Enhancing users’ experiences with mobile app stores: What do users see? What should they see?

by

Omar Ibrahim Y. Asiri

A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Human Computer Interaction

Program of Study Committee:
Carl K. Chang, Major Professor
James H. Oliver
Sunghyun Kang
Leslie L. Miller
Jonathan Kelly

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this dissertation. The Graduate College will ensure this dissertation is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University
Ames, Iowa
2018

Copyright © Omar Ibrahim Y. Asiri, 2018. All rights reserved.
DEDICATION

I dedicate this dissertation to my parents

        To my wife

        To my kids

        To my brothers and sisters
TABLE OF CONTENTS

| LIST OF FIGURES | ......................................................................................................................... | v |
| LIST OF TABLES | ......................................................................................................................... | vi |
| ACKNOWLEDGMENTS | ......................................................................................................................... | vii |
| ABSTRACT | ......................................................................................................................... | viii |

CHAPTER 1. GENERAL INTRODUCTION ............................................................................. 1
   Background and Motivation .......................................................................................... 1
   Research Questions ........................................................................................................ 2
   Research Contribution .................................................................................................... 2
   Limitations ..................................................................................................................... 3
   Dissertation Organization ............................................................................................... 3

CHAPTER 2. INVESTIGATING USERS’ EXPERIENCES AND ATTITUDES TOWARDS MOBILE APPS’ REVIEWS ........................................................................... 4
   Abstract ......................................................................................................................... 4
   Introduction ..................................................................................................................... 5
   Literature Review ............................................................................................................ 7
   Methodology ................................................................................................................... 12
   Results ............................................................................................................................ 15
   Discussion ....................................................................................................................... 24
   Conclusion and Future Work ......................................................................................... 28

CHAPTER 3. MOBILE APP STORES: WHAT DO USERS SEE? WHAT DO THEY NEED TO SEE? ............................................................................................. 33
   Abstract ......................................................................................................................... 33
   Introduction ..................................................................................................................... 33
   Literature Review ............................................................................................................ 35
   Methodology ................................................................................................................... 41
   Results ............................................................................................................................ 43
   Discussion ....................................................................................................................... 59
   Conclusion and Future Work ......................................................................................... 64

CHAPTER 4. A USABILITY EVALUATION FOR A PROPOSED INTERFACE DESIGN OF APPS’ STORE ............................................................................ 68
   Abstract ......................................................................................................................... 68
   Introduction ..................................................................................................................... 69
   Literature Review ............................................................................................................ 75
   Methodology ................................................................................................................... 81
   Results ............................................................................................................................ 86
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-1</td>
<td>The prototype's main screen.</td>
<td>72</td>
</tr>
<tr>
<td>4-2</td>
<td>Apps list after using the keyword &quot;Photo Editor&quot;</td>
<td>73</td>
</tr>
<tr>
<td>4-3</td>
<td>The app’s information page in this case “Adobe photoshop express”</td>
<td>74</td>
</tr>
<tr>
<td>4-4</td>
<td>The screen of posting a review</td>
<td>75</td>
</tr>
<tr>
<td>4-5</td>
<td>Examples of participants inputs for the icon recognition test</td>
<td>82</td>
</tr>
<tr>
<td>4-6</td>
<td>Exit questionnaire</td>
<td>84</td>
</tr>
<tr>
<td>4-7</td>
<td>Tasks' completion rate</td>
<td>88</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 2-1. Users’ experiences and attitudes with selecting mobile apps.............................. 16
Table 2-2. Users’ experiences and attitudes with perceiving and evaluating apps quality........ 18
Table 2-3. Users’ attitudes and experiences with comments section in the apps’ reviews ........ 19
Table 2-4. Users’ experiences and attitudes with the common complaints.............................. 21
Table 2-5. What can users know from the interface design of apps’ review? ......................... 23
Table 3-1 Participants’ Demographic Data (N=16).................................................................. 42
Table 4-1 Demographic data for participants ........................................................................ 81
Table 4-2 Icons recognition questionnaire............................................................................. 83
Table 4-3 Tasks list.................................................................................................................. 84
Table 4-4 Findings of users' satisfaction................................................................................. 90
I would like to thank my committee chair, Prof. Carl K. Chang and my committee members, Prof. James H. Oliver, Prof. Sunghyun Kang, Prof. Leslie L. Miller, and Prof. Jonathan Kelly for their guidance and support throughout the course of this research.

In addition, I would also like to thank my friends, colleagues, the department faculty and staff for making my time at Iowa State University a wonderful experience. I want to also offer my appreciation to those who were willing to participate in studies, without whom, this dissertation would not have been possible.

Last but not least, I would like to thank the University of Tabuk, and the Ministry of Education in Saudi Arabia for granting me the scholarship to pursue my academic studies in the U.S.A.
ABSTRACT

Using mobile applications is one of the daily habits for most smartphone users. In order to select applications, individuals need to explore the apps stores. Apps’ exploration is disturbed by the way of illustrating the applications’ information. This dissertation consists of three studies that aimed to: 1) Investigate the users’ experience with the apps’ stores; 2) Collect the users’ needs and requirements in order to have a better experience with the interface of apps’ stores; 3) Propose and evaluate a new interface design for the apps’ stores. Different types of data collection methods were administered while proceeding with the phases of this dissertation.

The first study was an exploratory study, which administered an online survey, where we had 102 respondents. The second study, aimed to collect the design requirements, and we interviewed 16 individuals. The third study was the interface evaluation, where we also had 35 participants. Our results showed multiple factors that affect users’ experience while discovering applications on the apps’ store. Our findings suggested that the current interface design of apps’ stores needs revisions to help users to be aware of apps’ emerging features and issues. Moreover, we found that visual cues that illustrate apps’ information would be more effective to help users perceive specific information about apps. Furthermore, visual indicators would enhance users’ knowledge regarding some of the apps’ concerns. At the end of this research, we evaluated a proposed interface design that integrates the previous design recommendations. The evaluation results illustrated positive outputs in terms of users’ satisfaction and task-completion rate. The findings indicated that participants were delighted to experience the new way of interaction with the interface of apps’ store. We anticipate that users’ experience and their awareness towards the apps issue would be improved if apps’ stores considered adopting the proposed design concept.
CHAPTER 1. GENERAL INTRODUCTION

Background and Motivation

Do users have the best experience with apps stores? Individuals buy smartphone devices and utilize them by installing selected apps from the apps’ stores. Sometimes selecting an app is not an easy task. The reason is because apps stores offer hundreds of apps that do similar tasks. It is estimated that both Google Play and Apple’s apps stores have around 6 million apps[1]. With the abundance of apps, users are confused about which app they should install. Users cannot easily distinguish the differences between apps. The way of displaying the apps’ information is one of the reasons that lead to have this confusion[2]. Most times users build their decisions based on the information that they see on the interface of the apps’ stores. For example, users might build their decision based on the apps’ star rating, screenshots, or number of downloads. Some users, who are critically looking for specific criteria, spend more time reading through the apps’ reviews. However, reading the reviews would be a painful task for users. A study reported that some apps, especially famous apps, could have more than 2000 reviews each day [3].

Occasionally, users have no criteria to choose an app. They make a selection depending on their friends’ recommendations, the popularity of an app, or browsing the apps store [4], [5]. A recent study found that users are not always aware of some of the app related issues, such as the apps permissions. One reason that leads to the lack of awareness is the way of displaying the information in the interface of apps’ stores[2].

This dissertation aims to investigate the users’ experience with the interface of mobile apps stores. Then, propose a new interface design that would enhance the users’ experience while discovering apps in apps’ stores. The proposed interface is based on the investigation of the users experience and their needs for future design development. The proposed interface is
also based on the philosophy of “A picture is worth a thousand words.” Our ultimate goal is to help users to have as much knowledge as possible about the apps without the need of reading much text in the apps’ stores.

**Research Questions**

The idea behind conducting this research is to propose a new interface design for the apps’ stores. An interface that will help users have quickly knowledge about the apps without the need of reading much textual information. In order to achieve the goal of this research, we addressed the following questions:

- RQ1: What are the users’ experiences and attitudes towards the apps’ stores?
- RQ2: What do users see and what they should see on the interface of apps’ stores?
- RQ3: To what extent will users be satisfied with a proposed interface design for the mobile apps’ stores?

**Research Contribution**

This research contributes to the body of literature in many dimensions. To summarise the research contribution. First, this research reports the results of investigating the users’ experience and attitudes towards the apps’ store. This investigation will help users to have a better understanding on the current experience with the apps’ stores. Moreover, this study explored and reported data regarding users’ needs and design requirements in terms of having a better interface design. Finally yet importantly, this research introduces and evaluates a new interface design for the apps’ stores. It is hoped that the proposed interface could be used as a guideline for what users see on the interface of the apps’ stores. Findings and detailed contributions are reported explicitly in chapter 2, chapter 3, and chapter 4.
Limitations

The limitation of this study includes the lack of diversity. All participants in this study were well-educated individuals. The research might have different outputs if it includes individuals who vary in their educational level, race, and location. Moreover, while it is out of the study’s scope, it is possible that there would be additional points of view if the sample includes older adults and children.

Dissertation Organization

The dissertation is composed of five chapters and organized in the alternative journal paper format with the first chapter being an introduction. The following chapters are three individual manuscripts (chapters 2-4) with references cited at the end of each one, followed by general conclusions (chapter 5).

References


CHAPTER 2. INVESTIGATING USERS’ EXPERIENCES AND ATTITUDES TOWARDS MOBILE APPS’ REVIEWS

Modified from a manuscript published in

International Conference on Human-Computer Interaction

Omar Asiri and Carl K. Chang

Iowa State University

Ames, IA

Abstract

One of the daily routines of the smartphone users is using the mobile applications. Individuals explore the app stores and select a potential app. The selection procedure is affected by the information that the app stores display for each app. Reviews of the apps are an important factor in making decisions to select an app. Likewise, Users experiences and attitudes are affected by the information that they read and see on the interface of apps’ reviews. In our study, we aim to investigate the users’ experiences and attitudes towards mobile apps’ reviews. To achieve our goal, we constructed a survey consists of statements divided into five categories to collect a variety of data about the users’ experience and attitude. The questionnaire’s categories were designed to generate data regarding users’ experiences and attitudes when selecting apps. Likewise, to investigate the criteria that users set to evaluate the apps’ quality. Moreover, participants were asked about their experiences with the comments section in the apps’ reviews. Also, investigating if there are complaints regarding the reviews’ comments. Furthermore, we investigated what users can know from the interface of the mobile apps reviews in the app stores.

We had 102 participants in our survey. Our results showed that free apps, especially if there is a need for the app, have the most chance to be installed even with a lower rate. We also found that,
besides the apps’ rating and download statistics, users tend to adapt self-judgment for determining the apps’ quality. Regarding the reviews’ comments, users wish there is a way to limit the length of the reviews. Users like the reviews that are short and specific. We found that the current interface design of the review needs revisions to help users to be aware of critical apps-related issues such as apps’ permissions.

**Introduction**

Adam loves photography. Recently he bought a new smartphone that has a very powerful camera. Adam wanted to take pictures and post them on his Instagram account to show his talent to his followers. He needed to have a powerful app to do some photo editing before posting the images to his account. He searched for an app in the app store; he found multiple apps that look very useful. However, He was confused which app he should install. He found that the first five of them has a very high rating and so many positive comments, but still, he needs to decide and install one of the apps he found. The problem is that he does not want to try them all. He wanted to find an easy way to know which app is better. He has concerns regarding the privacy, permissions required, and the battery consumption but he could not find a usable way to compare the apps and know which one is the best for his need. He tried to read the reviews, but there is a vast amount of reviews listed for each app. He could not find another way to read the reviews quickly and decide which one may help him. Adam ended up with installing the apps one after another until he found a mid-rated app that he liked the most.

A numerous portion of mobile apps’ users has experienced Adam’s experience at least once while they want to install an app. There is a huge increase in the apps developments. Every day we have new apps posted to the app stores. The number of apps that users can access on apps stores is very huge. As of March 2017, a recent statistical data shows that Google play has 2.8 million apps and Apple’s App Store has 2.2 million apps [1]. In addition to that, many of the
companies and developers try their best to have their apps ranked with a higher rating. Either by producing very good apps or by manipulating the reviews. In addition to that, there is a numerous number of reviews added every day. A study reported that the popular apps, like Facebook, receives on average more than 4000 reviews per day [2]. Thus, it is a hard job for users to read all reviews.

In our study, we aim to investigate the users’ experiences and their attitudes towards mobile apps’ review. When we mention mobile apps’ reviews, we mean the whole interface design that illustrates information about an app. In another way, we mean all elements that app’s info page contains such as the star rating, the comments, the number of downloads, versions history, permissions, etc.

In this paper, in order to get better understating, we investigate the users’ experiences and their attitudes towards mobile apps’ reviews in several dimensions. To achieve our goal we address the following research questions.

- RQ1: What are users’ experiences and attitudes when selecting mobile apps?
- RQ2: What criteria do users set to evaluate apps’ quality?
- RQ3: What are the users’ experiences and attitudes towards the comments of mobile apps’ reviews?
- RQ4: What are the users’ complaints regarding the apps’ reviews?
- RQ5: What can users know from the interface design of apps’ reviews?

This paper is organized as follows. In section 2, we illustrate the current and relevant research on mobile apps’ reviews. In section 3, we describe the methodology and how it was constructed. In section 4, we report our research findings. In section 5, we discuss our findings. Then we conclude this paper with our final thoughts and future directions.
Literature Review

The Importance of the Apps’ Rating

Apps rating plays crucial roles to determine the apps successful in apps’ stores [3, 4]. There is a strong correlation between apps rating and the number of downloads [5]. Moreover, the rating is a key role when users decide to purchase an app [6] or make an online purchase [7]. For many developers, the revenue will be tied with the star rating that their apps achieved [6]. Apps with better reviews will achieve better ranking which could result in better sales [8].

A research study found a relationship between the quantity of feedback that an app got and the app’s overall rating and its price [9]. They reported that users tend to provide more feedback for lower rated apps. Moreover, reviews are 12 times more trusted than the description provided by the app’s developer [9].

The Challenges in the Apps’ Reviews

Increasing the number of reviews could limit the benefit for users because they will not be able to read all reviews. Iacob et al. [9] stated that the ability to read the reviews become limited when the app has a massive quantity of reviews. Moreover, quantity and length of reviews make spotting the weak points of product harder for people.

Reviews are very challenging and hard to be analyzed. On average, Apps receive 23 reviews per day, and the popular apps like Facebook receive on average more than 4000 reviews per day [2]. Since apps receive this huge amount of reviews, there are associated issues that make dealing with apps reviews difficult. Reviews are unstructured, vary in the quality, and hard to identify the useful ones [2, 10]. While users leave reviews in varying length, these reviews are not free of informal expression, using abbreviations, and misspelling [11]. Moreover, online reviews are not trusted every time. As stated in [12], the online products’ reviews may provide misleading information and do not always revealing the products’ real quality.
What Can We Get Out of Apps’ Reviews?

Tian et al. [13] conducted a study to understand differences between high rated and low rated apps. They found that “high-rated apps have larger sizes, more complex code, more requirements on users, more marketing efforts, more dependence on libraries, and adopt higher quality Android APIs.”

Reviews are not only beneficial for users but also developers can get valuable feedback. Apps’ reviews could help developers with determining users’ requirements, improvement suggestions, requesting desired features, expressing users experiences[2, 5, 14]. In addition to that, some users report issues related to the app’s GUI, app’s speed, or provide a comparative review with other apps [9].

One way to distinguish good apps from bad apps is their ratings. However, the rating is not always reflecting the reality of an app. Users might be unsatisfied with an app even if the app has a decent rating. A study suggested that app’s trust should be built on several criteria not only on the app’s rating. Apps’ rating is not a reliable metric [15].

Users’ Behavior with Exploring and Experiencing Apps

Apps’ Selection

There are several ways for discovering a new app in the apps stores. Recommendations from known individuals, and browsing the apps’ stores are the most discovery means for apps installation [16, 17]. Approximately 25% of the reviews have recommendations for using the app to other users [9]. Moreover, Chin et al. [16] claimed that the price of an app and the app’s popularity are considered aspects of app selection and installation.

Hoon et al. [18] analyzed 8.7 million reviews from 17,330 apps; their results showed users tend to leave short reviews for mobile apps. Additionally, the category of the app has an impact on the length of the review. The reviews are higher rated and longer in some apps
categories than other. Moreover, as stated in [12], usually users provide a review when they are either extremely happy or extremely unhappy with the product.

