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Literature Review

Prototyping a mobile engagement app: Evaluating push notification strategies for improved customer engagement

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1. Introduction

The aim of this literature review is to critically evaluate previous existing research on customer engagement, and mobile push notifications in small and medium enterprises (SMEs). This literature review will specifically assess how customer behaviour, satisfaction, and retention are affected by strategies like notification timing, frequency, and customisation (Wohllebe, Adler and Podruzsik, 2021; Stach et al., 2024). It will also examine the technical aspects of implementing push notifications in mobile apps, as well as the role of digital touchpoints in supporting the competitiveness of SMEs.

This review is significant because smaller businesses often face obstacles in utilising such as a result of a lack of resources and technical expertise, as opposed to large retailers who have successfully made use of mobile notifications (Gavilan and Martinez-Navarro, 2022). By comparing and contrasting existing findings, this review will identify gaps in current knowledge. Especially in the context of SMEs. It will also provide a foundation for this project which aims to design a mobile app prototype that combines customisable push notification strategies to improve customer engagement.

2. Related works

2.1. Digital transformation and SMEs

Digital transformation is an essential part of business for smaller companies trying to compete with larger enterprises. Kilcourse and Rowen (2023) urge the adoption of mobile engagement tools which allows SMEs to improve communication with customers. Their research noted that mobile commerce currently accounts for over half of global e-commerce transactions. Ewim et al. (2024) explains that SMEs face challenges such as limited technical knowledge and financial limitations, but through digital adoption these SMEs can increase their market reach and service delivery. Nanta et al. (2025) also found that digital touchpoint experiences can heavily influence customer loyalty. These studies show that SMEs require digital transformation and adoption, making use of mobile engagement strategies to compete effectively.

2.2. Push notification timing and frequency

The timing and frequency of push notifications play an important role in keeping users engaged. O'Brien et al. (2022) showed that sending fewer but better-timed notifications can keep users interested over the long term. In a similar way, Ji et al. (2024) introduced the Temporal Interaction Model (TIM), which looks at the best times of day to send notifications. Their study found that managing notifications across the whole day improves engagement and reduces disruption, showing that timing should be treated as an ongoing process.

Other research also shows how timing affects user responses. Bell et al. (2023) found that notifications increase the chance of users interacting within the next hour, although the effect becomes weaker over time. Stach et al. (2024) focused on "interaction delay," the gap between receiving a notification and responding. They found that this delay is affected by factors such as time of day, suggesting that well-timed delivery makes users more responsive.

The number of notifications also matters. Pham et al. (2016) showed that targeted notifications can improve engagement, but sending too many causes users to lose interest. Nguyen Tran et al. (2025) supported this by showing that small delays, such as waiting 15 to 30 minutes before sending, made users more willing to accept notifications and less annoyed by them. Wheatley and Ferrer-Conill (2021) added that sticking to fixed routines, such as sending many alerts at the same time, often puts organisational needs before user experience and can lead to alert fatigue.

Overall, the research shows that notifications work best when both timing and frequency are managed carefully. Sending fewer, personalised, and well-timed messages helps keep users engaged, while sending too many or delivering them at the wrong time increases frustration and reduces effectiveness.

2.3. Personalization and user control

According to Kim and Park (2025), allowing users to customise how they receive their notifications with different modes reduces the overall notification load and positively impacts user engagement. Users receive upwards of 60 push notifications daily, which can be “disruptive and distractive” (Gavilan and Martinez-Navarro, 2022); thus, the user should be able to mitigate that number by personalising their method and consistency of push notification reception. Customisation and personalisation mitigate push notification overload; however, these methods fail to recognise changing daily occurrences, as people often have fluctuating routines (Özdemir, Mottus and Lamas, 2025). Standardised, non-personalised notifications increase the rate of uninstalls; thus, notifications should be relevant and add value to the user experience (Wohllebe, Adler and Podruzsik, 2021) at the users’ discretion. These studies confirm that user control, personalization, and context awareness are needed for better customer retention and engagement.

2.4. Engagement outcomes of push notifications

According to the findings of Kunkel, Hayduk III and Lock (2023), progression incentives yield great results in terms of improved user engagement. It outperformed both social incentive and a combination of social and progression affordances. This finding implies that the gamification of push notifications has a greater effect on notification effectiveness. By predicting user patterns in user engagement with push notifications (Tian, Zhou and Pelleg, 2022), more satisfying services can be provided to users, thus improving user engagement. However, if push notifications are too frequent, the uninstall rates among users increase (Wohllebe et al., 2021); thus, notifications should be pushed at a consistent yet infrequent rate so as to minimise the chances of the app being uninstalled. These studies show that while notifications can increase customer engagement, the effect of it depends on keeping people motivated, but not overdoing it so that customers are no longer satisfied.

