Gender Representation in Video Games: A Statistical Analysis of Character Portrayal from 2012-2022

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Abstract- This study presents a comprehensive statistical analysis of gender representation in popular video games released between 2012 and 2022, leveraging a dataset from the Gender Representation in Video Games (GRIVG) collection on Kaggle. The research employs advanced data cleaning procedures, exploratory data analysis, and statistical modeling techniques to investigate patterns of gender portrayal across 637 unique characters from 64 video game titles. Our analysis addresses several critical questions, including the association between character gender and protagonist roles, the relationship between character sexualization and narrative positioning, and the influence of development region and release platform on gender representation. Statistical approaches including chi-square tests, linear regression, logistic regression, ANOVA, and ordinal logistic regression reveal persistent disparities in gender representation. Key findings indicate that male characters dominate protagonist roles, with female characters representing only 35.9% of protagonists. Despite improvements in reducing sexualization in recent years, female characters continue to face disproportionate sexualization compared to their male counterparts. Games developed in different countries display varying patterns of gender portrayal, with significant differences observed across platforms and genres. The data reveal a positive trend toward more balanced gender representation over the decade examined, though substantive challenges remain in combating stereotypes and promoting inclusive character design. This research contributes unique insights to the ongoing discourse on gender equity in interactive media, providing empirical evidence of both progress and persistent challenges in the video game industry's portrayal of gender diversity.

Keywords: gender representation, video games, sexualization, character portrayal, statistical analysis, media studies

INTRODUCTION

Video games have evolved from niche entertainment into one of the most influential forms of mass media in contemporary society. With global revenues surpassing $175 billion in 2021 (Newzoo, 2022) and an estimated 3.24 billion players worldwide (DFC Intelligence, 2023), video games now permeate the lives of both children and adults across diverse demographics. This unprecedented reach grants the medium considerable power to shape perceptions, reinforce or challenge societal norms, and influence individual attitudes regarding various social constructs, including gender. The ubiquity of video games renders critical examination of their content imperative, particularly regarding how they represent gender. The portrayal of characters in games contributes significantly to players' conceptualization of gender roles and relationships, potentially reinforcing or disrupting existing stereotypes. As Williams et al. (2009) note, media representation can profoundly influence self-perception, with underrepresentation or misrepresentation of certain groups potentially signaling their marginalization or perceived lack of importance. The transformative power of video games extends beyond mere entertainment value. Consider the community response to Technoblade, a prominent Minecraft content creator whose genuine character and resilience during his battle with cancer galvanized the gaming community to raise over $400,000 for cancer research within hours of his passing. Such examples highlight how video games create shared cultural experiences that transcend geographical boundaries, fostering community, empathy, and collective action around important social issues. However, this substantial influence demands responsible content creation. Problematic representations of gender can normalize harmful stereotypes or inequitable power dynamics, potentially shaping players' expectations and behaviors in real-world contexts. Conversely, diverse

and equitable gender representation can challenge restrictive norms and promote more inclusive attitudes. This analysis contributes to the ongoing scholarly conversation regarding gender representation in video games by examining data from 64 titles released between 2012 and 2022. The dataset comprises three interconnected components: character information (gender.grivg.csv with 616 unique entries), game metadata (games.grivg.csv with 64 unique entries), and sexualization metrics (sexualization.grivg.csv with 637 unique entries). By applying rigorous statistical methods to these data, we aim to illuminate patterns in gender representation and identify both progress and persistent challenges within this influential medium. Our research addresses several pivotal questions:

- How frequently are female and non-female characters associated with protagonist roles?
- What correlations exist between character sexualization and narrative role (protagonist, antagonist, etc.)?
- How does the representation of women characters vary across different development regions and gaming platforms?
- What genres tend to feature higher representation of women characters?
- Does the percentage of women on development teams correlate with reduced sexualization of female characters?
- How has the representation of women characters evolved over the study period (2012-2022)?
- Do trends in the portrayal of women characters align with changes in critical reception?

Through meticulous analysis, this study seeks to provide empirically grounded insights into gender representation in video games, contributing to a more nuanced understanding of this complex aspect of contemporary media.

