Analyzing Gamer Complaints in Reviews of Cross-Platform Video Games on Steam

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***Abstract*—Video gaming now represents the largest category in the entertainment industry in terms of revenue. To expand their market share, game developers are creating more cross-platform games, which are compatible with various platforms, including PCs, consoles, and smartphones. However, creating such games poses challenges as developers encounter platform-specific issues that may only surface on one of the target platforms. Consequently, many ported games fail due to careless adaptation from one exclusive platform to another. This paper presents the first empirical study on cross-platform issues by analyzing game users' reviews for video games on both PC and game console(s). Our findings reveal that platform-related issues occur more frequently on the PC side, particularly for games that are ported from consoles. To address this challenge, we develop machine learning-based approaches to automatically identify and categorize reviews discussing platform-related issues, achieving a reasonable classification performance with 79.73% to 90.06% accuracy. Our approach would help cross-platform game developers save considerable time when analyzing user reviews.**

***Index Terms*—cross-platform games, game reviews, game data science, issue classification, game analysis**

I. Introduction

According to a report by Newzoo [1] in 2021, the global video gaming market achieved record-breaking revenue of $180 billion. Sales on PC accounted for 20% of the total revenue, while (game) consoles and mobile devices generated 28% and 52% of the revenue, respectively. As each game platform contributes a significant portion of the revenue, game developers are increasingly opting to make their games "*cross-platform*", i.e., supporting more than one game platform.[1]

Developing cross-platform games poses a significant challenge as the mobile, PC, and console running environments and game development supporting tools often differ significantly. Consequently, *platform-related issues* may arise, which are issues specific to a particular platform. For example, console games are designed for a limited number of standard hardware layouts and similar operating environments. On the other hand, PC games need to be compatible with a vast array of hardware, software, and operating systems. Without considering these differences, game developers may encounter platform-related issues when porting their console games to PC. While researchers have explored issues in video games, most studies have focused on a single platform [2–5]. No prior research has investigated platform-related issues for cross-platform games.

As the first step towards a better understanding of issues on cross-platform games, we mainly focus on the platform-related issues that occurred in the PC versions of popular cross-platform games on Steam.[2] Because game users' reviews on Steam are feasible to collect, and their platform-related issues are more prevalent on PC versions (ref. Section III-A). Our research aims to achieve three objectives: 1) examine the distribution of complaints across various types for both console and PC versions of popular cross-platform games, 2) classify the types of platform-related issues affecting PC versions based on their underlying causes, and 3) develop a tool capable of automatically identifying platform-related issues and their types to assist developers in monitoring the evolution of platform-related problems in new releases.

In order to accomplish the objectives above, we propose a heuristic cross-platform game matching approach to gather a set of 824 popular cross-platform games that are available on both Steam and at least one console. The selected cross-platform games can be classified into two categories: *ported games*, initially developed for consoles and later adapted for PC, and *multi-platform games*, which are developed for both PC and consoles simultaneously. We utilized web crawlers to collect 5,156,144 and 41,230 user reviews of the selected games from Steam and Metacritic[3], respectively. Metacritic is the largest website that aggregates reviews and ratings from various sources for video games, music, movies, etc. Metacritic provides user reviews for video games on various gaming platforms, e.g., Xbox and PS4.

Our analysis reveals that among the informative complaints, 47.5% and 5.2% of them are complaining about non-feature-related issues on PC and console versions of the studied cross-platform games, respectively. Furthermore, 62.3% of the informative complaints on the PC versions of both ported and

[1]Note that cross-platform is different from cross-platform-play, which means one game player can join other players on different platforms.

[2]https://store.steampowered.com/

[3]https://www.metacritic.com/

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multi-platform games are related to the platform, encompassing discussions of bugs, crashes, graphical/video issues, and control issues specific to PC environments. We demonstrate that it is feasible to automatically identify sentences containing platform-related complaints and their specific types from negative reviews. Our findings indicate that 14% of platform-related complaints arise during the launch period. Furthermore, different games display distinct patterns of evolution following the launch period. As developers release corresponding updates to address issues, the number of platform-related complaints decreases.