2.5. Technical challenges and implementation

While all these notification strategies and studies provide behavioural insights into customer engagement, there are further technical challenges for implementing the proposed application. Bidkar et al. (2024) observed there are trade-offs between reliability, latency, and battery usage when managing notifications in the background of Android applications. A concern also mentioned by O’Brien et al. (2022) is how a reinforcement learning framework requires backend decision making, this not only adds to a mobile device’s resource consumption, but it can also be complex to implement for SMEs with limited resources. To conserve these mobile device resources and reduce unnecessary device wake-ups, Acer et al. (2015) looks at the possibility of an energy-efficient notification scheduling approach.

Jošt and Taneski (2025) conducted a comparative study of different mobile cross-platform frameworks. They concluded that Flutter is one of the most widely adopted frameworks for developing mobile applications. The balance of cross-platform reach, developer productivity, and community support is what makes Flutter so attractive and why the framework will work for a SME-friendly mobile notification system.

Pairing this with a framework like Firebase will simplify development and help to keep costs low, as Firebase has a free tier that includes Cloud Firestore which is a NoSQL database, Firebase Cloud Messaging (FCM) for notifications, Cloud Functions for backend logic, authentication, and hosting (Google Firebase, 2025). Although relational databases like Postgres used for Supabase offer advantages when complex join statements are needed or for heavy data gathering for analytics, Firestore's NoSQL model will be better suited for the proposed application requiring real-time notifications and engagement.

Together, these works show that the development and implementation of notification strategies in a SME-friendly mobile application will require well informed decisions about architecture, frameworks, and energy use.

Overall, research concludes that push notifications can be effective for customer engagement and retention when implemented effectively, but some technical challenges need to be addressed. However, few studies have specifically looked at addressing these challenges in combination with notification strategies in SME-focused context.

3. Finding of the related work

The reviewed literature identifies a few clear patterns. Firstly, although technical and financial limitations exist, SMEs need to adapt to a mobile-first customer engagement strategy to be competitive in the current digital transforming market. Secondly, studies show that there are three main factors that affect the effectiveness of push notifications. These are timing and frequency, personalization and user control, and the design of engagement outcomes. Lastly, there are technical challenges to consider when implementing these notification strategies in mobile applications, such as architecture and framework selection, reliability, and energy efficiency.

A gap that persists across the reviewed literature is that the focus is on large-scale industries including health, social media, and news. The findings in these studies can still be valuable for designing notification strategies, but do not necessarily carry over to SMEs in retail and subscription-based markets. Some of the studies also don't combine and integrate all the necessary factors for customer engagement. They might exclude timing, frequency, personalization, or user control when concluding their results. While technical considerations are discussed in the literature, few studies combine the above-mentioned strategies with the practical development of a mobile application that is SME-friendly.

This study aims to address these gaps by designing, developing, and evaluating a cross-platform mobile application focused on SMEs. The development will integrate the best notification strategies by implementing the system in Flutter and Firebase. By combining behavioural insights with technical feasibility, the researchers aim to provide a practical and scalable solution for smaller businesses.

4. Conclusion

The purpose of this review was to look into prior research which may assist in the creation of an application which utilizes push notifications to facilitate communication between businesses and their clients as well as what factors impact the engagement of users on mobile applications utilizing push notifications. The journals and papers which were chosen for review were used to evaluate different aspects of the creation of this application which have already been studied. Three main factors which affected user engagement and notification effectiveness were highlighted: timing and frequency of notifications, personalization and user control, and the overall design and use of the notifications. Ultimately, the studies seemed to point to the fact that well timed push notification, using the correct strategy can improve customer satisfaction and engagements for SMEs.

The studies also indicated, however, that small businesses may face additional challenges in adopting the effective strategies found due to their lower pool of resources to place into developing their own system. So far, the majority of research of this kind has been primarily focused on larger businesses, as well as sectors like health, news, and social media, with very limited research involving small businesses. Due to these limitations, it is important for these gaps in research and development to be addressed as smaller businesses are being forced to transform with larger businesses which have more resources to do so, to ensure they are able to stay afloat and compete. By creating a platform which integrates effective push notification strategies with other considerations into the most effective methods for design and development, this project's purpose is to design and build a prototype of a platform which can be used by SMEs to stay competitive. By doing this, there will be contributions to both practical and theoretical insights with regards to how small businesses can most effectively utilize these strategies, as well as whether or not it is worth the effort.

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