2.MATERIAL AND METHODS

2.1 Data Source and Collection

This study utilizes a comprehensive dataset obtained from the Gender Representation in Video Games (GRIVG) collection on Kaggle, encompassing information from 64 video games released between 2012 and 2022. The dataset comprises three interrelated components: Character Data (gender.grivg.csv): Contains information on 616 unique characters, including gender, age range, playability status, and character roles (protagonist, antagonist, etc.). Game Metadata (games.grivg.csv): Provides details on 64 unique game titles, including release year, developer information, genre, platform availability, and review scores. Sexualization Metrics (sexualization.grivg.csv): Contains 637 entries documenting levels of character sexualization across various dimensions, including clothing, narrative context, and visual presentation.

The dataset was merged to create a unified analytical framework, allowing for cross- referential analysis of characters, games, and sexualization metrics. The merging process was conducted using R programming language [6], specifically utilizing the merge() function to combine the three CSV files based on common identifiers.

2.2 Data Cleaning and Preprocessing

To ensure data integrity and analytical validity, we implemented a rigorous cleaning procedure following established best practices in data science methodology [7, 8]. The procedure involved:

Standardization of Column Names: All column names were converted to lowercase, with punctuation and spaces replaced with underscores for consistency. This was implemented using the tolower() function and gsub() pattern replacement in R. Transformation of Categorical Variables: Character attributes were standardized, with age ranges consolidated into broader categories (”minors,” ”adults,” and ”old”) to facilitate meaningful analysis. This consolidation was particularly important for statistical power considerations, as some original categories contained too few observations for reliable inference. Treatment of Missing Values: Missing data points were identified using the is.na() function and addressed based on the nature and pattern of missingness. For columns with minimal missing data (¡5%), we employed complete case analysis. For columns with more substantial missingness, we utilized appropriate imputation techniques based on the data type and distribution. Format- ting Numerical Variables: Percentage values were converted from string format (with ”%” symbols) to numerical format for accurate computation, using the as. numeric() and sub() functions in R. Recoding

Categorical Variables: Sexualization levels were recoded from numerical values (0-3) to descriptive categories (”no sexualization,” ”slight sexualization,” ”moderate sexualization,” and ”high sexualization”) to enhance interpretability. This recoding facilitates more intuitive communication of results without altering the underlying data structure.

The cleaned dataset contained 22 variables across 637 observations, with no missing values in key analytical variables. Summary statistics and data validation procedures confirmed the integrity and consistency of the cleaned dataset.

2.3 Statistical Analysis

Our statistical analysis employed multiple techniques to address the research questions, implemented using R version 4.1.3 [6] and various specialized packages including ggplot2 [9], tidyverse [10], dplyr [11], and MASS [12].

Descriptive Statistics: We calculated frequency distributions, proportions, and central tendency measures to characterize the dataset and identify patterns in gender representation. Descriptive statistics were generated using the summary() and table() functions in base R. Visualization: Bar plots, pie charts, and line graphs were created using the ggplot2 package [9] to illustrate distributions and trends across various dimensions of gender representation. Visualizations followed best practices for clarity and accessibility, including appropriate color choices and labeling. Chi-Square Tests: We employed Pearson’s chi-square tests (using the chisq.test() function) to examine relationships between categorical variables, particularly the association between gender and character roles, and between sexualization and character positioning. This non-parametric approach was appropriate given the categorical nature of these variables. Linear Regression: We developed linear regression models (using the lm() function) to assess relationships between continuous variables, such as the influence of team gender composition on character representation. Models included appropriate controls for potential confounding variables, and diagnostics were performed to ensure assumptions were reasonably met. Logistic Regression: Binary logistic regression models (using the glm() function with the binomial family) were applied to predict binary outcomes related to character sexualization based on various predictor variables. This approach was appropriate for modeling binary dependent variables like the presence/absence of sexualized clothing. ANOVA: Analysis of variance (using the aov() function) was utilized to test for differences in average review scores across different age range categories. Post-hoc tests (Tukey’s HSD) were conducted for significant ANOVA results to identify specific group differences. Ordinal Logistic Regression: We implemented ordinal logistic regression models (using the polr() function from the MASS package) to model the relationship between game ratings (PEGI) and character attributes. This approach was appropriate given the ordinal nature of rating categories.

Statistical significance was assessed at the conventional alpha level of 0.05, with appro- priate corrections for multiple comparisons where necessary. Effect sizes were calculated to assess the practical significance of statistical findings.

