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Effective Approaches for User Engagement Improvement in Mobile Health Applications: A Comprehensive Literature Analysis

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Abstract *– Mobile health (mHealth) applications have become an integral part of our existence, offering multiple functions and a new level of user engagement. However, the competitive market presents difficulties for development teams attempting to attract and retain customers. User engagement is crucial to the success of mHealth applications, as it promotes interaction, adherence, and behavior modification. This paper presents a systematic literature review to investigate methods for enhancing user engagement in mHealth applications. The review identifies successful strategies from existing research and seeks to provide developers with guidance for creating engaging mobile applications. The selected studies are subjected to systematic searching, screening, data extraction, and quality evaluation, followed by narrative synthesis and thematic analysis. The findings emphasize the importance of gamification, design, personalization, social media integration, and push notifications in boosting user engagement. The review also emphasizes the need for experimental research to evaluate the efficacy of different user engagement strategies to achieve more accurate and reliable results. By addressing gaps and employing effective engagement strategies, mHealth applications can increase user satisfaction, encourage continued use, and improve health outcomes. The study lays the groundwork for future research and suggests strategies to increase user engagement in mHealth applications.*

Keywords: *mHealth; Mobile Health; User Engagement; User Experience; User Interface*

I. INTRODUCTION

Mobile applications have rapidly become an indispensable component of our lives in this day and age, fulfilling various functions and engaging users on an entirely new level (Baumel et al., 2019; Bitrián et al., 2021). Nevertheless, the rapidly growing market for mobile apps presents substantial hurdles for development teams, who must work hard to attract consumers and keep them as customers in an intensely competitive environment(Ikwunne et al., 2022)It is not surprising that mobile health (mHealth) applications have become a focus of research in health care, given their widespread use, powerful communication and interactive capabilities, and access to the internet, which provides an inexhaustible amount of health information.

Mobile health applications are internet-based mobile applications that support health-related and medical activities(Wang et al., 2021). In general, mobile health applications provide the ability to monitor the health status of consumers, document their health-related data, provide medical references, and facilitate medical decision-making. Since then, mobile health has been used to aid in the management of diabetes, asthma, melancholy, hearing loss, anemia, and migraine (Wang et al., 2021). Recent surveys indicate that the market for mHealth apps is rapidly evolving, introducing thousands of health-related apps at a low price to individuals (Vaghefi & Agu, 2019). User engagement is crucial to the success of mobile health applications because it encourages sustained interaction, adherence to health interventions, and positive behavior change. To address this issue, there is a pressing need for a credible and accessible source of information that can guide developers and designers in creating engaging mobile

applications(Cusumano, 2021). By providing relevant insights and practical guidance, such a resource can equip developers with the necessary knowledge to enhance user engagement and create successful apps in this competitive landscape.

As an outcome of this research, a systematic literature review will be carried out to investigate the numerous approaches that may be utilized to raise the level of user engagement inside mobile health applications. This research will explore the approach, strategy, and factors utilized to enhance user engagement in multiple ways based on a complete examination of existing scholarly literature. The goal of this research is to identify the approaches that have the potential to have the greatest impact on boosting user engagement in mobile health applications. The review process will involve systematic searching, screening, data extraction, and quality assessment of selected studies. A narrative synthesis and thematic analysis will be conducted to organize and summarize the findings. Limitations and gaps in the current literature will also be discussed to guide future research in this field.

This systematic literature review aims to cast a new light on the role of different strategies in enhancing user engagement on mobile health applications. By examining existing research and identifying successful strategies, this study will provide a foundation for future research and provide recommendations for designing and implementing strategies to promote sustained user engagement in mobile health applications.

The industry of healthcare has undergone a significant transformation with the advent of mHealth (mobile health) applications, which can be attributed to the growing ubiquity of smartphones and other mobile devices, particularly smartphones (Alam et al., 2020). All of these applications present a potentially auspicious pathway for dispensing services related to healthcare, keeping track of health, as well as encouraging overall health promptly to individuals without temporal or spatial constraints (Birkmeyer et al., 2021). The efficacy and triumph of mHealth applications are significantly contingent upon the level of user engagement, which pertains to the degree of active involvement, interaction, and dedication of users toward utilizing these sorts of purposes (Burns & others, 2020). Being familiar with user engagement in mobile health (mHealth) applications is of utmost importance as it has a direct influence on the efficacy and sustained utilization of such interventions (Balapour et al., 2019).

