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Examining Mobile Consumption through Paid Apps Context: A Topic Modeling Approach to Türkiye Market

Mobil Tüketimin Ücretli Uygulamalar Bağlamı Üzerinden İncelenmesi: Türkiye Pazarına Konu Modelleme Yaklaşımı

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ABSTRACT

Mobile consumption is a vital part of today's consumers and a fundamental marketing research area. Several contexts and markets are examined in the mobile consumption literature. However, the literature on the paid apps context and the Türkiye market is limited. The study aims to fill this gap by examining the context of paid apps in the Türkiye mobile app market and discovering the topics included in user conversations. For this purpose, 11.749 reviews of 25 mobile apps are used as the study sample. The study employs topic modeling methodology using the BERTopic approach to extract the topics in the sample set. Following a descriptive evaluation of the sample, 57 individual topics are extracted in topic modeling, and they are grouped into three main topic groups, namely: app-related (27 topics), money-related (11 topics), and user evaluations (19 topics). Insights and implications regarding the topic groups can shed light on the developers and mobile marketing decision-makers.

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ÖZ

Günümüz tüketicilerinin hayati bir parçası olan mobil tüketim, pazarlama araştırmalarının temel alanlarından biridir. Mobil tüketim literatüründe çeşitli bağlamlar ve pazarlar incelenmiştir, ancak ücretli uygulamalar bağlamı ve Türkiye pazarına ilişkin literatür sınırlıdır. Bu çalışma, Türkiye mobil uygulama pazarındaki ücretli uygulamalar bağlamını inceleyerek ve kullanıcı konuşmalarında yer alan konuları keşfederek bu boşluğu doldurmayı amaçlamaktadır. Bu amaçla, 25 mobil uygulamaya ait 11.749 yorum çalışma örneği olarak kullanılmıştır. Çalışma, örneklem kümesindeki konuları çıkarmak için BERTopic yaklaşımını kullanarak konu modelleme metodolojisini kullanmıştır. Örneklemin betimlemeyici değerlendirilmesinin ardından, konu modellemesinde 57 ayrı konu elde edilmiş ve bu konular üç ana konu

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grubunda toplanmıştır: uygulama ile ilgili konular (27 konu), para ile ilgili konular (11 konu) ve kullanıcı değerlendirmeleri (19 konu). Konu gruplarına ilişkin içgörüler ve çıkarımlar, geliştiricilere ve mobil pazarlama karar vericilerine ışık tutabilir.

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1. INTRODUCTION

With mobile platforms and applications, the concept of mobile consumption is one of the most important areas in the lives of today's consumers. According to recent statistics (we are social & Meltwater, 2024), the average time spent using the internet is 6 hours and 40 minutes, while the share of web traffic for mobile phones is 57.94%. Issues such as the mobile applications used by consumers who spend a significant part of their day in the mobile world, how they spend their time, and their behaviors pose new research questions for consumer research.

Mobile applications, which serve users' various purposes, such as accessing the internet, participating in social networks, and getting information on mobile devices, are important for today's mobile marketing research. Users who fulfill their consumer needs for both utilitarian and hedonistic motivations through mobile applications create economic value through the time and financial resources they spend. From this point of view, issues such as which applications are used more, which factors affect consumer preferences, and the adoption/non-adoption of applications have become topics studied in different market contexts. Previous studies in mobile research evaluate the mobile user reviews topic in various contexts such as user interface (Chen et al., 2021), user complaints (Khalid et al., 2014), customer satisfaction (Kumar et al., 2023), and in various markets such as German (Wohllebe & Stoyke, 2022), Sri Lanka (Sally, 2023), Pakistan (Hussain et al., 2023). However, studies focusing on the Türkiye market context are limited. As the Turkish market has potential in terms of the number of users and the amount of consumption, addressing paid apps in this context is important for addressing contexts in different countries. For example, Srisopha et al. (2019) examine nine English-speaking countries to evaluate user reviews and conclude that all countries have some factors that are different than US market. From this point of view, this study set out to examine the specific market, the Türkiye market, through Turkish language user reviews. The study's main research question is, "What are the topics included in the user reviews in the paid apps context?" The study also examines the context through topic groups and individual topics.