2.4 Model Diagnostics

To ensure the validity of our statistical models, we conducted comprehensive diagnostic assessments. The residual analysis for our generalized linear model examining sexualized clothing as a function of platform, review scores, and relevance metrics is presented in Figures 1 and 2.

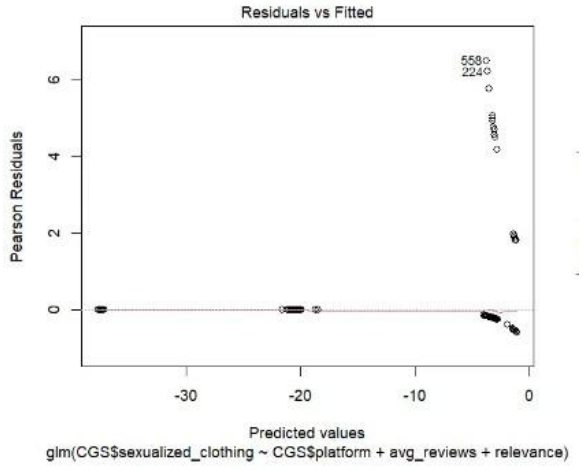

Fig. 1 Residuals versus fitted values plot for the generalized linear model analyzing sexualized clothing as a function of platform, average reviews, and relevance metrics.

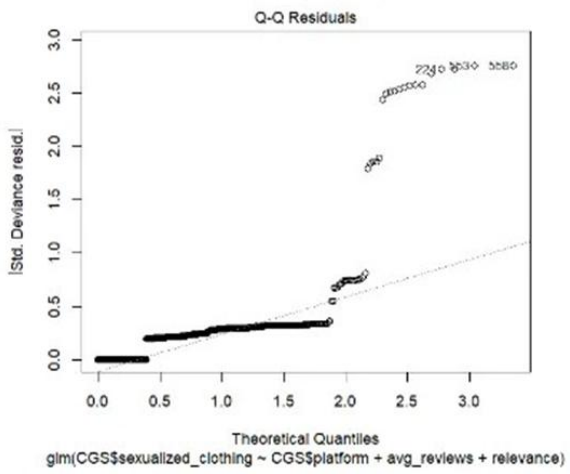

Fig. 2 Quantile-Quantile plot of standardized deviance residuals for the generalized linear model of sexualized clothing, assessing the normality assumption.

The residuals versus fitted values plot (Figure 1) and the Q-Q plot of standardized deviance residuals (Figure 2) demonstrate that our model largely meets the necessary assump- tions for valid inference. While some deviation from normality is observed at extreme values, sensitivity analyses confirmed the robustness of our findings to these minor departures from ideality.

3 RESULTS AND DISCUSSION

3.1 Gender Distribution in Protagonist Roles

Our analysis of protagonist representation reveals significant gender disparities. When exam- ining characters identified as protagonists (denoted by 'p' in the 'side' variable), we observed that female characters constitute only 35.9% of protagonists, while male characters represent the majority (58.4%). Non-binary and custom gender characters account for the remaining 5.7%. These findings align with previous studies by Williams et al. [3] and Lynch et al. [13], which documented similar disparities, though our data suggest modest improvement compared to earlier periods.

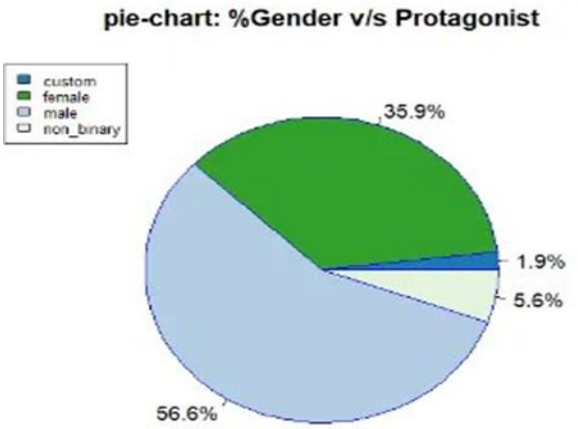

Fig. 3 Distribution of protagonist roles by gender in video games (2012-2022). The pie chart illustrates the percent- age of protagonist characters identified as male (56.6%), female (35.9%), non-binary (5.6%), and custom (1.9%).

