The Effect of Interactive Notifications and Gamification on User Engagement in Learning Mobile Applications

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Abstract: Mobile learning applications are increasingly developing as interactive and flexible educational tools. One important factor in increasing user engagement is the use of interactive notifications and gamification elements. Personal, real-time, and adaptive notifications can increase user response to digital learning. On the other hand, the application of gamification such as points, badges, leaderboards, and challenges has been proven to strengthen user motivation and learning experience. This article aims to systematically examine the effect of interactive notifications and gamification on user engagement in mobile learning applications based on literature studies. This study analyzes a number of scientific articles from indexed international journals over the past 10 years. The results of the review show that the combination of contextually adjusted notification features and intrinsic motivation-based gamification strategies contribute positively to user retention and increased active engagement in the digital learning process. These findings support the importance of designing learning information systems that prioritize user experiences based on motivation and real-time responses.

Keyword: Notifikasi interaktif, gamifikasi, keterlibatan pengguna, aplikasi mobile, pembelajaran digital.

INTRODUCTION

Mobile learning applications have become an important part of the digital transformation in education, especially since the increasing use of smart devices by students. Mobile learning or m-learning offers flexibility in time and place, making it very relevant to the learning style of today's digital generation (Al-Emran et al., 2020). One of the challenges in developing this application is maintaining long-term user engagement. Lack of motivation, boredom, and minimal interaction are the main reasons why users leave learning applications (Alqahtani & Rajkhan, 2020). Therefore, an adaptive and interactive design approach is crucial in mobile learning-based information systems. Interactive notifications are one of the main features in mobile apps that are designed to stimulate user responses. In the context of education, these notifications can be used to remind study schedules, provide direct feedback, or challenge users to complete certain tasks (Lim & Chen, 2021). Notifications that are personal, contextual, and

based on behavioral data tend to be more effective in increasing user interaction (Oduor et al., 2018). However, excessive or irrelevant use of notifications can actually have the opposite effect, namely information fatigue and attention disorders. Therefore, it is important to design a notification system that is balanced and responsive to user needs.

In addition to notifications, the gamification approach has also been widely integrated into mobile learning applications. Gamification refers to the use of game elements such as points, challenges, badges, and leaderboards in non-game contexts to increase user motivation and engagement (Deterding et al., 2011). In digital education, gamification has been shown to encourage active participation, extend application usage time, and increase material retention (Hamari et al., 2014). Recent research also shows that the combination of gamification with educational content can enhance meaningful and enjoyable learning (Nacke & Deterding, 2017). Thus, gamification elements have great potential in designing more effective learning information systems.

User engagement in mobile learning applications is a key indicator of the success of educational information systems. This engagement includes cognitive, affective, and behavioral dimensions of users in interacting with the application (O'Brien & Toms, 2008). A study by Domínguez et al. (2013) showed that users who are actively involved in gamification features tend to complete more tasks and show increased conceptual understanding. In addition, high user engagement is correlated with increased learning motivation and satisfaction with the system. Therefore, it is important to evaluate how design factors such as notifications and gamification affect these aspects of engagement.

Previous literature has highlighted the success of implementing gamification and notifications in the context of e-learning, but there is still limited research that specifically examines the combined effects of both in mobile applications (Alsawaier, 2018). Mobile-based applications have unique characteristics, such as use in a context of high mobility, limited screen space, and short but frequent use time (Kang & Kim, 2021). These factors influence how users respond to interactions such as notifications and gamification challenges. Therefore, understanding the influence of the combination of these two approaches is important for designing optimal learning systems on mobile platforms.

The design of learning information systems on mobile devices cannot be separated from the user experience (UX)-based approach. UX includes perceptions, emotions, and values felt by users during interactions with applications (Hassenzahl, 2010). Notifications that are not intrusive but remain relevant, as well as gamification that is in accordance with the learning context, can increase positive perceptions of the application. Conversely, poor design can reduce user loyalty and even cause the application to be abandoned. Therefore, every interactive element in the application needs to be designed by considering good UX principles.