Gamification, a technique for increasing patient engagement, was first described on Google in 2010 and has since gained considerable traction (Kalali et al., 2019). As consumers become more invested in their own health, they may play a larger role in the management of their condition. Gamification is the use of game design elements in non-game contexts to increase user engagement and motivation (Baumel et al., 2019). Cechetti et al.'s application is an example of the application of gamification; they develop one app with gamification and one without (Cechetti et al., 2019). The results demonstrated that gamification encouraged participation by stimulating the intrinsic motivation of participants.

The majority of the investigated mHealth interventions were utilized in chronic disease and harmful lifestyle prevention programs. Mobile applications were widely utilized as delivery mechanisms (Baumel et al., 2019; Ikwunne et al., 2022; Wei et al., 2020). This study identified six analytical themes that play a significant role in enhancing user engagement: design objective, design target population, design method, design approach, socio-technical aspects, and design evaluation. This results in approximately 93 applications meeting the criteria for inclusion. The median percentage of daily active users is 4%, with a difference between tracker and peer support apps, respiration apps, and exercise apps.

Smartphone applications with a health focus present a growing opportunity to enhance the effectiveness and sustainability of national and individual health systems (Santos-Vijande et al., 2022). A comprehensive analysis of m-health user feedback is required because this type of application is utilized by the general public. In the interim, numerous prior studies have utilized app evaluations to investigate user reviews and feedback; however, many of these studies are limited in scope, size, or analysis (Haggag et al., 2022). While conducting a massive investigation and analysis of mHealth application evaluations. This study extracted and translated over 5 million user evaluations for 278 mHealth apps, with one example being that there has been a significant increase in the number of mobile apps for mental health over the past decade, which has been viewed as a promising method for assisting individuals with schizophrenia(de Almeida & Marques, 2023). The engagement strategies included push notifications, message prompts, personalization, application customization, goal setting, game-like features, the use of multiple multimedia formats, social connectivity, content dependability, and the quality of the received feedback.

Attributes play a significant role in user engagement with an application. A multiplayer game mode, rewards, clear interface, social interaction, a variety of challenges with a personalized level of difficulty, self-monitoring, and a variety of customization options, among others, such as self-set goals, personalized feedback, progress, and narrative, were related to engagement(Schwarz & others, 2023).

According to an increasing amount of literature concerning user engagement strategies in mHealth applications, which continues to grow, it has become apparent that there are various gaps and limitations that require attention (Schiavone, 2020). One such limitation is the absence of standardized metrics and evaluation methods aimed at assessing user engagement. To overcome this issue, the development of a framework would serve to improve the rigor and reliability of research being conducted in this field (Pham & others, 2019). In addition, it is essential to prioritize ethical considerations as pivotal domains, as this safeguards the privacy of users' personal data, and to integrate ethical protocols and devise strategies to increase users' trust and confidence in mHealth applications(Böhm et al., 2020). On top of that, the engagement of users is a crucial element in tackling the difficulties related to low

retention rates of applications and high rates of attrition among users of mHealth applications(Schmidt-Kraepelin et al., 2020). Even though numerous individuals tend to download health applications, unfortunately, they have a tendency to drop interest or cease their usage simply because of several factors, such as ineffective motivation, restricted personalization, inadequate accessibility, or insufficient apparent value(Santos-Vijande et al., 2022). Through the identification and resolution of these gaps, along with the implementation of efficacious user engagement strategies, mobile health applications have the potential to augment user contentment, sustain prolonged app utilization, and ultimately enhance health-related results (Zhao et al., 2021).

II. METHODS

This indicated study uses the application of Systematic Literature Review, or SLR, derived from numerous references in worldwide publications. Other than that, this paper makes use of Preferred Reporting Items for Systematic Reviews and Meta-Analysis or PRISMA checklist methodology as the systematic review model framework. The reason behind the chosen research approach, PRISMA, is the accepted norm for reporting evidence of information in systematic reviews and meta-analyses.

This comprehensive examination of the systematic literature review aims to determine how effective approaches have an impact on improving user engagement in applications, focusing on mobile health as the main area of interest. The present study has formulated the following Research Questions (RQ) for investigation :

- RQ 1: What approaches are applied to improve user engagement with mobile health applications?
- RQ 2: What are the most recommended approaches for enhancing user engagement in mobile health applications, as evidenced by the existing literature?