In summary, the main contributions of this paper are:

1) We perform the first empirical study on platform-related issues of cross-platform games leveraging game users' reviews.
2) We propose a heuristic approach for identifying cross-platform games, i.e., PC games that exist on Steam and game consoles.
3) We propose automated platform-related issue analysis that can achieve an accuracy of 90.06% for identifying platform-related complaints from negative user reviews and an average accuracy of 84.46% for categorizing platform-related complaints into specific types.

Our findings and automated game review analysis approach can facilitate developers with the timely identification of cross-platform issues.

II. Study Design and Data Collection

A. Terms

1) *Cross-platform game* refers to any game that is released for both PC and one or more console platform(s).
2) *Multi-platform game* refers to a cross-platform game that is developed simultaneously for both console and PC.
3) *(Console to PC) Ported game*[4] refers to a cross-platform game that is initially developed for one or more console platforms and is later ported to PC.

B. Research Questions

We have formulated the following research questions:

RQ1 *For cross-platform games, are the complaints on their PC versions similar to the complaints on their console versions?*

RQ2 *Is it possible to automatically identify and categorize platform-related issues from user complaints?*

RQ3 *How do platform-related issues evolve over time?*

C. Data Collection

An overview of the data collection process is shown in Figure 1 and comprises four steps. In Step 1, we collect PC and console games by extracting game information from Steam and GameFAQs.[5] Next, the collected games and their profiles are forwarded to Step 2, where a heuristic approach is applied to identify cross-platform games. In Step 3, we gather gamer users' reviews for games selected in Step 2. We manually annotated a sample of them for answering RQ1 and RQ2. In Step 4, we collect updates and discount news for the evolution analysis in RQ3.

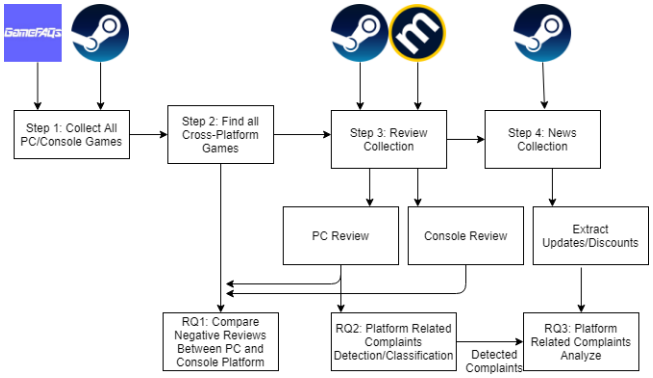


Fig. 1: An overview of the data collection process.

Step 1: Game Collection. We collected data of console and Steam games using two different methods. For console games, we crawled all 89,909 games listed on GameFAQs, covering 18 different platforms. Each game profile includes information on its available platforms, type, developer/publisher, release date, and a link to its Metacritic page, if available. For Steam games, we utilized the official Steam API to collect data on all listed games. Specifically, we retrieved a JSON file for each game containing basic information such as game name, developer name, publisher name, release date, and game description.

Step 2: Identifying Cross-platform Games. To identify cross-platform games, we developed a heuristic approach that retrieves pairs of games with similar profiles on PC and console platforms. Specifically, we compared the profiles collected from Steam and GameFAQs, focusing on game name, developer, and publisher. However, we observed discrepancies in these fields, even for the same game, as shown in Table I. To address this, we implemented several text normalization steps: translating foreign characters to English, removing non-English and non-numeric characters, lower-casing all characters, and removing stop-words (e.g., CO, LTD) from developer/publisher names. The resulting sample outputs for each normalization method are also shown in Table I.

After applying text normalization, we generate a set of candidate game pairs by considering all possible combinations of games across Steam and consoles. For each candidate pair, we calculate a similarity score that measures the likelihood of these two games being the same. We use three attributes for each game: game name, developer name, and publisher name. If two games have the same name (by string matching), and either the developer or publisher name matches across platforms, we assign a similarity score of 1.0 to the considered game pair. Otherwise, for two games g_i and g_j, we calculate

[4]It is important to note that ported games may also refer to PC to console ports, i.e., games initially designed for PC and later released on consoles. However, as this study focuses on issues related to the PC versions of cross-platform games, the term ported game refers to a console to PC ported game.

