Article

Evaluating Developer Responses to App Reviews: The Case of Mobile Banking Apps in Saudi Arabia and the United States

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Abstract: Application stores (app stores) enable developers to interact with users by responding to their reviews. Many developers continuously monitor user reviews and seek to respond to them effectively and efficiently to boost user satisfaction, which in the end increases the app's rating. Thus, it is essential to study developer responses and how to improve them. This research was aimed at evaluating developer responses to user reviews in both the Apple App Store and Google Play Store in the banking domain. Ten Saudi and ten United States (U.S.) bank apps were selected from each store as the sample. Quantitative and qualitative approaches were employed to code and categorize developer responses for each app using content analysis. The study found that developers' responses can be divided into three types of interaction: interactive response, semi-interactive response, and no response. A main finding is that responses by U.S. bank app developers outperformed those by Saudi bank app developers in terms of the number and quality of responses. This research provides valuable recommendations for users, developers, and app stores to enhance user–developer interaction.

Keywords: developer responses; user reviews; interaction; mobile apps; bank app; app store

1. Introduction

Robust internet infrastructure has allowed for significant technological advancements resulting in the widespread use of smartphones and an increase in the number of mobile apps available in app stores. According to Statista, the number of mobile app downloads grew from 140.68 billion in 2016 to 230 billion in 2022 [1]. App stores enable users to express their personal experiences, ask a question, make requests, and report complaints in the form of reviews and star rating [2]. User reviews frequently offer helpful information for developers, since the reviews can help them improve the apps to satisfy users' needs [3]. App stores have enabled developers to interact with users by responding to user reviews. This feature came early in the Google Play Store in 2013, followed by the Microsoft Store in 2014, and then the Apple App Store in 2017 [4]. Developers can respond to user complaints or express gratitude for a positive review. They may persuade the user to modify their rating or post a more positive review [3,5]. Consequently, this interaction creates a direct line of interaction between users and developers through app stores, which improves the user experience and increases the app's rating [6]. User reviews in different app stores have been explored extensively [7–10]. However, little effort has been made to study developer responses to reviews. To the best of our knowledge, no research studies on developers' responses to reviews from more than one app store have been reported [5,11–14].

Saudi and U.S. bank apps were selected as the sample for the current study. The reason for selecting Saudi banks pertains to the Saudi government's interest in developing financial sector services. Saudi Vision 2030 has an executive program called the Financial Sector Development Program, which aims to develop the financial sector into an effective one by using existing or new technology in an innovative way to improve work procedures [15]. Therefore, this study can help Saudi banks enhance their interaction with customers by

educating bank staff on the front lines to deliver high-quality services and build supportive relationships with customers [16]. The reason for selecting U.S. banks is to have another sample to compare to Saudi banks. Developer responses to customer reviews were extracted from both the Apple App Store and Google Play Store.

To study developer responses, the researchers first explored the similarities and differences between app stores in viewing user reviews and developer responses. Developer responses to 10 Saudi and 10 U.S. bank app reviews in both stores were then extracted using Python programming language [17,18]. This step was completed by transforming responses from JSON into Pandas DataFrame and then saving the data in a CSV file. The data were cleaned by removing unnecessary rows and columns. The extracted data were then imported into the MAXQDA program [19,20]. Finally, developer responses were manually examined and divided into various categories and themes through content analysis.

The paper's key contributions include understanding the degree of interaction between developers and users and providing recommendations to enhance this interaction. These recommendations can assist users in writing evaluations that clearly describe their needs and any issues they have with the app. Additionally, this study should help developers improve their responses to user reviews to achieve a sustainable relationship. Furthermore, this study can assist app stores in improving user interfaces and making the feedback loop clearer for all users.

The rest of the paper is organized as follows. Section 2 reviews the literature related to this research, while Section 3 describes the research methodology. Section 4 presents the research results. Section 5 discusses the findings. Section 6 displays the recommendations. Section 7 shows the research limitation. Finally, Section 8 concludes the research.

1.1. Sustainable Relationship

Sustainability refers to a strategy that considers a product's or process's ability to work in the long term without impacting the needs of the future generation [21,22]. Sustainability is not limited to environmental issues. In fact, it could be applied to other domains, such as the business domain. For example, sustainable customer service entails finding the core elements that customers require [23]. Indeed, effective customer service is essential to obtaining a sustainable competitive advantage. A business cannot grow and compete if it does not completely meet the needs and expectations of its customers [24]. Enhancing customer service from a sustainable viewpoint is crucial for a business to gain customer loyalty, which is less expensive than regaining lost customers or luring new ones [25,26]. Improving customer service can greatly increase organizational effectiveness and customer and employee satisfaction [27]. Online reviews have evolved into IT-enabled customer service systems capable of communication and interaction [28]. Users can provide valuable reviews that show their experience when using bank apps. Responding to online reviews enhances the bank's reputation and guarantees a sustainable relationship between banks and customers [29]. Undoubtedly, bank app developers are interested in enhancing the interaction with their users by responding to them properly. As a result of proper responses, user satisfaction and loyalty increases [30].

1.2. Mobile Bank Apps

Mobile apps have grown rapidly in recent years because of the exceptional expansion and development of the smartphone market [31]. Additionally, since the arising of COVID-19, the majority of users have resorted to working remotely via digital channels in order to stop the virus from spreading by remaining at home and adhering to social seclusion. Human sustainability seeks to protect and enhance society's human capital [22]. Therefore, mobile apps have been applied by many businesses to meet user needs, such as mobile healthcare apps (m-health), mobile government apps (m-government), and mobile banking apps (m-banking) [7]. Users can use banking services such as checking account balances, transferring money, opening accounts, or others that can be implemented on the m-bank applications. Mobile banking services save users' time and effort because they can

execute bank operations without having to visit a bank's branch, and they can be used anywhere [32]. Good-quality m-banking services can also help to retain and attract customers [33]. Furthermore, improvements in the provision of m-banking services contribute to increasing the bank's market share, reducing the cost of failure, lowering the costs of business, and attracting new customers to the bank. Users can be attracted and kept by offering high-quality m-banking services [8]. Moreover, improvements in the provision of m-banking services add to increasing the bank's market share, lowering the cost of failure, lowering business expenses, and attracting new users [7].

1.3. User–Developer Interaction in App Stores

Users are able to download an app from one of the app stores and then share their experience through an app review. After a user interacts with an app, they may quickly express their feelings about it and contact the developer directly via a review, providing a public evaluation that includes a text review as well as a star rating. The stars are assigned on a scale from 1 to 5. A user review could be positive or negative, with bug reports, feature requests, queries, and/or a complaint about the app [9]. Unfortunately, decisions to download an app are influenced by other users' experiences through reviews and ratings [7]. Users cannot post various reviews for the same app, but they may update or delete their existing reviews. Users can also assist or hurt the reviews of others by upvoting or downvoting them [34]. On the other hand, developers have access to all user reviews via the app management interface. Reviews can be filtered by developers depending on several criteria, such as user rating or app version. Reviews can also be sorted, for instance, by helpfulness. Developers are unable to remove reviews, but they are able to publicly respond to them. After a developer reads a review, they may do one of three things: not respond, publish a public response on the app store, or adjust the app based on the issues, such as feature requests, bug fixes, and app maintenance needs, identified from user reviews without informing users [35]. When the developer responds to a review, the user will receive an email and a push notification. Hence, the user can choose to do nothing or change their rating and review [36]. Figure 1 summarizes the interaction between the user and the developer.
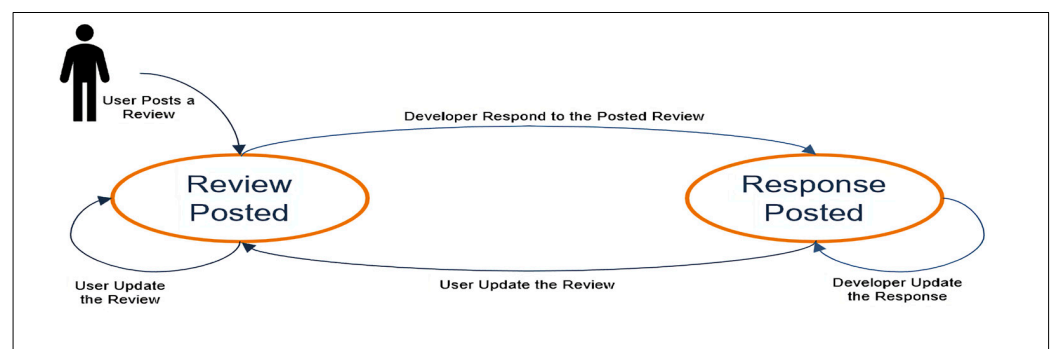

Figure 1. Interaction between user and developer.

2. Related Work

This section presents a review of related studies. For instance, Outay et al. [11] examined developer responses to user complaints. They analyzed 1825 unmanned aerial vehicle (UAV) mobile apps from the Google Play Store, with 162,250 evaluations/user reviews, and developers' responses, in the broadest and most comprehensive empirical research on UAV mobile apps. They categorized developer responses into seven major categories, namely, providing a solution, requesting details, a solution-in-progress notification, offering a refund, offering direct support, a solved notification, and other. They discovered that 35% of developer responses were related to directly solving the drone app user's difficulties. Only 1% of developer responses were due to monetary refund difficulties with the software.

Tony et al. [12] examined norms in developer responses, with a total of 24,407 reviews and 2668 responses for the top 20 apps in the Google Play Store. They established 12 norms in developer responses in three categories based on past studies in computer-mediated interactions (obligation norms, prohibition norms, and domain-specific response norms). For example, they noted that 81% of responses for all apps were made within a week. In addition, they found that the developers of 70% of apps were aware of greeting norms, since their responses included an appropriate greeting (e.g., "Hi"). The other 30% of responses lacked personalization and were reused with several users.