Understanding which factors are determinant for mobile apps consumption is crucial for evaluating the marketplace. For example, Liang et al. (2015) conclude that user comments on service quality have effect on sales rankings for mobile application context. From this point of view, the study employs topic modeling methodology through BERTopic (Grootendorst, 2022) approach, which examines the text content to discover the included topics in the content. The methodology employs context-related knowledge to examine the text data better which is relevant for evaluating the specific contexts such as paid apps. 11.749 reviews from 25 mobile apps are collected as the study sample, and 11.747 reviews are used in the topic modeling methodology. The study starts with a literature review section focusing on mobile consumption and electronic word-of-mouth concepts, then continues with a methodology section, and concludes with a conclusion section which covers theoretical contribution, practical implications, and future research directions.

2. LITERATURE REVIEW

2.1. Mobile Consumption

Two significant advances at the end of the 2000s have significantly impacted today's consumer. The first of these, the advancement and spread of technology and digitalization, has led to more people joining the internet, accessing the internet with faster connections, and developing new digital applications. The second development is the launch of smartphones and mobile applications that appeal to different consumption habits. Through these advances, the consumer, who 30 years ago had limited consumption scenarios with limited means, devices, and platforms, has new and creative consumer habits that can be accessed from anywhere. Belk (2013) updates extended self concept which was proposed in 1988 with digital world aspect and concludes five updates in the study: i) dematerizalition, ii) reembodiment, iii) sharing, iv) co-construction of self, v) distributed memory. According to author; consumers are using the invisible possessions, represented in virtual worlds and share content on internet, co-construct themselves and others on digital world and have distributed memory included in digital world. In the new digital world, new consumers are surrounded by new technologies, new platforms, mobile world and social media.

Mobile applications are a crucial part of the mobile world- software consumers use on their portable devices (phones, tablets) and address specific consumption habits. These applications have various categories, such as pro-

ductivity applications through daily to-do lists, calendars, and agendas, social communication applications through social media platforms, and shopping applications through e-commerce applications. According to Kim et al. (2013), mobile apps let customers to do several daily tasks including buying products, finding local businesses, browse menus of restaurants. The fact that today's consumers spend a significant portion of their day on mobile devices and consume mobile applications makes it necessary to examine the issue from the perspective of both businesses and consumer behavior.

The economic side of mobile consumption is a significant part of business decision-making. The monetization of mobile apps, advertising models of mobile applications, and diffusion drivers/barriers for mobile apps are some of the topics discussed in this aspect, as they represent the economic nature of the concept. According to Tang (2016), developers can monetize the apps through three main ways: i) paid apps as they get payment front, ii) in-app purchases as they request extra money for some features, iii) advertisement in the apps. Since each general way have pros/cons in relative aspects, the evaluation of form-specific characteristics is vital for developers and decision-makers.

Online app marketplaces are one of the platforms that mobile users can communicate to each other and developers by writing user review. Google Play -as one of the popular marketplace for mobile apps- has more than 2.5 billion monthly users from 190+ countries (Google, 2024). Users can download the categorized mobile apps to their mobile devices and can write reviews on the applications pages. Customer reviews of mobile apps either on marketplaces or social media let users to express themselves on the evaluations of the product and services that mobile apps offer (Kumar et al., 2023). These expressions through text-based reviews with numerical rating scores contain the user insights regarding the mobile applications and the content side of the review includes electronic word of mouth components.

2.2. Electronic Word of Mouth

The concept of electronic word of mouth, an extension of the traditional word-of-mouth concept expressed in the digital world, is based on the assumption that the information transferred between users in digital environments is more effective than the information transferred from the business to the user due to "people like me" effect (Allsop et al., 2007). Accordingly, evaluations and information shared online about a product/service influence other users' attitudes, opinions, and behaviors about the product/service. Ismagilova et al. (2020) examine eWOM communication effect on intention to buy through a meta analysis and conclude the determinants in three levels: best predictors (argument quality, valence, eWOM usefulness, trust in message), promising predictors (eWOM credibility, emotional trust, attitude towards website) and least effective predictors (volume, existing eWOM, source credibility).

The concept of electronic word of mouth has been addressed in the context of many different products/services and its effects are present in different fields. For example, Chopra et al. (2024) utilize eWOM concept on tourism context, while they present information quality and quantity as two most significant factors for influencing eWOM behavior related to travel. In another study, Mladenović et al. (2024) focus on cryptocurrency payment methods adoption topic and conclude that individuals' expectations which are affected by quality, consistency and volume of eWOM impact the adoption behavior. The variety of scope for eWOM concept poses potential for marketing research.

