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The Effect of Computer Games on the Personality and Creativity of Students of University Interested in Gaming Using Data Mining Techniques

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Abstract

Psychologists and sociologists have proposed various theories highlighting the deep connections between computer games and young people's lives, emphasizing their significant impact on morale and personality development. The computer game industry has emerged as one of the most widespread and profitable sectors in youth entertainment.

Examining the effects of computer games on different aspects of personality is essential. In this context, a research study titled "The Impact of Computer Games on the Creativity and Personality of Students Interested in Games" was conducted involving a sample of 53 university students. A questionnaire was used for data collection.

Data mining techniques, particularly clustering, were employed to analyze the data, with the K-Means algorithm being the primary method used. The results indicate a direct impact of computer games on several personality traits among students, including hidden stress, increased introversion, and a sense of distance from family. Furthermore, the research revealed a positive correlation between computer games and enhanced problem-solving creativity and quicker decision-making abilities.

Keywords: Data Mining Techniques, Computer Games, Personality

1 Introduction

The computer games industry is considered one of the emerging sectors globally and has significantly impacted human life in a relatively short time. With the development of powerful computers that offer advanced graphics processing, the industry has experienced substantial growth and is now reaching maturity. This sector is expanding rapidly around the world. In 2023, it generated its highest global income in recent years, with a significant portion of that revenue coming from the Asia-Pacific region [2].

In 2020, the coronavirus pandemic impacted the entire world, causing many entertainment industries to suffer significant declines in income. However, the computer games industry was an exception to this trend. It experienced minimal effects from COVID-19, with its income and profitability remaining stable or even increasing. Since computer games are a form of home entertainment, their popularity not only remained steady but grew during the pandemic. According to a report from NPD, the number of American students interested in games rose by 79% during quarantine. Moreover, the time spent playing games increased by 26%, and game-related expenditures climbed by 33%.

The expansion of the Internet has made it possible for almost everyone around the world to access this vast network, leading to significant growth in online gaming, which has been very well received by audiences. The computer games industry includes various aspects such as the development, marketing, and monetization of games, encompassing numerous job fields and thousands of jobs worldwide. By July 2018, annual global sales of computer games had reached $134.9 billion. In the United States, revenues were approximately $9.5 billion in 2007, $11.7 billion in 2008, and $25.1 billion in 2010, according to the ESA's annual report. Research from Ampere Analysis indicates that the sector has been continuously growing since at least 2015, with a projected growth of 26% from 2019 to 2021, ultimately leading to a record high of $191 billion.

The number of people who enjoy computer games has significantly increased in recent years, making them the most popular form of entertainment in human history. The first computer game, a tennis simulator, was created in 1958,

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marking the beginning of major advancements in the gaming industry. Today, games are available in various genres, the most popular of which include action-adventure, sports, horror, construction, and racing.

Among these, the action-adventure genre stands out for its emphasis on exploration, collecting items, solving puzzles, and engaging in combat. Many popular games have been developed within this genre. Other notable genres include simulation games, which have subcategories such as urban simulation, life simulation, and driving simulation, allowing players to construct and expand their desired cities [5].

The rise of computer games has changed how we spend our leisure time and interact socially, especially among younger generations. Although researchers have extensively examined the positive and negative impacts of gaming, the connection between gaming and cognitive abilities such as creativity and personality traits remains a topic of ongoing debate. This study aims to explore how computer games affect the creativity and personality of university students who are interested in gaming, using data mining techniques to identify underlying patterns and relationships.

Previous research has shown that gaming can improve cognitive functions such as problem-solving, spatial reasoning, and attention. However, the effects of gaming on personality traits and creativity are more complex and have produced mixed results. Some studies suggest that gaming can enhance creativity and innovation, while others argue that excessive gaming may lead to social isolation and decreased academic performance. Additionally, the use of data mining techniques in this area has opened new opportunities for exploration [14].