Hassan et al. [5] examined 4.5 million reviews in the Google Play Store, with 126,686 responses, for 2328 of the most popular free-to-download apps. They conducted a qualitative study of developer replies to figure out what motivates developers to respond to a review. For the 10 apps with the most developer responses, they carefully assessed a statistically representative random sample of 347 reviews with responses. They identified seven factors that prompt a developer to reply to a review, the most essential of which was thanking users for using the app and requesting further information about the reported issue. They also found four patterns: developers who respond only to negative reviews, developers who respond to negative reviews or reviews based on their content, developers who respond to reviews posted soon after their app's most recent release, and developers who respond to reviews posted long after their app's most recent release. In addition, they discovered that responding to a review boosts the likelihood of a user upgrading their rating by up to six times when compared to not responding at all.

McIlroy et al. [14] conducted an empirical study to investigate app reviews and responses to reviews from the perspective of developers of the top apps in the Google Play Store. Over two months, they analyzed reviews and developer responses for the top 10,713 apps in the store. Responses within the study period to 111,099 reviews were manually labeled. They used an automatic analysis to compute the average rating change for reviews with responses, the chance of a rating change, and the extent of the rating change. They found that developers of only 13.8% of the apps responded to at least one review. During the research period, none of the most-reviewed apps responded to a review. Following a developer response, users updated their ratings 38.7% of the time. In addition, they found 10 common types of developer responses.

Chen et al. [13] undertook an in-depth empirical investigation to assess the user interface (UI) difficulties of mobile apps. They examined more than 3 million UI-related evaluations from the Google Play Store's 22,199 top free apps and 9380 top non-free apps. They investigated the patterns of interaction between app developers and users when confronted with these UI difficulties. The review–response mechanism revealed eight trends in how app developers communicated with users about UI concerns. They discovered that apologies or appreciation and information requests were the two most common patterns. They concluded that upgrading the user interface regularly in response to feedback was critical to keeping users happy. Furthermore, app developers might repair UI issues without upgrading the UI, particularly for issue types that fall within the interaction category. Their findings indicate that app developers should actively engage with users to raise UI quality and increase users' satisfaction with the UIs.

Bailey et al. [37] focused on feedback loops, which happen when developers respond to a user's review. To conduct the study, they used both supervised and unsupervised algorithms to evaluate a corpus of 1752 distinct apps from the iTunes App Store, which included 30,875 release notes and 806,209 app reviews. Additionally, they automatically identified feedback loops using support vector machine (SVM) classifiers and a semantic relatedness algorithm based on reviews and release notes, and by using sentiment analysis. They found feedback loops in 18.7% of the apps. They discovered interesting behaviors in these feedback loops, such as that feedback loops with feature requests and login issues were twice as likely to be fixed by developers than general bugs; users who reviewed with an even tone were most likely to have their concerns addressed; and the star rating of app reviews had no bearing on the developer likelihood of completing a feedback loop.

Vu et al. [38] performed a preliminary investigation into the characteristics of mobile app reviews and human-written responses. They gathered 35,240 reviews from 22 apps selected from the Google Play Store. These reviews included 334 pairs of reviews and responses. They separated their dataset of 334 reviews into 600 segments, each of which was labeled with at least one intention. They discovered that an app review generally comprises numerous components, each with its own purpose. A response also contains numerous portions, some of which are meant to respond to the effect sections of evaluations such as complaints, requests, or information seeking. Responses frequently follow a similar pattern, and most of their content is prepared using pre-defined templates. It was also discovered that comparable evaluations can have the same or similar responses. Based on the findings, they suggested creating a semi-automated tool to assist mobile app developers in more successfully writing comments to user reviews.

Srisopha et al. [34] aimed to see whether a machine learning algorithm and features taken from user reviews can be used to predict developer response behavior, as well as to discover the learning link between these features and developer response. A random forest method was used on the generated features to make the forecast. Then, they conducted a feature importance analysis to determine the relative value of each feature and its subsets. The findings show different patterns in developer response behavior in a case study of eight popular apps. In addition, not only were rating and review length among the most relevant factors, but review posting time, mood, and writing style also played roles in response prediction. Furthermore, the diversity in feature priority ranking suggested that various app developers prioritized responses using different feature weights.

Srisopha et al. [36] aimed to investigate the possibility of predicting whether a developer's answer to a review would be successful. Additionally, they aimed to determine how developers can make their responses more likely to succeed. They observed changes in user review ratings and developer responses for the 1600 most popular free-to-download apps in the Google Play Store. They discovered that, following a response, ratings improved in 11,034 of 228,274 one- to four-star reviews. From the responses to these reviews, they extracted three sets of features: time, presentation, and tone. To predict the success of a developer's response using these attributes, they used the extreme gradient boosting (XGBoost) technique. To extract insights from the model, they used model interpretation approaches. However, they discovered that feature engineering and machine learning have the potential to allow developers to predict the likelihood of success of their response at the time of composition. Additionally, they defined the features that play the largest roles in determining the success of the response, such as the ratio between the length of the review and the response, the linguistic similarity between the review and the response, and the response's timeliness.

Liu et al. [23] used bed and breakfast (B&B) online reviews as a sample to investigate the relationship between service providers' responses and potential customers' perceptions. They collected 3696 reviews from 24 privately owned B&Bs in Chengdu. They used the content analysis method to measure response voice. They found three types of voices (defensive, formalistic, and accommodative). They indicated that the most successful communication style combines an accommodating speech with empathic statements. They believed that a key element influencing company reputation and long-term success is how service providers react to negative reviews on the internet.

Li et al. [39] intended to determine what responses strengthen customer relationships and whether they merely aid in managing reputational issues to keep potential customers from leaving. They demonstrated that consumers perceive sellers as being self-interested when they respond to online evaluations with promotional material, which lowers the quality of the relationship and repurchase intention. Moreover, they found that sincere responses that do not include promotional material, such as gratitude and apology, are highly correlated with good relationship quality and the likelihood of future repeat business. Piehler et al. [40] investigated the impacts of explanation and compensation on potential customers as particular accommodative management responses to negative online cus-

tomer reviews. They used scenario-based online experiment with 306 participants to look at how explanations and compensation affect prospective customers' buy plans in the hospitality industry's hotel sector. The findings show that the most successful management response is the one that includes both an explanation and compensation. Wu et al. [41] examined the best ways for retailers to respond to positive reviews in order to encourage customer repurchase intention. They conducted two laboratory studies, and found that a friendly communication style and an active and constructive reaction raise consumer repurchase intention.

3. Research Methodology

In this research, we followed developers' public responses to users' reviews for a sample of Saudi and U.S. bank apps available in the Apple App Store and the Google Play Store from January 2018 to April 2022. The U.S. banks were Bank of America, Truist Financial Corporation, Wells Fargo & Co., Capital One, TD Bank, U.S. Bancorp, PNC Financial Services, Bank of New York Mellon Corp, Citigroup, and JPMorgan Chase [42]. The Saudi banks were Riyad Bank, Arab National Bank, AlJazira bank, Banque Saudi Fransi, The Saudi British Bank, Alinma Bank, Al Rajhi Bank, AlBilad Bank, The Saudi Investment Bank, and The Saudi National Bank.

This study was designed to accurately describe the interaction between the developer and user using a generally accepted conventional inductive content analysis method [43]. Inductive content analysis is a qualitative method that aims to produce and comprehend the meanings of data. Inductive content analysis is usually used by researchers in studies where there are few or no prior investigations into the phenomenon under consideration [43]. Inductive data analysis starts with the raw data being organized through a process known as open coding. The method employs a set of codes to convert large amounts of verbal or printed material into more manageable data, from which researchers can identify themes and gain insight [44]. It summarizes and divides enormous amounts of text data into several categories that have similar meanings using a systematic categorization method of coding and detecting themes or patterns to afford information on and comprehension of the topic under investigation [19,43].

Quantitative statistical data were used to measure the responses to compare Saudi and U.S. banks. Additionally, the qualitative content analysis approach helped in finding and capturing how developers responded to the user reviews of Saudi and U.S. bank apps. This approach created themes from developer responses rather than preset classifications [10]. However, some of the responses were assigned to more than one group in accordance with the categories found in the responses. As shown in Figure 2, we manually analyzed the sample of developer responses in the following steps:

1. The developer responses were imported from a CSV file into the qualitative data management software MAXQDA. MAXQDA was selected because it is a powerful tool that can be used to analyze large volumes of qualitative data to extract response patterns [19];
2. The data were analyzed in general by combining and reading all developer responses. This was done to make sense of the whole concept [45];
3. The developer responses were read once more, word by word. This process entailed first identifying critical terms from responses that appear to convey how developers respond to user reviews [11];
4. The researchers took notes on any patterns, ideas, and preliminary understandings in order to generate codes. A code is a label assigned to the text to be examined, which can be a word or a phrase. For example, the code "email" is assigned when users are asked by developers to contact them through email. As the process progressed, labels for codes were created that reflected the data's core ideas [46];
5. The grouping approach was based on how codes relate to each other—codes were organized into groups, and then themes were generated [47]. For example, the codes "email" and "phone" are grouped in the "Contacting via other channels" category.
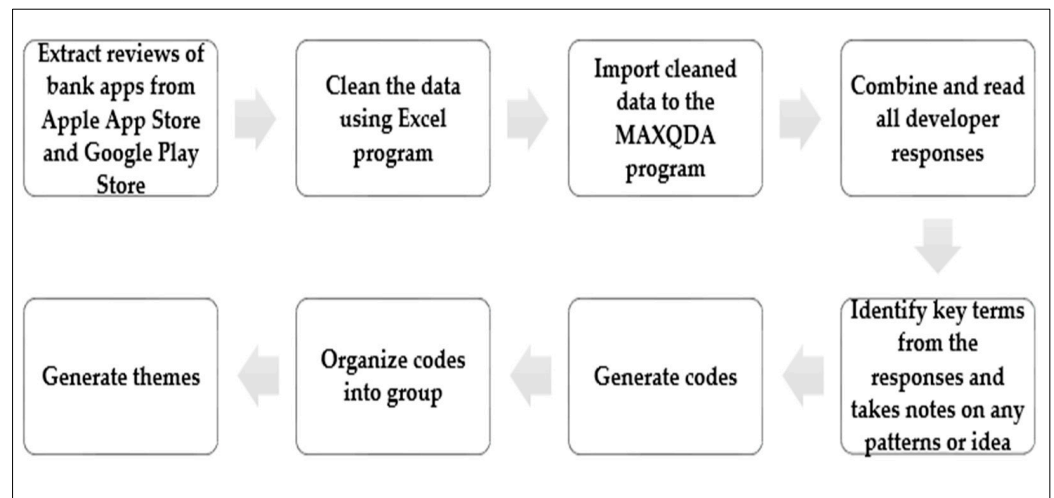
Figure 2. A brief overview of our approach.