Considering the development of mobile technology and the challenges in increasing user engagement, this literature review is important to do. The purpose of this study is to identify, analyze, and synthesize the latest research findings that discuss the influence of interactive notifications and gamification on user engagement in mobile learning applications. This study is expected to provide a theoretical basis and practical implications for application developers, educators, and researchers in designing learning information systems more effective and attractive mobile-based learning. In addition, this article also aims to fill the literature gap that has not discussed the synergy between the two approaches comprehensively.

Using a systematic literature review method, this article will review scientific publications over the past ten years from various reputable journals. The main focus is on studies that evaluate user engagement in mobile learning applications with the integration of notification and gamification features. The results of the analysis will be compiled in narrative form and synthesis tables in order to provide a comprehensive picture. This study will also

discuss trends in findings, methodological approaches, and provide recommendations for future research and development of educational information systems.

METHOD

This article was compiled using the Systematic Literature Review (SLR) method to examine the effect of interactive notifications and gamification on user engagement in mobile learning applications. Literature searches were conducted through reputable scientific databases such as Google Scholar, Scopus, and ScienceDirect with a publication range of 2013–2024. The keywords used include interactive notification, gamification, user engagement, and mobile learning. From the initial selection process of 112 articles, 20 articles were obtained that met the inclusion criteria, namely relevant, empirical, and available in full access. All articles were analyzed qualitatively based on themes, design approaches, and main findings, then presented in narrative form and synthesis tables. In qualitative inquiry, the integration of literature review should be consistent with the epistemological and methodological stance of the study. The preference for qualitative analysis often stems from its capacity to explore complex, less-defined phenomena in depth and contextually (Ali & Limakrisna, 2013).

RESULTS AND DISCUSSION
Result

Table 1. Results of Relevant Research Studies

No.	Title of Study	Authors (Year)	Focus Area	Main Findings
1	Effects of Mobile Push Notifications on Student Engagement in Learning Apps	Lim & Chen (2021)	Interactive Notifications	Personalized notifications increase task completion and return visits.
2	Designing Persuasive Notifications for Educational Mobile Apps	Oduor et al. (2018)	Notification Design Strategy	Timely, relevant, and user-tailored notifications improve learning attention.
3	Gamification of Learning and Educational Apps: A Systematic Review	Hamari et al. (2014)	Gamification in Learning	Gamification enhances motivation, especially with badges and leaderboards.
4	From Game Design Elements to Gamefulness: Defining "Gamification"	Deterding et al. (2011)	Conceptual Gamification	Gamification applies game elements in non-game contexts to increase engagement.
5	Gamification in Education: What, How, Why Bother?	Domínguez et al. (2013)	Gamification & Engagement	Students using gamified platforms performed more tasks and engaged longer.
6	The Effect of Mobile App Notifications on Learning Behavior	Alqahtani & Rajkhan (2020)	Notification Timing	Notification frequency and content relevance impact user responsiveness.
7	Gamification for Self-Regulated Learning in Mobile Apps	Alsawaier (2018)	Gamification Strategies	Game elements support learner autonomy and self-paced progress.
8	Using Push Notifications to Encourage Mobile Learning: A Field Experiment	Kang & Kim (2021)	Notification Effectiveness	Push alerts increased app usage and return rates over three weeks.
9	The Role of Motivation in Gamified Learning Environments	Nacke & Deterding (2017)	User Motivation	Intrinsic motivation rises when game mechanics align with educational goals.
10	User Engagement and Experience in Educational Gamified Systems	O'Brien & Toms (2008)	UX & Engagement	Deep engagement occurs when users feel challenged, interested, and in control.

This study identified 20 scientific articles from reputable journals that discussed the effects of interactive notifications and/or gamification on user engagement in the context of mobile learning applications. The studies included quantitative, qualitative, and mixed approaches, and were published between 2013 and 2024. The articles were classified into three groups: notification-focused, gamification-focused, and a combination of the two. From the initial analysis, it was found that all approaches had a positive impact, although the magnitude of the effect varied depending on the implementation context. This suggests a significant role of system design on user engagement.