Mobile consumption is also one of the areas where eWOM is relevant. Ransbotham et al. (2019) imply that when the WOM content is created on mobile devices, it is more affective, more concrete and less extreme. In another study, Grewal and Stephen (2019) examine the effect of mobile devices information to consumer perception in their study. They conclude that knowledge of the "posted from a mobile device" can be factor for having higher purchase intention, because customers assume that writing on mobile requires more physically effort and that effort can be related to review credibility. In the consumer behavior side, Shankar et al. (2020) examine the eWOM concept in mobile banking adoption context while concluding argument quality, valence and consistency as triggers for intention of adopting mobile banking.

There are different methodologies for addressing the concept of eWOM in terms of marketing research, depending on the nature and type of eWOM content. Understanding the meanings of the words and sentences used in user reviews where textual content is dominant, the issues/topics they point to, and the emotions they evoke are in the fields of marketing research. For example, Lucini et al. (2020) focus on text content side of online reviews in airline industry by employing latent dirichlet allocation (as a topic modeling approach) and identify 27 dimensions of satisfactions. In another study examining the content side, Sezgen et al. (2019) employ latent semantic analysis to passenger reviews, while they evaluate the drivers of satisfaction/dissatisfaction for airline industry. For the emotion side, Ullah et al. (2016) utilize sentiment analysis methodology to examine the emotions in online product reviews, while they compare experience goods and search goods in the study.

This study evaluates the paid apps context in Türkiye market through online reviews and employs topic modeling methodology to evaluate the user conversations and conclude the topics included in the user reviews. Consistent to research aim, user reviews on Google Play Store mobile app market are retrieved and topic modeling methodology is employed to examine the context.

3. MATERIALS AND METHODS

Google Play Store (Google, 2025a), as one of the most popular mobile app stores, provides users with a platform to download mobile apps and write user reviews to share with others. Consistent with the aim of the study, it is selected as the sample source. As the user reviews contain several components regarding user experience and evaluations, they are used in this study to extract the topics to understand the user conversation.

Data collection takes place on 20.02.2025 and the top paid apps list on 19.02.2025 list on SensorTower website (Sensor Tower, 2025) is used for sample source. Python programming language (Van Rossum & Drake, 1995) is used in Google Colab platform (Google, 2025b), and "Google-Play-Scraper" (Jo, 2019) code package is used to retrieve the user reviews data. "lang=tr" and "country=tr" parameters are used to retrieve the user reviews in Turkish and reviews of Türkiye market. For each application, most relevant 500 reviews are included in search query (count=500 and sort=Sort.MOST_RELEVANT parameters) as the sampling decision. Table 1 indicating 11.749 reviews sample set presents the app names and review counts for each app.

Data analysis consists of two parts in the study, as the first part focuses on the descriptive examination of the review set, while the second part implements the topic modeling approach. The results of first part is included in Figure 1 which presents the price distribution of the paid apps in the sample and Figure 2 which presents the rating score distribution. Before the implementation of topic modeling in the second stage of data analysis, a pre-processing that removing empty and only-space reviews. From 11.749 reviews, 2 reviews are dropped and topic modeling is implemented on 11.747 reviews.

Rating scores in the user reviews can be used for correlation, regression and other numerical analysis, however,

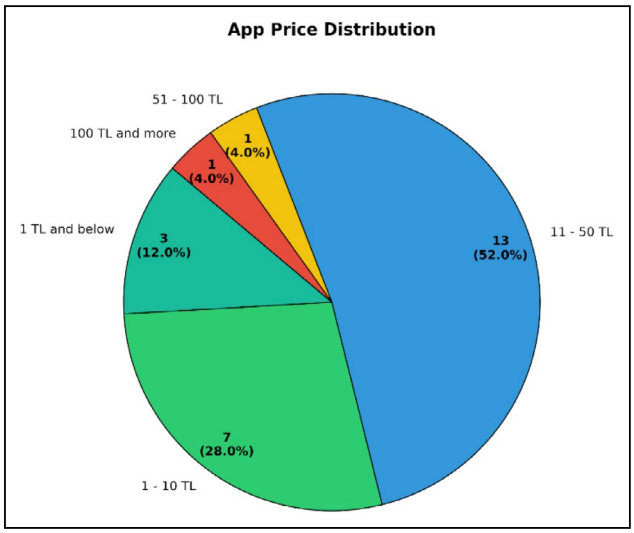

Figure 1. Price Range Distribution.