Collecting Data

We obtained screenshots of developer responses from the Apple App Store, Google Play Store, and Microsoft Store to locate similarities and differences in how each app store displays developer responses. Then, as shown in Figure 3, we collected developer responses for Saudi and U.S. bank apps in the Google Play Store and the Apple App Store. We used the Python programming language to extract the developer responses from the stores. The following steps were employed to extract developer responses. First, we installed and imported the required packages. Next, we found the app name and app ID for the Apple App Store, whereas Google Play Store needed only the IDs of apps. Then, we scoured the reviews. Saudi banks were selected from the S.A. market, and both Arabic and English were considered. U.S. banks were selected from the U.S. market, and those in the English language were considered. After that was the process of transforming reviews from JSON into Pandas DataFrame. Finally, we saved the data in a CSV file and downloaded it file to a computer [17,18]. For each bank app, the following data were collected:

1.　In Apple App Store—review title, review text, review date, reviewer name, star rating, edit, and developer response text;
2.　In Google Play Store—review ID, review title, review text, review date, reviewer name, reviewer image, star rating, developer response text, and developer response date.
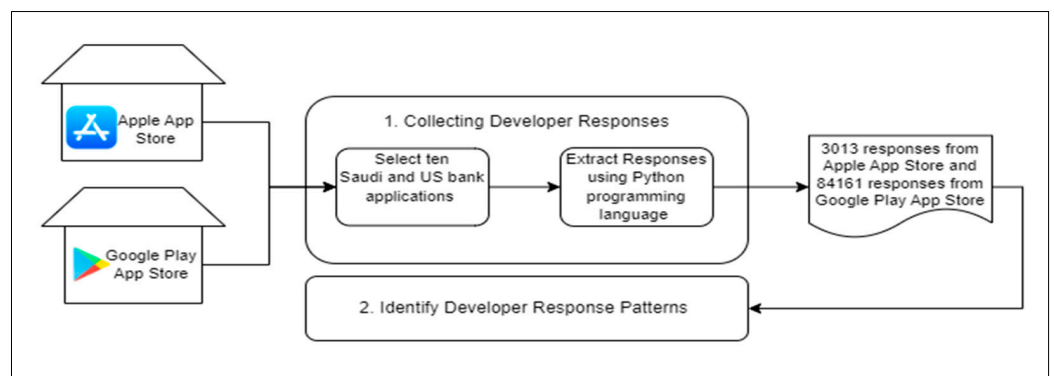

Figure 3. Overview of our approach to collecting developer responses.

The data in the CSV file were cleaned, unnecessary columns were removed, and the rows between 2018 and 2022 were selected; data from before 2018 were excluded since this was outside the research scope. We gathered a total of 81,874 developer responses from the Google Play Store and 2211 developer responses from the Apple App Store for the U.S.

banks, as well as 2287 developer responses from the Google Play Store and 802 developer responses from the Apple App Store for the Saudi banks. Figures 4 and 5 illustrate in detail the number of developer responses for each bank.
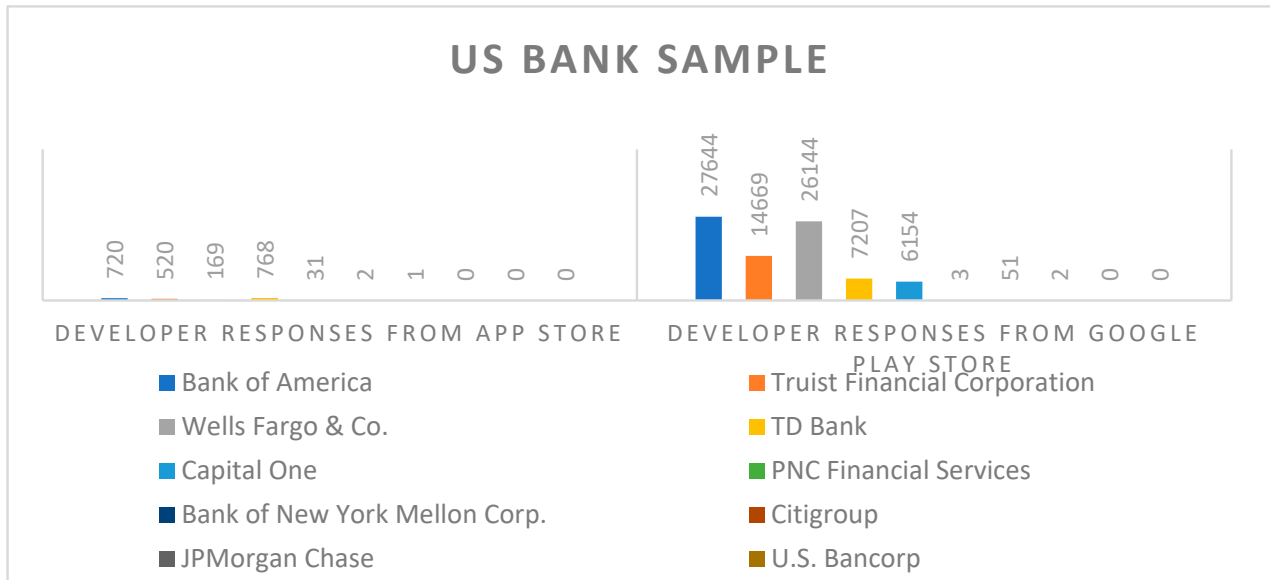

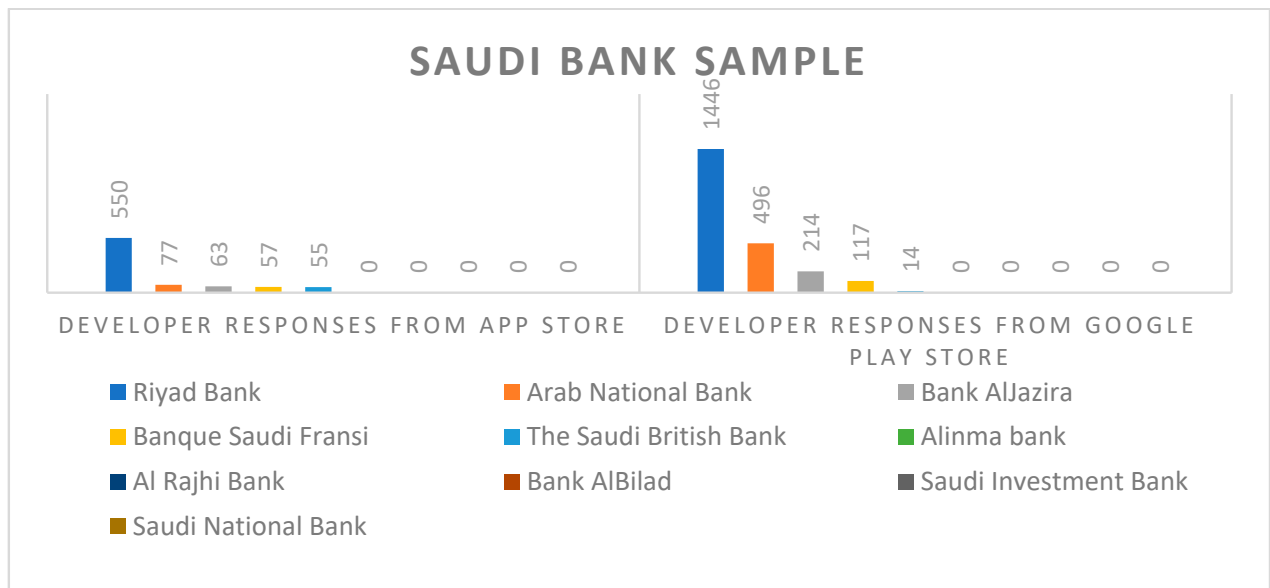**Figure 4.** The number of developer responses for U.S. banks.

Figure 5. Number of developer responses for Saudi banks.

4. Results

The results of this study are structured into subsections. The first part explains the similarities and differences between app stores in viewing developer responses. The second part shows the results of the qualitative analysis. The third part demonstrates the results of the quantitative analysis. The fourth part presents the comparison between the results of Saudi banks the U.S. banks.

4.1. Similarities and Differences between App Stores

There are certain distinctions and similarities between the Apple App Store, Google Play Store, and Microsoft Store, as indicated in the figure below.

Figure 6 shows an interaction between a user and a developer of the Dropbox app in the Apple App Store: (1) title of the review; (2) star rating; (3) date of review update; (4) name of the user; (5) body of the review; (6) date of developer response; and (7) body of the developer response. The user wrote about an issue; afterward, the developer responded and provided some solutions. Unfortunately, the Apple App Store does not illustrate an interaction loop between users and developers. Additionally, if the review period is more than a year previous, it does not indicate the exact dates for users and developers. Moreover, other users can like or dislike the user's review, but the number of those who like or dislike it is not shown to the public. In this example, after the developer responded to the user review, the user updated the review to clarify (after trying the solutions provided by the developer), but not all users expand on a previous review.