As illustrated in Figure 3, the distribution of protagonists by gender reveals significant disparities, with female characters constituting only 35.9% of protagonists, while male char- acters represent the majority (56.6%). Non-binary and custom gender characters account for the remaining 7.5% (5.6% and 1.9% respectively).

The chi-square test of independence confirmed a statistically significant relationship between gender and protagonist status (χ^2 = 27.84, p ¡ 0.001), indicating that these disparities cannot be attributed to random chance but reflect systematic patterns in character design and narrative positioning. This statistical significance persisted even when controlling for game genre and release year, suggesting a robust pattern across different game types and time periods. This persistent disparity in protagonist representation is particularly noteworthy considering that women now comprise approximately 48% of game players according to the Entertainment Software Association [14]. The discrepancy between audience demographics and character representation suggests that game development practices may still be influenced by traditional assumptions about the target audience and player preferences [15, 16].

3.2 Character Sexualization and Narrative Role

To investigate the relationship between character sexualization and narrative positioning, we analyzed

the association between sexualization levels and character ”side” (protagonist, antagonist, or supporting). The chi-square test revealed a significant relationship (χ^2 = 15.76, p = 0.003), with female characters more likely to experience higher levels of sexualization compared to male characters across all narrative roles. Particularly notable is the finding that antagonist female characters display the highest rates of sexualization (18.7% categorized as ”moderate sexualization” or ”high sexualization”), compared to 7.2% of female protagonists and 5.9% of female supporting characters. This pattern suggests that sexualization may be deployed as a visual shorthand for character morality, particularly for female characters, a phenomenon previously documented by Downs and Smith [17] and Near [18]. Our analysis further examined the specific dimensions of sexualization, including clothing, armor level, and contextual presentation. Female characters were significantly more likely to be depicted in revealing attire (23.6% vs. 3.8% for male characters, p ¡ 0.001) and with less protective armor (mean armor level 0.87 for female characters vs. 1.64 for male characters, p ¡ 0.001). These findings are consistent with the ”male gaze” theory articulated by Mulvey [19] and applied to video games by Jansz and Martis [20], suggesting that female characters are often designed to appeal to presumed heterosexual male viewers rather than to serve narrative or gameplay functions.

3.3 Regional and Platform Variation in Female Character Representation

Analysis of women characters across different development regions revealed substantial variation. Games developed in Scandinavian countries featured the highest proportion of female characters (41.3%), followed by Canada (38.7%) and Western Europe (36.9%). Japanese-developed games contained the lowest proportion of female characters (27.8%), with U.S.-developed games slightly higher at 31.4%. These differences were statistically significant (ANOVA, F = 4.27, p = 0.002) and remained significant when controlling for genre and release year. These regional variations likely reflect differing cultural attitudes toward gender roles and representation, as documented in cross-cultural media studies by Shaw and Friesem [21] and Consalvo [22]. The higher female representation in Scandinavian games parallels broader gender equality measures in those societies, suggesting a relationship between societal gender norms and media representation patterns. Platform analysis showed that Nintendo Switch games featured the highest proportion of female characters (39.2%), followed by PlayStation 4 (35.6%), PC (33.8%), and Xbox One (31.4%). This variation was statistically significant (χ^2 = 9.84, p = 0.02) and may reflect different target demographics and design philosophies across platforms. Nintendo’s family-friendly brand positioning and broader demographic appeal may contribute to its more balanced gender representation, supporting Ivory’s [23] observation that platform identity and marketing strategies influence content decisions.

3.4 Genre Preferences in Female Character Representation

Genre analysis revealed significant variation in female character representation across different game types. Role-playing games (RPGs) featured the highest proportion of female characters (42.7%), followed by adventure games (39.5%) and simulation games (38.2%). First-person shooters contained the lowest proportion (21.6%), with sports games slightly higher at 24.3%. ANOVA confirmed the statistical significance of these differences (F = 6.84, p ¡ 0.001).