[5]https://gamefaqs.gamespot.com/

TABLE I: Game matching problems and normalization methods.

Matching Problem Type	Game Name on Steam	Game Name on Console	Normalization Method
Foreign characters	Ubisoft Montreal	Ubisoft Montréal	Translating foreign characters to English
Special characters	FOR HONOR™	For Honor	Removing other special non-English and non-numeric characters.
Stop-words	Capcom	CAPCOM CO LTD	Remove stop-words, e.g., "CO" and "LTD".

the similarity score S using the following formula:

$$S(g_i, g_j) = 0.8 * f(gname_i, gname_j) + 0.2 * \max(f(gdev_i, gdev_j), f(gpublisher_i, gpublisher_j))$$

where f is a string metric[6] that measures distance between two strings. $gname_i$, $gdev_i$, and $gpublisher_i$ refer to the name, developer name, and publisher name of the game i. The weights (0.8 and 0.2) are determined heuristically by checking the ranking results' quality while varying configurations.

We rank all candidate game pairs based on their similarity score S and consider pairs with a score higher than 0.6. This threshold is set heuristically based on our observation that matched games are rarely found with a similarity score below 0.6. We identify 11,393 PC-game console-game pairs after this step, involving 3,944 games on Steam. A random sample of 1,000 identified game pairs is manually examined to determine if the retrieved games are identical. We find that 98% of the sample is matched. Many of the 3,944 identified cross-platform games are trivial games; thus, we remove games with fewer than ten reviews on Steam and their console versions, resulting in 979 cross-platform games. We manually examine publicly available information for each of the 979 games and identify 824 games as either ported or multi-platform, following the definitions provided in Section II-A

Step 3: Review Collection. We collected reviews for each of the 824 cross-platform games identified in the previous step. To collect the reviews, we retrieved data from two sources: Steam and Metacritic. We collected Steam reviews directly through the official Steam API. For each game, we retrieved all the reviews available on Steam for all its released versions. To collect Metacritic reviews, we used links collected in Step 1 from GameFAQs. Following the links, we crawled all Metacritic's reviews for the selected games. In total, we collected 5,156,144 game users' reviews from Steam and 41,230 from Metacritic for the selected games.

Step 4: News Collection. For RQ3, we required additional information such as release dates, update details, and promotional events related to different versions of games. This information was extracted from news pages associated with each game on Steam. We collected a total of 116,098 news items for the 824 target games. However, we found that many developers used general tags like 'Community Announcements" or "Announcement" to describe patches and discount events. To identify relevant news, we defined a set of keywords (listed in Table II) for patch and promotion events. As a result, we identified 6,100 news items related to patches and 2,240 news items related to discounts.

[6]We use SequenceMatcher from Python build in library difflib https://docs.python.org/3/library/difflib.html.

TABLE II: Keywords for news type identification.

Types	Keywords
Patch-related	update, patch, changelog, bugfix, bug, fix, fixes, hotfixes, hotfix, version
Discount-related	off, off!, %, sale, discount, deal, free

III. Results

A. RQ1: For cross-platform games, are the complaints on their PC versions similar to the complaints on their console versions?

To answer RQ1, we select five popular cross-platform games—Top-3 most popular multi-platform games and Top-2 most popular ported games (see Table III). The popularity of a game is measured by the total number of user reviews received by the game. For each selected game, we randomly select 200 negative reviews from its launch version on Steam and its console version(s), i.e., a total number of 400 reviews for each game. We then manually examine the types of complaints covered in the 2,000 reviews (400*5). We focus on the launch version because the launch version is critical and often receives the highest number of complaints [6].

We identified eight types of complaints mentioned in the sampled negative reviews. They are: 1) control issues, 2) audio issues, 3) graphic issues, 4) network issues, 5) cost issues, 6) bugs and crashes, 7) features, and 8) uninformative (do not discuss specific issues related to the game). Figure 2 presents the identification results on five sample games. For the informative reviews, 52.5% and 94.8% of the informative complaints are feature-related on PC and console, respectively. In other words, 47.5% and 5.2% of the informative reviews on the PC and console version of a video game complained about non-feature-related issues, which could be specific to a particular platform.