Figure 6. Interaction between user and developer of Dropbox app in Apple App Store.

Figure 7 displays an interaction between a user and a developer of the Dropbox app in the Google Play Store: (1) name of the user; (2) star rating; (3) date of review; (4) view update history; (5) body of the user review; (6) body of the developer response; and (7) date of developer response. In this example, a user wrote a review, and the developer responded. As shown, the user increased their star rating from one to four stars out of five. Thus, interaction can increase user satisfaction. Additionally, other users have the option of liking or disliking the user's review. The number of people who like a review is shown in the Google Play Store, whereas the number of people who dislike a review is not displayed. The most important feature in the Google Play Store is the ability to view the update history with clear dates and times. However, the store does not show an update history for developer responses.

Figure 7. Interaction between user and developer of Dropbox app in Google Play Store.

Figure 8 presents an interaction between a user and a developer of the Passwarden app in Microsoft Store: (1) star rating; (2) body of the user review; (3) name of the user; (4) date of review; (5) body of developer response; and (6) date of developer response. In this example, the user wrote a positive review after the developer responded to express thanks for the positive review. Additionally, Microsoft Store shows the number of people who like or dislike a review. However, the store does not show an updated history for user reviews and developer responses. Additionally, the store does not show the exact date and time for reviews and responses.
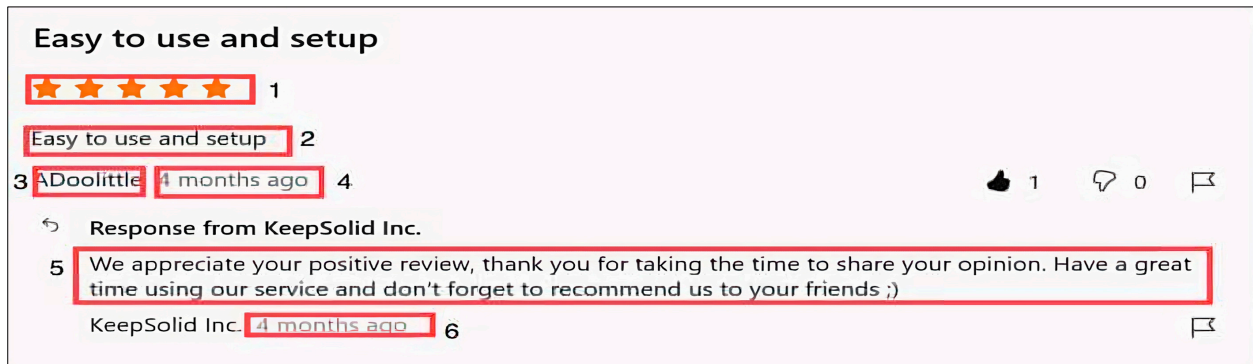

Figure 8. Interaction between user and developer of the Passwarden app in Microsoft Store.

The primary distinctions between the three app stores are summarized in Table 1.

Table 1. Comparison of app stores in viewing developer responses.

	Store / Feature	Apple App Store	Google Play Store	Microsoft Store
User	Can provide review and rating	☑	☑	☑
	Can update reviews and rating	☑	☑	☑
	Shows update history	☒	☑	☒
	Shows exact date	☒	☑	☒
Developer	Can respond to user reviews	☑	☑	☑
	Can update response	☑	☑	☑
	Shows update history	☒	☒	☒
	Shows exact date and time	☒	☑	☒

4.2. Qualitative Content Analysis

Figure 9 shows the result of qualitative content analysis for Saudi banks and U.S. banks. Developer responses have been classified into three main themes: no response, semi-interactive response, and interactive response.

The first theme is no response; developers here never engaged with users, answered their inquiries, or addressed their issues. The second theme is semi-interactive responses; developers responded to users, but the responses did not offer any special assistance, and some of the responses followed a pre-defined template. The third theme is the interactive response. In this theme, developers connected with users and responded to their inquiries by offering specific assistance and providing solutions to resolve issues. Additionally, this theme includes interaction in the form of feedback loops.
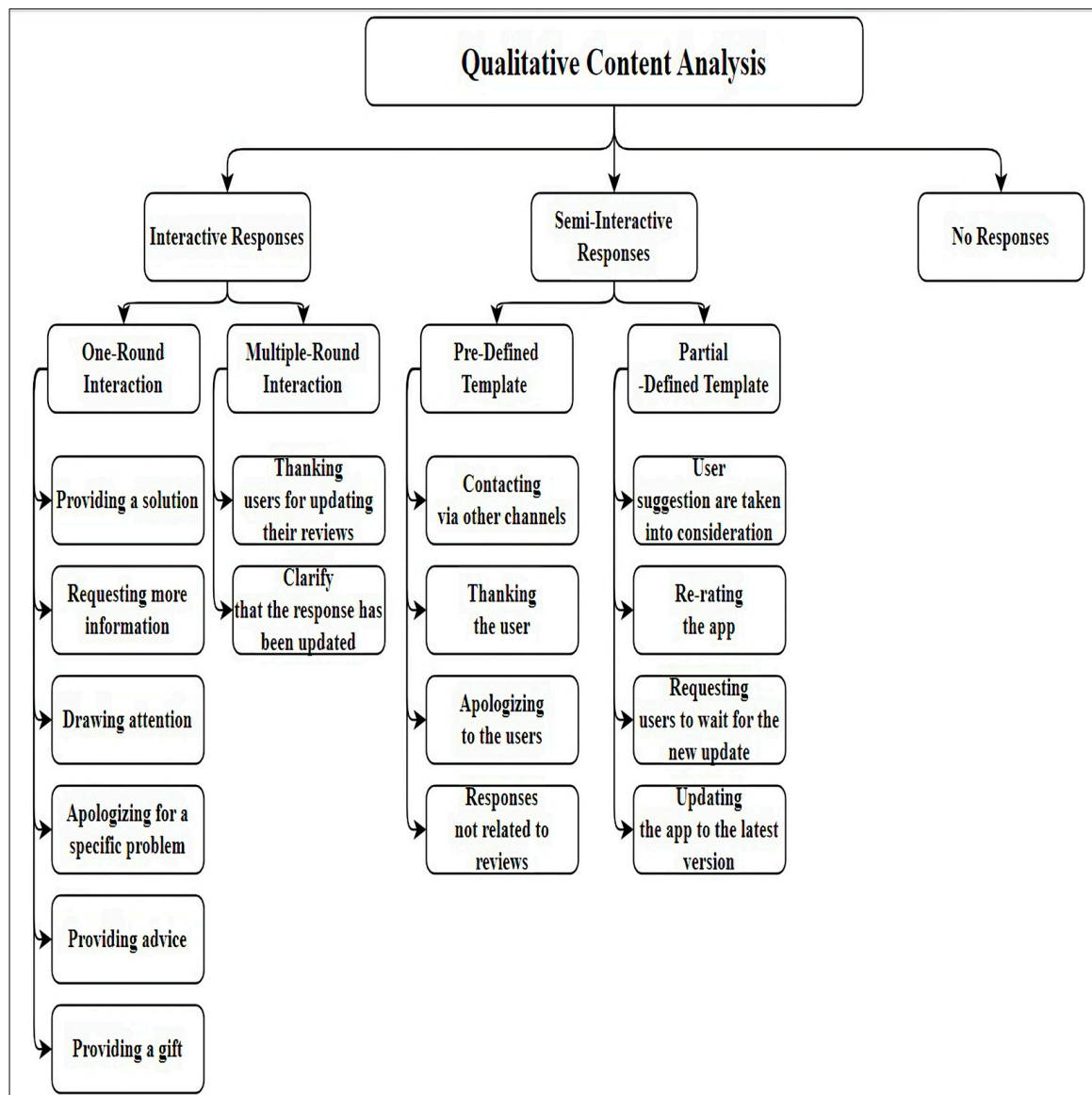
Figure 9. The result of qualitative content analysis.

4.2.1. Interactive Responses

For interactive responses, two sub-categories were created: single-round interactive and multiple-round interactive. In single-round interactive, developers interacted with users by responding appropriately to user reviews in one round of interaction. The developer responded to user reviews without editing the responses thereafter. In multiple-round interactive, the developer interacted with users by responding to reviews in an appropriate manner. The developer frequently updated their response, forming a chain reaction. The categories are discussed in the following sub-sections, with a brief description and an example for each.

Single-Round Interaction

We captured six types of single-round responses:

1. Providing a solution—developers provide solutions to solve users' issues. This solution came in a variety of ways, such as in sequential stages, in a direct solution, with more than one solution, or via a web link. Example—"Hi Jon, thanks for your feedback. When you are in the mobile banking app go to the Bill Pay section and

select Activity. Then select the calendar icon near the top on the right and where there's a dot on a date, that's where you have scheduled activity. Select the date and you will see the activity for editing below the calendar. Regards—Brad.";

2. Requesting more information—developers ask for extra information from users regarding the encountered problem. Example—"Hi Deann Marie, can you please provide more details on the issue you are having with the app? Why did it give that message? What were you trying to do? We are here to help. Thanks—Ashlyn.";

3. Drawing attention—users are informed that their issue has been resolved in the most recent app update. Example—"Hi Dyanna, we have addressed the issue with the mobile check deposit. Please update the app to the latest version (20.10) and make a deposit as you normally would. Please reach out if we can be of further assistance.—Ashlyn.";

4. Apologizing for a specific problem—users receive an apology from the developers for a specific issue that they experienced. Example—"Hello L G, We apologize for the troubles you've had with making a deposit. We continually work to enhance the mobile check deposit functionality in the app, so please watch for future updates. Thanks for your feedback.—Ashlyn";

5. Providing advice—developers advise users on how to safeguard their privacy and security. Example—"Do you need help with a specific concern? Email us the details (with your phone number, link to this public comment, and your reviewer name) at appstorefeedback@wellsfargo.com. Do not share sensitive info such as accounts or social security numbers in your email. Please delete the review showing the last 4 digits of your social security number.—Suzette";

6. Providing a gift—users are given a gift for their constructive suggestions to develop the app. Example—"Our apologies for the unpleasant experience with the new Riyad Mobile App, we would like to inform you that we are releasing an improved update within days. Please provide us with your user ID via email: app@riyadbank.com, Since you are a part of developing the Riyad Mobile App, you will be awarded 1000 Hassad points as an appreciation for your kind contribution."