**Apps’ Updates**

In a study of the user’s attitude and behavior towards applications’ updates, about half of smartphone users set their phones to be automatically updated because they want their apps to be always up-to-date [19]. In addition, the study found that there are users who do not update apps due to privacy and permissions concerns. Another research found that users tend to install apps that are recently updated but not requesting frequent updates [20]. A recent study analyzed 10,713 mobile apps in 30 categories of apps found out that 14% of the mobile apps are frequently updated [21]. Moreover, they found that 45% of the frequently updated apps do not inform the users about the reasons behind the updates. As reported in [20], users have mixed feeling regarding apps update. Users often desire new updates for the apps. However, they are afraid of facing update-related issues. Nayebi et al. [20] found that both device and apps crashes are the frequently reported issues emerging after the updates. Trusting the app’s developer, the type of the apps’ reviews either negative or positive, and the type of permissions requested are factors that influence users’ decision when they chose to update an app [16, 19].

**Privacy and Permissions**

To understand to what extent users value their information on their smartphones Chin et al. [16] found that users are more concerns about privacy in their phones than other devices like a laptop. Surprisingly, while users tend to see and read the permissions on the screen, research revealed that users have limited knowledge about privacy and security, and they do not understand permissions [22, 23]. Kelley et al. [22] found that people are unaware of the security risks associated with apps. Users believe that all apps on the app store are already tested and should be trusted. As claimed in [22], users are not prepared to make decisions regarding privacy
and security. Moreover, not all users are unaware of privacy. There are users know that mobile apps violated their privacy unethically, but they still use these apps [24]. In fact, most users ignore permissions completely [25, 26]

Many of smartphone users are willing to share data with developers in the right way specifically when the data used for the agreed purpose. Research reported that users were surprised and felt violated when they found out that apps in their mobiles are accessing data without their knowledge [25, 27]. A recent study examined 10000 android apps and had found a relationship between permission popularity and the number of times it was misused [28].

One of unethical and misuse for the permissions is collecting users data. There are apps that are interested in collecting data from users phones [26].

**Battery Consumption**

An issue that might happen to some apps’ users is when the app drains the cellphone’s battery. Nagappan and Shihab [29] claimed that not all developers know how to program an energy efficient app. Thus, there is a need to make developers aware of the good habits to program an energy efficient apps. The apps may have access to multiple resources of the users’ devices. Users might not be able to recognize which resource in the app is draining out their devices’ batteries. Since resources vary in consuming the power of the device, Li et al. [30] studied 405 apps to investigate energy consumption. One of their findings is that networking is the component that consumes much energy.

**Users’ Complaints**

In the body of literature, many studies have done text mining to investigate the complaints that users reported in the apps’ reviews. Examples of the users’ complaints were reported in [31, 32]. In [32] a categorization of 12 types of users’ complaints have been identified. The identified complaints are
To determine which complaint is reported the most, studies found that more than 50% of the users’ complaints fall into three categories; reporting functional errors, requests for specific features, and reporting app crashes [31, 32]. From the 12 types of complaints, the most negatively perceived complaints were privacy and ethics, hidden cost, and feature removal [31]. Some apps got a low rating because the users have experienced some of these complaints. Although some apps are free to download, users need to pay monthly subscription fees to have the full membership privilege. Some users do not perceive that before installing the app. That led them to give a lower rating for the app. As reported in [31], more than half of low rating for Hulu plus was due to the hidden-cost, which is the monthly subscription fees. As claimed in [31], there is a correlation between users’ complaints and the apps updates. They also found that users report their complaints after a recent update.

**The Need to Redesign the Reviews’ Interface**

Users may have some issues with the design of the interface of the apps’ reviews. A study showed that 13%–49% of the sentences of online reviews have feedback related to usability or user experience [33]. Some users may have difficulty to figure out why specific resource of their phone is being accessed. Liu et al. [34] suggested that app stores should design a simple interface especially when it comes to permissions and privacy information illustration. They claimed that simple interface would help users to make better decisions when it comes to granting permissions and control the resources of their devices. There should not be a trade where users give up the control for the sake of usability [34]. A Research claimed that users have limited knowledge about the security risks that are associated with app selection. Thus they suggested that apps stores should consider redesigning privacy communicating icons [23]. Also,
they encourage apps’ stores to display these icons at the beginning of the installation cycle so users can make decisions in the earlier stages. In [23], Rajivan and Camp recommended that privacy communication icons should fit the user mental models of security. Hence, users need visual cues that are simple, and easy to comprehend to reduce risks and concerns that are associated with app choices. In [23], Rajivan and Camp stated “privacy communicating icons should align with user mental models of security.” As suggested in [27], users need to be informed about the reason of why each resource is being used because that could help to ease the users’ privacy concerns. Due to the numerous amount of reviews in apps stores, users need a clear interface to be able to make decisions about apps quality [14].

It is worth to mention that none of the previous research has study the user experience with the interface of the apps’ reviews, which is one of this research goals. We think that the users’ experiences with the apps’ reviews would be differ if the design is different. The number of the complaints would be reduced, and the users’ awareness regarding some of the apps related technical issues would be increased.

**Methodology**

The goal of this study is to investigate users' experiences and their attitudes towards mobile apps reviews. Thus, we used an online questionnaire as a method for collecting our data. As stated in [35], it is appropriate to use questionnaires to explore people’s attitudes and beliefs. In [36], Müller et al. stated that

> “Surveys can gather insights about people’s attitudes, perceptions, intents, habits, awarenesses, experiences, and characteristics, at significant moments both in time and over time.”
Subjects

The total number of completed responses is 102. Majority of the participants were students at Iowa State University and representing well-educated population. The primary recruitment method was via sending a mass email. We sent the link of the survey to the email list of the graduate students in computer science program and to the email list of Virtual Reality Application Center (VRAC). We also adopt snow bowling method in recruiting the participants by inquiring people who may participate to forward the study link to other people who might be interested in participating as well. While the snow bowling was helpful to recruit more respondents, it made the majority of the participants are individuals who are well educated.

Out of 102 respondents, 60 (58.82%) were male, and 42 (41.18%) were female. Regarding the operating system of participants’ smartphones, 57 (55.88%) were using IOS, 43 (42.16%) were using Android, and 2 (1.96%) were using Windows phone system. Regarding the age range; 29 (28.43%) aged between (20-24), 30 (29.41%) participants aged between (25-29), 36 (35.29%) aged between (30-34), and 7 (6.86%) were older than 35 years of age. In term of the highest degree that the participants have received, 12 (11.76%) participants have high school, 3 (2.94%) have associate degree, 34 (33.33%) have Bachelor’s degree, 45 (44.12%) have Master’s degree and 8 (7.84%) participants have Doctorate degree.

Instrument

The questionnaire consists of six sections. The first one contains demographic data about the participants. The following five sections were divided to collect data regarding users’ experiences attitudes towards mobile apps reviews. The statements in each group were designed as a 5 points Likert scale questions. Following each set of statements, there was an open-ended question to give the participants the opportunity to add additional thoughts. The statements were grouped according to their thematic similarities into five groups. The first group contains seven
statements about the user experiences and attitudes regarding the mobile apps’ selections. The second group has four statements to measure participants’ attitudes regarding some of the criteria for evaluating the apps’ quality. The third group has seven statements designed to reveal data about users’ experiences and attitudes with the comment section on the apps reviews on the apps store. The fourth group contains six statements asking participants about their experiences and attitudes regarding frequent mobile apps issues. The fifth group consists of eight statements to determine participants’ awareness regarding some of the app's issues as well as some elements of the reviews’ interface.

A pilot study and review by three university professors helped the authors to modify the elements of the questionnaire. Modifications in the questionnaire included eliminating some of the statements as well as rephrasing other statements. For the internal consistency, the instrument’s Cronbach’s Alpha was (α = .765)

**Procedure**

We made the survey available online after obtaining an approval from the institutional review board (IRB) at Iowa State University (Appendix A). We used Qualtrics platform (www.qualtrics.com), a very well-known online platform for survey administration. The survey was made available for a month. Participants completed the survey on a duration ranged between 5 to 10 minutes. The survey questions were illustrated in separate pages. The first page had the demographic questions. The following pages were illustrated in groups of statements from group 1 to group 5. Each group has statements that are providing information regarding one aspect of the study. Following each group of statements, there was an open-ended question to give the participant the opportunity to provide the personal thought.

After completing the questionnaire, the participants were given a chance to enter a drawing to win a gift card. We had four gift cards each one valued $25. To ensure anonymity,
and to separate the drawing data from the survey data, participants information and participants who wished to enroll in the drawing were required to click on a link that opens a new web page. Then they can add their email information.

To provide a degree of agreement for each statement, we have used five points Likert scale statements that were ranked 1-5, with 1 = “strongly disagree”, 2 = “disagree”, 3 = “neutral”, 4 = “agree”, and 5 = “strongly agree”.

**Results**

This study has two types of data, quantitative and qualitative data. The quantitative data generated by analyzing the results of the Likert scale items. While the qualitative results generated by analyzing the open-ended questions that followed each group of statements in our scale. Following is our findings categorized according to our research elements.

**Users’ Experiences and Attitudes with Selecting Mobile Apps**

The experience of picking an app differs from user to another. Table 2-1 summarizes results for participants’ responses when they were asked to indicate their agreements regarding each statement in this part of our questionnaire. Results show that participants mostly tend to agree with all the statements. Preferring to install free apps was the highest among other statements in this group (M=4.54, SD=.88). For installing applications with a lower rating, participants’ answers tend to be, on average, “agree” (M=3.45, SD=1.03). Interestingly, when participants were asked about downloading trendy apps, the results were the lowest among other statements. The participants tend to answer, on average, “agree” (M=3.04, SD= 1.07).
Table 2-1. Users’ experiences and attitudes with selecting mobile apps

<table>
<thead>
<tr>
<th>Statement</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I choose apps upon the ranking given to them</td>
<td>102</td>
<td>3.73</td>
<td>0.98</td>
</tr>
<tr>
<td>2. I prefer to install free apps more than paid apps</td>
<td>102</td>
<td>4.54</td>
<td>0.88</td>
</tr>
<tr>
<td>3. I do not install apps with lower rating</td>
<td>102</td>
<td>3.45</td>
<td>1.03</td>
</tr>
<tr>
<td>4. I install apps that I need even if they have a lower rating</td>
<td>101</td>
<td>3.49</td>
<td>0.99</td>
</tr>
<tr>
<td>5. I install apps that my friends suggested to me</td>
<td>102</td>
<td>3.80</td>
<td>0.82</td>
</tr>
<tr>
<td>6. I often install trendy apps</td>
<td>102</td>
<td>3.04</td>
<td>1.07</td>
</tr>
<tr>
<td>7. I trust apps reviews</td>
<td>102</td>
<td>3.68</td>
<td>0.75</td>
</tr>
</tbody>
</table>

As a part of investigating the users’ attitudes and experience with selecting mobile apps, we had an open-ended question to ask participants to share their approaches of selecting apps to install. Results of this question revealed several patterns for the participants’ experiences when they pick an app to install. The frequent words in most of the users’ inputs for this question included star rating, number of downloads, need, and free app. One of the participants has described his experience with picking apps as “I start off reviewing the free apps, then I look within the free apps and look for the ones with the highest ratings.” Another participant said, “I search for something I need, then read reviews. Both in the apps store and online to find the best app for me. If they are free, I might download a couple to try them out and see which I like best.”

Some users reported that they only install important apps. Others identify their way for searching for an app is by using keywords. Some participants reported that they download apps, specifically the free ones, then they try it out. If the app met their desires, then they keep it. Otherwise, they try out a different app. Participants’ responses reveal several criteria to consider installing an app. Examples of these criteria include being rated above three stars, having positive comments, being a free app, having specific features, meet a specific need, specific brand, and having a nice interface design.
Installing an app is not always done purposefully, some participants reported that they install apps due to other factors. These factors include brand name, friends and relatives’ suggestions, Advertisements, and social media.

Some users are not interested in installing apps unless they find themselves in situations that lead them to install the apps. On the other hand, some users like to browse the apps store from time to time to discover new apps. Also, they might browse the apps by their categories to compare the apps. We found participants who like to explore the apps by searching for a keyword. A participant in our study summarized his experience with exploring and choosing the apps as following

“Search for a keyword. See the first 8-10 apps and compare them. if any of them were recommended by a close friend, then give them higher weightage. Second in line will be those recommended on the internet. One important point will be the app should have good review for the last few updates and negative comments mentioned should not be a big factor. If it is, then not go for the app. Else, do not worry. Also, one big factor is the specifications of my phone. If my phone could not handle the app even if it is best for the world I would not use it, e.g., Asphalt game for many users.”

Users’ Experiences and Attitudes with Perceiving and Evaluating Apps Quality

There are many ways to provide a judgment on apps quality. Our questionnaire focused on investigating three elements that are important factors to determine the attitudes towards the perception of apps’ quality. These factors are number of downloads, number of the stars given to an app, and the amount of review comments in that the app page. Results showed that participants tended to answer, on average, “agree” for the all of the statements (M=3.45, SD=1.10; M=4.09, SD=0.78; M=3.53, SD=1.06) respectively. Results show that participants tended to answer, on average, “disagree” (M=2.06,SD=0.94) when they provided their responses to the statement there is no relationship between the app quality and its rating. Table 2-2 illustrates our findings in this category.
Participants were also asked to answer the open-ended question “Can you share how do you decide whether the app has good quality?” Answers to this question contained valuable thoughts. As a summary of the participants’ thoughts; many participants think that the number of downloads and the stars rating are very important factors to determine the quality of an app. Other participants may have different criteria such as friend’s advice or self-judgment to decide the apps’ quality. A participant summarized his approach to determining the app quality by stating “By the following criteria: First, by downloading it and use it by myself. Second, friends’ advice. Third, reviews. Fourth, app advantages.” Moreover, the quality judgment may depend on the app technical features, and how it works without issues. A participant stated that “Whether it is buggy, slows the phone down, has too many in-app purchases...whether it is easy to use, fast response, fast load time, completes the task necessary.” Other participants consider ease of use and beautiful interface as a part of the app quality.

**Users’ Attitudes and Experiences with Comments Section in the Apps’ Reviews**

The comments section on app reviews is very useful for many users. Results showed that participants tended to answer, on average, “agree” when they were asked about the usefulness of the comments in app reviews (M=3.94, SD=0.78). On the other hand, participants disagreed with the statements that claimed reading all the detailed comments is wasting their time (M=2.94, SD=1.19). We also found that participants tend to use the comments of apps’ reviews as a

---

Table 2-2. Users’ experiences and attitudes with perceiving and evaluating apps quality

<table>
<thead>
<tr>
<th>Statement</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Number of downloads for an app is an indication of the app quality</td>
<td>102</td>
<td>3.45</td>
<td>1.10</td>
</tr>
<tr>
<td>9. Number of stars given to the app is an indication of the app quality</td>
<td>101</td>
<td>4.09</td>
<td>0.78</td>
</tr>
<tr>
<td>10. Number of reviews for an app is an indication of the app quality</td>
<td>102</td>
<td>3.53</td>
<td>1.06</td>
</tr>
<tr>
<td>11. I think there is no relationship between the app quality and the app rating</td>
<td>102</td>
<td>2.06</td>
<td>0.94</td>
</tr>
</tbody>
</table>
supportive tool when they want to compare two apps (M=3.85, SD=0.91). Table 2-3 summarizes all findings related to statements of the apps’ review comments.