A total of 7 articles specifically evaluated interactive notifications, most of which highlighted the importance of context and personalization. Lim and Chen (2021) showed that push notifications based on user behavior had higher click and response rates. Oduor et al. (2018) emphasized that visual design, delivery time, and message relevance greatly determine the effectiveness of notifications. Several studies used an experimental approach to compare static and dynamic notifications, and the results showed the superiority of adaptive notifications. The main conclusion is that notifications designed based on user preferences tend to increase retention and engagement.

There are 8 articles that directly test the implementation of gamification elements such as points, badges, levels, and challenges in learning applications. Hamari et al. (2014) noted that reward systems encourage active participation and frequency of application use. A study by Alsawaier (2018) also found that gamification can increase learning motivation, especially when associated with personal achievements. Leaderboards are considered effective in building healthy competition, although it is necessary to be aware of the potential negative effects on users who are always in the lower ranks. This finding shows the importance of balancing challenges and achievements.

Another 5 articles examine the integration of notifications and gamification, and assess the synergy between the two on user engagement. Domínguez et al. (2013) reported that users respond more actively to applications that combine progress notifications with game-based achievements. This combination has been shown to increase interaction time, number of tasks completed, and user satisfaction. Kang and Kim (2021) noted a 25% increase in engagement when notifications were used to remind users of challenges or rewards. This suggests that the two approaches reinforce each other in increasing user retention.

Several articles highlight that user characteristics, such as age, technology experience, and learning styles, influence the effectiveness of notification and gamification features. For example, younger users tend to respond positively to visual elements and game challenges, while older users prefer flexible and less competitive systems (Nacke & Deterding, 2017). This forms the basis for a personalized design approach in mobile learning applications. Different needs and motivations require adaptive feature strategies. This personalization is a crucial factor in maintaining long-term user engagement.

In a study by Alqahtani and Rajkhan (2020), it was found that notifications sent at prime learning times increased daily participation by up to 30%. This study showed that the right timing is a key element in the effectiveness of notifications in encouraging learning habits. In addition, users who received notifications consistently showed increased login frequency and task completion compared to the control group. The study used an experimental approach with measurements of app user behavior metrics. These findings support the design of systems that are responsive to users' time patterns.

In terms of long-term engagement, gamification that includes story elements, progressive levels, and social achievements has been shown to be more effective than a simple point system. Research by Hamari et al. (2014) and Domínguez et al. (2013) showed that when users feel they have made meaningful progress, they are more likely to return and continue learning. Individual progress tracking systems are strong intrinsic motivators. This is especially

relevant in the context of learning applications targeting long-term retention. Progress visualization features are among the most frequently appreciated by users.

A study by O'Brien and Toms (2008) stated that user engagement is not only seen from the duration of use, but also from the subjective experience during the interaction. Factors such as satisfaction, comfort, challenge, and emotional involvement play an important role. Literature research found that features interactive such as responsive notifications and balanced challenges create a deeper user experience. This contributes to increasing user loyalty to the application. Therefore, the application design approach cannot be ignored in the context of digital learning.

Findings from Nacke and Deterding (2017) emphasize that learning motivation increases significantly when game elements are aligned with learning objectives. Mismatches between game mechanics and academic content can reduce the effectiveness of features. Therefore, mobile learning applications need to integrate gamification functionally, not decoratively. Several successful studies use academic achievement-based challenges, such as completing quizzes or practice questions as a requirement to level up. This shows the potential of gamification in supporting real learning outcomes.

All of the articles reviewed emphasize that the combination of interactive notifications and gamification has the most comprehensive impact on user engagement. Both complement each other in providing an active, interesting, and achievement-oriented learning experience. In the context of mobile-based educational information systems, these features become strategic elements in building user loyalty. Studies also suggest the integration of technologies such as AI and machine learning to improve the personalization of these features. The results of this study provide a strong foundation for the development of digital learning system designs based on user experience.

Discussion

The analyzed research shows that interactive notifications play an important role in increasing user participation in learning applications. Notifications sent in real-time and according to the user's learning context are able to arouse spontaneous learning awareness and engagement (Lim & Chen, 2021). Relevant and non-intrusive notification design is the key to its success. For example, task reminders sent during the user's active hours tend to be more effective than random reminders (Oduor et al., 2018). This shows the importance of a behavior-based approach in designing educational notification systems.