Multiple-Round Interaction

We captured two types of multiple-round interactions:

1. Thanking users for updating their reviews—the developer thanks users who took the time to update reviews. Example—"Hi Donna, Thank you for your updated feedback! We are glad the problem is resolved. Please reach out here anytime you have an issue! Regards—Ashlyn";

2. Clarifying that the response has been updated—the developer indicates that their response has been updated and provides the date of the update. Example—"*Update 2/21/18: Hey Synthia. The payment option should be up and running smoothly. If you continue to experience an issue, please let us know by contacting our team on Facebook (www.facebook.com/CapitalOne) or Twitter (@AskCapitalOne). Just be sure to reference this review for clarification.*"

4.2.2. Semi-Interactive Responses

We divided this theme into two sub-categories: pre-defined template and partial-defined template. These categories are described in the following sections.

Pre-Defined Template

With a pre-defined template, developers provide general responses that do not provide any assistance to users. There were four types of pre-defined templates:

1. Contacting via other channels—the developer requests users to communicate through other communication channels to receive support, such as communicating over the phone, via email, or through a live web chat or social media. Example—"The app is running on all cylinders, so we'd like to recommend two options. Give us a buzz at:

866-750-0873 to be sure that we have your contact details on file correctly. You can also message us at: www.facebook.com/CapitalOne or @AskCapitalOne on Twitter referencing this review. Thanks!";

2. Thanking the user—developers express their appreciation to users for submitting their reviews by using a pre-defined template. Example—"Aaron, thanks so much for the positive feedback! We're glad you're enjoying the app. Feel free to reach out with any additional comments or suggestions by emailing asktruist@truist.com. Thanks, CP, Truist Mobile";

3. Apologizing to the users—developers express their apologies to users for the problems they encountered by using a template. Example—"Hello H Pacheco, we apologize for the inconvenience. We are continuously working on app enhancements and new features to add. Please keep an eye out for future updates as we continue to enhance our app and user experience! Thanks —Ashlyn";

4. Responses not related to reviews—this category includes responses from developers to user reviews that are unfavorable and do not meet any user needs. Example—user review, "The app is excellent and easy to use." Developer response, "Dear customer, we are sorry to hear this and we hope that you can contact us at 920,002,470 or through the email info@riyadbank.com and provide us with your feedback so that we can serve you better."

Partial-Defined Template

At other times, the developer provides general assistance by using a pre-defined template while changing some keywords such as the username. We captured four types of partial-defined templates:

1. User suggestions are taken into consideration—developers express gratitude to users for their feedback and inform them that the app will be updated in light of their recommendations. Example—"Hi Verrona, we are always looking to improve the mobile banking experience. We've forwarded your feedback to our developers. Please keep an eye out for future app updates. Thank you for taking out the time to send us your suggestions! —Rachel";

2. Re-rating the app—developers request that users enhance the rating they have been assigned. Example—"Hello Rick, We appreciate your review. We strive to provide a 5 star service and app experience. What would make this app 5 stars in your eyes? —Ashlyn";

3. Requesting users to wait for an update—the developer informs the user that the issue will be rectified in a future version, thus, he or she is advised to wait for the update. Example—"Hey Jon, we appreciate your feedback. We're always looking at ways to improve the app, so stay tuned for future updates!";

4. Updating the app to the latest version—developers ask the user to update the app to the most recent version in order to address issues. Example—"Hello William, We appreciate you taking the time to leave us a review. Please update the app to our latest version (20.05.2). Let us know if this improves your experience! Thanks —Ashlyn"

4.3. Quantitative Content Analysis

This sub-section shows the quantitative content analysis for Saudi and U.S. bank apps from Google Play Store and Apple App Store. The statistical data were calculated as follows. The total numbers of interactive and semi-interactive responses were divided by the total number of responses for each bank's app. In the no-response theme, developer responses were subtracted from user reviews to determine the number of reviews that were not responded to, then divided by the overall number of user reviews for each bank separately.

4.3.1. Google Play Store

This section shows the analysis of data from Saudi and U.S. banks in the Google Play Store.

Saudi Banks

Figure 10 shows banks, user reviews, developer responses, response rates, interactive responses, and semi-interactive responses. Five of the Saudi banks did not respond to user reviews at all: Alinma bank, Al Rajhi Bank, Bank AlBilad, Saudi Investment Bank, and Saudi National Bank. Five banks did respond to users' reviews. Arab National Bank was the best bank in responding, with a total of 6.57%, followed by Riyad Bank (0.82%), AlJazira Bank (0.29%), and Banque Saudi Fransi (0.12%). However, when it comes to semi-interactive responses, Arab National bank ranked the highest, with a total of 25.95%, followed by AlJazira Bank (12.41%), Riyad Bank (8.96%), Banque Saudi Fransi (7.20%), and the Saudi British Bank (0.58%), respectively.
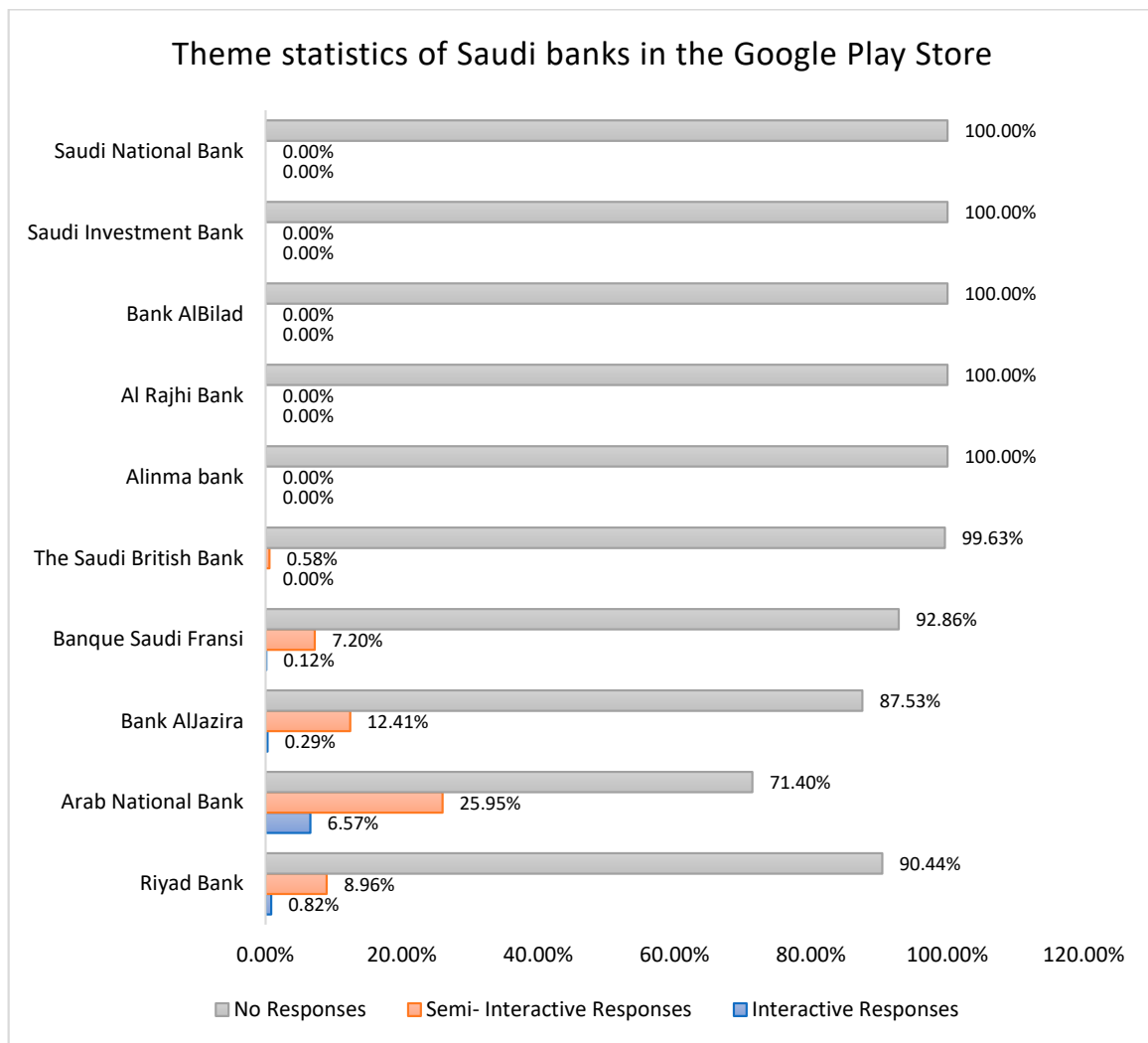

Figure 10. The percentage of developer responses in all themes: no response, semi-interactive response, and interactive response for Saudi banks in the Google Play Store.

