

Evaluating the Impact of Different User Engagement Elements on Software Applications

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Abstract— User engagement elements are important aspects of any software application. The presence or absence of these elements can have different levels of impact on applications' success or failure. However, to the best of our knowledge, the presence or absence of these elements in successful and unsuccessful software applications has not yet been analyzed to help software engineers understand the impact each of these elements can have on applications. To fill this gap, in this paper, based on the reviewed literature, we have categorized the user engagement elements into eight main elements and evaluated them against 50 successful and unsuccessful software applications. Evaluation results indicate that utility, interactivity, and design quality have been highly used in successful software applications, while gamification, personalization, and social networking have been almost absent in unsuccessful applications. We have discussed the implications of these findings and given some recommendations for improving user engagement in software applications.

Keywords— *User engagement, software application, utility, interactivity, design quality, social networking, personalization, gamification, content quality, privacy*

I. INTRODUCTION

One of the essential factors of any software application is user engagement. Collaborative software applications such as social media or instant messaging can quickly fail without appropriate user engagement, and applications with less user engagement are less widely used [1]. As a result, user engagement can tremendously affect applications' success or failure [2]. User engagement is crucial for enabling some applications to make billions [3]. Having said that, any application can succeed by increasing user engagement, which can be done by adequately implementing user engagement elements. Increasing user engagement not only makes the application's current users keep coming back and using it, but it also gains new users for the application by increasing word of mouth (WOM) about the application [4].

Considering the importance of user engagement in software applications, knowing the elements that can affect it is necessary. In some literature, user engagement was defined as the quality of the user interaction and experience with the application [5]. However, beyond this definition, many criteria can impact the quality of user interaction. Some of these criteria and elements were mentioned in several studies [6, 7]. The design quality is among those elements that can impact user engagement. Ramírez-Correa et al. (2019) [8] found that the perceived ease of use, enjoyment, and usefulness increases user engagement in social networks for older people. Other criteria that can

affect the quality of design and interaction are interface aesthetics, personalization, reinforcement, communication, navigation, credibility, and message presentation [9]. The interactivity of the application is another element that impacts user engagement. Criteria such as the presence of clickable items, interaction prompts, reminders, and different types of notifications can determine the quality of interactivity, which can impact increasing user engagement [9, 10].

Torous et al. (2018) [1] suggest that to have an engaging application, it should solve the user's problems and give the user the service their desire. In other words, it should have a good utility for the users. Similarly, Tian et al.'s (2021) study on mobile travel apps revealed that compatibility with users' expectations and needs is an important factor that impacts user engagement along with an attractive user interface and ease of use [11]. The importance of application utility and other criteria such as customization, privacy, user interface, and the credibility of the information was also mentioned in [12]. The study results in [13] suggest that privacy concerns lead to decreases in user engagement in the long run. The findings of [13] imply that the users who enjoy the application are more concerned with privacy issues, and if these concerns do not address properly, user engagement will be decreased. Some criteria that impact user engagement because of privacy concerns in the software application are clear opt-in and opt-out policies [14] and transparent data protection notices [13].

In addition to elements such as utility, privacy, trust, enjoyment, and type of language used in the application, personalization was another element that impacted applications' user engagement [15, 6]. Personalization has been mentioned in several recent studies as another element that can increase user engagement in software applications [16]. The finding in [17] reveals that personalizing application content based on the users' personalities and emotions can increase user engagement with the application. Criteria such as giving personalized feedback to the users and allowing them to customize when and how to receive reminders can be considered personalization [9]. Personalization can also be made using different recommender systems, such as collaborative or content-based ones [18]. Moreover, personalization can be made on the user interface, known as customization, by enabling users to change their background music or other interface features [10].

Nevertheless, other elements, such as gamification, are also playing a role in software applications' user engagement [19]. Today gamification is used in various software applications with different utilities, such as

educational applications, to change user behavior and increase user engagement [20]. Amo et al. (2020) [21] found that gamification criteria such as points and leaderboards can affect user competence and increase user engagement. In another study, the gamification level effectively increased user engagement [22]. Another element used in software applications to increase user engagement is the quality of information or content. In [23], the authors found that the quality of the information in the application increases user satisfaction in health application sites by increasing site reuse and perceived benefits. This aligns with [24], which stated that the quality of information, system, and service positively impacts user engagement. Sharing content and spreading information is among other criteria that increase user engagement. These criteria can be translated to social networking features [7, 25]. Social networking allows users to connect and like each other posts and profiles [26, 27]. These types of interactions and communications among the application's users can increase user engagement and improve the users' trust in the application [28].