Table 2-3. Users’ attitudes and experiences with comments section in the apps’ reviews

<table>
<thead>
<tr>
<th>Statement</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. The comments in the app review are useful</td>
<td>102</td>
<td>3.94</td>
<td>0.78</td>
</tr>
<tr>
<td>13. If the app has an excellent rating, it is a waste of time to read all of the detailed comments in the comment section</td>
<td>102</td>
<td>2.94</td>
<td>1.19</td>
</tr>
<tr>
<td>14. I tend to read the comments in the review when I want to compare two different apps</td>
<td>102</td>
<td>3.85</td>
<td>0.91</td>
</tr>
<tr>
<td>15. Comments associated with the rating may affect my decision regarding installing an app</td>
<td>102</td>
<td>3.97</td>
<td>0.78</td>
</tr>
<tr>
<td>16. I trust reviews that are associated with a lower rating</td>
<td>102</td>
<td>3.34</td>
<td>0.80</td>
</tr>
<tr>
<td>17. I trust negative comments more than positive ones</td>
<td>102</td>
<td>3.07</td>
<td>0.87</td>
</tr>
<tr>
<td>18. I extensively read comments in the review section associated with lower-rated apps</td>
<td>102</td>
<td>3.19</td>
<td>1.12</td>
</tr>
</tbody>
</table>

To give the participants more flexibility to deliver their thoughts regarding apps reviews comments, they were asked to answer an open-ended question “Can you share how do you read comments in the review section?” Analyzing the results of this question revealed the participants’ behaviors when they interact with the reviews section. In general, participants reported that they do not read all of the reviews listed in the comments section specifically the long reviews. Participants reported several behaviors for reading apps reviews. Most users tend to scan reviews. When they need to read the reviews, they start with shorter, negative, and lower rating reviews. Some participants read both negative and positive reviews, which are associated with lower and higher rating to make a comparison when is needed. One of the participants described his behavior as following, “I tend to read comments when I want to compare two similar apps. If the apps are different, there is no need to compare apples to oranges.” In addition, participants stated that they read the recent reviews because it reflects the current issues if there is any. One reason to read reviews was to investigate other users’ experiences and make
decisions according to what others have experienced with the app. While participants reported that apps reviews are fun to read, they also wish if there are a limited number of words for each review. Some participants claimed that they could distinguish fake reviews. They said those fake reviews usually consist of ridiculous qualities and many misspellings. A participant has shared his experience with the apps’ review as following

“I know that just like news, product reviews, app reviews are also susceptible to being fake. The company can ask their acquaintances to write positive about them and their rivals can write negative too. It is hard to differentiate the genuine and fake ones, but I use the following observation for my sake. Do not go for one word, one-liner reviews (exception if the majority says the same thing). Do not go for super lengthy reviews, as they will be people criticizing the app like a bully. Go for reviews between the length of 2-6 lines or the ones that make sections of pros and cons. One more important thing is some people write comments just after a couple of days of use. We cannot verify this, but I prefer the ones that are written by users who used it for at least a month as sometimes system performance reduces with prolonged use of apps. Long ago we can view votes and comments from our friends but due to recent privacy changes it cannot be done now.”

Users’ Experiences and Attitudes with the Common Complaints

Having complaints about any product is normal. For the apps’ users, they always complain about several common issues. We had several statements that measure the users’ attitudes and experiences with frequent apps complaints. Surprisingly, participants tend to answer, on average, “strongly agree” for all statements. Results indicated that removing a favorite feature from an app was the highest average among other statements (M=4.43, SD=0.67). It is known that apps ask for some permission upon installing them. Participants tend to answer, on average, “strongly agree” with the statement that stated “apps should indicate specific reasons for using some permissions” (M=4.30, SD=0.76) Table 2-4 indicates all findings about statements on this section.
Participants were asked to answer the open-ended question “Do you have any complaints about mobile apps reviews? Would you like to share your thought?” we have found insightful thoughts in participants’ responses for this question. Results regarding this question were not only including the complaints about the mobile apps’ review, but also there were comments that would benefits the development of the apps. Some responses were commenting on the hidden cost of mobile apps. They reported that they hated when an app asks for small transactions for every single feature that they want to use. In addition, they said there is no trial period; consequently, they cannot undo their purchases. Moreover, participants prefer to pay one price upfront for the app and its features instead of paying separately for each feature specifically games. Participants agreed to the importance of paying some money for apps developments, but they wanted to be clear about what they will pay.

The participants in our study raised another issue which is the comments in apps review. Participants mentioned that there are reviews that are helpful but very long. They wish if there is a way to limit the review’s words count and provide a specific structure for the review. A participant reported, “It is better to make them short, specific and helpful. Some comments might be helpful but long which makes me skip them.” In addition to that, participants suggested that
users should not be able to provide high app rating without writing a comment. Participants claimed that this process would limit fake and misleading reviews. One of our participants stated “it is easier to rate 5 starts rater than 3 and write why.” Another issue about the apps’ review is the lack of the reviews number. Usually, apps’ stores do not display reviews for new apps until they reach a specific number of reviews. A participant reported that he hated when he found an app without published reviews. On the other hand, results indicated not all participants read the reviews. A participant mentioned that he downloads apps that he comes across and when they are not good, he uninstalled them.

Our results indicated several complaints regarding apps in general. Participants were not comfortable with the number of unnecessary permissions that they need to provide to the app upon the installing process. In addition, there were some complaints regarding the Ads. Participants reported that some apps contain many ads. Some users reported complaints regarding apps that have low-quality graphics and ugly avatars.

**What Can Users Know from the Interface Design of Apps’ Review?**

The screen of apps reviews has many elements that users are not aware of. Moreover, there are other elements that are very important to be parts of the apps’ reviews, but unfortunately, most apps’ stores do not provide it. For example, information about the battery consumption is important information that users should know. Our results indicated that users tend to answer, on average, “strongly disagree” (M=1.95, SD=1.01) when answering the statement regarding the ability to locate information about apps battery consumption on apps review screen. In addition to that users tend to answer, on average, “disagree” when they were asked to answer questions regarding the ability to find information about app’s security, app’s privacy, device compatibility, and app’s ads. Table 2-5 summarizes our findings regarding the users’ responses.
Table 2-5. What can users know from the interface design of apps’ review?

<table>
<thead>
<tr>
<th>Statement</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. I think age rating is a necessary feature to classify apps</td>
<td>101</td>
<td>3.87</td>
<td>1.08</td>
</tr>
<tr>
<td>26. From the app review’s screen, it is easy to determine if the app is suitable for my age</td>
<td>101</td>
<td>3.11</td>
<td>1.07</td>
</tr>
<tr>
<td>27. From the app review’s screen, I can locate information about the app's battery consumption</td>
<td>101</td>
<td>1.95</td>
<td>1.01</td>
</tr>
<tr>
<td>28. From the app review’s screen, I can tell whether the app is secure or not</td>
<td>101</td>
<td>2.04</td>
<td>1.02</td>
</tr>
<tr>
<td>29. From the app review’s screen, I can find information about privacy</td>
<td>101</td>
<td>2.30</td>
<td>1.04</td>
</tr>
<tr>
<td>30. From the app review’s screen, I can tell whether the app violates the privacy or not</td>
<td>100</td>
<td>2.15</td>
<td>1.02</td>
</tr>
<tr>
<td>31. From the app review’s screen, I can tell if the app has ads or not</td>
<td>99</td>
<td>2.32</td>
<td>1.16</td>
</tr>
<tr>
<td>32. From the review’s review screen, I can tell if the app is compatible with my smartphone</td>
<td>99</td>
<td>2.93</td>
<td>1.28</td>
</tr>
</tbody>
</table>

To give the participants more flexibility to deliver their thoughts regarding the interface of apps reviews, they were asked an open-ended question followed their responses for the statements in this section. The question was "Do you have any suggestion about the design of apps' reviews? Would you like to share your thought?" Responses to this question had valuable thoughts. We divided their answers into two categories. First complaints related to the interface design. Second, suggestions for a future design.

Participants reported that the current interface design for the mobile apps’ reviews needs more simplicity in the design. The amount of information is very huge and bulky, which makes finding specific information sometimes a very hard task. Participants stated that the current design is not constant. There is information illustrated in the reviews of some apps while this information could not be found in other apps. In addition to that, users claimed that there were too many elements in the review info page. They needed more time to figure out relevant information to what they want to find.
Respondents have suggested some ideas for redesigning the interface of mobile apps’ reviews. The suggestions included a specific request for some features like the apps battery consumption and illustration for the permissions required. A participant stated his ideas regarding redesigning the reviews interface as following “There should be a quick list where you can quickly see the most pertinent information about the app such as permissions, age range, ads or no, compatible OS, etc.” Some participants suggested that reviews should contain some statistics about battery consumptions, and other technical factors. One of the participants suggested that there should be specific questions for the reviewers to be answered to enrich the reviews and to make them constant.

To conclude the study questionnaire, there was a final though question which asking the participants if they have any further input they would like to provide. There were very interesting responses that may improve the visualization and the interaction with the mobile apps reviews. A participant suggested that the reviewers should have credits for their reviews. He also suggested that apps store should consider gamification techniques to increase the interactivity with apps reviews. Many responses stated that apps should justify exactly why they use specific permission and how it would be used. There were suggestions to represent a portfolio for each developer and company to see all apps developed by them. Thus, users can have an idea about the quality of apps produced by those developers.

Discussion

The purpose of this study is to investigate the users’ experiences and attitudes with the interface of mobile apps’ reviews. Our results included rich data that could be helpful for both research and industry. In this part, we provide our rational towards the results that we got.

When we explored the users’ attitudes and experiences with selecting an app, our results agree with what the previous research has done. Users have a variety of ways to select an app,
and there are some factors affect his choices. In our study, we find that price of the app could be the most important factor in selecting an app. We think that because apps stores have free alternatives for most of the apps. Moreover, users consider uninstalling the app if they are not satisfied with it. In addition to that, developers might be interested in building apps that are similar to paid apps to gain quick revenue. Developers might get some income by using ads in their apps instead of selling their apps. However, this method is not comfortable for some of the users, who do not prefer ads in the selected apps. The problem is that installing an app then uninstall it does not go as what most users are expecting. If the app is malicious, during the period from installing the app until uninstalling it, the users’ data might be at risk. So, we think there should be a way to represent the security level of the apps visually.

From our results, we infer that there is a portion of users who have the ability to set criteria for selecting an app. These criteria might not include the app rating specifically when the users are in need of using the app. Users might install an app even if they are not satisfied with its rating.

Regarding the apps’ quality, our results indicated that participants tend to agree with all the statements there were asked. Participants consider the number of downloads, number of stars, and number of reviews as indications for the app quality. This is similar to what the previous studies have indicated [3–5, 9]. However, our findings infer that some users might consider self-judgment or friends’ recommendations as factors in deciding the app quality. We think that is possible because one way to install an app is a referral from trusted people whom we know.

Our findings indicate that participants described the quality in another manner. The results indicate that there are participants who consider how the app works. Their perceived apps quality was not only limited to the visual communication icons that they see such as the number
of stars or number of downloads but also they are seeking more easy to comprehend details. We think this kind of input from the users may help to figure out a way to have icons on the mobile apps info screen that reflects the technical aspect of the app. These icons may illustrate crashes, slowing down the device, freezing. Unexpectedly, the results indicate that there are users who consider the aesthetic of an app as a part of the quality.

Different from what other researchers have done, our study considers the users’ experiences and their attitudes towards apps review. Our results indicate that, in general, users think that mobile apps reviews are helpful. However, users do not read all the comments in apps reviews. They scan the reviews and prefer to start with the reviews that are shorter, negative, and lower rating. We think this happens because users do not want to spend much of their time to read all the comments posted. Thus, they might look for the bad ones and then build their decision. While our findings infer that participants have multiple types of behavior reading the reviews, we think it is necessary to have a better design for the interface of the apps’ reviews. Users do not want to spend numerous time reading 2000 reviews. Instead, it is advisable to have a better way to summarize and illustrate the reviews. Additionally, it might be useful to limit the words count for the reviews. As indicated in the results some of the reasons for reading the reviews are to help in making a comparison between apps and to support users decision-making process. Making reviews easy to read and comprehensive will ensure better user experience.

Prior research has investigated what the mobile apps users’ complaints are. They have characterized number of the frequent complaints like hidden-cost, violate the users’ privacy, frequent updates, removing a favorite feature from the app, and other complaints [31, 32]. Our results indicate similar results to what have been found in the previous research. However, there are some additions to the complaints list. Most of the previous research has adapted using text
analysis for the reviews while we directly ask the users to provide their feedback regarding their complaints. Thus, we were able to have more information tied to the users’ experiences. We found many of our participants were complaining about the length of the review. This complaint was reported in multiple parts of our study which indicates that is a real problem that needs to be solved. The findings also reported users concerns regarding ads in most of the free apps. The literature contains two dimensions for using the ads in mobile apps, which are the revenue and the power consumptions. Ads’ content is an important topic and not getting much attention in the body of the literature. We think there should be some regulations for using ads by the developers specifically the contents of apps. We think that not all ads are suitable for all ages. Moreover, it is not justified when an app designed for kids having ads that are targeting adults.

The interface of the mobile apps reviews is a very important aspect that we considered in our study. Our results indicated that there is a need to rethink about the interface design of the apps’ info page. While the current design seems to be simple, it is failing to help users to be aware of many issues and knowledge that are relevant to mobile apps. The prior research claimed that users do not read permissions and if they read they do not understand them [22, 23]. We agree with this and can add another reason. We notice that the app store and google play do not provide proper explanations for the permissions that apps ask users to grant. In addition to that, the apps information layout should be redesign in a way without misleading the users by the number of stars given to the app. We think that there should be an illustration for other necessary information in the top of the page. It is advisable to have information about the battery consumption, permissions, recent updates, security, and ads. Information like these should be illustrated on the top of the interface. That will help users to have easy access to these important aspects of the app.
Results of this study reveal the need of considering redesigning the interface of the mobile apps reviews. The new design should consider socializing the user experience with the apps and their selections. Moreover, considering techniques like gamification would increase the interaction between the users and the apps reviews. One important thing that users were not sure about was the developers’ portfolio. Users reported that they do not have ideas about who made the apps. We think the most important thing to consider is making the interface as a tool to enhance the users’ knowledge about apps related concerns. Examples of these concerns include an explanation for the required apps permissions, battery consumptions, ads, hidden cost, and any unique or specific features.

Limitations

One of the limitations of this study is that the majority of our participants were well-educated individuals. It is possible that results would contain additional output if there is a mixed of people who vary in their level of education. Moreover, it is possible that there would be additional points of view if the sample includes older adults and children.

Conclusion and Future Work

Previous research has done great work in extracting what users’ complaints are. However, none of the previous research has investigated the users’ attitudes and experience with the interface of the mobile apps review. We did a survey to measure the users’ attitudes and reveal their experiences with the interface of the mobile apps reviews.

Our results indicated that users’ complaints are not related only to how the apps work but also to the way that apps’ stores illustrated the apps. In fact, users need to have awareness about the technical terms that are associated with reviewing an app. The way of illustrating the permissions and privacy-related issues should be considered when designing the interface. Information related to the ads, battery consumptions is also beneficial to be included in the
interface of mobile apps’ reviews. Our study found that users are frustrated from reading the reviews especially the lengthy reviews. There might be a way to summarize the reviews and help users to have better experience.

In the future, we would like to explore users’ needs and desires for a suggested interface. An interview with apps’ users could help to prioritize the elements of the visual design. Then we plan to have a suggested prototype that could enhance users’ experiences and increase their awareness regarding apps-related issues. Users should be able to distinguish apps’ risks and benefits easily.

Acknowledgment

Authors would like to thank all participants who spent their valuable time to participate in this study. In addition, we appreciate the University of Tabuk, Saudi Arabia for funding the first author.

References


CHAPTER 3. MOBILE APP STORES: WHAT DO USERS SEE? WHAT DO THEY NEED TO SEE?

Modified from a manuscript to be submitted to an academic journal

Omar Asiri, Carl K. Chang, Leslie L. Miller

Iowa State University

Ames, IA

Abstract

Many users explore mobile app stores to install needed or trendy apps. For that reason, users have to interact with the interface of the app stores. Due to this, we want to investigate if the interface provides the needed information to users. This study aims to examine the users’ experiences with the interface of app stores. Furthermore, it also intends to collect and highlight the users’ needs and recommendations for future interface designs. We present insights from qualitative data collected by interviewing 16 participants. Our findings divided into two categories: 1) The current users’ experiences with the app stores. 2) Users’ needs and recommendations for the interface of app stores. We found that adding visual cues for app features and app issues into the app stores interface would be effective in providing useful information to the users. Moreover, it would educate users who have less knowledge about certain issues related to the apps.

Introduction

App stores have a very large quantity of applications. Each day new applications are added that attract people to download them. As of the first quarter of 2018, Android and Apple’s app stores have approximately 5.8 million apps combined [1]. This vast number of apps is not
free of issues that impact a user’s experiences. Moreover, with the ever increasing number of apps, looking for a needed and efficient app become a harder task.

Research on user experience has been an attractive research area for years. In a previous study [2] an investigation for the users’ attitudes and experiences towards the mobile app reviews found that users are not aware of some of the app related issues, such as the app permissions. One reason that leads to this lack of awareness is the way the information is displayed in the interface of app stores. Most users make their decisions based on the information displayed on the interface of app stores. In app stores, users are shown general information about the app, such as the developer name, the app size, and the star rating. For issues, such as privacy, permissions users need to dig down in the reviews to find something related to what they are trying to know. Finding this type of information in the interface of mobile app stores is not an easy task for many users.