Comparing the reviews discussing non-feature-related issues of console and PC versions, we observe that most bugs, crashes, audio issues, graphic issues, and control issues reported on Steam are specific to the PC environment, i.e., platform-related issues. As for the distribution of different platform-related reviews, we find that different games have different problems. For instance, reviews for Fallout 4's Steam version report more graphical issues than others. In contrast, reviews for Halo: The Master Chief Collection mention more bugs and audio problems.

TABLE III: Representative ported and multi-platform games. MP refers to multi-platform games.

Game name	Type	Platform	# Reviews	# Negative reviews
Destiny 2	Ported game	Steam	121,702	11,167
		PS4	558	552
Halo: The Master Chief Collection	Ported game	Steam	65,718	6,122
		Xboxone	296	138
The Witcher® 3: Wild Hunt	Multi-platform game	Steam	130,467	3,032
		PS4	1,642	239
Fallout 4	Multi-platform game	Steam	123,654	32,429
		PS4	1,089	626
Red Dead Redemption 2	Multi-platform game	Steam	89,734	26,826
		PS4	3,168	1,004

TABLE IV: Definitions and examples of eight complaint types.

Complaint Type	Description	Example Review
Control issue	The game is having unresponsive or difficult control.	*"This game may be fine for a gaming console, but for a PC (without a controller pad) the controls are over-complicated. Mouse and keyboard play are problematic and annoying."*
Audio issues	The game is experiencing no or poor audio quality.	*"I had no voice in the cutscenes. The forums said it did not support 5.1 or 7.1 and recommended to change audio to 2.0, but the only options my audio settings have are exactly 5.1 and 7.1."*
Graphic issue	A game experiencing problem such as graphic stuttering, texture rendering issues or graphic setting issues.	*"Nothing like starting a game and being in the wrong resolutions, then not being able to see what i am selecting so i cant change it. Also forcing the game to start before i can go into setting."*
Network issue	The game is having connection issue to the server.	*"me and my friend trying to play HALO CE campaign for the past 2 days..and all you get is this "connection to service interrupted"."*
Bugs and crashes	The game is crashing or cannot be opened or having serious game play affecting bugs.	*"Great game but weak PC port. Got a lot of crashes in my desktop and lost almost 1 hour to find a hidden setting in a config file to make it work. Turns out it was incompatible with SLI+VRR/GSync in Vulkan (the default setting)."*
Cost issue	The game is over priced.	*"No forge mode, not enough gamemodes, other games are taking a while to be released. I think wait till everything comes out before spending $40 on an incomplete version of Halo Reach."*
Feature	Complaints about missing feature or feature needs improvement.	*"Obnoxious hunting and crafting system that tries to be realistic but fails miserably. To craft clothes/satchels/trinkets/something something game mechanic upgrade, you're going to need a LOT of animal pelts in perfect condition."*
Uninformative	Complaint does not discuss specific issues related to the game	*"A tough game to review, Fallout 4 is not terrible, it's just incredibly disappointing. I expected so much more from Bethesda and the Fallout series, particularly coming off the bat of the terrific Fallout: New Vegas."*

Summary of RQ1

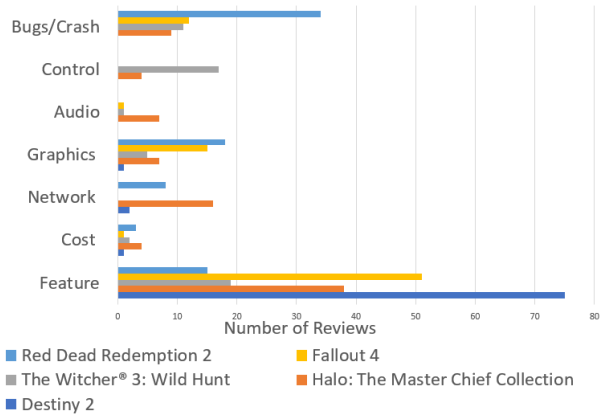
While the studied cross-platform games have similar types of complaints on both PC and console platforms, non-feature-related issues are more frequently reported by users on PC versions. The percentages of each platform-related issue type reported in user complaints varies across different games.