2.1 Search Strategies

This research was carried out by utilizing the search phrases (“user engagement” OR “user experience”) AND (“mhealth” OR “mobile health”) in order to determine pertinent electronic databases and scholarly journals that will be utilized for the literature search. All things considered, the search framework integrated pertinent keywords and restricted terminology to explore three fundamental concepts, namely user engagement, mobile application, and approach utilizing the publication database of ScienceDirect and other sources such as Google Scholar and Mendeley. This research involved a systematic exploration of scholarly articles and conference papers written in the English language and published in scientific peer-reviewed journals and proceedings, within the timeframe that spanned the last five years, specifically from 2018 to 2023.

2.2 Eligibility Criteria

Regarding this, we discarded duplicate papers and screened the remaining articles based on their titles, abstracts, and keywords to eliminate irrelevant studies. In this phase, the following types of articles were excluded:

- Studies that are not accessible (full-text not available).
- Studies that do not concentrate on improving or enhancing user engagement in mobile health applications.
- Studies that do not evaluate and discuss specific approaches, techniques, strategies, or features implemented in mobile health applications to enhance user engagement.

We obtained full-text versions of the remaining articles and evaluated their eligibility based on the eligibility criteria. Only empirical studies that clearly describe the approach or strategy used to enhance user engagement in mobile health applications. The eligibility criteria were determined through ongoing discussions among the three authors. The first author screened and evaluated both abstracts and full texts, whereas the first, second, and third authors peer-reviewed the obtained article compilations.

2.3 Data Extraction and Analysis

For the final collection of full-text articles, a document for data extraction was developed. The data collected consisted of several key elements, namely the year of publication, the title of the article, the classification of the mobile health application, and the study design. The first and second authors read and reread the included articles to determine the method or strategy used to increase user engagement in mobile health applications. Effective engagement strategies were found for each article based on the authors’ analysis of subjective user engagement gathered through the most used approach in all of the articles.

III. RESULTS AND DISCUSSION

Across all databases, 366 articles were identified in total. 49 (13%) duplicate articles were removed from the 366 total. After reviewing the titles and abstracts of the remaining 327 studies, 190 (58%) were deemed ineligible, and the full texts of 137 (42%) articles were downloaded and assessed for compliance with the inclusion and exclusion criteria. This review includes 12 (8.7%) of the 137 articles, while 98 (71.5%) are excluded. Figure 1 provides an overview of the procedure for selecting articles.

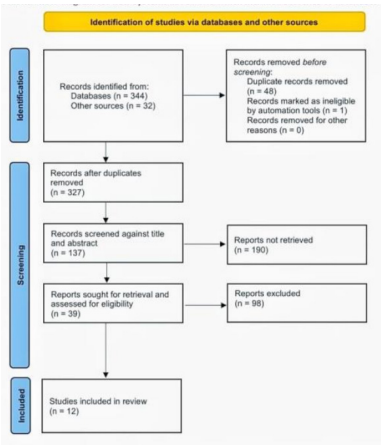

Figure 1. Prisma Flow Diagram

3.1 Study Characteristics

Figure 1 presents the general description of the studies. Of the 12 studies. 12 (100%) were published between 2018 and 2023. The study design included experimental studies (4/12, 33%), qualitative studies (3/12, 25%), systematic review (2/12, 16%), quantitative study (1/12, 8%), observational study (1/12, 8%), mixed-method studies (1/12, 8%).

3.2 Experimental Studies

Four (44%) of the twelve included studies were experimental studies. Navarro-Alaman et al. [26] conducted a two-week study with 15 participants who were not compensated monetarily. The findings highlight the importance of patient participation in PRO success and the potential of gamification as an engagement-boosting strategy. Five participants participated in an experimental study conducted by (Pernencar & others, 2018). The result demonstrates that gamification techniques utilized in the development of a mobile application effectively encourage adolescents to engage in healthy activities. (Grua & others, 2022) conducted an experimental investigation with 20 and 9 participants, respectively, in the first and second user studies. According to the findings of this study, e-health mobile applications are perceived favorably by end users due to personalization and self-adaptation strategies. 14 hypertension patients participated in an experiment in which (Cechetti et al., 2019) Compared two variants of the application, one with game elements and one without. The results indicated that gamification increased participation by stimulating the intrinsic motivation of participants. The groups assisted by health professionals utilized the application for a longer duration and were more motivated to maintain health control. In all studies, Gamification was used to increase user engagement with mobile health applications.