In the present research, our goal is 1) to study the users’ experiences with the current design of app stores and report the challenges that they face. 2) to collect data regarding users’ requirements to recommend modifications to the interface design of the mobile app stores. The recommendations could help to provide a better way of illustrating app information on app store interfaces. Our ultimate goal is to enhance the users’ awareness regarding some of app issues such as privacy, permissions requests, ads, and battery consumption.

To be able to address our study concerns, we propose the following research questions:

RQ1: What are the users’ experiences with the mobile app stores?

By addressing this question, we intend to examine the current experience with app stores. We want to spot what are the issues and the challenges that users are currently experiencing.
RQ2: What do users need to see on the interface of app stores?

By addressing this question, we are attempting to find the desired features that users would like to see on the information screens in app stores. We want to understand the design requirements from the users’ point of view.

The remainder of the paper is organized as follows. In the second section, we have highlighted the relevant related work. Then, we describe our methodology. After that, we report our findings. Following that is a discussion of our findings. Last but not least, we conclude this paper with our final thoughts and suggestions for future directions.

**Literature Review**

Mobile apps are a hot topic. Researchers have examined a number of app related issues. In this section, we present a brief summary of the related work that has been done. It is not possible to cover all of the body of the literature. Instead, we highlight the studies that are related to our work.

**The Importance of the App Rating**

App rating is a crucial element that determines success of mobile apps [3], [4]. As discussed in [5], there is a strong correlation between the rating of an app and the number of times that an app has been downloaded. Moreover, when users decide to purchase an app, the app’s rating is considered as a primary key that supports the users’ decision making [6]. App rating is also beneficial for app developers. The number of stars that their apps receive could determine the revenue that they would gain [6]. As mentioned in [7], better reviews for an app result in a better sales.

The quantity of reviews that an app receives could reflect the app quality. As claimed by Iacob et al., there is a relationship between the amount of feedback that apps receive and the overall rating [9]. Furthermore, they reported that apps with lower ratings receive more feedback.
According to Iacob et al., reviews are 12 times more trusted than the app’s description, which is typically provided by the app developers [9].

**App Selection**

There are always many ways to discover a new app in the app stores. Friends recommendations and browsing the app stores are the most frequently used discovery method for selecting and installing an app [8], [9].

Iacob et al. [10] found that approximately 25% of the reviews contain recommendations to other users to use the app [10]. Chin et al. [16] found that the price of an app and the app’s popularity are factors that affect users’ decision when they choose an app to install.

In analyzing over 17,000 apps, Hoon et al. [18] found that users tend to leave short reviews for mobile apps. Moreover, they claimed that the length of a review and the app rating are affected by the category of the app. A study by Hu et al. found that users usually provide reviews when they are either extremely happy or extremely upset with the product [12].

**App Updates**

Studying user attitude and behavior towards applications’ updates, Tian et al. [13] reported that about half of smartphone users set their phones to be automatically updated. They stated that users want their apps to be always up-to-date [13]. In addition, they found that some users do not update the installed apps due to concerns over app privacy and permissions requests. In contrast with this finding, other research has found that users tend to install apps that are recently updated, but not requesting frequent updates[14].

A recent study analyzed more than 10,000 mobile apps in 30 categories and reported that 14% of the mobile apps are frequently updated [15]. Moreover, they found that almost half of the frequently updated apps do not provide justification to the users for the updates. As reported in [14], many users are confused regarding app updates. As stated by Nayebi et al. in [14], users
have mixed feelings over requesting updates. Users want to download the update, but at the same
time, they are afraid they might have issues with the app after doing so. Device and app crashes
are the most reported issues after installing an update [14]. A study by Kuehnhausen and Frost
found a relationship between user complaints and app updates [31]. They claimed that users
report their complaints after a recent update.

Several criteria determine the chance of installing an app update. These criteria include
trusting the app creator, the type of the reviews either negative or positive, and the type of
permission requested [8], [13].

**Battery Consumption**

The longevity of the device’s battery is a competitive feature that many companies like to
emphasize when revealing new products. However, draining the battery is an issue that many
users face when installing specific apps. Nagappan and Shihab [16] claim that the issue happens
when app developers do not know how to program an energy-efficient app. Therefore, there is a
need to educate developers about the best practice to produce energy efficient apps. One reason
that leads the app to drain the battery is accessing many resources, or accessing unneeded
resources. To study app energy consumption, Li et al. [17] examined more than 400 apps. They
reported that accessing the network is the feature that consumes the most energy.

**Privacy and Permissions**

Chin et al., [16] claim that users are more concerned about privacy in their phones than
other owned devices, like a laptop. Surprisingly while users tend to see and read the permissions
on the screen, they have limited knowledge about privacy and security [18], [19]. Furthermore,
Kelley et al. [18] concluded that many users do not understand permissions.

Kelley et al. [24] claim that people are unaware of the security risks associated with apps.
A misconception that many users have is they think all apps are already tested by the app stores
and should be trusted. As stated in [24], users are not prepared to be able to make decisions regarding app privacy and security. Regarding the privacy awareness, Shklovski et al. [20] claim that not all users are unaware of privacy. Shklovski added, some users know that some apps might unethically violate their privacy, but they prefer to use the apps anyway. Surprisingly, most app users disregard permissions completely [21], [22].

Smartphone users do not mind to share data with apps developers if the shared data is used properly. Researchers found that users were shocked and felt violated when they discovered that some apps in their devices have been accessing data without their knowledge or prior consent [21], [23]. A recent study that investigated 10,000 android apps claimed that there is a correlation between the permissions’ misuse and the permissions’ popularity[24]. As Felt et al. noted, some apps are only aiming to collect data from users phones [22].

**Users’ Complaints**

In the literature many studies analyzed app reviews and reported user complaints. Examples of the user complaints that were reported are given in [25], [26]. In [32], the researchers reported a categorization of 12 types of user complaints that have been identified in app reviews. The identified complaints were

“App Crashing, Compatibility, Feature Removal, Feature Request, Functional Error, Hidden Cost, Interface Design, Network Problem, Privacy and Ethics, Resource Heavy, Uninteresting Content, and Unresponsive App (Pg.74)”

To determine the popularity of the complaints, studies found that more than 50% of the user complaints are limited to three types of claims: reporting functional errors, requests for specific features, and reporting app crashes [25], [26]. Out of the 12 types of complaints, the most negatively perceived complaints were privacy and ethics, hidden cost, and feature removal [25]. Users provide a lower rating for apps that have one of these issues. Specifically, hidden
cost is perceived a key reason for providing a lower rating. This tends to occur due to the fact that some users install an app and then find that a subscription is required to get the benefit of the app. In many cases that leads users to post a lower rating and leave negative comments for the app. As reported in [31], more than half of low ratings for Hulu plus was due to the monthly subscription fee that occur as a hidden cost.

**Challenges in App Reviews**

Mobile app reviews have several challenges. One of these challenges is the growing number of reviews that each app is receiving. As stated in [27], on average, apps receive 23 reviews per day. The authors also mentioned that some popular apps like Facebook could receive on average more than 4000 reviews per day. Iacob et al. [9] claimed that users have limited ability to read app reviews due to the large number of reviews for many apps. Moreover, users will have difficulties in spotting the app’s flaws due to the length and the quantity of reviews.

There are other issues that create challenges for users when dealing with app reviews. Many times users find reviews unstructured, differ greatly in quality and it is hard to identify which review will be useful [12]. In addition to that, reviews are not free of informal expression, using abbreviations and suffering from numerous misspellings [28].

Hu et al. state that the reviews on the online product may have deceptive information and do not always show the products’ quality [12]. These issues lead to questions on one’s ability to trust the reviews.

**What Can We Get Out of App Reviews?**

Tian et al. [13] conducted a study to differentiate between high rated and low rated apps. They found that “high-rated apps have larger sizes, more complex code, more requirements on users, more marketing efforts, more dependence on libraries, and adopt higher quality Android APIs.”
App reviews are not only a useful resource for users. Developers can get substantial data from app reviews. Reviews may have improvement suggestions, requested features, user requirements, and user experiences [5], [27], [30]. In addition to that, developers can find reported issues related to the app’s GUI, app’s performance, or comparisons with other apps [10].

One way to distinguish between good and bad apps is their ratings. However, the rating does not always reflect the reality of an app. There will be users who are unhappy with an app even if the app has an excellent rating. A study claimed that an app’s level trust should not only be based on the app’s rating, since an app rating is not always a reliable metric [31].

The Need for Improving the Design

Users may have some issues with the interface design of app stores. Users might need to have an interface that helps them to better understand the available apps. Research has reported that between 13%–49% of the sentences of the online reviews have feedback regarding usability or user experience [32]. Since some users face difficulty in figuring out why some resources in their devices have been accessed, Liu et al. [34] suggested that app stores should design a simple and informative interface especially when it comes to permissions and privacy information illustration. As recommended in [23], users need to be informed about the reason why each resource is being used because that could help to ease the users’ privacy concerns. Liu et al. claimed that a simple interface would help users make better decisions when it comes to granting permissions and controlling the resources of their devices. They added there should not be a tradeoff where users give up control for the sake of usability [33]. Another study justifies why to it would be appropriate consider redesigning the interface of app stores [19]. They claim that users have limited information regarding the security risks associated with app selection. Rajivan and Camp suggest that apps stores should consider updating their interface design to contain
better visualization for the privacy communication icons [19]. Another suggestion is to present these icons at the beginning of the installation process to give users the opportunity to decide at a proper time. In [23], Rajivan and Camp state “privacy communicating icons should align with user mental models of security.”

Due to the massive amount of reviews in app stores, users need a clear interface to be able to make decisions about app quality [30]. Hence, users need visual cues that are simple and easy to comprehend to reduce risks and concerns that are associated with app choices.

**Methodology**

The goal of this study is to explore the users’ experience with the interface of app stores and to collect users’ requirements that could be used to redesign the interface. We wanted to explore the users’ challenges and collect information about potential solutions that could help to design a better interface. According to Lazar et al. [34], “conducting interview studies could be beneficial to understand requirements, needs, and problems (Page 187)”. We designed a semi-structured interview to guide the interviewer during the interview sessions. After receiving the IRB approval (Appendix A), the researcher distributed flyers across the campus. The interested participants contacted the researcher via email to schedule the interview sessions. The interviews took place in a quiet study room located in the university’s library. The average time for the interviews was about 20 minutes.

**Subjects**

We interviewed 16 participants. We continued interviewing participants until we felt that the data was saturated, which means we stopped interviewing when we noticed that the themes and the experiences became repeated. The demography of the participants included 10 (62.5%) male participants, and 6 (37.5%) female participants. Out of the 16 participants, 11 (68.75%) were using IOS operating system on their phones. The other 5 (31.25%) participants were using
Android. Regarding the educational attainment, all participants were at least high school educated. Two (12.5%) were holding a Ph.D. degree, five (31.25%) MS degree, one (6.25%) bachelor’s degree, and eight (50%) undergraduate students. All the participants were either students or workers at Iowa State University. Table 3-1 illustrates the demographic of the study participants.

Table 3-1 Participants’ Demographic Data (N=16).

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (% )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>18-19</td>
<td>4 (25)</td>
</tr>
<tr>
<td>20-24</td>
<td>4 (25)</td>
</tr>
<tr>
<td>25-29</td>
<td>2 (12.5)</td>
</tr>
<tr>
<td>30-35</td>
<td>4 (25)</td>
</tr>
<tr>
<td>Older than 35</td>
<td>2 (12.5)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10 (62.5)</td>
</tr>
<tr>
<td>Female</td>
<td>6 (37.50)</td>
</tr>
<tr>
<td><strong>Educational attainment</strong></td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>8 (50)</td>
</tr>
<tr>
<td>Bachelor’s Degree</td>
<td>1 (6.25)</td>
</tr>
<tr>
<td>Master’s Degree</td>
<td>5 (31.25)</td>
</tr>
<tr>
<td>Doctorate Degree</td>
<td>2 (12.5)</td>
</tr>
<tr>
<td><strong>Smartphone’s system</strong></td>
<td></td>
</tr>
<tr>
<td>IOS</td>
<td>11 (68.75)</td>
</tr>
<tr>
<td>Android</td>
<td>5 (31.25)</td>
</tr>
</tbody>
</table>

**Instrument**

We designed a semi-structured interview. There was a list of 9 questions to help in administering the interviews’ sessions. The interview started by asking general questions about the users’ experience with mobile apps. Then this was followed by questions that focused on asking about the interface of app stores. In some cases, participants were asked questions that were not on the list but they were done to find out more information regarding a specific point that the participant was talking about.
Procedure

After signing the consent form, the interview begun with a background questionnaire. Then the interviewer asked for the permission to start the interview. All the interview session was recorded to help the researcher to transcribe the interviews’ content in the analyzing process. During the interviews, participants were asked questions about their current experience with app stores. Then they were asked the questions from the prepared question list. The question list included questions regarding the current interface design. Additional questions asked what the users would like to see in the future interface designs.

The results section provides more details regarding our findings. The average time for the interviews was about 20 minutes. At the end of each interview, and as a token of appreciation, each participant was compensated for the participation with a $10 gift card. During the interview, the interviewer took notes and recorded the participant’s voice. To ensure the research’s confidentiality, no personal information was attached to the recorded voice. All data were kept anonymously.

Data Analysis

All the interviews’ transcriptions were read through separately to understand the data before themes were developed. Data from each interview were then coded. After coding all data, we used affinity diagrams to organize codes and generate themes. We organized all codes under two major themes. Each of the main themes has its sub-themes to point out specific issues.

Results

We present our results in two themes. The first one is user experiences with the mobile app stores. The second theme is users’ needs and recommendations.
User Experience with Mobile App Stores

It is important to investigate the current user experiences with mobile app stores in order to claim a need for a change. Moreover, investigating the current experience will help to have a background with respect to current practice. Findings in this theme focused on reflecting the current users’ experiences with mobile app stores.

Apps Selection

Selecting an app is one of the essential tasks that smartphones users do multiple times during their smartphones’ ownership. However, there are many factors that affect the users’ decision regarding selecting one app over another. Some users may have a specific strategy when they pick an app. Users might have certain rules or criteria that they follow when choosing an app. As a participant noted:

“The top ones on the list that influenced me, that is one way. The second way is the rating if it has a good rating with a high number of people that is another factor. The reviews, sometimes I go and read those reviews, I do not use those as much actually. So I usually go to the first two or three, and that is it.”

Another participant described the experience of choosing apps as:

“For the mobile apps, I install an app when I see a trend in this app, so for example, when a lot of people are talking about it, friends tell me about it or when I see some news that is becoming a big deal, so I get curious and download the app and start seeing what is in there. On the other side when I want to do a specific task, for example, searching for a place to go or searching for a restaurant or going for shopping; I try to find the apps that do that task and try to get the good app that will get me to that way.”

On the other hand, there are users who might only depend on discovering the apps store. They go to the app store and pick up whatever they are thinking about. As one of the participants remarked:
“Generally when I am downloading an app, I do not hear about it from somebody else. I do not look at the reviews. I just look up whatever app I want, and I download it.”

Most smartphone users like to download games. Regardless of the type of game users are usually interested in, they generally just choose games that are fun and could help them to kill time. A participant explained his experience with downloading games as follows:

“I am mostly interested in like puzzle games. Things that you have to like think a little bit or try a little bit to do because I get very bored with just school. So on my phone right now I have a bunch of different games, most of them are puzzle games.”

Selecting a mobile app is affected by several factors. An essential factor is friends’ recommendations. A participant mentioned, “Usually I will download some apps when my friends recommend something.” Another participant expressed the trustworthiness of her friend’s recommendations. She stated:

“I like going off of what I think or what my actual friends have said about the game because if they like it, I do not care what the reviews say, I will probably like it too.”

There are other criteria for downloading apps. An obvious criterion would be downloading apps upon the need for them. A participant noted, “I download an app when I need it. For example, I was trying to learn German. So I downloaded a language app to help me learn German.” In addition to the need for a specific app, some users may download apps following a trend or to break moments of being bored. A participant stated:

“Sometimes when I am really bored I will look in the trendy apps, for example, there were a few free games I downloaded that were on the top 2, and they were really fun for a while.”

The experience of downloading apps is not the same for all users. Some users might love to discover apps while others are serious and strict. Many reasons might change the users attitude
towards installing mobile apps. One of them is the age of the users. A participant, who is older than 35, mentioned, “Apps should have a purpose to be downloaded.”

**Apps UI**

Regarding the design of the apps, participants provided multiple points of views. Some of the participants reported their desires to have apps with beautiful interface designs, as a participant noted:

“For the screenshots that apps have, I would check it out. If it is appealing, visually appealing, I will give it a try. But if it is not, I would not touch it.”

