

Data Analysis in Game Design: Enhancing the Player Experience

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Abstract: Data science plays an important role in many fields, and games have grown by leaps and bounds in recent years to occupy an important place in the entertainment industry. This paper explores the various applications of statistical analysis in game design, highlighting how developers can use data to optimize game mechanics, improve player engagement and overall user satisfaction. The results of the study show that by exploring and analyzing player behavioral patterns, market trends, and feedback, a science-based method is utilized to assist in decisions during the whole game development process. This method enables the developer to create games that are more relevant to the player's preferences, providing a better gaming experience. Additionally, developers can use the data feedback to constantly optimize their games and make improvements based on player feedback in time after release. However, due to the rapid advancement of the gaming industry and the heterogeneity of the player community, data science is merely a supplementary instrument that assists developers in enhancing the player's gaming experience.

Keywords: Game Design, User Experience, Data Analysis, Optimization.

1. Introduction

With the rapid development of technology, games have become an important part of the entertainment market. The Unity 2024 industry report points out that the game development field is undergoing a very big change. Gaming culture has spawned an unprecedented influence and video games as a category have surpassed movies and music in terms of revenue size over the years[1]. Data analysis is becoming an important tool in game design, which enables developers to explore new ways to improve the player experience. However, challenges remain in utilizing player data and market insights to inform design decisions. While data analysis can assist developers in designing with an advantage, current research in the field has not clearly indicated how to use this information effectively in order to improve game design. The focus of this research paper is to explore specific applications of data analysis in game design. How data related to player behavior, market trends, and feedback can be used to optimize different aspects of a game to improve players' engagement and the overall experience of the game. The study not only provides a data-based decision-making basis for game development, but also offers useful recommendations on developing more appealing games in a competitive market.

2. The current situations and challenges in the development of the gaming industry

2.1. The state of the gaming industry

In recent years, the gaming industry has been growing dramatically, and the magnitude of the market has been expanding constantly. In 2023, the revenue of the global gaming market totaled \$184 billion, with mobile games reaching \$90 billion, which is 49 percent of the total revenue[2]. In addition, electronic sports (Esports) has become an important part of the gaming industry. Esports not only attracts a large number of players and spectators, but also brings great commercial returns. According to statistics, the global ESports market will reach \$1,384 million in 2022, and is expected to reach \$1,866 million in 2025[3]. More and more companies are beginning to pay attention to ESports, and consider it as an important way to enhance their brand influence and increase revenues.

2.2. The challenges of the markets in the gaming industry

Because of the game industry's rapid development, game production also faces numerous challenges. The market competition is fierce, with hundreds of games being produced and released every year, which means that players can keep encountering new games, leading to higher expectations for a new game, shorter game life cycles, and increasing game development costs year by year. How to stand out in such a competitive market environment has become a challenge for every game developer. With the significant increase in game production, there are three main challenges facing game production.

First of all, players have higher and higher demands for game quality. To be successful in the market, a game needs not only excellent visual and auditory experience, but also innovative gameplay and good game mechanisms. Secondly, the game development cycle is becoming shorter and shorter. With the ever-changing market demand, game companies need to launch new games quickly or update existing games in time to keep players' interest and stickiness to a game. Finally, game development costs are rising. With the advancement of technology and the increase of players' requirements, game development needs to invest a lot of human, material and financial resources, which is a great challenge for game companies.

2.3. Current production process of the game

The game production process usually includes the following stages: concept setting, design planning, prototype development, testing and feedback, official release and post-maintenance. At each stage, data analysis can provide essential support to help developers make more scientific decisions.

The beginning of a game must be the setting of the concept. In this phase, the developer needs to define the theme of the game, the genre of the game, the art style of the game and the core mechanics of the whole game. Within the developer team, the producer takes on the primary role of providing ideas for the entire development. Market research and player feedback help identify the most promising game concepts, and the developer must understand the game's Razor Pitch and Unique Selling Points (USPs)[4]. Uniqueness is also the most important reason for a game to be competitive and innovative in its genre.

Once the gameplay and theme of the game are finalized, developers need to specify more detailed planning for the game, including storytelling, character design, level design, game mechanics, and so on. In this stage, team members need to make a clear division of labor and work together. 2D artist creates the design of the game characters and scenes, and then 3D artist models and sculpts to create them. Level design builds and designs the scene maps and completes the program to realize the mechanism. The programmer is responsible for the overall program writing, including how to control the game character, the UI program writing, how to switch levels and so on.

With the development and production of each part of the game, the developer needs to transform the content of the program into an operational game prototype. The purpose of this phase is to verify that the core mechanics of the game work and to collect feedback from players through prototype testing. The game needs to pass through different versions to get the final release license, starting from a demo to an alpha version, to a beta version, and finally to a gold version[5].

After the creation of each version of the game, the game needs to be extensively tested to find out the problems and shortcomings of the game, so that it can be modified and optimized in the subsequent development process. This phase consists of a combination of internal and external testing to find out how the game is perceived by different groups of people.

In the official release phase, developers need to make final optimizations and adjustments to the game, and prepare for the release and promotion of the game. This phase also involves working with publishers and platforms to make sure the game is ready for launch.

For the game's production team, the task is still not finished, and the developer will need to continue to update and optimize the game. This phase also involves analyzing the game's data, identifying the reasons for player attrition, and taking steps to improve player retention.