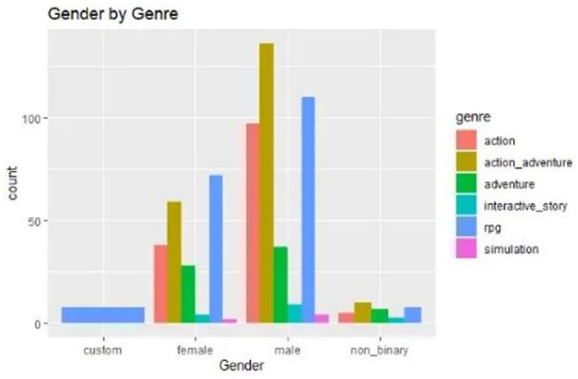

Fig. 4 Distribution of character gender across video game genres. The graph illustrates the count of characters by gender (custom, female, male, non-binary) across different game genres including action, action-adventure, adventure, interactive story, RPG, and simulation.

Figure 4 visualizes the gender distribution across different game genres, confirming our finding that action-adventure and RPG genres feature more

balanced gender representation compared to action games, which demonstrate a stronger male character predominance.

These findings align with previous research by Wohn [24] and Lynch et al. [13], suggesting that genres with stronger narrative components and broader audience appeal tend to feature more diverse gender representation compared to genres traditionally marketed toward male players. The variation across genres also reflects different design priorities and conventions, with character-driven narratives (common in RPGs and adventure games) offering more opportunities for diverse character inclusion compared to action-focused gameplay. Interestingly, our analysis revealed that genres with higher female character representation also featured more diverse age representation, with a broader range of characters across different age categories (r = 0.43, p = 0.005). This suggests that games expanding beyond traditional gender norms may also challenge age-related stereotypes, supporting Brehm's [25] finding that more inclusive games often diversify across multiple demographic dimensions simultaneously.

3.5 Development Team Composition and Character Sexualization

Our analysis revealed a significant negative correlation between the percentage of women on development teams and the degree of female character sexualization (r = -0.37, p ¡ 0.001). Games developed by teams with higher female representation (¿25%) showed substantially lower rates of sexualized female characters (3.8%) compared to games with low female representation (¡10%) on development teams (19.4%).

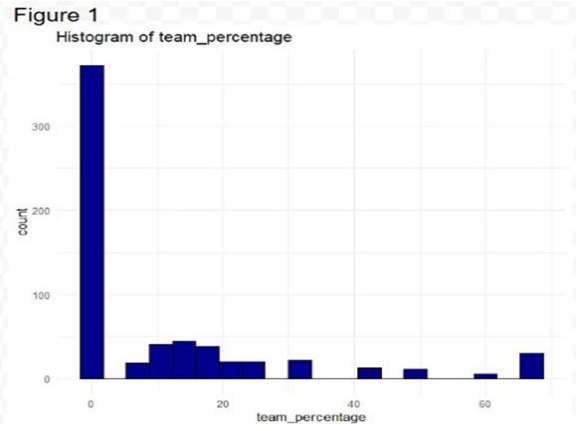

Fig. 5 Histogram showing the distribution of female representation (team percentage) across video game development teams in the dataset. The x-axis represents the percentage of women on development teams, while the y-axis shows the frequency count.

Figure 5 illustrates the distribution of female representation on development teams across the sample. As evident from the histogram, the majority of development teams feature less than 20% female representation, with a pronounced skew toward minimal representation (0- 10%), underscoring the gender imbalance in video game development.

The linear regression model confirmed this relationship, with each 10% increase in female development team representation associated with a 4.2% decrease in the probability of female character sexualization (p ¡ 0.01), controlling for other factors including game genre, release year, and platform. This model explained 32% of the variance in character sexualization (adjusted R^2 = 0.32), suggesting a substantive though not deterministic relationship. These findings support Fisher and Harvey's [26] hypothesis that diverse creative teams produce more diverse and less stereotypical content. They also align with Gray and Leonard's [27] research on the relationship between production demographics and content characteristics in digital media. The significant relationship between team composition and character portrayal provides empirical support for diversity initiatives within the game industry, suggesting that such efforts may directly impact content diversity. However, the relatively low overall per- centage of women on development teams (mean = 10.9%, median = 8%) indicates that the industry still faces significant challenges in achieving gender parity among creators. This mirrors broader patterns of gender imbalance in technology fields documented by Cassell and Jenkins [28] and persisting in contemporary studies [29, 30].