B. RQ2: Is it possible to automatically identify and categorize platform-related issues from user complaints?

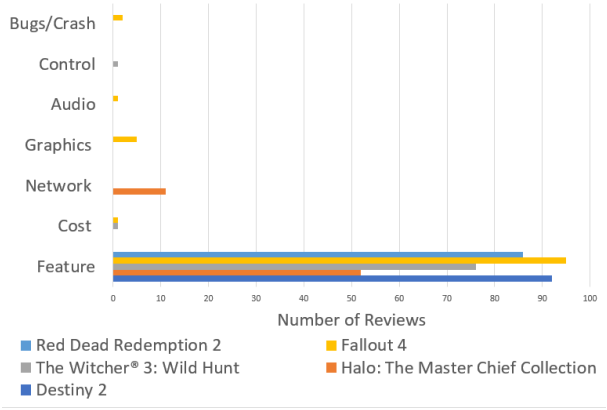
The findings from RQ1 suggest that not all user reviews provide relevant information regarding platform-related issues. Manually identifying them from large-scale user review data is time-consuming. To address this issue, in RQ2, we investigate the potential of developing a machine learning-based approach to identify platform-related issues and their types automatically. This approach would enable game developers to monitor and analyze the occurrence of platform-related issues throughout the life cycle of their games.

Specifically, we target two classification tasks: 1) identifying complaints discussing platform-related issues in user reviews collected from Steam, and 2) categorizing platform-related complaints into different types. We annotated the labels at the sentence level instead of the review level. This is because we observed that many reviews contained multiple issues that were discussed in separate sentences. Our classification scheme includes four types of platform-related issues (control issues, audio issues, graphic issues, and bugs and crashes), as defined in Table IV. Given the relatively low number of audio and graphic issues and the fact that they are often mentioned together, we group them as one type of complaint, i.e., audio/graphic issues.

To create a dataset for training and testing our machine learning-based approach, we selected 20 popular cross-platform games, comprising Top-10 most popular ported games and Top-10 multiple-platform games. We collected all negative reviews of their launch versions and randomly sampled 100 reviews per game. This resulted in a total of 1,624 reviews, of which 668 were from ported games and 974 were from multi-platform games. We manually annotated each



((a)) Number of reviews in different complaint types for PC versions.



((b)) Number of reviews in different complaint types for console versions.

Fig. 2: Number of reviews in different complaint types in negative gamer users' reviews.

sentence in these reviews to determine whether it discussed a platform-related issue and, if so, which type of issue was mentioned (control, audio/graphic, bug & crashes). Out of the 10,192 annotated sentences, 690 (6.8%) mentioned platform-related issues. Among these, control issues were the most commonly mentioned (423 sentences, 61.3%), followed by audio/graphic issues (152 sentences, 22.2%) and bug & crashes (114 sentences, 16.5%).

Before training the models for the two tasks, we conducted standard text preprocessing on all labeled sentences. This included lowercasing, tokenization, and removal of English stop words. However, we did not perform stemming as it was observed to negatively impact performance in experiments. Two models were then trained for the two tasks as follows:

Task 1: Identifying Complaints on Platform-related Issues. We utilized the annotated platform-related labels and preprocessed sentences to train three sentence classification models based on Support Vector Machine (SVM), Naive Bayes (NB), and Long short-term memory (LSTM) [7]. We generate the tf-idf vector representation of input sentences as training input for the SVM and NB classifiers.

Task 2: Categorizing Platform-related Complaints. Identifying the type of complaint associated with platform-related issues can be challenging, especially when there are multiple labels with limited training data. To overcome this challenge, we propose a data augmentation approach to increase training data size. We observe that certain keywords can strongly suggest the type of platform-related complaint being discussed. For example, the presence of the keywords "crash" and "bug" may indicate that the sentence pertains to bugs and crashes. Table V shows the manually identified keywords for each platform-related issue type. We search for any of the identified complaint type-indicating keywords on 100,000 reviews that are randomly sampled from the negative reviews collected from the 824 cross-platform apps. As a result, we identified 2,928 sentences discussing bugs/crashes, 955 about audio/-graphical issues, and 3,858 related to control issues. We added these heuristically identified sentences to the manually labeled training sentences to increase the training data for Task 2. We trained three machine learning models for both tasks - SVM, NB, and LSTM - the same as task 1.