3. Application of statistics at different stages of game design

3.1. Application of statistics in game planning

In the preparation stage, the development team mainly needs to learn about and analyze the following three contents:

The first is to analyze the market demand. By statistically analyzing game sales and market demand, developers can identify target user groups, market trends and player preferences. Analyzing sales data across different game genres can help identify the popularity of each type within the market. It is crucial to understand the mechanics and elements of popular games that resonate with our audience. At the same time it's very important for us to keep ourselves at the forefront of the market[6]. As Shaz Yousaf did, he used data from the steam platform to analyze different types of games. He compared text-based games, cooperative games and role-playing games. The median rating for cooperative games was 79 times higher than for text-based games, and role-playing games were 17 times higher than text-based games. This comparison clearly demonstrates the preference for cooperative games[7]. Secondly, the user group must be analysed in order to ascertain the age, gender, geographic location and other pertinent information of the target users. This will enable the developer to conduct the positioning and promotion of the game in a more informed manner. The best way to decide on appropriate marketing channels and content depends on the target audience you are trying to reach[8]. Different promotional methods can be used for different ages, such as short video platforms which young people like. For different geographic locations, it is important to consider the cultural differences in the players' living environment to avoid some unconscious cultural attacks.

Thirdly, the positioning analysis of the game helps developers to design the core mechanics and USPs of the game, in order to stand out in the market of the same type of game. Understanding and analyzing competing games helps identify the market expectations, unfulfilled ideas, and existing issues, which can help developers optimize and improve the game in the process of game design to better meet the needs of players.

3.2. Application of statistics to character, scene, and level design

Statistics can analyze player preference and behavioral data in character and scene design. By analyzing the data on players' choice of roles, it is possible to understand players' preferences for different types of roles, so that optimization can be done in the role design. For example, if the data analysis shows that players prefer to use characters with high attack power, developers can consider

increasing the character's attack power when designing new characters to meet players' needs. By analyzing the data of players' behaviors in different scenes, it is possible to understand which scenes are more welcomed by players, to optimize them in scene design. By comparing the time players stay in certain scenes, find the scenes or areas where players stay more time and developers can refer to the design style and elements of these scenes when designing new scenes to enhance players' game experience. By analyzing the data of players' use of items, it is possible to understand players' preferences for different types of items, to optimize the design of items. For example, when players are found to prefer using recovery tools, developers can consider increasing the types of recovery tools when designing new tools to meet players' needs.

By analyzing the players' pass rate data and behavior in each level, developers can understand whether the difficulty of the level is reasonable or not, to make adjustments in the level design. Excessively low pass rates or repeated deaths in the same location will increase player frustration, and the inability to pass a level for a long time will make players bored with the game.

3.3. Application of statistics in user testing

Vera Rabkina does a good job of introducing us to what user testing is, "When a person who fits the appropriate target audience is asked to perform a set of tasks related to a product. The interviewer tracks their activities to identify product flaws and get to know their audience better, or even to receive ideas for potential product development"[9]. Bugs can be fixed, and the game's balance and difficulty can be adjusted through observing whether the players' behavior in the game meets expectations and considering their feedback. A good example is what Maria Amirkhanyan encountered while doing beta testing for *Cyberpunk 2077*. The game's mini-map over-zooms in, making it impossible to zoom out. When players drive to markers, they usually can't turn in time because the map doesn't move while they're moving[10].

4. Discussion

This thesis explores the use of statistics and data analysis in all stages of the game lifecycle to improve the experience for players. Despite the significant advantages of data analytics, there are still some challenges that require attention. The advantages of data analytics are its objectivity and accuracy. By collecting and analyzing huge amounts of user data, developers can gain better insights into industry trends and players' gaming preferences. This data can be used to help optimize the game in various aspects, as well as to precisely target the appropriate audience for better positioning and promotion. Player feedback can also be utilized to improve and fix the game, extending the game's lifecycle.

While data analysis can provide some unique insights, it also faces challenges in practice. Firstly, data collection and processing require a lot of investment, including technical tools, data storage, and specialized talent support. Secondly, the overuse of data analysis results to appeal to market trends can lead to a lack of innovation in the game. Data analysis is based on the analysis of past behavioral patterns. In other words, data analysis is based on the existing game data to summarize and predict after summarization. Game is a form of art presentation. It is uncertain and the future trend may not be fully reflected in the existing data. The design of the game cannot be completely dependent on data, and data analysis is only a reference. In addition, another issue that cannot be ignored is how to make full use of the data while protecting the privacy of the players, which is an issue that developers must seriously consider.

5. Conclusion

This paper has looked at how data analytics can be helpful in different stages of game design. Applying data analytics to game design allows for a better understanding of player needs as well as different aspects to improve the player's user experience. Data analysis can help identify market trends in the planning stage, satisfy players' preferences in the art design, better control the game difficulty and balance the game experience in the level design, and get players' feedback to make timely adjustments after release. Although data analysis has great potential to improve all aspects of game design, it still has some limitations. One of the biggest challenges is the reliability of existing data. Data analysis relies on historical data and does not always accurately predict future trends, especially as player preferences can change over time. While insights from data can provide guidance to developers, relying on data alone without incorporating creative ideas and intuition can limit innovation. In addition, data privacy also remains an essential issue. If developers begin to collect detailed data on player behavior, it could fully record every attribute of a player's in-game activities. This kind of information should indeed be adequately protected. Finding a balance between data usage and privacy protection is an important step to maintaining player trust. In addition to data analysis, improving the player experience also requires significant efforts in other areas. For example, user interface design and social characteristics are important factors in improving player satisfaction. Data analysis can be combined with research in these areas to provide a more comprehensive view of optimizing the player experience. The development and application of AI has recently impacted many different industries and AI products are beginning to be incorporated into game design. AI can personalize games in real-time and adapt to individual preferences and player behavior. However, over-automation can also pose serious risks. Relying too much on data and AI can lead to a more uniform gaming experience, which can undermine the unique creativity and individuality of the game experience. Therefore, a balance will need to be found in the future to ensure that games are both data-driven and artistically innovative.

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