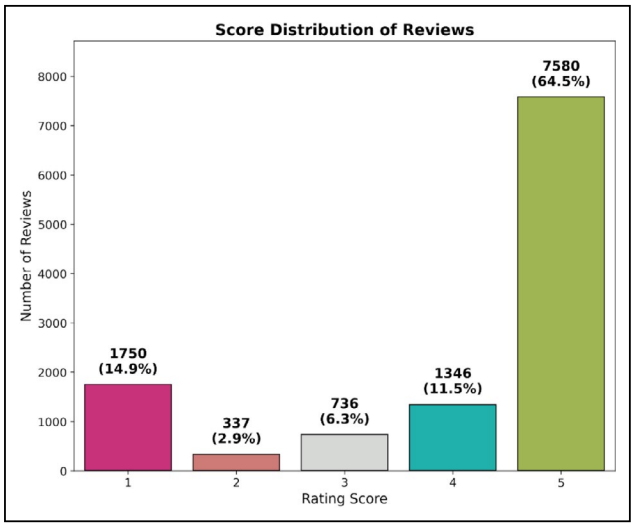

Figure 2. Rating score distribution.

Table 1. Study sample details

App Name	Review	App Name	Review
Grand Theft Auto: San Andreas	500	My child lebensborn	349
Minecraft	500	Terraria	500
1 TL	500	Bridge constructor	500
RFS - real flight simulator	500	Game booster 4x faster pro	500
Earn to die	500	PGT +: Pro GFX & Optimizer	500
Stadew valley	500	Streets of rage 4	106
Human fall flat	500	Incredibox	446
Dead cells	500	Five nights at Freddy's 2	500
Vector classic	500	Shadow fight 2 special edition	500
TeamSpeak 3 - voice chat	500	Geometry dash	500
Feign	500	Monument valley	500
Five nights at Freddy's	500	Torque pro (OBD 2 & Car)	455
50 kurus	393	Total sample	11.749

text content must be processed for detecting the patterns or discover the topics. Text mining -as a methodology of examining the text content- deals with unstructured or textual information and extracts meaningful information and knowledge from text in large size (Hashimi et al., 2015). The meaningful information and knowledge can refer to repeating patterns, the topics highlighted directly or in a latent form, polarity of text in terms of emotions. According to Blei (2012), "*topic modeling algorithms are statistical methods that analyze the words of the original texts to discover the themes that run through them, how those themes are connected to each other, and how they change over time*". According to Grootendorst (2022), traditional topic modeling treats the document as bag-of-words and each document is treated as a mixture of latent topics in the approach. As author implies, this approach neglects the context-based information leading to fail the representation accurately. BERTopic proposed by Grootendorst (2022) uses pre-trained language model to create document embeddings to fix that problem. In this approach; i) pre-trained language model is employed for creating document embeddings, ii) dimensionality of document embedding is reduced, iii) topic representation from each topic is extracted. In this study, a specific sentence similarity model titled as "distiluse-base-multilingual-cased-v1" (Reimers & Gurevych, 2019) is used as sentence similarity model for better analysis for Turkish language. Individual topics and representative words are extracted in the first stage, then individual topics are grouped into topic groups.

4. RESULTS AND DISCUSSION

The first descriptive examination in the sample set is about the price ranges of the paid apps. There are five different price ranges in the sample set: 1TL and below, 1-10TL, 11-50 TL, 51-100 TL and 100TL and more. Majority of the apps in the sample set (52% - 13 apps) are in the 11-50TL price range, while it is followed by 1-10TL apps (28% - 7 apps). The distribution of price ranges for the apps are included in Figure 1.

Figure 2 reveals the distribution of rating scores in the dataset. Reviews with a score rating of 5 constitute the majority (64.5%) of the entire sample set. This suggests a positive consumer reaction in the context. Ranking of the remaining 35% of the sample shows that, the reviews with a maximum rating of 1 are in the second rank, while they are followed by reviews with a rating of 4, 3 and 2.