U.S. Banks

As seen in Figure 11, the highest response rate in the interactive theme was shown by Truist Financial Corporation (59.14%), followed by Bank of America (6.59%), TD Bank (6.45%), Wells Fargo & Co. (1.20%), and Capital One (0.43%). Truist Financial Corporation also had the highest semi-interactive response rate with a total of 118.81%, followed by Bank of New York Mellon Corp. (50.00%), TD Bank (24.69%), Wells Fargo & Co. (14.40%), Bank of America (8.55%), Capital One (0.99%), and PNC Financial Services (0.20%). Citigroup and JPMorgan Chase did not respond to users at all.
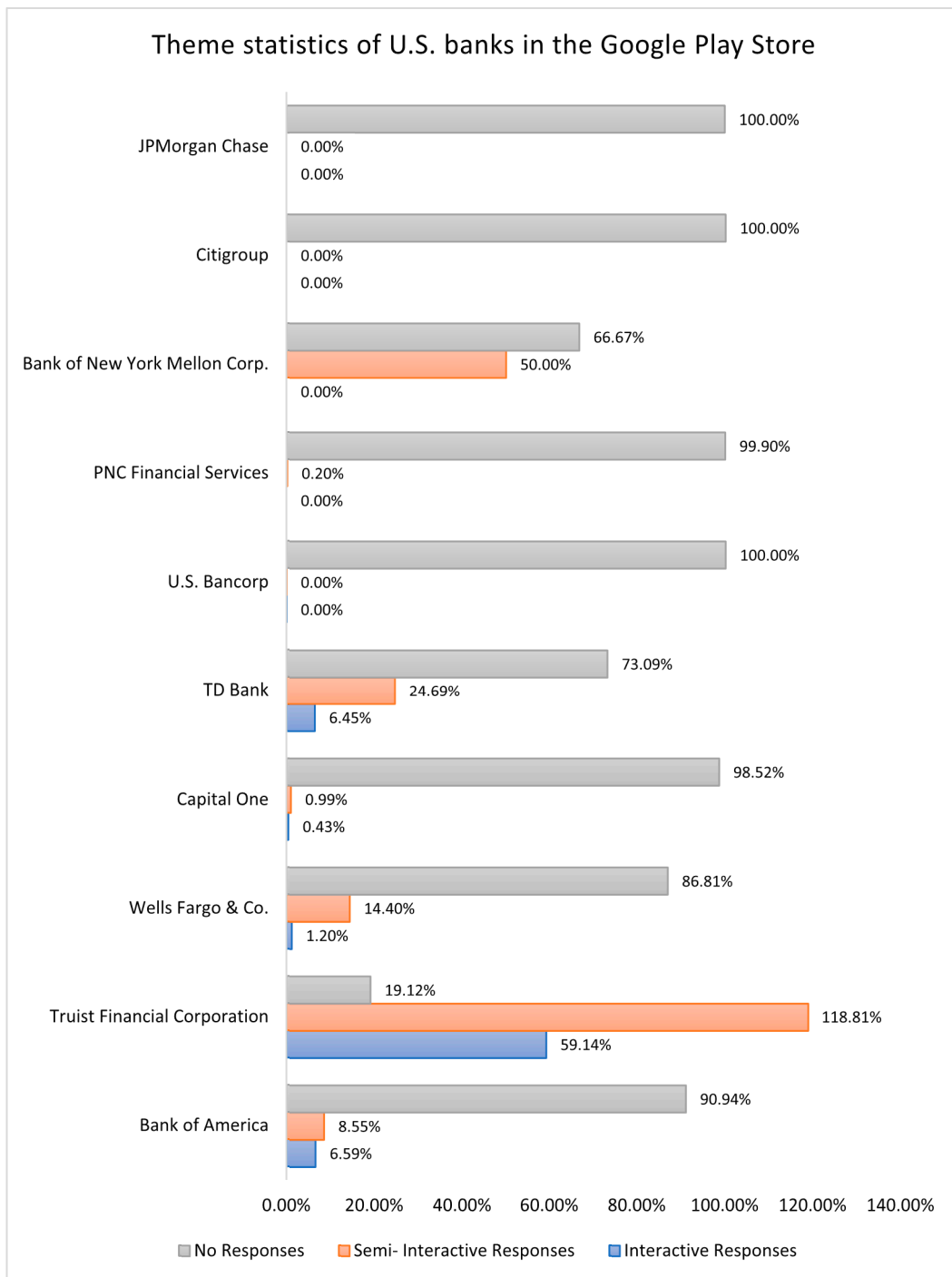
Theme statistics of U.S. banks in the Google Play Store

Figure 11. The percentage of developer responses in all themes: no response, semi-interactive response, and interactive response of U.S. banks in the Google Play Store.

4.3.2. Apple App Store

This section presents the data analysis for Saudi and U.S. banks in the Apple App Store.

Saudi Banks

As Figure 12 shows, five banks responded to reviews: Riyad Bank, Arab National Bank, Bank AlJazira, Banque Saudi Fransi, and Saudi British Bank. Arab National Bank had the highest score for interactive responses with a total of 5.04%, followed by Riyad Bank (3.08%) and Bank AlJazira (1.20%). On the other hand, Riyad Bank had the largest score in the semi-interactive theme (39.38%), followed by Arab National Bank (28.78%),

Bank AlJazira (23.26%), The Saudi British Bank (14.85%), and Banque Saudi Fransi (5.36%). The remaining five banks, which did not respond to user reviews, were Alinma Bank, Al Rajhi Bank, Bank AlBilad, Saudi Investment Bank, and Saudi National Bank.
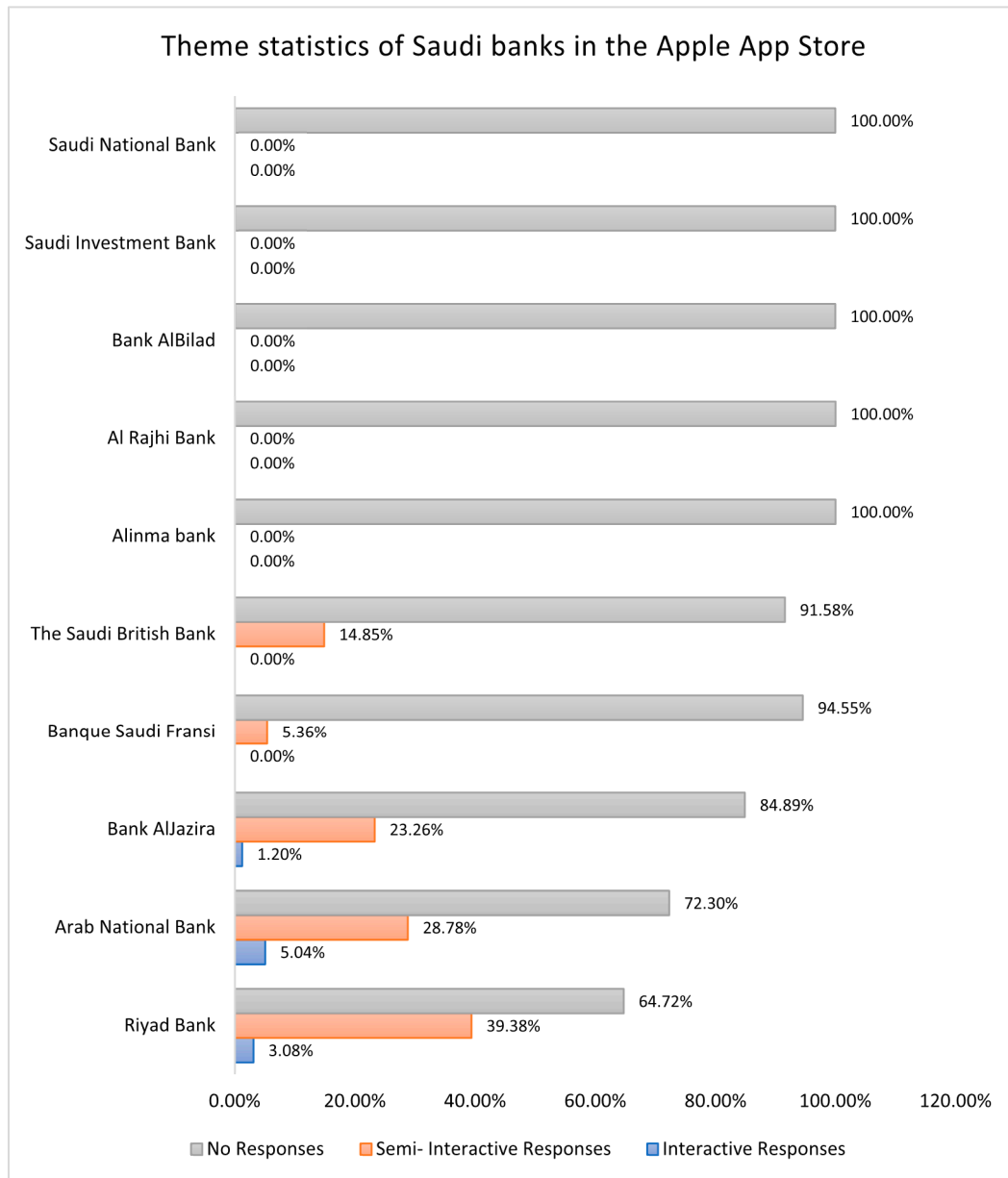

Figure 12. The percentage of developer responses in all themes: no response, semi-interactive response, and interactive response of Saudi banks in the Apple App Store.

U.S. Banks

This sub-section shows data analysis for U.S. banks, as shown in Figure 13. In the interactive responses theme, Bank of America had the largest score (22.39%), followed by Truist Financial Corporation (15.66%), Wells Fargo & Co. (4.06%), TD Bank (4.00%), Capital One (0.33%), and PNC Financial Services (0.07%). On the other hand, Truist Financial Corporation had the largest score in the semi-interactive response theme, with a total of 69.49%, followed by TD Bank (56.19%), Bank of New York Mellon Corp. (50.00%), Bank of America (44.84%), Wells Fargo & Co. (17.72%), and Capital One (2.00%). Developers from JPMorgan Chase, Citigroup, and U.S. Bancorp did not respond to user reviews.

Figure 13. The percentage of developer responses in all themes: no response, semi-interactive response, and interactive response of U.S. banks in the Apple App Store.