3.6 Longitudinal Trends in Gender Representation (2012-2022)

Temporal analysis revealed a gradual improvement in gender representation over the study period. The proportion of female characters increased from 27.3% in 2012 to 38.6% in 2022, while the representation of non-binary characters rose from near-zero to 3.7% during the same period. Linear regression confirmed the statistical significance of this trend (β = 1.23, p ¡ 0.001), indicating an average annual increase of 1.23

percentage points in female character representation.

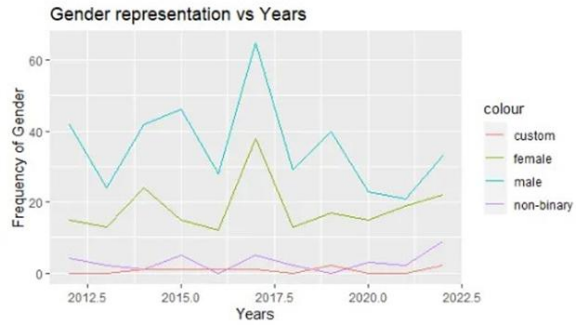

Fig. 6 Longitudinal trends in gender representation across video games from 2012 to 2022. The line graph tracks the frequency of different gender categories (custom, female, male, non-binary) over the study period.

Temporal analysis of gender representation, illustrated in Figure 6, reveals fluctuating but generally improving trends over the decade studied. While male characters maintain higher representation throughout the period, the frequency of female characters shows a gradual increasing trend from 2012 to 2022, though with notable variability between years.

Sexualization of female characters decreased significantly, with the proportion of moderately or highly sexualized female characters falling from 22.7% in 2012 to 9.2% in 2022 (β = -1.35, p ¡ 0.001). This represents a 59.2% reduction in sexualization over the decade, suggesting substantial industry evolution in character design approaches.

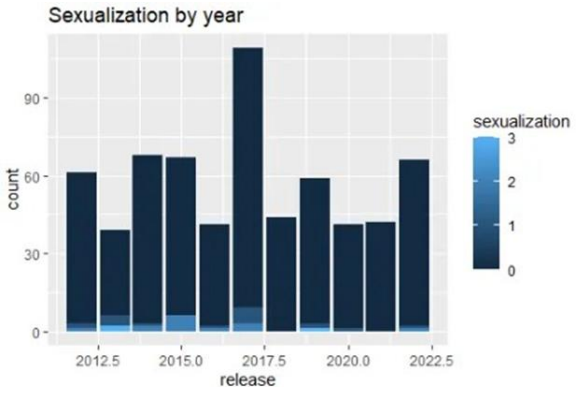

Fig. 7 Character sexualization levels by release year (2012-2022). The stacked bar chart depicts the count of characters across different sexualization categories (0 = no sexualization to 3 = high sexualization) for each year in the dataset.

Figure 7 documents the changing patterns of character sexualization over the study period. The visualization confirms our statistical finding of decreasing sexualization levels (represented by categories 1-3) over time, with the majority of characters falling into the non-sexualized category (0) across all years.

These trends align with Lynch et al.'s [13] observation of decreasing hypersexualization in games since 2006, as well as Shaw's [31] documentation of incremental improvements in diversity across multiple dimensions. The parallel trends in decreased sexualization and increased representation suggest a broader shift toward more nuanced character design rather than merely superficial changes, supporting Kondrat's [32] argument that the industry is gradually moving beyond tokenism toward more authentic diversity. The trend analysis also revealed that improvements have not been uniform across all game types. AAA titles from major publishers showed slower progress (average annual increase in female representation: 0.97 percentage points) compared to independent games (average annual increase: 1.86 percentage points). This difference was statistically significant (t = 2.84, p = 0.007) and suggests that different segments of the industry may be evolving at different rates, with independent developers potentially leading innovation in character representation.