As can be seen, different user engagement elements have been mentioned and studied in different literature. However, some of these features are present in some software applications, while others are not present in other applications. Hence, it raises the question of which of these user engagement elements is more important and can highly affect the success and failure of an application. The answer to this question is important because software engineers and developers can use this information to prioritize their tasks and objectives in developing software applications. However, to the best of our knowledge, this question remained unanswered in the literature. Hence, this research aims to fill this gap by investigating the presence of criteria mentioned in the literature that affect user engagement in software applications to find the most important and less important user engagement elements. Understanding the impact of implementing each user engagement element is the first step to developing a successful application with high user engagement. As a result, by evaluating the presence of user engagement elements in both successful and unsuccessful software applications with respect to their criteria in previous works, we can identify the impact of each of these elements and then give appropriate recommendations for implementing user engagement in software applications based on these findings. Therefore, we define our research questions as follows:

- RQ1: which user engagement elements are mostly used in successful software applications?
- RQ2: which user engagement elements were missed in unsuccessful software applications?
- RQ3: What mistakes did unsuccessful software applications make, and how may they address these mistakes to improve user engagement?

To answer these questions, in the next section, we have described how we have used our theoretical framework to evaluate several successful and unsuccessful software applications.

II. RESEARCH METHOD

To evaluate the impact of different user engagement elements on the success or failure of software applications, first, using the reviewed literature in section 1, we have categorized the user engagement elements into eight categories, including interactivity, social networking, gamification, personalization, content quality, design quality, utility, and privacy [1, 4, 6, 9, 12, 7, 25, 10, 29]. Then based on the criteria of each user engagement element that was mentioned in Section 1, we evaluated several successful and unsuccessful mobile applications by analyzing the degree of adaptation of these criteria and the effectiveness of adaptation. To this end, during the evaluation, we inspected which user engagement elements have been used inside each application. To this end, we have calculated the usage level and visibility level of each engagement element inside the application, and we wrote down a score for each user engagement element for each application on a scale from 0 to 10.

In our study, we downloaded 50 apps from the google play store for evaluation. Selecting this number of applications for evaluation is inspired by a study in [10] about user interaction with iOS apps. We have considered download counts and user rankings to determine whether an application is successful or unsuccessful. The reason for using a combination of both download counts and ranking was that some apps are new to the store or might have a low number of installations. Hence, they are not well-established to understand their success or failure. Moreover, applications with very low download counts might not have a correct ranking since few users might rank them, and they could be biased. Figure 1 shows the theoretical framework of this study.

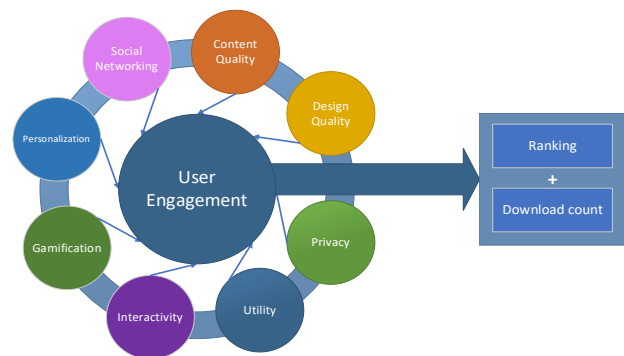


Figure 1. The theoretical framework for evaluating the impact of different user engagement elements on software applications.

Of the 50 evaluated applications, 30 were selected from successful applications with over 100 million download counts and ranked more than 3.7 out of 5. These applications were selected using Google's top application list, Wikipedia's most downloaded apps list, and the businessofapps.com list. We have also excluded games and preinstalled apps. Moreover, 20 apps were selected from unsuccessful applications with 1K to 50K download counts and user ranking below 2.5. However, finding unsuccessful apps was difficult because app stores usually promote top apps, not worse ones. To find such applications, we conduct a custom search in the google play store by entering the subject of the apps based on the title of the apps reviewed in the first stage. Type of applications used for

the evaluation was health and fitness, communications, photography, social media, travel, tools, media streaming, cloud storage, auto and vehicles, news, magazines, music and video, entertainment, dating, lifestyle, weather, shopping, productivity, social, simulation, and education.