This study aims to fill gaps in the existing literature by exploring the relationship between gaming habits, personality traits, and creativity among university students. Specifically, we seek to:

1. Identify the most common types of computer games played by university students.

2. Investigate the correlation between gaming habits and specific personality traits, such as extraversion and openness to experience.

3. Examine the relationship between gaming habits and creativity, as assessed by standardized creativity tests.

4. Utilize data mining techniques to uncover underlying patterns and associations among gaming, personality, and creativity.

By addressing these research questions, this study adds to the increasing body of literature on the psychological effects of gaming. The findings carry implications for educators, parents, policymakers, and the gaming industry.

Video games have become a crucial part of modern culture, significantly impacting various aspects of people's lives, including their cognition and behavior. While earlier research mainly concentrated on the overall cognitive effects of gaming, this study takes a closer look at the specific connections between game characteristics, personality traits, and cognitive abilities among university students.

This research investigates how game genres, academic stress, and gaming habits affect problem-solving creativity, long-term memory, decision-making speed, reaction time, introversion/extraversion, communication with family, and confidence levels. A sample of 53 students aged 18 to 21 from Azad University, Karaj branch, was selected for this study. By employing clustering techniques, the study aims to reveal hidden patterns among gaming habits, personality traits, and cognitive abilities.

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This paper is structured as follows: Section 2 provides background information on how computer games affect the personality and creativity of students interested in gaming. Section 3 explains the research methodology in detail. Section 4 presents the findings, and Section 5 concludes with a summary of our work.

2 Background and Related work

Game development, or computer game creation, is a specific software development process focused on producing computer games. This process can be undertaken by a range of individuals, from solo developers who engage in game-making as a business, to large, dedicated companies that specialize in this field and are continuously growing and expanding.

Computer games can significantly influence the personalities of their players. For instance, in a violent game, a player might adopt a specific role for an extended period sometimes for days or even months. This immersion allows

players to deeply connect with their character's story and context within the game. [6].

It is completely affected by its computer games are not only designed for children, and compared to other media, they do not have a specific content and audience, and everyone can use them depending on their interest. Computer games such as movies, books, and serials can be about any subject and designed for any age group, opinions, and interests, most computer games are designed for adults. And children are not their target market [7].

The impact of computer games on players can often elicit a stronger reaction than movies. In Iran, following the establishment of the National Computer Games Foundation in 2006, a military initiative called the National System of Age Classification of Computer Games was introduced. This system is responsible for monitoring game content and determining appropriate age ratings for each game. By 2008, this classification system had been successfully implemented, making Iran one of the countries with an age classification system for games that aligns with the nation's cultural norms and values. The age categories are detailed in "Table 1" as follows:

Table 1: Age Classification System for Computer Games [3]

Age classification	**Description**
EC	Games for Childhood
E	Suitable games for all age groups
E10	Suitable games for children over 10 years old
T	Game for teenagers
M	Games for adults
AO	Exclusive games for adults

2.1 The Benefits of Playing

Playing computer games offers several benefits, including enhanced creativity. Research indicates that certain computer games, particularly those with numerous changes during gameplay, can lead to an increase in the volume of gray matter in the brain. Gray matter is a layer that covers the outer part of the brain and the cerebellum; its expansion can improve learning capabilities. [13].

Strengthening gray matter is crucial for enhancing memory. A decline in this substance due to aging can ultimately lead to dementia and conditions such as Alzheimer's disease. Recent research conducted by scientists at the University of California indicates that playing 3D computer games may help prevent Alzheimer's. One significant benefit of these games is that they keep the mind active and help prevent the degeneration of brain tissue. [8].

Increasing the speed of decision-making is often essential, as it allows us to react quickly to events around us and make better choices in sensitive situations, combining accuracy with speed. Research indicates that this ability has a significant impact on the lives of many people. The allure of technology, including various games, has led family members to spend a substantial amount of time watching TV or playing computer or mobile games. Interestingly, individuals who engage in online mobile or computer games tend to react to their surroundings much more quickly than those who do not. Moreover, this increase in reaction speed often comes with enhanced accuracy [10].