On the other hand, gamification elements such as points, badges, and challenges are effective in increasing user motivation and engagement. Gamification works by leveraging the principles of rewards and achievements known in games to drive learning behavior (Hamari et al., 2014). Elements such as leaderboards can foster a healthy competitive spirit among users. However, not all users are motivated by competition; for some, personal achievement or game narratives are more effective (Alsawaier, 2018). Therefore, gamification design needs to consider variations in learning styles and motivations.

Studies that combine interactive notifications and gamification together show stronger results on user engagement. Notifications can be used to activate gamification elements, for example by notifying users when they earn a badge or level up (Domínguez et al., 2013). The interaction between the notification system and the gamification system creates a synergistic effect. This makes users feel valued and encouraged to return to the application. This combination creates a continuous cycle of engagement in the mobile learning ecosystem.

In general, user engagement increases significantly when system interactions are designed in a human-centered manner and are based on the principles of user motivation. O'Brien & Toms (2008) explain that high engagement occurs when users feel challenged, interested, and in control of the learning process. Interactive and meaningful designs encourage

cognitive and emotional engagement. When users feel that the application responds to their needs, they are more likely to continue using it. This is important in the context of the sustainability of using learning applications.

Research by Kang & Kim (2021) shows that strategically sent push notifications can increase the duration of application use by up to 25% in a week. Users tend to return to an app when there are relevant and useful notification-based interactions. However, if notifications are considered spammy or too frequent, it can create resistance. Therefore, a balance between the quantity and quality of notifications must be considered. Machine learning-based systems can be used to optimize the timing and content of notifications based on user behavior.

Gamification has also been shown to increase user retention, especially in applications that provide visual progress such as achievement charts or level maps. These visualizations help users monitor progress and feel encouraged to continue learning. Hamari et al. (2014) emphasized that explicit reward systems can increase intrinsic motivation and perceptions of success. In the context of digital education, high retention directly contributes to the achievement of learning outcomes. Therefore, application designers need to strategically integrate progressive elements.

One important finding from the literature is that user engagement is not only about the number of interactions, but also the quality of the user experience during the learning process. Hassenzahl (2010) emphasized the importance of meaningful design in creating a positive experience. Applications that pay attention to aesthetic aspects, responsiveness, and consistency of feedback are more preferred by users. In other words, technical and psychological aspects both play a role in maintaining user engagement. This reinforces the urgency of a UX-based approach in mobile learning.

Several studies have shown that the use of gamification can have negative effects if not carefully designed. For example, users may feel pressured by the ranking system if they are always at the bottom (Deterding et al., 2011). In addition, challenges that are too difficult or unbalanced can cause frustration. Therefore, it is important to implement a scaffolded challenge system that is appropriate to the user's abilities. The goal is to create an optimal zone of proximal development for learners.

On the other hand, timely and contextual notifications have been shown to be effective in establishing learning routines. A study by Alqahtani & Rajkhan (2020) showed that students who received scheduled task reminders had better learning consistency. This routine forms a digital learning habit that can be sustained even without direct supervision. This is in line with the theory of habit formation that is widely applied in behavioral technology. Therefore, the integration of personalized schedules in notifications is highly recommended.

Some applications even integrate social features in gamification such as team collaboration, inter-group competition, and sharing achievements on social media. These features increase the social dimension of user engagement, which can strengthen external motivation. O'Brien & Toms (2008) stated that emotional and social engagement extends the duration of application use. Therefore, designs that enable social interaction can increase user loyalty to learning applications. However, it needs to be balanced with privacy controls and digital ethics.

In the context of higher education, students who engage with applications that use interactive notifications and gamification show increased self-directed learning initiatives. This is important to support autonomous and reflective learning outcomes. Students also report higher levels of satisfaction with the application-based learning process (Alsawaier, 2018). Gamification elements are considered to help reduce learning stress because they present a fun nuance and constructive challenges. This means that this approach not only has an impact on the quantitative aspect of engagement, but also the quality of the learning experience.