III. RESULTS

After evaluating all 50 successful and unsuccessful applications, the average score was 5.37 (S.D = 3.43), with a median of 6.12. The highest score was 9.62, and the lowest score was 0. Figure 2 gives us an overview of the usage level of each user engagement element in all evaluated applications.

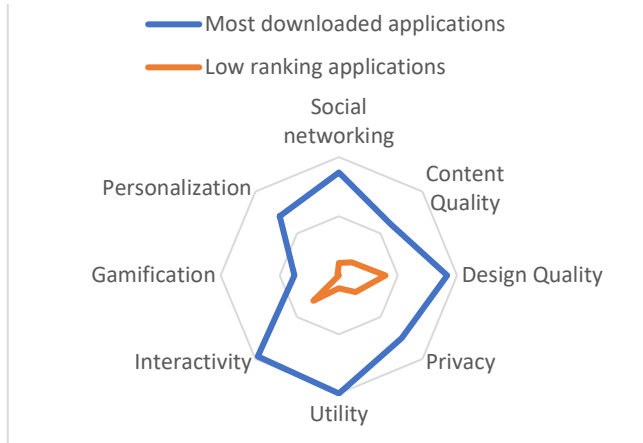


Figure 2. Visual presentation of using each user engagement element in successful apps versus unsuccessful apps.

To inspect this in detail, figure 3 compares the overall percentage of using each engagement element in 30 successful and 20 unsuccessful applications.

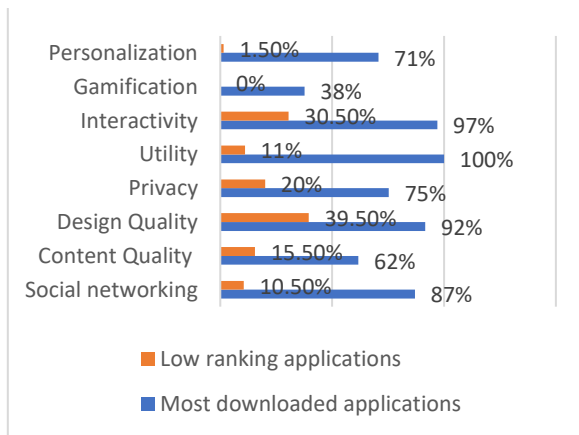


Figure 3. Comparing the user engagement element usage between successful applications and unsuccessful applications.

Moreover, figure 4 illustrates the boxplot of received scores for each user engagement element in successful and unsuccessful applications (on a scale of 0 to 10).

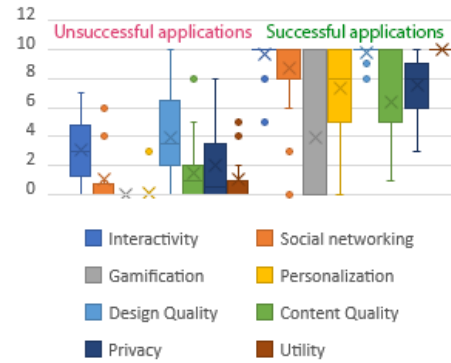


Figure 4. Boxplot of engagement elements usage in successful and unsuccessful applications.

Moreover, table 1 shows the obtained score differences between the successful and unsuccessful applications.

Table 1. Difference between the highest and lowest scores.

User engagement element	Difference
Utility	89%
Social networking	76.5%
Personalization	69.5%
Interactivity	66.5%
Privacy	55%
Design quality	52.5%
Content quality	46.5%
Gamification	38%

Figures 2, 3, and 4, in addition to Table 1, gave us insights into the usage of user engagement elements in successful and unsuccessful software applications. During the evaluation, we observed that all the user engagement elements of the theoretical framework have been present in successful applications. However, some were missing in unsuccessful applications. To understand what this data means in action and how successful applications benefit from the user engagement elements and unsuccessful applications lack them, in the next section, we will discuss these results more deeply and talk about their implications.

IV. DISCUSSION AND IMPLICATIONS

Since each user engagement element has been implemented differently in different applications, this section will discuss the results and lessons learned from evaluating the most successful and unsuccessful mobile applications.