4.4. The Comparison between Saudi Banks and U.S. Banks

Figure 14 shows that U.S. banks outperformed Saudi banks in both the interactive and the semi-interactive themes, where the percentages for interactive responses were 73.81% higher, and those for semi-interactive responses 217.63% higher, than those of Saudi banks in the Google Store. Interactive responses from Saudi banks reached 7.81% and semi-interactive responses 55.11%. In the no-response theme, the Saudi banks outperformed by a percentage of 941.85%, while the American banks also excelled (835.04%).
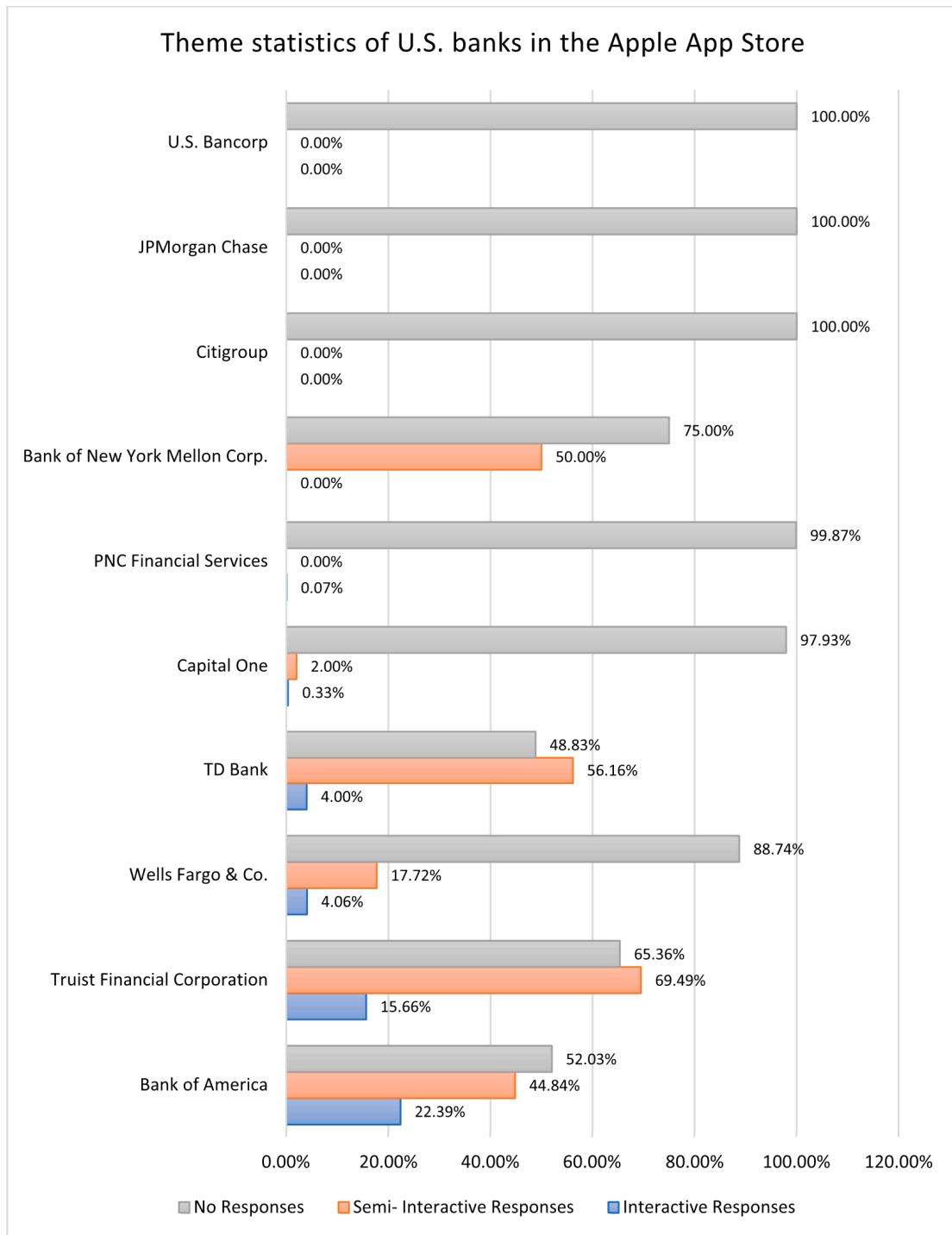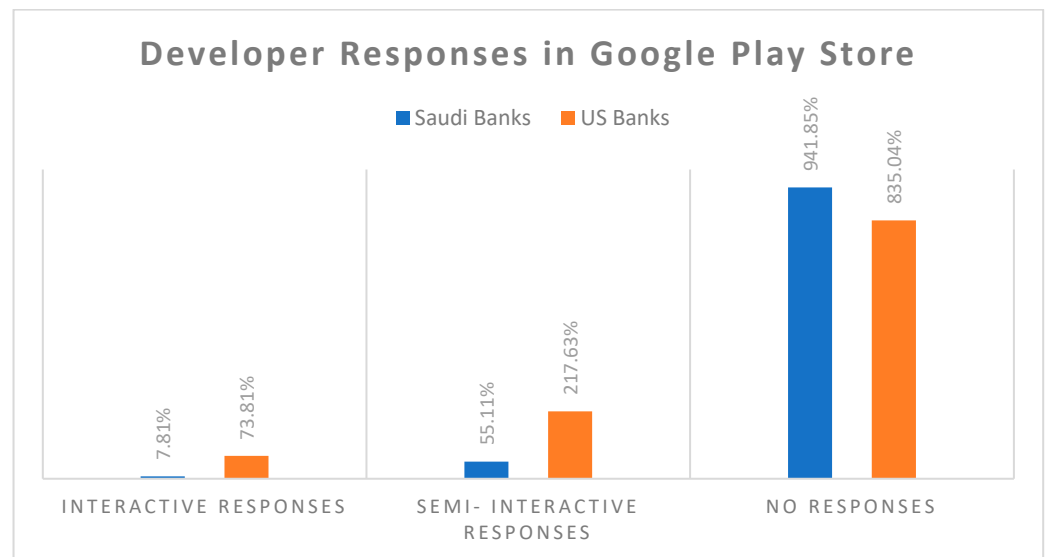
Figure 14. The percentage of developer responses in all themes: no response, semi-interactive response, and the interactive response of Saudi banks and U.S. banks in the Google Play Store.

Figure 15 demonstrates that U.S. banks also beat Saudi banks in the interactive and semi-interactive themes in the Apple App Store, with 46.50% of responses interactive and 240.21% semi-interactive. For Saudi banks, interactive responses totaled 9.31% and semi-interactive responses 111.64%. Saudi banks had the higher overall rate of no responses to user reviews (908.04% vs. 827.76% for U.S. banks).
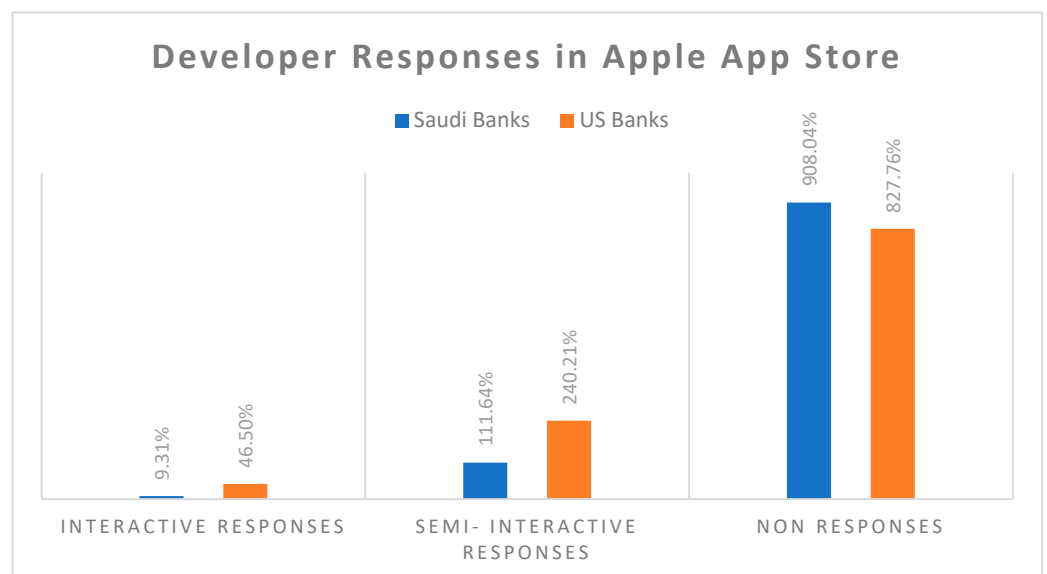
Figure 15. The percentage of developer responses in all themes: no response, semi-interactive response, and the interactive response of Saudi banks and U.S. banks in the Apple App Store.

Table 2 shows the statistics for response categories in the Google Play Store. The overall number of categories was 15, some of which were common between U.S. and Saudi banks, namely, providing a solution, requesting more information, user suggestion taken into consideration, drawing attention, contacting via other channels, thanking the user, apologizing to the user, and updating the app to the latest version. Six categories were unique to U.S. banks, namely, re-rating the app, thanking the user for updating their review, apologizing for a specific problem, providing advice, clarifying that the response has been updated, and requesting the user to wait for an update. In contrast, one category was

unique to Saudi banks, namely, response not related to review. Accordingly, U.S. banks have excelled at providing a variety of responses and engaging with their users.

Table 2. Statistics for response categories in the Google Play Store.