2.2 Disadvantages of Playing

Disadvantages of playing video games include issues such as social and family isolation. In today's technology-driven world, excessive gaming can lead to weakened relationships among family members. Additionally, long-term gaming can cause skeletal and muscular problems across all age groups. Common issues include back pain, neck pain, and joint pain, particularly in the thumb joints. Many students who are interested in gaming often neglect proper posture and may sit still for extended periods, leading to spine problems and back discomfort.

The rise in desire for violence has been influenced by the design and marketing of computer games in various ways. One particularly popular genre among teenage boys is war games. Prolonged engagement with these games fosters a sense of violence in students who are interested in gaming [9].

The primary effect of computer games is on people's personalities. Personality is a crucial aspect of a person's identity, defined as the set of behaviors exhibited in response to various events. Sometimes this can be summarized in a single word, but it also encompasses physical reactions. This research examines two personality types that are influenced by computer games, focusing specifically on these two categories:

- **Introverted:** introverted people, only mental life is beautiful to them introverted people enjoy being alone with themselves and their loneliness.

- **Extrovert:** Extroverts are primarily social and express themselves verbally. They can effectively communicate with others, are pragmatic, and tend to work well in group activities.

Studies indicate that individuals can change their personality types based on their circumstances. For example, a student passionate about games may display an extroverted personality while playing but can exhibit introverted traits during social interactions outside of gaming. Therefore, surveys suggest that it is important to consider both the advantages and disadvantages of playing video games. [12].

2.3 Datamining Technique

Data mining is the science of extracting patterns, information, and insights from raw data sets generated by organizations, societies, or other entities. In the past, when data production was limited, many managers could grasp the underlying concepts with a superficial understanding by manually sorting through the data. However, as the volume of data grew, it became practically impossible for any individual to analyze it effectively and extract meaningful patterns. Today, data mining offers a robust platform that enables the classification, analysis, and extraction of valuable insights from large data sets. This process supports informed decision-making by leveraging advanced technologies such as artificial intelligence and machine learning [3].

Clustering is an unsupervised machine-learning technique that groups similar data points. It helps to discover hidden structures within data without predefined labels. The choice of evaluation metric depends on your specific problem. Here are some common metrics:

- **Silhouette Coefficient:** This measures both the cohesion within clusters and the separation between different clusters [11].
- **Calinski-Harabasz Index:** This metric compares the variance within clusters to that between clusters, aiming for well-separated and compact clusters [1].

Important factors to consider in clustering algorithms include [2]:

- ☑ **Number of Clusters (k):** This can be a challenge since there's no one-size-fits-all solution. Techniques like the Elbow Method (used for K-Means) help identify the optimal k based on WCSS.[1].
- ☑ **Distance Metric:** This describes methods to measure similarity between data points. Common methods include Euclidean distance (straight-line) and Manhattan distance (taxicab geometry).

Clustering Algorithms: There are many types of clustering algorithms, each with its strengths and weaknesses. Some common examples include [3]:

- ❖ **K-Means Clustering:** This process divides data into a predetermined number of clusters, denoted as k.
- ❖ **Hierarchical Clustering:** This method establishes a hierarchy of clusters, enabling either a top-down or bottom-up approach.
- ❖ **DBSCAN[2]:** Identifies clusters based on their density, which is useful for analyzing data with varying density levels.

Choosing the Right Clustering Technique: The ideal algorithm depends on your data and the specific problem you want to solve. Consider factors such as [4]:

- **Data Shape:** K-Means is effective for detecting spherical clusters, whereas DBSCAN is capable of handling clusters of arbitrary shapes.
- **Presence of Outliers:** DBSCAN is resilient to outliers, whereas K-Means is not.