While evaluating the user engagement of applications, we noticed that unsuccessful software applications result from incomplete development and sometimes the owners' greed to make money with unthoughtful elements. Most unsuccessful applications did not consider the users' needs and requirements. These applications struggle with engagement elements such as utility and interactivity, and engagement elements such as social networking, gamification, and personalization are almost absent in them. However, some of them have the potential to become popular, yet they have to increase their utility and

interactivity in addition to other user engagement elements. Then a wide range of online marketing techniques like methods mentioned in [30] can help them reach new customers. The following subsections will discuss our findings concerning each user engagement element studied.

A. Utility and user engagement

As Figure 3 shows, based on evaluating successful applications, the utility has been fully present in them (100%), meaning they fully address their users' needs and expectations. While in unsuccessful applications, the utility was observed only by 11%. Figure 4 shows that only a few unsuccessful applications had utility. According to Table 1, there is a significant difference (89%) between utility usage in successful applications and unsuccessful applications. This implies the crucial impact of utility on user engagement of software applications. Concerning Figure 2, we can see some apps with a low level of personalization, gamification, and even social networking features are among the best apps in the world because, interestingly, all of them have a high utility by perfectly solving human problems. In fact, they are so good at solving the problem that they did not implement other engaging features. SHAREit and Android Auto are among these apps that solve users' problems uniquely and efficiently without implementing several other engagement elements. However, because of having a high level of innovation and functionality, and for some of them, no competitor, they are successful and among the most downloaded apps on Google Play. Several studies, such as [11] and [1], emphasize utility as the only important factor of user engagement without mentioning other factors. However, we observed that other user engagement factors are also crucial in highly compatible applications, such as movie streaming or communication.

Figure 3 shows that unsuccessful apps generally had lower utility scores. Functionality problems, not loading the content, and crashing aside, some of these applications provide functionality only after buying a VIP membership, and without that, the application is completely useless. This implies that in order to have an engaging application, limiting the application's functionality is not a good solution for making revenue because having high utility is essential. Thus, software engineers should seek more innovative approaches to make revenue from their applications. Using user-centric design is also important for increasing the utility of applications [1]. Moreover, the application should regularly be tested to ensure they function correctly [31].

B. 4.2. Social networking and user engagement

Figure 3 shows that social networking features were highly used in successful applications (87%), while it was rarely used in unsuccessful applications (10.5%). At the same time, its usage score was only 10.5% in unsuccessful applications. Table 1 shows a significant difference (76.5%) between the usage of social networking in successful and unsuccessful applications, which implies that this feature can significantly increase user engagement in software applications. Some unsuccessful applications not only had a very basic social networking feature but also limited these features and required payment to allow users

to access them. The presence of social networking features in unsuccessful applications implies the fundamental change in the nature of software applications since the early 2000s and the emergence of Web 2.0. However, evaluated applications and statistical reports about social networking usage show that applications that want to succeed in today's world must implement social networking features [32].

C. Gamification and user engagement

Figure 3 shows gamification was not used much in successful applications (38%) and was utterly absent in unsuccessful applications. Moreover, gamification was used differently in each successful application. In most cases, gamification was designed based on the desired action application wants the users to take. The fact that gamification has lost 60% scores in evaluating successful applications implies that some of these apps provide a unique utility to their customers, and they do not have any competitors.

Although successful applications may still use classic gamification elements like those mentioned in Amo et al. [21], the findings of this study imply that software applications do not necessarily need to implement these gamification elements directly [21]. It is more meaningful for applications to innovate new game elements based on the functionality they want their users to perform. This can engage users similarly or better than using well-known game elements. For example, Snapchat, among the most successful applications, previously used trophies to reward users for their achievements. However, this feature was recently replaced by snap streaks, which encourages users to keep engaging with each other in an innovative gamification way. Moreover, instead of using leaderboards, Snapchat uses Snap Score, a general score for posting new content in snap chat. It allows users to compare themselves by going to other users' profiles and viewing other users' scores without using a leaderboard. Combining gamification with other user engagement elements, such as personalization, similar to the study [22], can improve its long-term effects on user engagement. Nevertheless, classic gamification elements have also been presented in some applications. Google street view benefits from gamification to reward users by badge, level, and points. It also shows the user progress and contributions to motivate users to contribute more to the application. As a result, using classic gamification elements in crowdsourcing applications and directly rewarding users like the described method in [33] can benefit applications' user engagement.

D. Privacy and user engagement

Figure 3 shows that privacy was highly present in successful applications (75%), while in unsuccessful applications, it had a low presence (20%). Figure 3 also shows that privacy notes were present in all the successful apps (mainly in their settings section). There was a devoted section for privacy settings in some successful apps with many options for customizing the user's privacy, while there were very few in others. Nevertheless, in unsuccessful applications (figure 4), many apps did not mention user privacy or did it poorly. This finding implies the important role of privacy in user engagement.