TABLE V: Keywords set for expanding training data for platform-related complaint type classification.

Type of Complaints	Keywords
Bug/Crash	crash, crashes, bugs, crashing, bug, optimization, buggy, errors, bugfixes, glitchy, buggie, glitched, error
Control	controls, mouse, controller, keyboard, controllers, buttons, binding
Audio	stuttering, stutters, stutter, laggy, loud, crackles, supports
Graphical	framerate, fps, audio, sound, display, framerates, ultrawide, frame, widescreen, graphical, resolution, visuals, graphics

We partitioned the labeled data into 90% training set and 10% test set for both tasks. To evaluate the performance of the classifiers under consideration, we utilized standard classification metrics such as accuracy, precision, recall, and F1-score.

Table VI shows the performance of the best-performing models on tasks 1 and 2. We observe that the SVM-based model can achieve the best performance, with an accuracy of 90.06%, on the platform-related issue identification task (task 1). The high performance also indicates that words used in platform-related complaints differ greatly from those used in other complaints. For task 2, our experiments show that the LSTM-based model consistently outperforms the other models, achieving high accuracy rates across all complaint types. Specifically, the model achieves an accuracy of 79.73%, 84.63%, and 89.03% for identifying audio/graphical issues, bug & crash, and control issues, respectively. These findings highlight the effectiveness of our proposed approach for complaint type classification.

TABLE VI: Performance of the best models on identifying and categorizing platform-related complaints from negative user reviews.

Task	Best Model	Accuracy	F1	Precision	Recall
Task 1: Identifying Platform-related Complaints	SVM	90.06%	89.58%	93.32%	86.4%
Task 2: Categorizing Complaints on Bug & Crash	LSTM	84.63%	83.46%	90.35%	77.54%
Task 2: Categorizing Complaints on Audio/Graphical Issues	LSTM	79.73%	76.69%	90.26%	66.66%
Task 2: Categorizing Complaints on Control Issues	LSTM	89.03%	88.26%	94.94%	82.45%

To further investigate the prevalence of platform-related issues in negative user reviews, we apply the proposed approach to analyze 4,322,062 sentences extracted from 769,851 negative reviews of 824 cross-platform games on Steam. Table VII presents the number of sentences and reviews identified by our approach. The results demonstrate that 24.12% of negative reviews for cross-platform games contained complaints related to platform issues. The most commonly cited complaints pertained to bugs and crashes, followed by issues with audio/graphical elements and controls.

Summary of RQ2

Our automated platform-related issue analysis approaches can achieve an accuracy of 90.06% in identifying sentences discussing platform-related issues and an accuracy of 79.73%, 84.63%, and 89.03% in determining whether the discussed issue is related to audio/graphical, bug & crash, control, or not.

C. RQ3: How do platform-related issues evolve over time?

The prevalence and nature of platform-related issues can fluctuate over time. As such, in RQ3, we explore the evolution of platform-related issues. The findings of our analysis would provide valuable insights for the effective management of platform-related issues throughout the life-cycles of cross-platform games.

To examine the evolution of platform-related issues, we begin with the 185,660 reviews identified as discussing platform-related issues from RQ2 (ref. Table VII). For each target review, we collect its post date and one or more labels that indicate whether the review discusses one or more types of platform-related issues. We then develop an analysis tool to generate visualizations of the monthly ratio of platform-related issues and complaints categorized by type for the reviews. Since updates, such as bug fixes and new releases, can lead to an increase in the number of reviews posted immediately after, our tool also calculates the monthly updates and post-game launch periods for all cross-platform games included in our analysis.

Figures 3 and 4 show the results obtained from our analysis tool for the 680 multi-platform games and 144 ported games selected for this study. A comparison of the bars in these two figures reveals that multi-platform games exhibit a longer active update period on Steam than ported games. For instance, during the study period, 44.03% of all updates for the 680 games occurred in the first year following their launch. This ratio decreases to 23.13% in the second year, 11.19% in the third year, and 8.18% in the fourth year, with subsequent years exhibiting a decrease to around 3% per year. We observe a similar pattern for ported games but with much shorter active update periods, where 49.07% of all collected updates occurred in the first year and 15.74% in the second year.