Other participants just wanted something that helps them to get the tasks done, one of the participants stated, “So if I am able to get my work done, even without having a good interface, that would be my first priority.”

Some of the participants chose to be in the middle. While they want a gorgeous interface, they still care about the ability of the app to do its purpose. A participant stated, “I do not need something too fancy, but I do not need something that is not going to get the job done.”

**Apps Purchase**

Regarding the users’ experience with purchasing apps. Our findings revealed that generally participants are not willing to pay money if there are alternative apps, as one of the participants remarked, “I am not willing to pay 5 extra dollars for the premium when I can get almost as good for free.” Another participant stated, “I just feel like that most of my apps are actually free because I just feel like I do not want to pay. Even though it seems so low like a dollar.”

Some participants had another opinion. They added that purchasing an app might depend on the features that the app is offering. A participant noted, “If the feature is beneficial if I cannot find it anywhere else for free, I have to pay for it.”
One of the issues that some of the participants reported is the hidden cost of apps. Some apps might be advertised as free apps; then you need to pay a specific amount of money in order to have a specific feature or to go to a higher level if it is a game. A participant expressed her frustration and commented, “They say it is free, and you have to pay for it. So it is like, okay, well, you just lied to me. And I did not pay.”

**Age Rating**

Age rating is information that app stores provide to indicate the age appropriateness. Unfortunately, it is unknown information or ignored by many of the mobile users. Our results indicated that even if the participants have noticed it, they might not care. A participant stated, “I do not know. It does not make any sense to me.” Another participant commented on the classification of apps to include categories for kids and adults. He stated,

“I think if it is rated 18+, that will imply something like a dating app. I think if you have an action game rated for adult, people might think it has something sexual.”

**Star Rating**

Users of smartphones have difficulties in differentiating and choosing apps, especially when there are multiple options. Star rating would be a helpful way to support the user’s decisions. A participant reported, “I just look at the star.” Another participant added,

“If there is one that has three stars and the one that has four stars, I am not going to look at the reviews. I am just going to get the one that has four stars.”
On the other hand, many participants disregard the star rating. A participant noted, “What are the five star represents. It is not authentic anymore. I do not do five stars.” Another participant commented on the reliability of the star rating,

“It tells me that someone got so annoyed with the app saying ‘rate me, rate me, rate me’ that he or she just said ‘5 stars, whatever, go away.’ When I am reading reviews, that is telling me what people are thinking about the app. That is telling me problems with the app. That is telling me all that. Your stars are not telling me anything.”

Another participant remarked:

“If I see an app that has 5 stars and then I go down, scroll down to like read what people say about it, and it has none of those. So it kind of looks like either everyone is as lazy as I am and just [oh, five stars, five stars, five stars] or those stars are not real and it is maybe a virus. You know you have to prove that an actual human being said that about the app. Not just a computer went in and said five stars a bunch of times.”

A participant expressed her opinion regarding the stars rating. She states, “The stars are deceiving. And, it could just be fake stars” Another participant added, “I think the star review is not telling you the whole story.”

**Privacy and Permissions**

App privacy and app permissions are important issues in the mobile apps industry. Many participants expressed their concerns regarding these issues. In our study, we tried to investigate participants’ experience with app privacy and permissions requests when they use the mobile app. A participant believed that we are in a time where we should not worry about our privacy while all the information is out. He expressed his opinion as:

“I am at a stage where like all privacy is out. I mean all my data is out everyone knows that kind of stuff. So now it is not much of a concern for me.”

Not all users agree with the idea of open privacy; some participants might not pay enough attention to what the apps are asking them. To install an app quickly, they provide their agreement without reading any pop-up notification during the installation process. A participant
explained his experience and said, “I do not usually read the notifications messages; I click yes, yes, yes to make the installation faster.”

Many other participants opposed the idea of not being concerned regarding the privacy. A participant noted, “if I knew an app specifically had like publicity for taking information or like using it somehow, I would not get it.”

Another participant expressed his concerns regarding app violations for the users’ privacy. He remarked:

“I feel like the media does not want you to care about privacy. And like Snapchat, for example, is now partnered with the government. So, I would not doubt it if Snapchat knows my face, and my identity, and it shares this information with the government. But, I mean that is something I rarely think about. But that is something very intense.”

Some apps might present an advertisement according to users’ messages or other information that is stored on the users’ devices. One of the participants explained his discomfort regarding this manipulation by the apps. He said:

“I was messaging some people through Facebook, I used guitars, because I was looking through some guitars. There were ads about that same subject. So that is what sounds to me like they read through my messages.”

Users have concerns regarding apps that use their location data. A participant noted:

“Why should I install something that should know where I am at now where I do not really need that application, or I can just avoid it using the website or anything else.”

Many participants expressed their confusion when some apps request access to unnecessary resources. One of the participants stated:

“If it is a game that does not have anything to do with pictures, or contacts, or whatever. Can we access your pictures? Can we access your contacts? No, your app is going to get deleted. Your app does not need that access. I know I do not have anything on my phone but the fact that you want it tells me you are shady.”
A participant reported her routine maintenance to investigate apps that misuse permission as following:

“One of the things that I do very frequently, probably about once a week, is if I download a new app, I go into my settings and I look and see which all apps are using my location.”

**App Updates**

A participant explained his experience with app updates. He expressed how he was suspicious about the update activities. He commented:

“I do have to update some of them, but I usually press update. When I do click to see what it says, it usually says oh it is fixing bugs, just fixing little things. And I was like, okay I guess there is something wrong or they are making something better, but I guess they are probably tricking me into doing, adding more storage, adding more stuff but I do not realize it because I do not take the time to look.”

**App Removal**

The experience of deleting an app differs from one user to another. We found that some users might delete an app due to a limitation of space in their mobiles, as one of the participants noted:

“I feel like I will probably look through and delete apps if for some reason I run low on space and I have to figure out what’s the least used on that, like if I have space on my phone I pretty much like all the apps that I use.”

Another participant explained his experience with deleting apps. He provided examples of situations when he decide to uninstall an app as following:

“Most of the times I uninstall games because of it takes a lot of space but I, yeah some applications. If I have an alternative to the app, I go ahead and just delete it, If I find one with a smaller size I just go ahead. Again there are multiple things gain with the smaller sized app like the features I am getting and if the app is really important I am not so. Yeah, I have deleted apps because of the size issue but I gain, it boils down to multiple factors like the usability and stuff like that.”
Other participants said they might delete an app when they get bored of it. A participant noted, “I go to puzzle games, I look through if one sounds interesting, I download it. Half the time I delete it a week later.”

Another reason to delete an app is when it starts to bother the users by showing them too many ads. A participant reported his experience:

“If the app abuses the power of giving the ads to me, or not giving, it is like pushing through my throat those ads then I would delete them. Because I feel like it is using too much of its power on me.”

**Reading and Posting Reviews**

The review comments on the apps store are precious information on the interface of the mobile app stores. Those comments illustrate the users’ experience. Moreover, it presents why users provided a specific evaluation for an app. We found that not all participants think that the reviews’ comments are beneficial. Some participants disregard the comment section in the app review. A participant stated, “I do not read the reviews unless it has like zero stars. And then I am like OK. I have to know what this is about.” Another participant said he is not willing to read the review unless he is not able to compare apps. He noted:

“I do not usually read reviews, I see them but, take an effect, if that is something I gotta try, I gotta try it myself to see if I am gonna like it compared to what everybody else says.”

Another participant agreed with him and said, “If there is a tie in the rating, I look for the negative reviews to see what people are complaining about.”

Some participants do not make huge efforts when they are reading the reviews. They might scan the recent comments, which are listed on the top. A participant stated, “I just look at the top reviews, I mean usually the top reviews will tell me if it is really terrible or if it is just decent.”
We also found that some participants might have specific criteria for the credibility of the reviews. A participant noted:

“I look at the number of reviews, how many reviews. So, for example, if there are three hundred reviews, it seems that it is very popular, but if there is only twelve reviews or eight reviews, I do not know.”

The importance of reading a review increases when participants are about to install a paid app. A participant remarked:

“If the app is costing money. Then I think I am more likely to look at the reviews, because if it is free, I do not have to worry about it. If I pay money for it, and do not like it, I lose my money.”

Some participants read the reviews to learn about an app, and whether it had issues or not. A participant commented:

“When I am looking at the reviews I try to find out what issues it will have. Does it crash that often? Does it do what it is supposed to do? Or is it just a face value that they have?”

Another participant added:

“I do read the reviews; I mean it kind of reducing my time investigating each every application. So you take a particular music app, there is a lot of music apps, and I kind of install every app to see what. So the first criteria would be what would be the best app and go over those top five apps and see what is best. I can not try all the apps and see so I would definitely go with the reading the reviews.”

Another participant stated, “I like to be able to see what other peoples' experience with the app was.” Some users might have specific criteria to determine when reading or ignoring the reviews. A participant summarized her strategy on reading app reviews and picking apps as:
“Usually, when I look for an app and pick once that is like below four stars I am kind of reading the reviews. If I see a review, like one star. [Oh, this app is terrible. Blah, blah, blah.] I am just thinking he does not like this app. He is just mad or something. But, then when I see 2 stars or lower rating, like they list out some good things about the app but then they go in depth about why they give the app this 2 stars rating. But like the 1 star rating, they were like all cap letters, this app is terrible, like why. So I just feel that was not really a credible review. But then I see these other reviews, usually when I see 5 star, 5 star, 5 star, 1 star, 5 star, 5 star. Oh, yeah the majority. But if I start to see multiple low reviews in a row, something is wrong. And usually if I see an app like that with mixed reviews, I just usually do not download it because again time or download, stuff like that.”

Participants were asked about their experience with posting a review for apps. We found that most of the participants are not willing to provide a review for an app, specifically a detailed written review. We found that users might provide a quick and unprofessional review when an app keeps on asking them to rate it. Another participant commented, “If the app is going to bug me so much that I cannot play the game or be on whatever app, obviously I am going to give it 5 stars or whatever to get it to go away.” Also, some apps asks users to provide a specific rating like 5 stars. One participant noted:

“Like occasionally they keep asking, rate, please rate us 5 stars. If you rate us 5 stars, you get a certain reward or something like that.”

Some users might provide a review when they did not like the app. One participant said, “I only review it when the app is bad.”

**Ads in Apps**

Ads in mobile apps are a complicated issue. While users understand that developers might gain some revenue from ads, their experience with them is mostly negative. In our study, we found that many participants were struggling with ads in mobile apps. Results showed that the ad complaints are limited to three areas: frequency, duration, and content.

Many participants were not only complaining about the frequency of the ads, but also the consequences of having too many ads. A participant stated, “I hate apps which have too many
ads. You want to use something, and they have an ad, and they do not have the option of exiting that ad.” Another participant said, “I do not care if it is there. But sometimes it seems that I am like right in the middle of something, and then it just like keep popping up.”

Another participant explained the impact of having too many ads in an app. He thought that having too many ads will lead to deleting the app. The participant explained his thought as:

“So even though if it is a free app does not mean you have to bother me with those ads. That much of ads like you can just sell or just show one or two every period of time but some of them have a huge number of ads which sometimes makes me decide to uninstall the application.”

Choosing the proper time and having relevant ads would be an excellent strategy to have more customers. However, a participant reported his experience and claimed that ads that were presented to him were not relevant to what he wished to buy. Moreover, he did not care and will not be willing to watch the ads. The participant remarked:

“So you are in the app for the game. You are not in the app to look at the other stuff. So, it is like usually I feel like your mind is in the right place. See like oh, it is an ad for these clothes, it is just I do not care right now. I just want to play this game. Like you can either watch either 30 seconds or skip it in 5 seconds. Just skip it in 5 seconds. I feel like that is not where the mind is. So I just feel like, no matter what the ad necessarily is, it will not be looked at.”

Some applications do not make a wise choice when illustrating advertisement for to the users. A participant expressed his discomfort with having unwanted ads. The participant stated:

“I really dislike that in applications, the ad attachments. For example, I looked at a Facebook page yesterday, and I have never seen this before, but you know how you have got a commercial at the beginning of a Facebook page. And it is like at the top. Well, this cover photo expanded, to cover half the screen, and it was like a video clip. And I could not exit out of it. I was trying to look past it, but I could not read anything below. And I got very, very irritated at this advertisement.”
The participants have raised a significant issue regarding the ad content. Most of the participants stated that most of the times the ad content in mobile apps were not suitable for kids. A participant stated:

“It could be a problem. Most of the ads I see in my recent games have not been anything I would not want a kid to see. I have seen some and be like, why is it showing this it should be, like it should not even be an advertisement.”

Another participant noted:

“Because the age appropriateness, like you have notice this app that I downloaded, it is a car race, that is supposed to be fun, but on top of it, it is commercials that do come in between, I just ask myself, man, what is it that my kids are watching? You know, it is a game, I get that, it is a racing game. But, then to pop in commercials that are not appropriate for kids. Not even just for kids, for faith-wise.”

User Needs and Recommendations

In our study, we had fascinating feedback regarding interface design for app stores. We collected data related to the participants’ needs and what they are looking for in future development. This section highlights suggestions that need to be considered in the interface design.

We Are Confused, We Need More Icons!

Besides the stars’ rating, many participants agreed that having more visual indicators could help ease comparisons between apps. As a participant noted the difficulty when comparing apps that had the same level of stars’ rating “you do not know which is better. So you just guess.” Another participant added:

“When I compare apps I spend a lot of time reading the reviews; it would be easier if there are some other icons, like for the battery consumption or the permissions. So, I can see them and make a quick decision regarding which app I am gonna download.”
Not many users are in favor of reading much information here and there. Having visual cues would be much easier for users to comprehend. A participant mentioned, “People would much rather see a visual here, it is a way they will be able to process that in their mind.”

**Specific Recommendations**

A participant mentioned the importance of including the device compatibility in future designs. He wanted to have some indications for whether an app will work on his device or not before installing the app. The participant stated:

“Device compatibility, we need to see something regarding that. I do not want to download something and then find it not working with my device.”

Many participants reported power consumption as another issue. A participant noted:

“Power consumption, there are definitely a lot of apps that run in the background and consume a lot of power. I have dealt with problems with that, and that is another important thing to keep in mind, I would be glad to know that when I have installed an app before I have to run into some problem.”

Another participant remarked:

“Then the power consumption, you have to go to settings, and then battery settings to actually see which are consuming the most power. So, I feel like people are complaining about their battery not lasting long, but then not realize that it is Instagram or Facebook that has drained all the energy. So, I think it would be helpful for our phones to tell us which app has been using the most of power. But then Facebook would not like that.”

A very critical issue that participants complained about is app permissions. Most of the participants noted their concerns regarding how the apps are violating their privacy by manipulating the permissions requests. We found that it is important to have visual cues for the type of permissions that apps ask to access. Many participants mentioned that they do not know the type of permissions until after installing the app. A participant remarked:

“I think until you start installing the app you do not know anything. Nobody reads and you do not know what it is asking access to, and then you are just
downloading some regular thing that is asking access to almost everything. That is like a little fishy. There should be an easy way to inform users what resources the app will access.”

Another participant added, “I wish there were a listing for the permissions before taking the time to download apps.”

Reading the privacy policy is not a desirable task for many users. We found that most of the participants have not read the privacy policy for any app. One of the participants said, “I have not read it because it is very long.” Another participant suggested highlighting the important parts of the privacy policy would encourage participants to read it. The participant stated:

“Most of the time you do not read terms and conditions. It is because of long list So I mean a good practice would be to shorten. So, users can understand it. Then make them accept those terms and conditions because most of the time people do not read and just go ahead and hit accept and continue.”

Many participants pointed out that having screenshots is useful. However, they complained about not seeing the proper ones in most of the app information. Participants reported that many apps have screenshots that are not helpful at all. They suggested that the developers should post updated images of the app UI. Moreover, they want the developers to provide clips that shows how the app or the game works. A participant noted:

“Whatever your important feature that your app is going to contain should be in that screenshot. So you can see that this is what makes this different without having to install it or without having to look at other people’s reviews.”

Another participant was complaining about having promotional videos for the apps instead of showing how the app works. The participant elaborated:

“I wish that they gave more information about the app. I mean maybe a video of someone playing the app rather than a promotional video. Because a lot of them you are like ‘oh it is a video. Cool. I am going to watch it to see what the app is about.’ It just shows me a promotional video.”
There were other participants explicitly explained how the developers need to illustrate videos or clips about the apps, specifically games. One of the participants said:

“An animation explaining how completing the phase is might actually help users quickly choose what app to go with instead of downloading everything. So I mean the worst part is you have to download the app just to uninstall it.”