E. Content quality and user engagement

Content quality in unsuccessful applications (Figures 3 and 4) was very low (15.5%), and most of these applications had very low-quality content. On the other hand, successful applications have a higher content quality (65%) based on Figure 3. That said, it is important to note that some successful applications are not content based. For example, the Google Auto application is not dependent on content. Moreover, social networking applications like Instagram heavily depend on their users for their content, and they have little content by themselves. However, Figure 4 shows that many successful applications have tremendous high-quality content. Applications such as Netflix and Spotify are among those which align with what Shim and Jo (2020) stated in [23], the quality of content increases user engagement. Hence, these findings imply that applications can have different content quality depending on their utility to have a high user engagement. However, if applications' users generate their content, personalization can play an important role in increasing the quality of content for users.

F. Design quality and user engagement

Figure 3 shows that the design quality in successful applications was very high (92%). In most successful apps, the design quality criteria were simple, and thanks to the user interface frameworks, most successful applications followed similar design principles and elements mentioned in [34] that increased their user engagement (Figure 4). For example, fonts and icons used in most of the apps were similar, and the same metaphors were used, which is suitable for users to remember functionalities. These criteria were also observed in the unsuccessful software applications (Figure 4), and they had almost a high-quality design. These findings imply that the design quality alone is not enough to achieve high user engagement in software applications, although it is an essential element.

G. Interactivity and user engagement

Figure 3 shows that in successful applications, the interactivity score is very high (97%). While in unsuccessful applications, the interactivity score is low (30.5%). Nevertheless, even the unsuccessful applications have some interactivity (figure 4), and users can interact with the application, similar to what [10] mentioned. However, our findings imply that this interactivity is not enough to keep the user engaged with the application. We noticed that some evaluated unsuccessful applications limit users' interactivity intentionally. In some of these applications, users cannot freely move around the application or interact with it without making a payment. Also, in some cases, the interactions are interrupted by advertisements, and sometimes they have delays in responding, or it seems the application is stopped. Hence, these interactivity problems made unsuccessful applications frustrating and useless.

H. Personalization and user engagement

As shown in Figure 3, personalization was high in successful applications (71%), while in unsuccessful applications, it was very low (1.5%). According to Table 1, there is a significant difference in the presence of personalization in successful applications compared with unsuccessful applications (69.5%). The high level of

personalization in the successful application (figure 4) implies that personalization is essential for the application's success. Several different types of personalization were used in evaluated applications, including customization of the app's utility, privacy, and user interface. These customizations were also mentioned as important user engagement criteria in [10]. However, one of the important personalization types used in these applications was personalizing the content presented to the user based on their interest. For example, on Netflix, users can get personalized recommendations, and this personalization is very effective in increasing user engagement. Recently it was reported that the Netflix personalization system alone generated a billion-dollar income for the company [3].

V. CONCLUSIONS

In conclusion, we have evaluated 50 successful and unsuccessful software applications against different user engagement elements to understand the level of impact of each of these elements on the success of applications. The study results showed that utility, interactivity, and design quality are respectively highly present in successful software applications (figure 3). Moreover, utility, social networking, and personalization elements are significant indicators of software applications' success since they are less present in unsuccessful applications (table 1).

To sum up, we answered the mentioned research questions in section one by conducting the evaluation and discussing the implication of our findings to help the software engineers understand the important aspects of user engagement. We also discussed how user engagement elements could be combined and implemented in software applications and why some software applications fail. We shed some light on the importance of each user engagement element with this article to help software engineers select more appropriate user engagement elements and assist them in developing successful software applications with high user engagement.

One interesting outcome of this study was that gamification has the most negligible impact on the success of software applications, and it was completely absent in unsuccessful applications. Thus, investigating how gamification can make more impact on the success of software applications would be an interesting topic to study in the future. Evaluating a similar study on applications of the same type (e.g., only communication apps) might be another interesting study.

ACKNOWLEDGMENTS

Researcher 1 (Mohammad Hajarian) acknowledges support from the CONEX-Plus programme funded by Universidad Carlos III de Madrid and the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 801538. And Spanish State Research Agency (AEI) under grant Sense2MakeSense (PID2019-109388GB-I00).



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