The text data and rating scores available at online marketplaces offers potential for marketing research, however, these data sources are not telling the underlying topics directly. It is crucial that the developers must examine the content and find the topics related which can be related to specific rating scores (Noei et al., 2019). In the second stage of the analysis, topic modeling is implemented to sample set and individual topics with representative words are extracted. Following the naming process of the individual topics, the topics are grouped into topic groups. Table 2 presents the sample reviews in three topic groups concluded in the analysis.

Table 3 presents the individual topics and topic group categories in the study. There are 27 app-related topics, 11 money-related topics, 19 user evaluations topics in the conclusion of the analysis and there are three topic groups which covers 57 individual topics.

Categorized into three main groups, the topics in user reviews highlight the multiple aspects of user review in the context of paid apps. While users include app-related topics about the apps themselves and their features, they also include their evaluations in the user evaluations topic group and topics that are more relevant to the paid apps context are included in the money-related topic group.

Among the topic groups, the app-related group has the widest scope and 27 individual topics are included in this

Table 2. Topic groups and example reviews

Topic group	Sample review (translated)	Sample review (original)
App-related	*"The game is perfect because it is detailed and realistic from other games, the only problem is that you can use 3 airplanes in the game, you need to buy the pro version for other airplanes, the pro version is very expensive."*	*"Oyun mükemmel çünkü diğer oyunlardan detaylı ve gerçekçi tek sorunu var oyunda 3 uçak kullanabiliyorsunuz diğer uçaklar için pro sürümü almanız gerekiyor pro sürümde çok pahalı"*
	"the game has not been updated for exactly 1 year"	*"oyuna tam olarak 1 yıldır güncelleme gelmiyor"*
Money-related	*"Very nice, worth the money"*	*"Çok güzel verdiğiniz paraya değer"*
	"I bought the game, there was no space on my phone and they didn't give me my money back, I want my money back"	*"Ben oyunu satın aldım telefonumda yer yoktu ve paramı geri vermedi ben paramı geri istiyorum"*
User evaluations	*"The game is good, but if you are going to play, download and play from the computer, the game is not for mobile, but for PC. I play from both PC and mobile."*	*"Oyun güzel ama eğer oynayacaksanız bilgisayardan indirip oynayın oyun mobile göre değil PC ye göre ben hem bilgisayardan hem de mobilden oynuyorum"*
	"More episodes would be nice :)"	*"Daha çok bölüm olsa güzel olur :)"*

Table 3. Topic modeling results

Topic group: app-related (27)				
Access to old feature	Ad-free experience	Advertisement in app	Connection	Crash and performance issue
FPS feature	Functionality	Game comparison	Game content	Game controller
Game length	Game mechanic	Game story	Game version / Game type mention	Gameplay duration
Graphics Setting	In-game resources	Language support	Mobile operating system	Multiplayer feature
Music feature	Offline feature	Reset of settings	Server adress	Server-related issue
Sound and echo issue	Updates			
Topic group: Money-related (11)				
Cheapness	DLC and additional cost	Frustration about In-game level purchases	Game length and price relationship	Limited free episode
Paid users evaluations	Payment error	Price discussion / evaluation	Refund	Worthiness
Worthiness / negative				
Topic group: User evaluations (19)				
App experience	Appreciation / Praise of developer	Appreciation of Turkish-made application	Device / model mention	Dissatisfaction about main function claim
Feature recommendation / request	Feedback	Game experience	Game name expression	High praise
Neutral feedback	Nostalgia	Playing with friends	Positive evaluation / feedback	Purchasing by reward points
Recommendation to developer	Recommendation to others	Star ratings	Usefulness	

group. Within this group, there are two main sub-groups: topics related to the functions of the app and topics related to the content. Function-related topics refer to features and usage of the apps as they include topics such as "Access to old feature", "Ad-free experience", "Connection", "Language support", "Multiplayer feature". On the other hand, content-related topics refer to the contents included in the apps, as they cover individual topics such as "Advertisement in app", "Game content", "Game length", "Game story". The functionality side of the findings are consistent to technology acceptance model (Davis, 1989) in terms of perceived usefulness and perceived ease of use.