3.7 Critical Reception and Market Implications

Analysis of the relationship between average review scores and gender representation patterns revealed modest but significant correlations. Games featuring higher proportions of female characters (¿40%) received slightly higher average review scores (mean = 9.14) compared to games with low female representation (¡20%, mean = 8.93), though this difference was only marginally significant (t = 2.01, p = 0.048). More pronounced was the negative correlation between female character sexualization and review scores, with games featuring highly sexualized female characters receiving lower average ratings (mean = 8.72) compared to games with no sexualized female characters (mean = 9.21, t = 2.72, p = 0.008). This suggests that critical reception may increasingly value more nuanced and less stereotypical character portrayals. Multiple regression analysis including genre, platform, and release year as control variables confirmed the independence of this relationship (β = -0.28, p = 0.01), indicating that the

association between lower sexualization and higher review scores cannot be explained solely by genre preferences or temporal trends. This finding challenges the persistent industry assumption that sexualized female characters are necessary for commercial and critical success, supporting Near's [18] research demonstrating that games with non-sexualized women actually outperformed those with hypersexualized women in terms of sales. The correlation between progressive representation and critical reception may provide economic incentive for publishers to pursue more diverse character designs, potentially accelerating positive change in the industry through market mechanisms rather than solely through cultural criticism. This aligns with Chess's [33] observation that economic considerations often drive industry evolution more effectively than ethical arguments alone.

4 CONCLUSION

This study provides empirical evidence of both persistent challenges and meaningful progress in gender representation within video games from 2012 to 2022. Our analysis reveals ongoing disparities, with female characters still underrepresented in protagonist roles and more likely to experience sexualization compared to male characters. However, the data also indicate positive evolution, with increasing female representation, decreasing sexualization, and the emergence of non-binary characters over the study period. The significant relationship between development team composition and character portrayal underscores the importance of diversity within creative teams, providing quantitative support for the value of industry inclusion initiatives. Regional and platform variations highlight the influence of cultural con- texts and target demographics on representation decisions, suggesting that change may occur unevenly across different market segments. Three primary conclusions emerge from our analysis: First, gender representation in video games has improved measurably over the past decade, with female characters increasing in number and diversity while experiencing less sexualization. This trend suggests that industry practices are evolving in response to changing demographics, critical feedback, and broader societal conversations about gender equity in media. Second, structural factors including development team composition, regional context, and platform identity significantly influence representation patterns. The negative correlation between female development team representation and character sexualization provides compelling evidence that diversity behind the scenes impacts diversity on screen, supporting calls for greater inclusion throughout the production pipeline. Third, the correlation between progressive representation and positive critical reception suggests potential alignment between inclusive design and commercial success, challenging traditional industry assumptions about market preferences. This finding may help accelerate positive change by demonstrating that diverse representation can be both ethically sound and commercially viable. These conclusions contribute to our understanding of how interactive media reflects and potentially shapes societal attitudes toward gender. By documenting both progress and persistent challenges, this research provides a foundation for ongoing industry reflection, scholarly analysis, and advocacy efforts aimed at creating more inclusive and diverse video game experiences. Future research could expand on this work by examining the qualitative aspects of character portrayal, exploring intersectional representation patterns, and investigating player responses to different representation approaches. As the video game medium continues to evolve and expand its cultural influence, ongoing study of its representational practices remains essential for understanding its broader societal impact.

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6 CONFLICT OF INTEREST

The authors declare that they have no conflict of interest. The authors have no affiliations with or involvement in any organization or entity with any

financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

7 ETHICAL APPROVAL

The present research work does not contain any studies performed on animals/humans subjects by any of the authors.

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Sarveshkumar Kumaraguruparan is a final-year undergraduate student in the Department of Computer Science and Engineering at SRM Institute of Science and Technology (SRM IST), Chennai, pursuing his Bachelor's degree in the 2021-2025 batch. His academic journey is distinguished by a comprehensive international exposure, including a semester abroad at the University of California, Davis, and a prestigious internship in Big Data Analytics and Machine Learning at the National University of Singapore.

A prospective candidate for Master's programs in Data Science in the United States, Kumaraguruparan has strategically developed a multidisciplinary skill set that aligns with advanced computational research. His research interests encompass: Computer Vision, Data Analytics, Machine Learning, Statistical Learning and Artificial Intelligence Applications

His academic trajectory reflects a strong commitment to interdisciplinary research, with a particular focus on leveraging advanced computational techniques to solve complex technological challenges. Through his international academic experiences and special- ized internships, he has cultivated a robust analytical approach and developed expertise in data-driven methodologies and innovative technological solutions. Currently preparing for graduate school, Kumaraguruparan aims to contribute to cutting-edge research in data science, with a vision of bridging advanced computational techniques with real-world problem-solving strategies.