Theme	Category	No. of Responses	Percentage of Responses	No. of Apps (Saudi)	No. of Responses	Percentage of Responses	No. of Apps (U.S.)
Interactive Responses	Providing a solution	45	1.97%	4	14,955	18.27%	5
	Requesting more information	160	7.00%	2	14,702	17.96%	5
	User suggestion taken into consideration	32	1.40%	2	13,534	16.53%	5
	Drawing attention	105	4.59%	2	964	1.18%	5
	Re-rating the app	0	0.00%	0	8412	10.27%	2
	Thanking users for updating their reviews	0	0.00%	0	1793	2.19%	2
	Apologizing for a specific problem	0	0.00%	0	46	0.06%	1
	Providing advice	0	0.00%	0	6119	7.47%	2
	Clarifying that response has been updated	0	0.00%	0	48	0.06%	1
Semi-Interactive Responses	Requesting users to wait for update	0	0.00%	0	160	0.20%	1
	Contacting via other channels	1488	65.06%	5	48,608	59.37%	7
	Thanking users	390	17.05%	4	14,104	17.23%	7
	Apologizing to users	21	0.92%	4	10,393	12.69%	6
	Updating app to latest version	22	0.96%	4	662	0.81%	2
	Responses not related to reviews	51	2.23%	2	0	0.00%	0

Table 3 shows these statistics for the Apple App Store. The total number of categories was 13. Again, some were shared by the U.S. and Saudi banks. Eight categories were common: providing a solution, requesting more information, user suggestion taken into consideration, drawing attention, contacting via other channels, thanking the user, apologizing to the user, and updating the app to the latest version. Three categories were unique to U.S. banks: re-rating the app, thanking users for updating their reviews, and providing advice. Two categories were unique in Saudi banks: requesting users to wait for an update and providing a gift. U.S. banks have excelled at responding in numerous ways and in interacting with their users.

Table 3. Statistics for response categories in the Apple App Store.

Theme	Category	No. of Responses	Percentage of Responses	No. of Apps (Saudi)	No. of Responses	Percentage of Responses	No. of Apps (U.S.)
Interactive Responses	Providing a solution	40	4.99%	3	295	13.34%	6
	Requesting more information	0	0.00%	0	37	1.67%	2
	User suggestion taken into consideration	9	1.12%	4	402	18.18%	4
	Drawing attention	10	1.25%	1	68	3.08%	2
	Re-rating the app	0	0.00%	0	80	3.62%	1
	Thanking users for updating their reviews	0	0.00%	0	23	1.04%	1
	Providing a gift	17	2.11%	1	0	0.00%	0
	Providing advice	0	0.00%	0	49	2.21%	1
Semi-Interactive Responses	Requesting users to wait for update	5	6.23%	1	0	0.00%	0
	Contacting via other channel	780	97.25%	5	839	37.94%	6
	Thanking users	73	9.10%	4	973	44.01%	4
	Apologizing to users	32	3.99%	4	514	23.24%	5
	Updating app to latest version	43	5.36%	1	50	2.26%	1

5. Discussion

This study found that U.S. banks outperformed Saudi banks in both the Apple App Store and Google Play Store in several aspects of responses to user reviews of mobile apps. Moreover, Microsoft Store did not contain all the banks' apps when data were extracted in 2022. Furthermore, there were not enough reviews for analysis. Thus, Microsoft Store was excluded from the analysis. However, several banks have just created their apps in Microsoft Store. Generally speaking, most of the user reviews in the Microsoft Store contain complaints about the functionality of the app. Therefore, developers should look carefully at these responses, then take the necessary actions to repair these issues.

Regarding Apple App Store and Google Play Store, this research found that developers responded more interactively to user reviews. Additionally, there were more types of developer responses. One reason for having more types is that the U.S. banks' users provided clearer reviews with more accurate descriptions of the problems they encountered. By contrast, users of Saudi banks did not accurately describe their problems when posting reviews. For example, some users either used emojis or wrote a single word or phrase, such as ("terrible" or "does not work"). This could be one reason banks use pre-defined templates. Our observation about user reviews agrees with Chen et al. [13], emphasizing that there are several types of unhelpful subjective reviews, totaling 16.0% of reviews, which make it difficult for designers to pinpoint specific issues. Additionally, Hassan et al. [5] noticed that users frequently write reviews with a complaint but with insufficient details to allow the developer to respond; therefore, developers request more information from the user regarding the problem.

Generally speaking, the content of developers' responses starts with a greeting (e.g., "Hi") followed by the username. Then, the developer responds to the user's concerns. After that, the developer thanks the user. At the end, some developers provide their name. Our observation is in line with [12], who categorized this pattern of developer response in social etiquette norms corresponding to social aspects of communication. Moreover, this study observed many users having similar issues; thus, the developer modifies some part of a response, such as the username, then repeats it. This observation is in line with [35], who observed that developers' responses frequently have similar patterns, and most responses are generated using pre-defined templates. Additionally, they indicated that similar reviews might have the same responses. This observation was also reported by [38], who stated that numerous people might have the same issue in a single app. In these circumstances, it ought to be simpler for the developer to copy and paste the response to an earlier review.

Furthermore, this study observed that some users provide helpful information to improve app functionality. Therefore, the developer expressed their thanks and promised the suggestion would be considered. Sometimes, the developer asks users to wait for new updates to see what features have been added based on their recommendations. In addition, some developers provide a gift to those who provide an excellent suggestion (e.g., the Riyadh Bank developer in the Apple App Store). Another study described the same observation and found that developer responses can promise users that they will consider their suggestions or tell them that the development team is actively working on adding the features [11].

One interesting type of response to a user review is that the developer responds without solving any problems; the developer seeks to direct the user to communicate through other channels. Because the banking field is a susceptible sector, developers want to protect users' personal information. Vu et al. [48] found that finance apps can reuse all developer responses because developers did not seek to solve any problem directly by responding; instead, they referred users to an external customer support system for a more private and personal solution. The current study also noted that some developers asked users to send an email and to include screenshots to clarify the problem encountered. Unfortunately, app stores do not offer a tool for users to post an image. Often, a user needs to post images to express their issues clearly with attached illustrations. However, there is a risk in submitting screenshots to app stores because the user may upload an image including personal information, which could make them vulnerable to hacking. Chen et al. [13] found that visual information must be conveyed to solve UI difficulties. Developers must pick another route because the current app stores do not offer image reviews—for instance, emailing a confidential screenshot. However, considerable information is hidden when the conversation is removed from the app store.

Furthermore, this study discovered that developers provide various solutions in response to user concerns. For instance, they offer straightforward solutions and may include step-by-step instructions that help users handle their problem without difficulty. Other users might gain from the solutions offered, saving them the time and effort of

contacting developers and waiting for a response. This observation was in line with [11], who observed that a drone developer offered several instructions to fix an issue. Another type is represented by the developer inviting the user to click on a web link that contains instructions on how to fix the issue. It is worth mentioning that this observation is in line with a previous study [48] that suggested providing solutions for specific problems by following a website link so that users feel that responses were made specifically for them.

6. Recommendations

Based on the findings, this section provides useful recommendations. The recommendations are grouped into three main categories: recommendations for users, recommendations for developers, and recommendations for app stores.

6.1. Recommendations for Users

Since some users do not explain their issues accurately, the researchers provide several recommendations that can help users improve their reviews to increase the chance of developers responding:

1. Users should control their emotions and write an impartial and accurate review;
2. The user should write a detailed review and may include an emoji;
3. The user should write a review that accurately describes the problem encountered;
4. The user should not include personal information in public reviews, such as a username, password, or ATM card number.

6.2. Recommendations for Developers

Since user satisfaction is greatly influenced by developers' responses, there are some recommendations that developers can use to deliver better responses:

1. The developer's response should be more personalized rather than generic;
2. The developer should be courteous and use various syntactic and social cues, such as welcoming and thanking users for their helpful reviews;
3. The developer should use emojis to communicate with others since they are crucial to effective communication;
4. The developer should try their best to fix the problem within the app store and not ask the user to contact them via other communication channels, as this gives users the impression that the developer is avoiding responding;
5. The developer should avoid pre-defined responses that are often irrelevant to users' needs and do not supply a response appropriate for a review;
6. If multiple user reviews mention the same issue, the same response might be utilized to save developers time and effort;
7. The developer should clarify that a response has been updated by writing "updated on XX/XX/XXXX".

6.3. Recommendations for App Stores

Since the developer response option has recently become available in app stores, there is a need to enhance some of its functionality. Thus, we provide a list of useful recommendations below:

1. App stores should indicate the date and time of user reviews and developer responses;
2. The history of user reviews should be clarified in the Apple App Store;
3. The history of developer responses should be clarified in both the Apple App Store and Google Play Store;
4. The Apple App Store and Google Play Store should clarify the feedback loop between users and developers;
5. They should add a feature that enables the user to upload a screenshot of the issue they encountered;
6. They should add "like" and "dislike" buttons to developer responses;

7. They should note the number of people who liked and disliked user reviews and developer responses;

8. They should include a tool that allows other users to view reviews and respond to the developer in a filter menu;

9. The app stores should encourage developers to respond to user reviews by offering special gifts such as reduced registration fees.

7. Limitation

This research aimed to evaluate and compare the interaction between developers and users over app stores. We selected Apple App Store, Google Play Store, and Microsoft Store since they are the most popular stores. We were able to show the similarities and differences between these app stores in terms of how they demonstrate this interaction. In Microsoft Store, we were unable to find sufficient data to represent this interaction. Thus, we only kept the results of the first stage for the Microsoft Store.

8. Conclusions

This research aimed to evaluate developer responses to user reviews on both the Apple App Store and Google Play Store. Particularly, it evaluated the responses of developers to user reviews of mobile banking apps. The study used a content analysis method to analyze developer responses for 10 Saudi and 10 U.S. bank apps from the Apple App Store and Google Play Store. The findings show similarities and differences between the app stores in viewing developer responses. Additionally, they showed that developer responses can be divided into three themes: interactive responses, semi-interactive responses, and non-responses. The developers of U.S. bank apps outperformed developers of Saudi bank apps in the number and quality of responses.

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