Money-related topic group covers 11 individual topics inside, while they cover a variety of topics in the main group. For example, "DLC and additional cost" category covers the content of the app and cost together by highlighting the downloadable content, while "Game length and price relationship" and "Limited free episode" topic cover the game duration or free episode available in the game. These specific aspects help developers to balance / optimize the content available as free, offered as DLC or optimize the overall content for the games / apps. Unlike these headings, the "Worthiness" and "Worthiness / Negative" headings can indirectly help developers. Users' "worthiness" or "not" statements, combined with other statements and topics mentioned in the messages, can provide developers with insights into what exactly they can focus on.

User evaluations topic group with 19 individual topics represent the subjective side of the user reviews. This topic group has similarities with the "App-related" topic group through some individual topics. For example, "App experience", "Game experience" and "Usefulness" individual topics are similar to app-related topic group. However, the individual topics in this group are more relevant for subjective expressions. On the other hand, direct expressions in polarity forms such as "Appreciation / Praise of developer", "Appreciation of Turkish-Made Application", "Dissatisfaction about main function claim", "High praise", "Positive evaluation / feedback" are available in the topic group. These individual topics can be useful for detecting either one specific mobile apps or discovering the competitors' apps in the marketplace. User evaluations topic group also contains eWOM related individual topics which can be useful for developers and marketing decision-makers. "Feedback", "Neutral feedback", "Recommendation to others" and "Recommendation to developer" individual topics contain the information regarding communication among the users in the marketplace.

5. CONCLUSION

The study aims to examine the topics in the user reviews in the paid mobile applications context in Türkiye market,

and topic modeling methodology is employed in the study consistent with the research aims. 11.747 user reviews from 25 mobile apps are used for topic modeling methodology, and individual topics are extracted and grouped into the 3 main topic groups: app-related (27 topics), money-related (11 topics) and user evaluations (19 topics). The main topic groups represent the overall structure of user conversation, while the individual topics within the topic groups presents the various aspects.

The study mainly contributes to eWOM theory by focusing on the context of paid apps in the Turkish market. This study contributes to eWOM studies, which have been previously examined in different contexts through user reviews, with a contextual expansion. On the other hand, from a methodological perspective, the transformers-based topic modeling approach used in the study also contributes to the topic modeling methodology. "Functionality," "ad-free experience," "gameplay duration," and "offline feature," which are included in the "app-related" topic group, are related to the utilitarian part of user reviews along with individual topics. In the context of paid apps, users mentioned issues related to the functional parts of the apps they used in their user reviews. On the other hand, the inclusion of "user evaluations" as a separate main topic group shows that users express themselves and their experiences in the context of paid apps. Specific topics such as "Appreciation of Turkish-Made Application," "Nostalgia," and "Playing with friends" were also included in this topic group. Finally, the "money-related" topic group, compatible with the context of paid apps, includes money-related topics in user comments. The identification of individual topics such as "DLC and additional cost," "Frustration about In-game level purchases," and "Game length and price relationship" is effective in better understanding what users tell about money.

The study's first contribution to industrial practices provide a general taxonomy regarding paid apps in the Turkish market. There are 57 individual topics in the general structure gathered in 3 main categories. By examining general topic groups and individual topics, sectoral decision-makers can have general information about user reviews in the context of paid apps and the Turkish market. The second sectoral contribution of the study is related to the use cases of the findings. The individual topics obtained can be used in decisions on issues such as the monetization process and the worthiness of applications in the paid apps. Mobile application developers can utilize the individual topics such as "ad-free experience", "FPS feature", "game mechanic" for the app-specific improvements to understand the experience of both their apps and competitors' apps in the marketplace. Money-related individual topics such as "DLC and additional cost", "Limited free episode" can also contribute to understand the relationship between paid apps context-specific topics and user perceptions and reactions.

The limitations of the study are three-fold: sample-based limitation, language-based, and methodology-based limitation. The study only focuses on 25 apps and the Türkiye market for the paid apps context as the first limitation. Increasing the sample size regarding reviews or apps can be a future research direction, while focusing on other country markets also poses an opportunity for future research. The second limitation relates to the language of the reviews since the study only examines Turkish reviews. Although it is consistent with the aim of the study, future research can focus on evaluating other languages to understand the context in new aspects and contexts. The last limitation is the topic modeling methodology, which focuses only on the content side of the reviews. Since user reviews contain emotion-based components, alternative methodologies such as sentiment analysis can be helpful for future research. The combination of topic modeling and sentiment analysis can also be an integrative approach for a better understanding of user reviews.

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