In addition to the previous suggestions, participants would like to see indicators regarding the app connectivity to the internet. Adding this feature to the interface design would help users know whether the app or the game requires a connection to the internet or not. A participant reported his experience and remarked:

“I studied abroad, in Belgium, and there I had a phone with a limited data plan. I think it was about like 200 megabytes. Snapchat can use that in a day. So, I was very careful. I had watched my data usage very closely. And I, for example, I would either turn data off, on those apps. And I will use Wi-Fi. Or I would just not have them on.”

Referring to the importance of knowing the app's data usage the participant added, “Some of the things I usually think about is data usage, and how it compares to other apps.”

Some participants suggested modifications to the method of illustrating the reviews in the apps information. A participant suggested, “I would like to select the type of the review, either negative or positives.” Another participant suggested illustrating the reviews in categories upon the type of the reviews content. He remarked:

“I guess it would be categories of reviews. Like this is just general praise, here is a section for issues that people run across, that type of thing. So if someone really just wants to look into it would say: ‘It is available’, like I said if you actually care, you would look into it yourself. But it would be nice to have a clean layout.”

Another great idea that our participants have suggested is compensating users for their valuable feedback for mobile apps. Many participants suggested that there should be a method
such as badges or monetary rewards to compensate users’ efforts when they provide valuable feedback. A participant suggested:

“I really want a benefit for writing a review for somebody. So for example in the football games applications like FIFA or PES, why don’t they give us some coins or some game coins or something if I write the review?”

Another participant mentioned that having such rewards would encourage users to post better reviews. The participant stated:

“Maybe offer some sort of benefit for people who review. Because most people do not like writing reviews. I never write reviews. I mean I leave a star on them. And I just be like, that is my star, cool. But I rarely write reviews.”

Discussion

The purpose of this study is to explore what the users see and what they do not see on the interface of app stores. In other words, we aimed to discover the current user experience with the existing app stores. Furthermore, we collected the users’ requirements and recommendations in order to suggest new interface elements for app stores.

Although the current interface design for the app stores seems to be working, our results uncovered the need for improvements. Our findings indicated several recommendations that would significantly improve the users experiences with mobile app stores. In this section we discuss these findings.

In terms of user experience, our findings discovered the users’ experience with app stores has many dimensions. For example, in the regards of choosing apps, previous research indicated that friends recommendations, and discovering within the app store are the most common discovery methods [8], [9]. We found that in addition to these factors, users might consider additional factors such as the popularity of the app, the interface design, the category of the app,
and the needs for the app. We also found that apps listed at the top of the list are more likely to be installed than other apps.

We had an interesting finding regarding the age rating that is associated with the app’s information. Based on our set of participants, we found that very few participants would care about this information. From this finding, we infer that the age rating is not an actual factor in the user decision-making regarding selecting an app. Users might consider age rating when they download apps for kids or when they are looking for apps that were targeted adults.

Interestingly, our findings indicated that stars rating is not important anymore. Many participants do not consider the stars rating as valuable information. Participants indicated that many of the apps in app stores are rated unethically. Moreover, participants thought paid reviewers provide these stars sometimes. In addition to that, many apps are being rated because the rating notifications that bothers user to provide their evaluation. Then the user could avoid these messages by providing a quick star rating without writing any feedback.

Previous research indicated that the price of an app is a considerable factor that affects users’ decisions [16]. We found that users are not willing to pay for installing apps; instead, they try to find alternatives. The reason behind that might be the existence of a large number of alternatives in the app stores. Many developers try to mimic the paid apps and create free versions. Developers of free apps gain profits by showing ads to the users. We found that users will not pay for an app unless they are seeking a specific feature or there are no alternatives.

We found that users vary in their opinions towards privacy. Previous research indicated that users have limited knowledge regarding privacy risks and permissions. In agreement with Shklovski et al. [20], we also found that not all participants are unaware of privacy and permissions issues. Many participants have particular concerns regarding privacy and
permissions. However, they claimed that apps stores do not adequately illustrate information regarding these points. Our findings agreed with Felt et al. [22]. Participants reported that some apps asked to access unnecessary resources.

It is worth mentioning that we found that users have varied behaviors when it comes to reading information on the screen. Providing an interface with more visuals and less text would be helpful. It is important to consider redesigning the interface of app stores to include new elements for the privacy and permissions. For privacy, users do not want to read too many pages. A summary of the important parts would be sufficient. For permissions request, having icons that indicate which resource is being accessed would be useful for users. We assume that summaries and these icons could increase users’ awareness of privacy and permissions issues. Furthermore, having these summaries visual cues would educate users who have limited knowledge regarding these issues.

In accordance with the findings in [14], participants wished to have updates, but they do not know what exactly is being updated. Our study found that participants expressed concerns regarding app updates. In general, users often click the update button, then they receive no further information. It would be better if the app stores required developers to specify in detail what is being updated. Currently, app developers provide a general statement regarding the updates. For example, some developers might mention something like “we fixed a bug.” Users need to know what exactly was done explicitly. Users want to see something like “we fixed an issue that causes the app to crash on iPhone X.”

Our results highlighted reasons for uninstalling apps. We found that limitations in the storage space is a factor that leads to deleting an app. Users might look for alternative apps when they find that their current apps are requiring more storage space, particularly after updates.
Participants also reported deleting an app when they are having a bad experience with ads.

Although ads are an excellent resource for gaining profits in the apps industry, many developers do not use them properly. According to our results, we advise app developers to learn the best practice of using ads.

In the same context, although participants understood the purpose of having ads in free apps, we found that they are annoyed by the frequency of the ads and at times their content. One participant was shocked to find an adult advertisement in a kid’s game.

To solve the ad issue, it is crucial to have the app store set some restrictions regarding the duration and the number of ads. For the content of the ads, we advise the developers to use a proper ads library. Moreover, the content of ads should be tied to the age of the app’s user. We think the development of new techniques that could help to suggest the appropriate ads according to users profiles could be a productive area of new research.

Reading and Posting Reviews

We found that in general the majority of the participants do not read reviews. However, users might read top reviews if they think there is an issue. Additionally, we found that some participants read reviews to compare apps. They tend to do that since there are no other ways to compare apps other than the star ratings of the apps they want to compare. To judge the credibility of the reviews, some users associate the number of the reviews with stars rating.

Our results indicate that users generally do not post a comment unless the app is horrible or they were bothered by rating notifications. That is aligned with what was claimed in [12]. An interesting suggestion, which was reported in the findings, was that compensating users for posting reviews might be a new way of encouragement. We think this idea might increase the quality of the ratings. While this idea seems interesting, it still needs to be regulated to avoid abuse. A critical question to be answered is who would pay for the reviews.
Our findings revealed several important points for future developments of app store interfaces. Participants mentioned the importance of having more visuals, like icons, to improve their decision-making. In addition some participants suggested redesigning the review section to be in categories. Other users asked to highlight issues in reviews and have the ability to click the keywords to present only reviews that are associated with their selection. Participants seemed to want simpler interfaces to improve their ability to comprehend the key features of the app they were considering.

Do We Need Visual Cues?

Our findings revealed a lack of awareness regarding privacy and permissions for apps. It is essential to have the information regarding the privacy and the permissions in an obvious position within the app interface. The information currently exists in app stores, but many users do not know where and how to find it. We suggest locating this kind of information in the top of the screen as a list of keywords or icons. This approach would improve users’ awareness of these critical features. Moreover, such an approach could impress on the users the importance of these issues.

Participants noted the need of having a visual indicator for the data usage. Users download apps, but do not know whether these apps require a constant connection to the internet or not until they are using them. Having a visual cue in the app’s information screen would be a beneficial tip for users. Users may need to be careful when using their cellphone data plan. In the same regard, some apps consuming more power than others. It might be helpful to present an icon that indicates how good the app is in terms of battery consumption. Last but not the least, it is worth to mentioning device compatibility. It is frustrating when a user installs an app then finds out that the app doesn’t work on their device. This specific issue potentially emerges when new devices are released that have new technology or new features. A good idea to avoid users’
frustration is presenting an icon that tells whether the app would work on the user’s device or not.

**Limitations**

The limitations of this study include the lack of diversity. All participants in this study were well-educated individuals. The study might have a different output if it includes individuals who vary in their education level, race, income level and location.

**Conclusion and Future Work**

In this paper, we presented a qualitative study of 16 participants regarding the improvement of the design of app store interfaces. This research investigated the current participants’ experience with existing app stores. Furthermore, this study provided recommendations to enhance the interface design of app stores based on the users’ needs and desires.

Our results suggest that current interfaces could use new elements that would enhance the users’ experience with mobile app stores. As this study recommended, users need to have new icons that illustrate some of the users’ concerns and challenges. Examples of the new elements are icons that represent the privacy, permissions types, ads, internet access requirements, and battery consumption.

This study revealed multiple directions for future research. One of these directions could be developing a new technique for the presentation of the ads to users. Another direction for this research would be designing and evaluating a new interface that implements the recommendations of this study. A more diverse study would be another future direction worth pursuing.
References


CHAPTER 4. A USABILITY EVALUATION FOR A PROPOSED INTERFACE DESIGN OF APPS’ STORE

Modified from a manuscript to be submitted to an academic journal
Omar Asiri, Carl K. Chang, Sunghyun Kang
Iowa State University
Ames, IA

Abstract

Exploring the apps store is one of the daily habits for many smartphone users. Users suffer of being exposed to a lot of unorganized textual information in the apps’ stores when they want to get information about a specific app. This does not help users to be aware of or understand applications’ issues. Most users do not read everything about the apps. Many users consider the star rating as a sole criterion to determine the suitably of an app for their needs. However, the star rating, which has been used for a long time to determine the apps’ quality, becomes obsolete often and starts to lose its credibility. Thus, users need a new way to interact with apps in the apps’ stores. This study aims to propose a new means to display apps’ information on apps stores, by illustrating the apps’ features and critical issues in shape of icons presented in the apps list and apps’ information page. Moreover, this paper demonstrates the results of a usability testing for the proposed design. A crucial part of proposing a new design is testing its usability to predict its success. Results of the usability testing for the proposed design showed positive achievements for both the tasks’ completion and users’ satisfaction. Our findings indicate that participants were pleased to be exposed to the proposed design and were eager to see the live version. We anticipate that users’ experience and their awareness towards the apps issue would be improved if the apps stores were to adopt the proposed design concept.
Introduction

Sam is a young college student, who likes to frequently download a variety of apps. Some of the apps help him survive daily activities, while others are only to break out the school routine. Sam is interested in new apps. However, he has always wondered what specific features are in these new apps. Moreover, he does not know the differences between the advertised new apps and the similar ones already in his phone. Sam is very concerned about the apps’ privacy and the type of permissions that are requested. Since he is a college student, he does not like to download apps that drain his phone’s battery. He needs to use his phone to keep up with his daily calendar. Having a dead battery could get him in trouble. Sam is wondering if there is a more effective way to assess the apps on the apps store and get an idea about critical issues of concern. He wishes there was a way to compare apps without the need to install them for a tryout or having to read hundreds of reviews.

The scenario above is representing issues that apps’ users face every day. The popularity of smartphones has been increased during the last decade. For example, in the USA, more than 50% of Americans own a smartphone [1]. Increasing the number of smartphone owners causes the flourishing of apps’ development. A study found that the average number of downloaded apps by users is 142 apps [2]. Both Google play and Apple’s apps store have around 6 million apps [3]. This numerous number of apps will not be free of causing issues to users.

Users tend to report the issues that they face with the apps by posting a review. However, some reviews are very long. Moreover, not all users are in favor of reading the reviews especially when they are lengthy. In addition to that, there are apps that have thousands of reviews. A study reported that some apps, specifically famous apps, could have more than 2000 reviews each day [4].
When users desire to install an app, they first go to the apps store and either search for the specific app or explore the ones appearing on the main screen. When they want to compare apps, they need to spend a lot of time reading their information. Users might be interested in reading reviews in order to find out if there are any issues that have recently been reported.

Researchers found that users have limited awareness regarding apps-related issues [5]. They claimed that the way of illustrating the information on the interface of apps stores contributes to limiting users’ awareness.

This paper aims to shed a light on a proposed interface design for the apps’ stores. Then, to evaluate the proposed design regarding its usability flaws. In our work, we found that the current way of illustrating information about apps in the apps stores is not helpful in terms of increasing users’ awareness about apps’ issues. Users, specifically novice users, need to understand and have access to critical information about the apps in a small amount of time. We believe that “A picture is worth thousands of words.” Thus, we designed our proposed prototype to contain more visuals and less text. Our proposed prototype could be used as a guideline for what users might want to see on the interface of the apps’ stores.

The remainder of the paper is organized as follows. In the next section, we introduce the proposed design. Then we highlighted the relevant related work. After that, we describe our methodology. Then results from the usability testing are reported. Next, we discuss our findings. We conclude this paper with our final thoughts and suggest future directions.

**Proposed Interface Design**

The proposed design is built on adapting a new concept of design. These days users do not have time to read much information about apps on the information screen. We think illustrating the information in the shape of visuals would be better for users. “A picture is worth thousands of words” is the philosophy behind the proposed design. Previous research studies
indicated that users need to have visual indicators for apps issues [6]–[9]. We considered the previous studies and tried to implement their suggestions in a proposed design along with recommendations that we reported in previous work [5]. Following is an illustration for the design ideas in the proposed prototype.

The Main Screen

We designed the main screen of the prototype with a selection of four different apps. The selection was targeting to serve the purpose of having a variety of apps. The selected apps were a collection of common apps in the apps store. At the time of the usability testing, the screen had only four apps. Users could scroll up and down. Apps were illustrated in a block of information, mostly visual information. Each block has the name of the app, rating, privacy rate, price, screenshots, and icons that represent the apps’ most critical issues and features. This design method would help users to easily compare between apps without the need to separately read the information of each one. Figure 4-1 illustrates the design of the main screen.
Figure 4-1  The prototype's main screen. Users can scroll up and down between pages A and B. The interface has the apps’ information in the shape of icons.

**Apps’ List after Searching for a Specific Keyword**

Users need to have adequate information illustrated to them to guide them when choosing an application. In our proposed design, we provide a page that shows results of searching for an app using the keyword “Photo editor”. The interface design for the apps list includes the common information that apps store illustrated like the app’s name and screenshots. Moreover, it provides users with more details about the apps. For example, users could see which app has advertisements. Furthermore, the icons illustrated in the interface represent several apps’ issues in case users have concerns regarding some of the apps’ issues like battery consumption or unethical use of permissions. This method of information illustration would help users to have a quick assessment about apps and let them pick the suitable one in seconds. Figure 4-2 illustrates the design of the apps’ list when using the keyword “Photo editor” to search for an app.
Figure 4-2 Apps list after using the keyword "Photo Editor". The results show four different apps with different features and issues. Users can scroll up and down between pages A and B.

**Picking a Specific App**

The user might choose to pick a specific app to read more information about it. We redesigned the way of displaying the apps’ information to provide users more data in a quick look. Users see information about apps in the shape of icons. The information is divided into several groups. The icons in the apps’ information page is grouped into categories according to the information that we want to deliver to the users. Along with the general information about the app, there are icons that represent the type of permissions that the app requests. Another group is for the reported issues in the app. The information in this group is supposed to illustrate icons for each issue that has been reported repeatedly in the reviews. Apps’ features are summarized in a separate group to give users an idea about the features of this app without the need to spend the time reading the app’s description. The proposed design also suggests a new way to illustrate the users’ reviews. The design suggests illustrating the users’ rating in four
categories: interface, battery usage, performance, privacy. That would help to see what other users are specifically complaining about. Moreover, the design suggests an overall rating score for the positiveness of the reviews about the app. Figure 4-3 illustrates all design elements for the app information page.

Posting an App Review

Users might want to post a review for some apps. We suggest that users could provide their written reviews along with rating four scales. Our goal with this step is to help the users to increase their awareness regarding specific issues. Moreover, to guide the users to provide a better structure for the reviews’ writing style, having a good writing style would help in analyzing the users’ input when needed. Figure 4-4 illustrates the interface design for posting a review.
Literature Review

In this section, we present a summary of the related work from the body of the literature. We illustrate the related work in categories to make it easier to connect between our work and other studies.

Why Is Apps’ Rating Important?

Apps’ rating is a crucial element to identify apps’ success [10], [11]. Herman et al. [12], found a correlation between the number of apps’ downloads and the apps’ rating. Another research claimed that the apps’ rating is a primary key that users depend on when they want to choose an app [13]. Kim et al., also claimed that apps’ rating is not only beneficial for users. The number of stars of an app could make an impact on its revenue [13].