Here are some important additional factors to consider:

- ➔ **Ground truth:** If you have labeled the data with known cluster assignments, you can use metrics such as the Adjusted Rand Index (ARI)[3] or Mutual Information (MI)[4] To compare the clustering results to the ground truth [1].
- ➔ **Domain knowledge:** Think about what constitutes a "good" cluster in your field. This consideration can aid you in selecting an appropriate metric.

In computer games, data mining involves using various techniques and algorithms to extract valuable patterns, information, and insights from the vast amounts of data collected during gameplay. Game developers continually gather a significant amount of diverse data, including information about player performance, behaviors, preferences, game events, and other aspects related to the flow of the game.

1. Within-Cluster Sum of Squares (WCSS)
2. Density-Based Spatial Clustering of Applications with Noise (DBSCAN)
3. Adjusted Rand Index
4. Mutual Information

Examples of data mining applications in computer games include progress tracking, risk management, experience customization, and the discovery of patterns and hidden characteristics [1].

In [3], it was noted that data mining techniques and artificial intelligence research specific to the gaming industry can be utilized in the development and implementation of an international competition focused on data mining. One notable company involved in this field is NCSOFT, which is based in South Korea. They employ deep learning, decision trees, and linear regression algorithms in their game development processes. Additionally, research in [4] indicates that several competitions have been organized in the area of game data mining, aimed at predicting players' aggressive behavior based on the number of weeks they have participated in the league.

Data mining in the context of computer games is a novel approach that can aid in developing games tailored to the interests of students and their particular fields of study. However, due to the emerging nature of this topic, there are currently few articles available on it. According to [2], the data mining process can generally be divided into four key stages or steps:

1. The first step: determining the goals, in the sense of choosing the desired data.

2. The second step: After collecting and preparing the data, it should first be cleaned and processed.

3. The third step: Patterns should be identified and extracted. By extracting these patterns from the data, a model can be developed to solve the problem.

4. The fourth step: It is possible to interpret and display the patterns by summarizing and evaluating the results.

All of these steps are illustrated in "Figure 1" below.

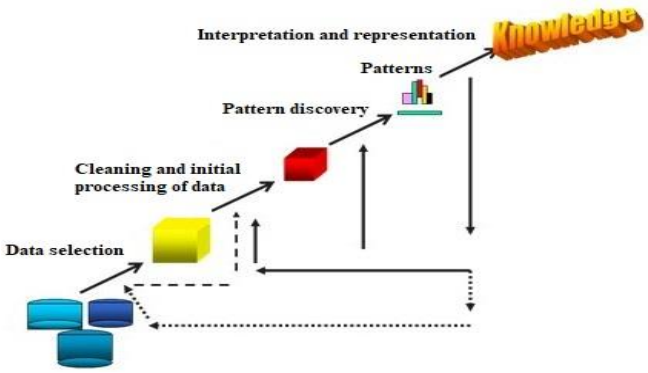

Figure 1: Data Mining Steps [3]

3 Research Method

This research was conducted in January 2024 to explore the impact of computer games on the personality and creativity of university students interested in gaming. The information was obtained using data mining techniques. Given that the data for this study is of the supervised type, we employed clustering techniques to simulate the data and extract useful information and patterns. The clustering algorithm is one of the most effective modeling algorithms in data mining. It is designed to work with data, allowing for a better understanding of the data structure within a given space. As a result, it is considered one of the most ideal methods for handling big data.

The clustering algorithm is a statistical method used for data reduction and identifying real groups within a dataset. This technique involves grouping the source data into clusters based on a set of specified values and placing the data into these clusters according to their similarity to one another.

The clusters have two important characteristics. First, there is a high level of similarity within each class. Second, there is a low level of similarity between different classes. When determining the category, all attribute values are treated equally. These types of algorithms are commonly used as a starting point to help users better understand the relationships between attributes in large datasets. In this research, the k-means algorithm has been chosen to implement this clustering technique. Additionally, cluster analysis does not involve any assumptions regarding the number of groups or their structure.

