectively, indicating a high level of usability. Six participants completed usability interviews, and eight completed SUS1 and SUS2, offering valuable feedback on NeoTree's usability.	[37]
Usability of a mHealth Solution using Speech Recognition for Point-of-care Diagnostic Management	2022	UEQ and UTAUT Surveys.	User acceptance of the MA workflow was very high, with most physicians showing positive attitudes toward the technology. Acceptance was measured using UTAUT and was found to be a key driver of actual usage behavior. Physicians' satisfaction with the smartphone-based mobile application (MA), which utilizes voice recognition technology for diagnostic imaging management, was very high, indicating positive user experience and acceptance.	[37]

Usability of Food Size Aids in Mobile Dietary Reporting Apps for Young Adults: Randomized Controlled Trial	2020	Gesture-Based Assistance (GBA), Key-Based Assistance (KBA), Photo-Based Assistance (PBA)	PBA performed best on cylindrical hot dogs, irregular pork cuts, and green tea. In this study, GBA outperformed PBA for beverages and KBA for some vegetables. Higher accuracy in hash brown weighting was achieved compared to other methods. User acceptance of all three aids was positive, indicating that each tool has its own strengths and highlighting the potential for future integration to optimize accuracy and efficiency in dietary reporting applications.	[38]
User-Centered Design of a Mobile Java Practice App: A Comparison of Question Formats	2020	Think-Aloud, Focus Group, and A/B Testing.	The MC version of the Java practice app received higher usability ratings, with an average SUS score of 78.97/100. Comparative studies indicated that higher SUS scores for the MC version contributed to greater user satisfaction, increased willingness to learn, enjoyment, and comfort while using the application, reinforcing its usability and user preference.	[39]
User Interface Design of Jaipong Dance Applications for Elementary School using the User-Centered Design (UCD) Method	2023	Interviews and Questionnaire Surveys.	Understanding of Jaipong dance improved significantly, with 86.7% of users showing good comprehension through the application. The study achieved an average score of 91% on the QUIM questionnaire, categorizing the application as 'excellent' based on user experience during Jaipong dance lessons.	[40]
Usability and effectiveness of adherence monitoring of a mobile app designed to monitor and improve adherence to event-driven and daily HIV pre-exposure prophylaxis among men who have sex with men in Taiwan	2022	Questionnaire Survey.	The average SUS score obtained for the UPrepu application was 71.5, indicating that the application's usability is acceptable and above average, with most participants scoring above 70 on the SUS.	[41]

From the review of 30 selected articles, it was found that the User-Centered Design (UCD) approach significantly enhances the usability of mobile applications across various domains. The average System Usability Scale (SUS) scores generally fell within the qualitative ranges of "Good" to "Excellent," indicating high levels of user satisfaction and positive perceptions of the applications. One study [37] reported that technology acceptance, measured using the Unified Theory of Acceptance and Use of Technology (UTAUT), was a major driver of actual usage behavior, with physicians and other users demonstrating positive attitudes toward technology integrated into mobile health (mHealth) applications. Applications developed using UCD were commonly perceived as easy to use, with users feeling comfortable and finding them more intuitive compared to those developed using other approaches. Moreover, users were able to complete tasks with high success rates during usability testing, reflecting a strong understanding of application features. Users also provided valuable feedback for further improvement, which is essential in the iterative UCD process and contributes to enhancing both usability and relevance. Overall, the UCD approach consistently improves usability, user satisfaction, acceptance, and the overall effectiveness of mobile applications.

3.2 Discussion

The implementation of User-Centered Design (UCD) in mobile application development plays a crucial role in improving user satisfaction. Based on the review of 30 selected studies, several key mechanisms explain how UCD influences satisfaction. First, UCD emphasizes a deep understanding of users' needs, preferences, and behaviors through systematic user research, enabling developers to design applications that closely match user expectations. The reviewed articles consistently show that UCD-based applications achieve higher adoption rates and more positive user reviews [11], [12], [13], [17], [18], [36]. Second, the iterative nature of UCD allows continuous refinement based on user feedback, ensuring that applications evolve in line with changing user requirements [26], [27], [28]. Studies report that applications undergoing multiple UCD iterations demonstrate significantly higher user satisfaction [36], [37], [38]. In addition, UCD supports the identification and resolution of usability problems, the enhancement of functionality, and the development of intuitive user interfaces [14], [19], [21]-[25]. Interfaces designed using UCD principles are easier to learn and use, contribute to lower error rates, and provide clearer navigation structures [20], [23], [24], [29], [32], [35]–[39]. Overall, the user-focused nature of UCD not only improves usability but also strengthens user trust, efficiency, and satisfaction in interacting with mobile applications [11], [25], [26], [40].

To evaluate the usability of UCD-based mobile applications, a variety of assessment methods have been employed across the reviewed studies. Usability testing is the most frequently used approach, involving direct observation of users as they complete representative tasks either in-person or remotely [12]-[14], [21-[23], [32], [34]. Heuristic evaluation is also commonly applied, where usability experts assess applications against established usability principles to identify early-stage design problems [14], [24], [30]. Surveys and questionnaires such as the System Usability Scale (SUS) and the User Experience Questionnaire (UEQ) are widely used to collect both quantitative and qualitative user feedback on perceived usability and experience [11], [20], [27]–[30], [33], [36], [37]. In addition, some studies apply A/B testing to compare alternative design versions and determine which provides a better user experience [39]. Usage data analysis—such as click paths [32], [35], [37], task completion time [11], [17], [23], [25], [27], [32], and drop-off rates [23]–[25], [36]—offers deeper insight into real user behavior and highlights areas needing improvement. Finally, cognitive walkthroughs are used in certain studies to simulate users' thought processes while performing tasks, helping identify potential points of confusion or difficulty [28]. Together, these methods provide a comprehensive evaluation framework for assessing usability in UCD-based mobile application development.

4. Conclusion

This literature review demonstrates that the implementation of User-Centered Design (UCD) has a significant impact on user satisfaction in mobile applications. By adopting a user-focused approach, applications are better aligned with users' needs and preferences, leading to higher adoption rates and more positive user reviews. UCD emphasizes a deep understanding of users through methods such as usability testing, heuristic evaluation, and surveys, which help identify and address usability issues early in the development process. The iterative nature of UCD ensures continuous design improvement based on user feedback, resulting in interfaces that are more intuitive, easy to use, and consistent with user expectations. The reviewed studies span multiple domains, including information and communication technology, interaction design, user psychology, digital health, education, and business management. The findings consistently show that UCD-based applications not only enhance usability but also positively influence user satisfaction, trust, and efficiency in interacting with mobile applications. Therefore, the adoption of UCD in mobile application development is strongly recommended as an effective strategy for achieving high usability and optimal user satisfaction.

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