3.3 Qualitative Studies

Three (25%) of the twelve included studies were qualitative. (Breeman & others, 2021) analyzed 33 eHealth applications in qualitative research. According to the findings, multiple stakeholders in the field of cardiovascular prevention and rehabilitation may derive the most benefit from a personalized eHealth platform that integrates a number of evidence-based interventions. (Woldaregay et al., 2018) conducted sixteen interviews with individuals from diverse cultural contexts, disease histories, ages, and genders. Individuals with a disease history favored learning from data and others via social media integration, according to the findings. Those without a chronic illness were more reluctant to integrate social media. (Alqahtani & Orji, 2020) conducted a qualitative study employing thematic analysis on 13,549 reviews of 106 mental health applications from the Apple App Store and Google Play. The analysis of the results indicates that users placed greater emphasis on the user interface and efficacy of the application. In addition, users favored applications with a variety of selectable options, features, and content. This study's designs utilize personalization, social media integration, and design as engagement strategies.

3.4 Systematic Review

Two (16%) of the twelve included studies were systematic reviews(Ikwunne et al., 2022) conducted a systematic review of 32 articles published between 2011 and 2020 on mHealth design interventions. The results indicate that the six critical topics of design objective, design target population, design method, design approach, socio-technical factors, and design evaluation have an impact on user engagement. (Wei et al., 2020) performed a comprehensive review of 35 articles. User engagement was influenced by personalization (82.85 %), reinforcement (65.7 %), communication (57.14 %), navigation (48.57 %), credibility (45.71 %), message presentation (5.71 %), and interface aesthetics (20 %). In conclusion, both study designs incorporated design and personalization strategies to enhance user engagement with mobile health applications.

3.5 Quantitative Study

One (8%) of the twelve included studies were quantitative. (Schmidt-Kraepelin et al., 2019) analyzed 500 apps from the Apple App Store and 500 apps from the Google Play Store in a quantitative investigation. 722 applications that had been downloaded, tested, and coded contained at least one game mechanic. 592 successful Apple App Store applications (M = 2.37; SD = 2.64) and 714 successful Google Play Store applications (M = 2.86; SD = 2.73) Collectively enacted game mechanisms. Initial research has shown that gamification strategies are effective engagement methods. Interaction concepts, feedback, reminders, meaning, and objectives were the most prevalent game mechanics identified by the study.

3.6 Observational Study

One (8%) of the twelve included studies was an observational study. (Bidargaddi & others, 2018) carried out an observational study on 1265 Jool App users. During the threemonth period, the algorithm sent 18,053 push notifications, with a median (average = 14.67) of 12 (mean = 14.67) per individual. In total, 59.64% (n = 10,767/18,053) of the data set's notifications were of the 'tailored suggestions' content type (n = 10,767/18,053). Initial research indicated that text notifications with 'tailored suggestions' strategies are effective engagement methods. However, push notifications with insights were related with higher self-monitoring among frequent app users. In general, push notifications with customized suggestions were more effective at boosting selfmonitoring.

3.7 Mixed-Methods Study

One (8%) of the twelve included studies employed mixed methods. 45 valid consumers and 25 experts participated in a mixed-methods study conducted in 2019 (Luna-Perejon & others, 2019). Over 69% of respondents to game questionnaires agreed that the games have outstanding usability features, according to the survey.

3.8 Engagement Strategies

User engagement is essential to the success of mobile health applications. When users are actively engaged and invested in their journey towards improved health, they are more likely to experience success. In this presentation, we examine methods for improving user interaction with mobile health applications and their effects on health

outcomes. Based on the findings of thirteen studies, we found that various techniques, such as Gamification, Design, Personalization, Social Media Integration, and Push Notification, can be used to increase user engagement in mobile health applications.

3.9 Recommended Engagement

Strategies Figure. 2. Recommended Engagement Strategies Chart Based on the results of all the engagement strategies used to improve user engagement in mobile health applications, Gamification (5/12, 41%) are the most used and effective approach to enhance user engagement in mobile health application, followed by Design (3/12, 25%), Personalization (2/12, 17%), Social Media Integration (1/12, 8%), Push Notification with Tailored Suggestions (1/12, 8%).