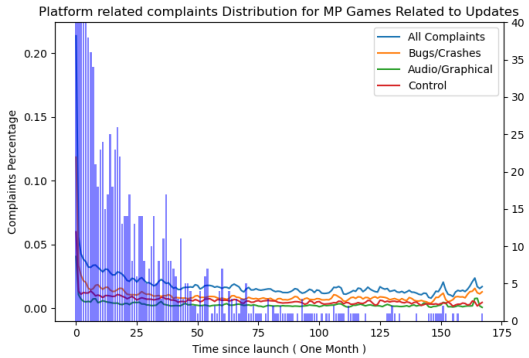


Fig. 3: Distribution of platform-related complaints on multi-platform in relation to update.

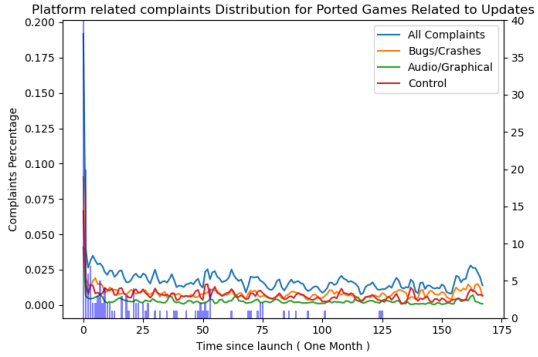


Fig. 4: Distribution of platform-related complaints on ported games in relation to update.

For both ported and multi-platform games, most of the platform-related complaints are posted during the launch period. Specifically, within the first month after launch, multi-platform games received 12.91% of the total number of platform-related complaints. This number drops to 4% and 2.8% for the second and third month, respectively. For the rest of the launch year, excluding the first month, multi-platform games received 23.08% of all complaints, while for the second and third year, this number was 13.57% and 12.75% respectively. Similarly, for ported games, 15.56% of the total complaints occur in the launch month, while the remaining 27.11% of complaints were received during the

TABLE VII: Statistics of identified complaints on platform-related issues for 824 cross-platform games.

Type	Number	% of All Reviews	% of Identified Platform-related Negative Reviews
All Negative Reviews	769,851		
Detected Platform-related	185,660	24.12%	
Bugs/Crashes	125,907	16.36%	67.82%
Audio/Graphical	32,356	4.2%	17.43%
Control	32,639	4.24%	17.58%

first year, excluding the launch month. Ported games received around 7.3% complaints during the second and third years.

Figures 5 and 6 demonstrate the temporal evolution of platform-related issues frequency, taking into account the discount events associated with the game. The results indicate that, within the studied period, merely 2% and 2.7% of the discount events for multi-platform and ported games, respectively, transpired within the first month of their launch, when both game types are generally released at full price. This circumstance may contribute to the notable spike in platform-related complaints encountered during the launch phase, as consumers paying the full price are less tolerant toward suboptimal game quality.

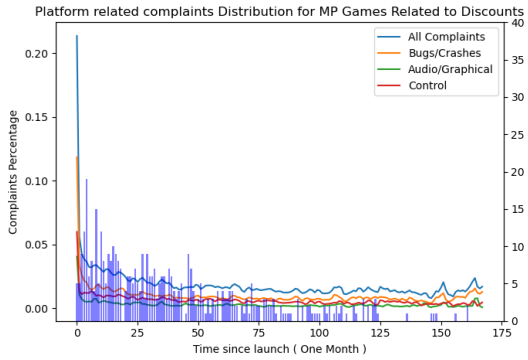


Fig. 5: Distribution of platform-related complaints on multi-platform game in relation to discount.

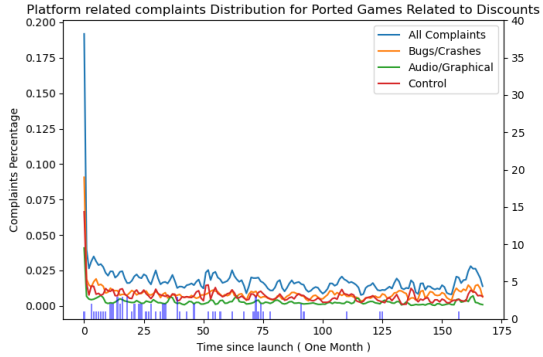


Fig. 6: Distribution of platform-related complaints on ported games in relation to discount.