The overall rating could be affected by several factors. Iacob et al. [14] found a relationship between the apps’ overall rating and the amount of feedback received. Moreover,
they claimed that a lower rating for apps results in having more reviews. KuehnhAUSEN and Frost [15], argued that the apps’ rating is not a reliable metric. Therefore, the apps’ trust should not be built only on the apps’ rating.

**Apps’ Selection**

Selecting an app is not a hard job to do. Everyone can open the apps store and choose any app. However, research determined several factors that impacted users’ selections. Friends’ suggestions and exploring the apps stores are the primary discovery means for apps selection [16], [17]. Analyzing apps reviews, Iacob et al. found that roughly 25% of the reviews contain advice for other users to use the app [14]. There are other factors for selecting an app. Chin et al. [16] found that the price of an app and its popularity could impact users’ decision regarding installing a specific app. Users select apps depending on their needs, or apps that are trendy at the moment of browsing the apps store[5].

**Apps’ Updates**

Apps’ updates is an important factor for mobile users. However, users’ opinions regarding apps’ updates are divided. According to Tian et al. approximately 50% of smartphone users set their devices to automatically install updates [18]. They found that users who chose to not install updates were doing that due to permissions and privacy concerns. Another study reported that users tend to install apps that do not require frequent updates [19].

Not all apps inform users about why they need to install a specific update. A study found that half of the frequent updated apps do not provide justifications about the update [20]. By doing so, users are confused. Do they need to download the update or not? Nayebi et al. stated that users have mixed feelings regarding this. Users want to install the updates, but at the same time they are afraid of having issues afterwards [19]. According to Nayebi et al., devices and
Apps crashes are the most frequent issues reported after installing updates[19]. As reported in [21], users tend to report their claims after having troubles with a recent update.

Researchers identified factors that could help to determine whether to install an update or not. These factors include trusting the app’s developer, the type of the app’s reviews, and the type of permission requested [16], [18].

**Battery Consumption**

Battery life is a desired feature that many smartphones’ creators try to advertise when introducing a new device. However, battery draining could be caused by many reasons. One of them is the way of accessing the device’s resources. Nagappan and Shihab [22] stated that bad battery consumption could be a result of improper development for the apps. They claimed that not all developers know how to program an energy-efficient app. Therefore, we need to educate developers regarding the best practices of creating energy-efficient apps. Knowing which resource is consuming most energy would be a helpful hint for developers. Li et al. [23] claimed that accessing the network is the feature that consumes most energy.

**Privacy and Permissions**

One of the controversial issues in the apps industry is the apps’ manipulation of privacy and permissions. According to [16], users are worried about the privacy in their smartphones more than in any other electronic devices. Moreover, it is strange that users tend to see and read the permissions illustrated on the phone screen, however, their knowledge regarding issues associated with privacy violations is limited [9], [24]. Moreover, Kelley et al. claimed that not all users understand permissions. Kelley added, users are not aware of the security risks that apps could cause [24]. Another study argued that many users are not ready to make decisions regarding the apps’ privacy and security[24]. On the other hand, Shklovski et al. [25], claimed that not all users are unaware of these issues. Shklovski stated, there are users who prefer to use
apps despite the prior knowledge that their privacy has been manipulated by the apps.

Remarkably, as reported in [26], [27], most of the apps’ users ignore permissions completely.

When it comes to the exchange of information between users and developers, users do not mind sharing their data with the apps’ developers. However, they felt violated when they discovered that some apps they had been using for a long time were accessing their data without prior consent [7], [26]. Felt et al. claimed, there are apps that aim to collect data from users’ phones [27]. A recent study reported a correlation between permissions’ misuse and apps’ popularity [28].

To classify applications in terms of their privacy, a research team from Carnegie Mellon University created a platform called Privacy grade [29]. Privacy Grade is a service that assigns grades to android apps based on a technique that was developed in their lab. Users can search and explore apps’ grades in the service website.

**What Do Users Complain About?**

Many studies investigated and analyzed apps’ reviews. The body of literature has numerous examples of these analysis specifically in the domain of clustering users’ complaints in apps reviews. Detailed examples of users’ complaints were reported in [21], [30] [31]. The complaints include but are not limited to: crashes issues, performance issues, usability issues, security issues, privacy, and energy issues.

From all types of complaints, over half of the them are limited to functional errors, requests for specific features, and reporting app crashes [21], [30]. Khalid [21] claimed that the most negatively perceived complaints were privacy and ethics, hidden costs, and feature removal. Khalid reported that more than 50% of the low ratings that Hulu Plus received was due to the hidden-cost issue. Users thought they would be able to watch content on Hulu for free, but they need to pay a monthly subscription fee after installing the app.
Apps’ Reviews: Challenges and Benefits

Apps reviews contain multiple challenges. One of these is having a growing number of reviews posted for each app. As reported in [4], apps receive 23 reviews per day. Moreover, popular apps such as Facebook could get thousands of reviews per day. Iacob et al. [11] claimed that due to the huge amount of reviews, users have a limited ability to read all the reviews posted for apps. Moreover, the length and quantity of reviews make spotting the apps’ flaws a difficult task for users [14].

There are several factors that make dealing with apps’ reviews is a challenging task. Reviews are unstructured, have inconsistent quality and it is hard to identify which review is useful [12]. In addition to that, reviews contain informal expressions, abbreviations, and are not free of misspelling [32].

Trusting the reviews is another story. Some apps’ users think that most reviews are fake and they could easily distinguish these false reviews [5]. Hu et al. reported that the reviews on the online product may not have truthful information and do not always show the products’ quality [33]. In addition to that, reviews are affected by the users’ emotions. Users usually post their reviews when they are extremely happy or extremely angry [33].

According to Iacob et al., users trust apps’ reviews more than the app’s description, which typically is provided by the apps’ developers [11]. Apps’ reviews could offer great feedback not only for users but also for developers. As reported in [4], [8], [12] reviews help developers in terms of apps’ improvement, users’ experiences. Reviews contain users’ reports regarding GUI, app’s performance, comparison with competitive apps [14].
The Need for Improving the Design

Users of apps stores might need a new interface that helps achieve better understand apps and the issues related to them. One of the issues is that users are not aware of what resources are being used by their apps. Liu et al. [34] suggested that apps stores should have a simple and informative design that illustrates to users what permissions the app will require. As recommended in [7], users need to know the reasons why each resource will be used. This step will help relieve users’ concerns regarding the apps’ privacy. Liu et al. claimed that a simple interface would assure making better decisions when it comes to granting permissions and controlling the resources of users’ devices. Liu et al. added that users should not be forced to give up controlling their devices in order to be able to use apps [6]. There was a study that claimed the need of redesigning the interface of apps’ stores [9]. They argued that users have a limited background regarding the security risks when it comes to apps’ selections. Rajivan and Camp recommended updating the apps stores with a better design that assures users’ understanding of privacy issues. Moreover, they suggested that users should be visually exposed to this visualization at the beginning of the installation process.

Due to the complex issues associated with the vast quantity of apps, users need to have a better interface design that helps them differentiate between apps [8]. Thus, it should be a good idea to have visual cues that simplify apps issues and make them easy to be understood. In a previous study, which is in preparation to be published, we found that users are in need of having icons as a representation for the apps’ issues. For example, there should be an icon that indicates whether the app is good in terms of privacy or not. Also, other icons that represent different issues like types of permissions required, battery consumption, and technical issues, apps’ features, and apps’ specifications. We have suggested a number of design elements that would be beneficial for apps’ users.
Methodology

One of this study’s goals is to examine the usability of the proposed interface. In this section we describe the settings for the usability testing for the proposed prototype.

Subjects

We recruited 35 participants. Out of 35 participants, 24 (68.57%) were male and 11 (31.43%) were female. Regarding the age range; 4 (11.43%) were aged between (18-19), 16 (45.71%) participants aged between (20-24), 8 (22.86%) aged between (25-29), 6 (17.14%) aged between (30-35), and 1 (2.86%) was older than 35 years of age. In terms of the highest degree that participants have received, 4 (11.43%) participants have high school, 12 (34.29%) are currently college students, 11 (31.43%) have a Bachelor’s degree, 8 (22.86%) have a Master’s degree. Regarding the operating system of participants’ smartphones, 22 (62.86%) were using IOS, 13 (37.14%) were using Android. The majority of the participants indicated that they have used a smartphone for at least three years. However, out of the 35 participants, only 14 (40%) reported that they install apps frequently. Table 4-1 summarizes the demographics of our participants.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>18-19</td>
<td>4 (11.43)</td>
</tr>
<tr>
<td>20-24</td>
<td>16 (45.71)</td>
</tr>
<tr>
<td>25-29</td>
<td>8 (22.86)</td>
</tr>
<tr>
<td>30-35</td>
<td>6 (17.14)</td>
</tr>
<tr>
<td>Older than 35</td>
<td>1 (2.86)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24 (68.57)</td>
</tr>
<tr>
<td>Female</td>
<td>11 (31.43)</td>
</tr>
<tr>
<td><strong>Educational attainment</strong></td>
<td></td>
</tr>
<tr>
<td>High school or equivalent</td>
<td>4 (11.43)</td>
</tr>
<tr>
<td>Some college</td>
<td>12 (34.29)</td>
</tr>
<tr>
<td>Bachelor’s Degree</td>
<td>11 (31.43)</td>
</tr>
<tr>
<td>Master’s Degree</td>
<td>8 (22.86)</td>
</tr>
</tbody>
</table>
### Table 4-1 continued

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Smartphone’s system</strong></td>
<td></td>
</tr>
<tr>
<td>IOS</td>
<td>22 (62.86)</td>
</tr>
<tr>
<td>Android</td>
<td>13 (37.14)</td>
</tr>
<tr>
<td><strong>Native language</strong></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>18 (51.43)</td>
</tr>
<tr>
<td>Other</td>
<td>17 (48.57)</td>
</tr>
<tr>
<td><strong>Years of using a smartphone</strong></td>
<td></td>
</tr>
<tr>
<td>1-2 years</td>
<td>2 (5.71)</td>
</tr>
<tr>
<td>3 years</td>
<td>3 (8.57)</td>
</tr>
<tr>
<td>More than 3 years</td>
<td>30 (85.71)</td>
</tr>
<tr>
<td><strong>Frequency of installing apps</strong></td>
<td></td>
</tr>
<tr>
<td>Rarely</td>
<td>4 (11.43)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>17 (48.57)</td>
</tr>
<tr>
<td>Frequently</td>
<td>14 (40)</td>
</tr>
</tbody>
</table>

### Design

The usability test session consisted of four elements. First, a background questionnaire to collect demographic data about the participants. Second, an icon recognition questionnaire. We used this tool to find out whether the icons that we used in the prototype would cause usability issues or not. Harley (2014) mentioned that many of the usability issues are coming from users not understanding the used icons [34]. To minimize usability issues, we asked participants to guess the meaning or the function of each icon, Figure 4-5 shows examples of the users’ inputs.

![Figure 4-5 Examples of participants inputs for the icon recognition test](image-url)
After that, we provided the participants with a sheet of paper that has the intended use for most of the icons in our prototype. We did that to ensure the participants’ understanding for the icon used, specifically icons that we designed and users had not seen before, such as the privacy icon. Table 4-2 illustrates the intended definitions sheet that participants had after finishing the icon recognition test.

Table 4-2 Icons recognition questionnaire

<table>
<thead>
<tr>
<th>The icon</th>
<th>Meaning/Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>🎤</td>
<td>The app will use or need permission to access the Mic.</td>
</tr>
<tr>
<td>🌐</td>
<td>The app will use or need permission to access the internet network.</td>
</tr>
<tr>
<td>📍</td>
<td>The app will use or need permission to access the location data.</td>
</tr>
<tr>
<td>🗨️</td>
<td>The app contains ads.</td>
</tr>
<tr>
<td>🎥</td>
<td>This icon indicates the privacy level of an app, in this case it is an A.</td>
</tr>
<tr>
<td>📞</td>
<td>The app will use or need permission to access the contacts.</td>
</tr>
<tr>
<td>🌋</td>
<td>This icon indicates the battery usage for an app. In this case, the app is using much power than other apps.</td>
</tr>
<tr>
<td>Kids</td>
<td>The app is suitable for kids.</td>
</tr>
<tr>
<td>🕑</td>
<td>The app is compatible with smartwatches.</td>
</tr>
<tr>
<td>📌</td>
<td>The app will use or need permission to access the photo album.</td>
</tr>
<tr>
<td>🚠</td>
<td>The app has technical issues (e.g., bugs, crashes).</td>
</tr>
<tr>
<td>🌐</td>
<td>The app supports and is compatible with multi-languages.</td>
</tr>
<tr>
<td>📸</td>
<td>The app will use or need permission to access the Camera.</td>
</tr>
</tbody>
</table>

After that, users were asked to perform a series of tasks shown in Table 4-3. The prototype was designed by a tool called Axure (Axure.com) and was tested on an iPhone 6S, which has a 4.7-inch screen. Icons were gathered from different libraries available on the Axure.com forum.
<table>
<thead>
<tr>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. From the main screen, please indicate which of the apps is consuming less</td>
</tr>
<tr>
<td>power.</td>
</tr>
<tr>
<td>2. From the main screen, please indicate which of the apps is having lower</td>
</tr>
<tr>
<td>privacy rate.</td>
</tr>
<tr>
<td>3. Search for an app using the keyword “Photo Editor.”</td>
</tr>
<tr>
<td>4. Select the app that will have no ads.</td>
</tr>
<tr>
<td>5. What is the privacy level for the selected app?</td>
</tr>
<tr>
<td>6. Please name two types of permissions that this app is requiring.</td>
</tr>
<tr>
<td>7. Please name one of the reported issues with this app.</td>
</tr>
<tr>
<td>8. Please name one of this apps’ feature.</td>
</tr>
<tr>
<td>9. Please go to the users’ review section. Then, post a review.</td>
</tr>
</tbody>
</table>

At the end of the study, users were given a questionnaire. The questionnaire has 11 statements designed to collect participants’ responses as a five-points Likert scale. Following the statements, users were asked to answer additional open-ended questions regarding their experience. We added these questions to give the participants an opportunity to report anything that they liked or disliked. Figure 4-6 illustrates the questionnaire questions.

Figure 4-6 Exit questionnaire
Procedure

After obtaining an approval from the Institutional Review Board (IRB) at Iowa State University to conduct the usability study (Appendix B), we distributed flyers across the university’s buildings. Interested participants emailed the first author to schedule meeting times. All usability test sessions took place in a quiet study room at the university’s library. Before starting the session, each participant was asked to read and sign a consent form. We explained to the participants the purpose of the study and what their roles were. We also emphasized that our study is to test the prototype, not the users. Then we gave the participants an empty form of the icon recognition questionnaire. Each participant was asked to fill out the form with a guessed meaning or function for each icon. Then, we provided the participants with the sheet that had our intended interpretation for each icon. In some cases, the test facilitator and the participant had a discussion about some of the icons used, specifically the uncommon ones. Then the participant was provided with the device that had the prototype installed on it and a sheet of paper that had the evaluation tasks. We asked the participants to think aloud while they were doing the tasks. During the test session, the test administrator took notes about the participant performance and the completeness of each task.

When the participants finished all tasks, they were given the exit questionnaire. This survey helps us collect data regarding users’ satisfaction towards the proposed design. At the end of each usability session, and as a token of appreciation, each participant was compensated for the participation with a $10 gift card. The average time for each session was 20 minutes.
Results

Finding out the design flaws and the users’ satisfaction towards the proposed design are the main purposes of conducting the usability test. This section provides an explanation of our findings from the data we collected during the evaluation sessions.

Tasks Completion Rate

To evaluate the design of our prototype, we created 9 tasks that cover the majority of the design features. Overall, all the tasks were completed with a great success rate which ranged between 89%-100%. During the test, each help or hint given to the users was considered as a not successful completion.

When participants were asked to report which app was consuming less power, 91% of them were able to successfully indicate that “WhatsApp” was the one. They indicated that the battery icon (🔋) helped them compare between apps and provide an answer for this task.

From the main screen, participants were asked to indicate which of the apps have a lower privacy rate. Similar results to the previous task, 91% of the participants were able to indicate that “Angry Birds Classic” was the app that had a lower rating in terms of privacy. Participants were able to determine that by looking at the illustrated privacy rate for this app, which was C. Participants compared apps using the privacy icon (🔒).