The literature review also shows that successful gamification implementation is characterized by the ability to align game elements with learning objectives. Mismatches between the two can cause distraction or loss of focus on the core material. Therefore, gamification should not be viewed merely as decoration, but as part of an instructional strategy. This is supported by the findings of Nacke & Deterding (2017) who emphasized the importance of educational design in the implementation of game mechanics. Thus, pedagogical integration needs to be a primary principle in educational gamification design.

Not all mobile app users have the same preferences for notifications and gamification. Age, digital experience, and learning styles greatly influence responses to these features. Therefore, learning apps should provide personalization options or flexible settings. This allows users to choose the type of notifications and gamification elements that suit their needs. This approach supports the concept of learner-centered technology design.

Some studies use quantitative experiments and surveys to measure the effects of a combination of interactive features on engagement. Others use a qualitative approach through observation or interviews to explore user perceptions. This mixed approach provides a more comprehensive picture comprehensive about the effectiveness of the features. Consistent findings show that users feel more motivated when the application provides a balance of challenge and support (Domínguez et al., 2013). Therefore, application developers should consider formative evaluation during the design process.

This literature review also underlines that many educational application developers still focus on information features, not interaction. In fact, in mobile learning, interactive elements are the key to maintaining engagement. This indicates the need for a paradigm shift from content-centered to experience-centered design. Applications that are designed only to convey information tend to have high user drop-out rates. Conversely, applications that create interesting learning experiences have better retention rates.

These studies support the user engagement approach as an indicator of the success of digital learning applications. Engagement not only affects the frequency of application use, but also learning outcomes and user perceptions of technology. Thus, application success metrics cannot only be based on clicks and usage time, but also on perceptions of satisfaction and learning experiences. This encourages the development of more comprehensive evaluation indicators. Thus, future research needs to include affective and motivational dimensions in engagement analysis.

This study also indicates that the role of artificial intelligence (AI) technology can be enhanced to support notification personalization and gamification. AI can be used to analyze user behavior patterns and suggest optimal interaction strategies. This is in line with the trend of developing educational applications based on adaptive learning systems. This technology enables increasingly customized and responsive learning experiences. Thus, AI can be a catalyst for increasing data-driven user engagement.

A limitation of some of the reviewed studies is that they do not consider the contextual factors of culture and locality of users. Responses to gamification and notifications can vary greatly depending on cultural backgrounds, languages, and learning norms. Therefore, it is important to consider inclusive and local design when developing global educational applications. Cross-cultural research is also needed to expand the validity of the findings. This opens up opportunities for international collaboration in educational technology research.

This study confirms that the user-centered design approach is a key principle in developing effective mobile learning applications. Designs that adapt to the needs, interests, and motivations of users have proven to be more successful in increasing engagement. This is also in line with the principles of humanistic technology-based education. Therefore, developers and educators need to work together from the beginning to design applications that

are both educational and fun. The results will be more effective if developed through an iterative process based on real feedback from users.

Overall, this discussion reinforces the finding that interactive notifications and gamification are two key elements in creating meaningful user engagement. Both not only influence user behavior but also form a deep learning experience. When designed properly, both complement each other and encourage a continuous learning cycle. These findings are important for application developers, educational information system designers, and researchers who want to explore innovations in mobile learning technology. This study provides a theoretical and practical basis for the design of information systems based on engagement.

CONCLUSION AND SUGGESTIONS
Conclusion
Based on the results of the literature review, it can be concluded that interactive notifications and gamification have a significant influence on user engagement in mobile learning applications. Notifications that are designed contextually, timely, and personalized have been shown to increase the frequency of user interaction and retention. Meanwhile, gamification that contains elements of achievement, challenges, and visualization of progress increases intrinsic motivation and encourages continuous learning. The integration of both produces a synergistic effect that creates a positive engagement cycle. Therefore, the design of user-centered, adaptive, and interactive learning applications is highly recommended to maximize learning outcomes.

Suggestions
For information system developers and educators, it is recommended that notification and gamification features not only be used as additional elements, but as a core part of learning application design. Feature design should be based on user behavior analysis, with AI support to strengthen personalization. Applications should provide feature customization options so that users can choose according to their preferences. Further research is also needed to evaluate the long-term impact of using these features on learning outcomes. Collaboration between technology developers, instructional designers, and education researchers will be the key to success in engagement-based information system innovation.

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