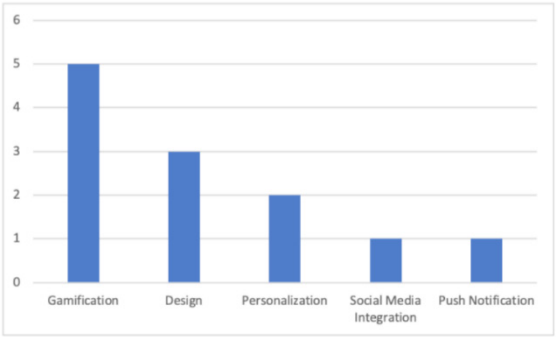

Figure 2. Recommended Engagement Strategies Chart

As the most relevant, 'Gamification' is the employment of various tactics to increase engagement with users has been thoroughly analyzed in relation to methods of interaction in apps for mobile health (Cechetti et al., 2019; Luna-Perejon & others, 2019; Navarro-Alamán et al., 2020; Pernencar & others, 2018; Schmidt-Kraepelin et al., 2019). This method is a powerful strategy technique that employs features of games like obstacles, prizes and victories, as well as the ranking lists designed to encourage those who utilize it and foster an overall feeling of accomplishment.

After that, the evident significance of 'Design' cannot be overstated, as it prioritizes the creation of interfaces that are friendly to users, intuitive navigating, together with visually pleasing components that augment accessibility and promote extended engagement (Ikwunne et al., 2022; Wei et al., 2020). Following after, the implementation of 'Personalization' is also a viable approach that involves customizing the contents and features that allow the application to cater to the unique preferences, demands, requirements and objectives of each user, which means that this technique promotes a feeling of significance and possession among the users itself (Breeman & others, 2021; Grua & others, 2022).

Other than that, the combined application of 'Social Media' platforms also allows individuals to disseminate their progression, accomplishments, and obstacles throughout their connections with others, thereby fostering a communal atmosphere and encouraging responsibility (Woldaregay et al., 2018). Last but not least, the incorporation of 'Push Notifications' perform as a constant reminder by providing custom-tailored and accurate messages to end users, prompting themselves to engage frequently with the application, furthermore, there are several different approaches for these enactments, which also could be substantiated by empirical evidence, and also consistently displayed the capability to enhance participation from users upon health care applications (Bidargaddi & others, 2018).

The application of a systematic review, referred to as a source search methodology, carries the potential drawback of excluding valuable publicly available materials and articles due to their perceived lack of alignment with the scope of the approach. The findings have been summarized in light of the authors' recommendations based on user engagement data and the most prevalent engagement strategy. The searching and review process was limited to accessible databases and articles that provided full-text access. Furthermore, it is noteworthy that conference resources were not considered in this review, although valuable materials are often disseminated through such channels. This study may have overlooked significant published works that could have been crucial to its findings.

IV. CONCLUSION

Numerous engagement strategies, including gamification, design, personalization, social media integration, and push notification, have been reported to increase user engagement in mobile health applications. According to the findings, gamification was the most popular method for increasing user engagement in mobile health applications. This approach is a potent strategy technique that employs game elements such as obstacles, rewards, and victories, as well as ranking lists designed to motivate those who employ it and nurture a general sense of accomplishment. The findings should be interpreted with caution due to the small sample sizes and incidental focus on engagement strategies in the included studies. Due to the data heterogeneity, it is impossible to draw any conclusions regarding the most effective engagement strategy. In addition, different sample types were employed, with some studies involving human participants and others relying on evaluations of mHealth applications, making it difficult to establish a valid comparison to determine the most effective approach for mobile health applications. Experimental research must be conducted on the efficacy of various engagement strategies to facilitate user engagement with mobile health applications.

Considering the study's findings, it is important to acknowledge certain areas where future research could significantly enhance our understanding of user engagement strategies in mobile health applications. First, a deeper analysis using more extensive and more diverse sample sizes would provide more reliable insights and increase the generalizability of the results. Additionally, incorporating a broader demographic perspective could show how user engagement varies across different age groups, genders, cultural contexts, and health conditions, allowing for more personalized and effective interventions. Lastly, integrating established theoretical frameworks, such as behavioral and motivational models, would offer a more structured basis for interpreting the effectiveness of various engagement

strategies. Future works could build upon this research by conducting experimental studies that directly compare the effectiveness of different engagement techniques across varied demographic groups. Furthermore, longitudinal studies could assess how user engagement strategies influence sustained use and long-term health outcomes over time. Finally, developing standardized metrics for evaluating user engagement in mHealth applications could provide a consistent approach to comparing future interventions. These improvements would address current limitations and contribute to the development of more comprehensive, user-centric mHealth solutions.

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