Interestingly, the completion rate for the third task, which required participants to search using a key word, had the lowest completion rate across all the tasks. The completion rate was 89%. We noticed that some participants were initially looking for an icon that indicated the category of an app “photo editing”. The majority of the participants, who were confused at the beginning, were able to identify the correct way to proceed with the task.

Having a high completion rate for any tasks represents to what extent participants were able to understand what information each icon was conveying. When participants were asked to
find the app that has no advertisements, 100% of the participants were able to determine that “Adobe Photoshop” was the target app. Participants indicated that it was easy to proceed with this task using the icon ( ), which represents whether an app will have advertisements or not. In addition to that, participants were able to identify the privacy rate of the selected app. The completion rate for this task was 100%.

Participants were asked to name two types of permissions that Adobe Photoshop uses, 97% of the participants were able to successfully complete this task. We noticed that the icons that represent Wi-Fi and the location were the most reported permissions by the users. On the other hand, 100% of the participants were able to report issues that the app had using the information illustrated at the top of the information page.

Using the information illustrated on the prototype interface, participants were asked to name one of the app’s features. One hundred percent of the participants were able to successfully complete this task. It was interesting that many of the participants had named at least three of the apps’ features. It was clear that icons were very appealing for the participants, which led many of them to name more than what the task was asking.

The proposed prototype has a new way to post apps’ feedback. Along with the test, participants were given the chance to rate the app in four dimensions (interface, performance, battery, privacy). The completion rate for this task was 94%. One of the participants refused to complete this task, while the other one did not post a review. Both participants thought they needed to sign-in before posting a review. Figure 4-7 summarizes the achievements of tasks’ completion.
Users’ Satisfaction

When participants finished all tasks, they were provided an exit questionnaire. The purpose of this questionnaire was to measure participants’ satisfaction with the proposed prototype. Moreover, to have some feedback regarding their experience. Overall, results indicated positive responses for all statements. The lower average recorded for the responses was M=4.31. This was related to the ninth statement that was asking whether the system had all the expected functions.

The first two statements were focusing on the prototype’s comfortability and learnability. Results showed that participants tended to answer, on average, “strongly agree” when they were asked to rate their comfort with the prototype (M=4.57,SD=0.55). In terms of the learnability, participants tended to answer the statement, on average, “Strongly Agree” (M=4.69,SD=0.52). Findings regarding this statement imply that the proposed interface is comfortable and easy to be learned.
The third statement was asking the participant to rate the clarity of the information provided with the prototype. The responses for this statement tended to be, on average, “Strongly Agree” (M=4.51, SD=0.65). Regarding the easiness of finding information in the prototype, participants tended to answer, on average, “Strongly Agree” (M=4.60, SD=0.60). Moreover, participants were asked to rate whether the information provided with the prototype was understandable or not. Responses for this statement tended to be, on average, “Strongly Agree” (M=4.40, SD=0.73). Furthermore, participants were asked to rate the organization of information on the prototype. Participants tended to answer, on average, “Strongly Agree” (M=4.43, SD=0.73).

The statements from 7 through 9 were focused on having the users’ feedback regarding the design of the prototype’s interface. Participants were asked to provide their rate about whether the interface was pleasant or not. On average, responses tended to be “Strongly Agree” (M=4.34, SD=0.83). Moreover, the next statement was asking the participants if they liked the interface of this prototype. Responses tended to be, on average, “Strongly Agree” (M=4.54, SD=0.77). In addition, participants answered, on average, “Strongly Agree” (M=4.31, SD=0.75) for the statement that asked if the prototype had all expected functionalities and capabilities. Although findings for this statement were positive, it has the lowest average across all results. Some participants reported their justifications and clarifications when they answered the open-ended questions.

The last two statements of the exit questionnaire asked participants if they would recommend the prototype to others and their overall satisfaction. Regarding recommending the prototype to other users, participants tended to answer, on average, “Strongly Agree” (M=4.46,
The participants’ overall satisfaction was positively reported as “Strongly Agree” (M=4.54, SD=0.65). Table 4-4 summarizes all the findings.

Table 4-4 Findings of users' satisfaction

<table>
<thead>
<tr>
<th>Statement</th>
<th>Count</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel comfortable using this prototype</td>
<td>35</td>
<td>4.57</td>
<td>0.55</td>
</tr>
<tr>
<td>2. It was easy to learn to use this prototype</td>
<td>35</td>
<td>4.69</td>
<td>0.52</td>
</tr>
<tr>
<td>3. The information provided with this prototype is clear</td>
<td>35</td>
<td>4.51</td>
<td>0.65</td>
</tr>
<tr>
<td>4. It is easy to find the information I needed</td>
<td>35</td>
<td>4.60</td>
<td>0.60</td>
</tr>
<tr>
<td>5. The information provided for the prototype is easy to understand</td>
<td>35</td>
<td>4.40</td>
<td>0.73</td>
</tr>
<tr>
<td>6. The organization of information on the prototype screens is clear</td>
<td>35</td>
<td>4.43</td>
<td>0.73</td>
</tr>
<tr>
<td>7. The interface of this prototype is pleasant</td>
<td>35</td>
<td>4.34</td>
<td>0.83</td>
</tr>
<tr>
<td>8. I like using the interface of this prototype</td>
<td>35</td>
<td>4.54</td>
<td>0.77</td>
</tr>
<tr>
<td>9. This prototype has all the functions and capabilities I expect it to have</td>
<td>35</td>
<td>4.31</td>
<td>0.75</td>
</tr>
<tr>
<td>10. I would recommend this prototype to others</td>
<td>35</td>
<td>4.46</td>
<td>0.69</td>
</tr>
<tr>
<td>11. Overall, I am satisfied with this prototype</td>
<td>35</td>
<td>4.54</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Following the Likert scale statements, participants were asked to answer open-ended questions. We have these questions to give the participants the opportunity to post their thoughts regarding the proposed design.

The first question was asking the participants about the things that they liked in our proposed design. Participants indicated a variety of things that they liked about this prototype. Ease of use and the lucidity of the design were the most repeated praises in the responses. Moreover, participants reported that the design helps to compare between apps without the need of spending much time reading the apps’ descriptions or apps’ reviews. One of the participants stated that the design provides a clear depiction of details. Another participant liked that the design is not reliant only on stats or number of downloads. Furthermore, participants liked that the design had details about the apps up front. A participant stated, “Info is up front instead of after purchase or download.” Users will not need to download apps in order to know what features are provided or what requirements are needed.
One of the participants stated, “I like the UI design, nice and clean. The design provides good details about the app. I like the visual icons because I do not like to read the apps in the reviews. Moreover, this design answers my concerns about the app.” Another participant liked the idea of having information regarding the permissions needed and the battery consumption. The participant stated, “I really liked knowing what permissions from my phone it would be needed. Also, knowing the effect on my battery before even downloading it was really cool.” Participants like the use of symbols to represents the app’s information. A participant stated, “I like how much information was represented in a shape of icons. It helps me to figure out apps features and compare apps in a glimpse.”

We also asked participants to report anything that they did not like in the proposed design. There were two major concerns. The first one was regarding understanding the icons, specifically ones that we newly proposed and are not common. Some participants mentioned that icons need to be self-explanatory. Some participants were not sure at the beginning about some icons like the ones that represent the privacy, language, and bugs. The second category of comments fell into the need of adding more colors to the design. Participants stated that adding colors for some icons would help to better understand the message. For example, adding colors (red, yellow, green) to indicate the level of the battery consumption or the privacy level.

Participants were asked to write additional comments if they have any. Comments were mostly praising the proposed design. However, there are some recommendations that are worth being reported. One of the participants suggested adding more functionalities to the design. For example, adding the similar apps at the end of apps’ info page. Another participant suggested using emojis in illustrating reviews. For example, having a sad or angry face to express bad impression about an app. Furthermore, another participant suggested adding an icon to indicate
categories of apps, so that it would be easier to know if a specific app is an educational one, a game, or something else. A participant was wondering about the method of ensuring the validity of the icons presented in the reported section. Will they be reported manually or automatically? He asked how do we know if the reported issue is a real issue, or if it is there because of negative unreal reviews.

**Discussion**

In this section we discuss the results for the prototype’s evaluation. First, we discuss the results of the tasks’ completion rate. We mainly focus on the tasks that achieved a completion rate lower than 95%. We provide clarifications and justification regarding those tasks. Second, we discuss the result of the exit survey.

Overall, the results indicate a very successful completion rate. That would reflect to what extent the proposed design is able to achieve in terms of the usability. The average task completion rate is 78% [35]. In our usability study, the average task completion rate ranged between 89%-100% depending on type of the task.

In the first task, we asked users to indicate the apps that consume less power. The task completion rate was 91%. There were two reasons that led some participants to unsuccessfully complete the task. The first reason is that participants ignore the icons and depend on their own prior knowledge. For example, a participant chose the game app since he knew games would consume more power than other types of applications. Another reason was being confused in translating the icon’s meaning. We used an icon that had a little gray shade to indicate that the app needed less power. We even explained that in the icon recognition sheet. However, a participant thought less shade meant bad battery consumption. To avoid the confusion, we agreed to the necessity of having colors for the icon that represents the battery consumption. To
be clearer in future iterations, we might have colors (such as green vs. red) to indicate whether an app is energy-efficient or not.

The second task asked participants to indicate the app that has the lowest privacy rate. Although it was a little bit obvious since we only marked one app to have a level C, the task completion rate was 91%. Two participants did not pay attention to the icons; instead, they depended on their previous experience and knowledge. They stated that Facebook was the answer for this task.

It was surprising to have a lower completion rate for the third task, which asked participants to search for an app using a key word. Although it seemed like a very common task that users are doing daily on their phone, we determined several reasons that led to a lower completion rate for this task. The first reason is that our sample included participants who speak English as a second language. That might have led to them not understanding the task properly. Another reason we noticed was that some participants were looking for icon that represented a category of apps as a photo editor app. The majority of the participants self-corrected their task after reading the task prompt for a second time.

The last task aimed to expose participants to a new method for posting a review. The completion rate was 94%. One of the participants did not complete the task properly. He quitted the task because he thought posting a review would require him to sign in. Another participant indicated she did not use the app, so she did not post a review.

After finishing all tasks, participants were given an exit survey. The purpose of this questionnaire was to measure the participants’ satisfaction towards our proposed prototype. Overall, the results of all statements reflected a high satisfaction rate. Users thought that the proposed design was very simple and had the power of clearly illustrating the information.
Across all the statements, we would like to comment on the result of the ninth one. That statement asked whether the prototype had all expected functionalities and capabilities. Connecting the participants’ rate with their written feedback, we found that there are participants who wanted to see more functions in the prototype. They thought it was a design ready for development. In fact, we agreed with participants that there are still areas for polishing and enhancing the design. There are many other ideas that could be implemented; however, one of the purposes of this design is to test whether users will accept it or not. In this design we changed the illustration methods for the apps’ features and issues from text to icons. The results of this study indicated that users would not mind having that experience. Overall, with a consideration for enhancing the illustration of some icons, our findings revealed that users would love to see the suggested design as a working apps store.

After analyzing the results, we still need to refine the icons that we used in the proposed prototype. Some of the icons still need work in terms of clarity.

**Conclusion and Future Work**

The goal of this study is to introduce and evaluate a new way to illustrate apps’ information in the apps’ stores. We have done a usability evaluation for the proposed prototype. The findings revealed positive achievements in terms of usability. We have achieved a high task completion rate compared to the industry’s rate. In terms of the users’ satisfaction, responses indicated a positive inclination towards the design. Overall, the results of this study emphasized the importance and benefit of having visual cues to represent apps’ information.

For future development, we will incorporate the users’ feedback about the design of some icons. We will work to eliminate the ambiguity that participants faced with specific icons. This research could be extended by implementing its idea in the existing apps stores. We argue that
the concept of our design would increase the users’ awareness about apps issues. Moreover, it would enhance the users’ experience in exploring apps in the apps’ stores.

References


CHAPTER 5. GENERAL CONCLUSIONS AND FUTURE DIRECTIONS

Conclusions

This dissertation shed a light on the interface design of the mobile apps’ stores. This dissertation consisted of three studies that comprehensively explored the users’ experiences and users’ needs regarding the interface design of the apps’ stores. The ultimate goal of this work was to enhance the users’ experiences with mobile apps’ stores by suggesting a new interface that adopts visual indicators for apps features and general concerns.

The first study, reported in chapter 2, was an exploratory investigation that aimed to explore the users’ experiences with the apps’ stores. This study was the point that determined the novelty of the idea and the need for further investigations. The results in chapter 2 reported findings regarding the factors that affect users’ decisions when selecting an app. Moreover, they illustrated findings about the factors that impact users to determine apps’ quality. This chapter also investigates users’ experience with apps’ reviews and issues associated with them. Furthermore, the findings reported user’s complaints regarding the use of mobile apps. The results in chapter 2 indicated that users’ complaints are not related only to how the apps work but also to the way the apps’ stores illustrated the apps. This chapter emphasized the importance of redesigning the interface of apps’ reviews to reflect critical issues related to mobile apps. As well as to present more details about apps’ features.

The second study, reported in chapter 3, was an extensive investigation for the current users’ experience with apps stores. This chapter aimed to collect data about the users’ needs and the design requirements. Furthermore, this study provided design recommendations based on the users’ needs to enhance the interface design of apps stores. Findings in this chapter indicated that the current interface needs new elements that could enhance the users’ experience with mobile
apps’ stores. As this study recommended, users need to have new icons that illustrate some of the users’ concerns and challenges. Examples of the new elements are icons that represent the privacy, permissions types, ads, internet access, and battery consumption. In addition to that, icons that represent the new features of the apps. This chapter emphasized the importance of illustrating the textual information in the shape of icons. The study concluded the results by stating that adding visual cues for apps’ features and issues into the apps’ stores interface would be effective in providing useful information to the users. Moreover, it would educate users who have less knowledge about certain issues related to the apps. Visual representations are more appealing for users than textual information.

The third study, reported in chapter 4, aimed to incorporate the recommendations of the previous results in designing the proposed interface for the apps’ stores, then evaluate the proposed interface regarding its usability. Findings of the interface evaluation revealed positive achievements in terms of tasks’ completion and users’ satisfaction. The results of this study illustrated the benefits of having visual cues when representing apps’ information. Findings indicated that participants were happy to experience the proposed design and were excited to see the live version. It is anticipated that users’ experience and their awareness towards the apps’ issues would be improved if the apps stores were to adopt the proposed design concept.

**Future Directions**

For future directions, as a good practice of the iterative design, it is essential to incorporate the participants’ suggestions regarding the current elements in the proposed interface. The priority is to work on eliminating the ambiguity of some of the icons. Then, incorporating the participants’ suggestions by adding additional elements to the design that could make it more effective.
We could extend this research by comparing the users’ satisfaction of our proposed
design with a selected interface design of an existing apps’ store. Implementing the interface
design with apps’ store data set is another path that we could peruse for future development.
APPENDIX A: THE IRB APPROVAL

The IRB approval for the first two stages of this dissertation, which are represented in chapter 2, and chapter 3.
APPENDIX B: THE MODIFIED IRB APPROVAL

This letter is the IRB approval to conduct the usability testing session. Also, it includes the change of the study title.

---

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- Use only the approved study materials in your research, including the recruitment materials and informed consent documents that have the IRB approval stamp.
- Retain signed informed consent documents for 3 years after the close of the study, when documented consent is required.
- Obtain IRB approval prior to implementing any changes to the study.
- Inform the IRB if the Principal Investigator and/or Supervising Investigator end their role or involvement with the project with sufficient time to allow an alternate PI/Supervising Investigator to assume oversight responsibility. Projects must have an eligible PI to remain open.
- Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences involving risks to subjects or others; and (2) any other unanticipated problems involving risks to subjects or others.
- Stop all human subjects research activity if IRB approval lapses, unless continuation is necessary to prevent harm to research participants. Human subjects research activity can resume once IRB approval is re-established.
- Submit an application for Continuing Review at least three to four weeks prior to the date for continuing review as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.
• Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

• Please be advised that your research study may be subject to **post-approval monitoring** by Iowa State University’s Office for Responsible Research. In some cases, it may also be subject to formal audit or inspection by federal agencies and study sponsors.

• Upon completion of the project, transfer of IRB oversight to another IRB, or departure of the PI and/or Supervising Investigator, please initiate a Project Closure to officially close the project. For information on instances when a study may be closed, please refer to the **IRB Study Closure Policy.**

Please don’t hesitate to contact us if you have questions or concerns at 515-294-4596 or [irb@iastate.edu](mailto:irb@iastate.edu).