As our previous exploration revealed, platform-related complaints tend to be more prevalent during the launch phase of a game's life cycle. Thus, we further conduct an in-depth analysis of platform-related complaints during the launch period, which we define as the initial 30 days following game release.

We categorize games into three types based on the number of their identified complaints on platform-related issues by our approach proposed in RQ2:

1) *No Problem*, i.e., the game does not receive any reviews discussing about platform-related issues.
2) *With Minor Problem*, i.e., less than 10% of the total reviews are discussing about platform-related issues.
3) *With Severe Problem*, i.e., more than 10% of the total reviews are discussing about platform-related issues.

We have chosen to employ a 10% threshold for distinguishing the latter two categories, based on our observation that the average rate of negative reviews across all studied cross-platform games is 13.8%, with ported games experiencing an average negative review rate of 12.4% and multi-platform games experiencing an average negative review rate of 14.1%. Given this context, we interpret the presence of platform-related complaints in 10% or more of a game's total reviews as a significant indicator of the prevalence and impact of such issues on player experience.

We observe that, during the initial three days following the launch of the studied games, a notable proportion of them (57.89% for multi-platform games and 51.1% for ported games) received reviews that addressed platform-related problems. Of these reviews, 16.22% (multi-platform) and 13.2% (ported) were labeled as "With Severe Proble" due to the platform-related issues being mentioned in over 10% of the total reviews. This percentage then showed a rapid decline. Following this initial period, the ratio of games with platform-related complaints stabilized for both multi-platform and ported games, with occasional fluctuations, after 15 and 9 days post-launch, respectively.

Summary of RQ3

The analyzed cross-platform games, typically released at full price, are more prone to receiving platform-related grievances in the earlier stages compared to the later periods. Within the first three days post-launch, 57.89% and 51.1% of the multi-platform and ported games examined, respectively, received reviews containing platform-related complaints.

D. Threats to Validity

Our proposed approach for RQ2 involved combining graphical and audio issues into a single class, but in practice,

developers may prefer to distinguish between the two. In manually annotating the sentences for RQ2, there is a possibility of misidentifying the label(s) associated with a review. For RQ3, news items obtained from Steam were utilized as context references to analyze the development of platform-related issues. However, some game-related events may not be apparent to users, as Steam enables developers to implement hidden updates without publishing any news items. Another challenge involves determining the event type, such as a patch, hot-fix, or promotion, based on the information in the news item. Certain news items may also be too vague to be considered in RQ3.

While we conducted our analysis on cross-platform games on Steam, which is the most popular platform for distributing PC games, some popular cross-platform games are available on other platforms. Therefore, our conclusions may not be generalizable to all cross-platform PC console games. In RQ1, we labeled a limited number of reviews from only five games, meaning our findings on the ratio of platform-related issues and their types may not represent the outcomes for other games. For RQ2, we annotated only a limited number of sentences for training and testing our model, resulting in the reported performance potentially not reflecting its actual performance on other reviews.

IV. Related Work

As far as we know, our study is the first to examine cross-platform games on Steam. Previous research has explored the content of user reviews on Steam to understand different aspects of games, such as the types of reviews [3], characteristics of early access games [8], urgent updates [9], and bugs [10]. In contrast, our approach involves connecting Steam with other resources, such as GameFAQs and Metacritic, to identify cross-platform games and their associated platform-related issues. Several studies have analyzed user reviews from mobile app stores for various purposes [11, 12]. A study that is similar to ours is the one conducted by Hu et al. [12], which collected a set of apps available on both Android and iOS app stores to study the consistency of rating and reviews of these cross-platform apps.

V. Conclusion

We are the first to explore gamer complaints in reviews of cross-platform video games on Steam. We first propose a heuristic approach for identifying cross-platform games. We then obtained 5,156,144 and 41,230 reviews for 824 identified cross-platform games from Steam and Metacritic. We propose a machine learning-based approach to identify sentences in collected reviews that discuss platform-related issues, such as bug & crash, graphical/video issues, and control issues. Our approach may save game developers time analyzing the prevalence and evolution of platform-related issues in an individual game or a set of games.

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