In this algorithm, the value of k is provided as input, and n objects are assigned to k clusters. This process must ensure that the clusters formed contain objects that are most similar to the center data of each cluster. The structure of these clusters can reflect the inherent characteristics of the data or reveal hidden patterns within it.

The clustering algorithm is utilized to identify patterns within a set of unclassified data. Until now, the K-means algorithm has been one of the most widely used methods in data mining for extracting hidden patterns from medical, scientific, and sports-related data. [3].

3.1 Statistical Population

In developing the research plan, it is essential to consider the nature of the problem being studied and the appropriate methods for investigation. This research falls under the category of trend research.

In this research, the factors affecting the impact of computer games on the personality and creativity of university students interested in games have been identified. These factors are displayed in "Table 2" below.

A questionnaire was utilized to gather the necessary information for this research. The statistical population for the questionnaire consisted of 53 students interested in games from the Islamic Azad University, Karaj branch, located in Karaj City, Alborz province, with ages ranging from 18 to 21 years old.

Subsequently, all tasks related to model building, data entry, and data pre-processing were completed.

For the simulation and analysis of the data, the researchers utilized the k-means clustering algorithm, which is a type of clustering technique. They set the number of clusters to 3 to achieve meaningful results from their research.

Table 2: The Name and Type of Characteristics Collected from the Factors Affecting the Personality and Creativity of Students of University Interested in Gaming

Characteristic Name	Characteristic Type
Game time (hours)	Numerical (below 1 hour, 1 to 2 hours, 2 to 4 hours, 4 hours or more)
Game genre	Categories (competition, action-adventure, sports-construction-horror)
The amount of institutionalized stress	Category (very low, low, medium, high, very high)
Creativity in solving problems	Category (very low, low, medium, high, very high)
Strengthen long-term memory	Category (very low, low, medium, high, very high)
The speed of decision-making and reaction	Category (very low, low, medium, high, very high)
Introverted/extroverted	Category (very low, low, medium, high, very high)
Communicate with family	Category (very low, low, medium, high, very high)
Confidence level	Category (very low, low, medium, high, very high)

4 Findings

After completing the previous steps, we applied the K-means clustering algorithm, which resulted in three meaningful clusters derived from 53 questionnaires, as illustrated in "Figure 2." In these clusters, all personality traits and levels of creativity in computer games are detailed in "Table 2," which includes:

- The Level of Institutionalized Stress
- Creativity in Solving Problems
- Strengthening Long-Term Memory
- Introvert/Extrovert Personality Type
- Communication with Family
- Self-Confidence Level has been Investigated.
- Speed Decision-Making (Reaction)

Weka 3.6 software, a specialized tool for data mining research, was used to implement the algorithm. The system requirements for this research included a CPU: Intel Core i5, RAM: 6GB, and an operating system: 64-bit Windows 8.1. Finally, the efficiency of the constructed model was evaluated.

Based on this information, it is possible to assess the effects and relationships of the examined traits concerning the influence of computer games on the personality and creativity of university students who are interested in games.

Final cluster centroids:

		Cluster#		
Attribute	Full Data	0	1	2
	(53.0)	(21.0)	(24.0)	(8.0)
Game play	2 - 4 H	4 H	2 - 4 H	2 - 4 H
Genre	Action	Action	Action	Racing
Stress	Much	Much	Middle	Little
Creatively	Middle	Much	Middle	Middle
Memory Improvement	Middle	Middle	Middle	Much
Decision	little	Very Little	little	little
Introverted/Extroverted	Middle	Much	Middle	Middle
Communication with Family	Middle	Middle	Middle	Middle
Self Confidence	Very Much	Much	Very Much	Middle

Figure 2: Results Obtained from Data Clustering

The clustering algorithm applied to the data yielded three results, as shown in Figure 2.

1) University students who are interested in gaming and play for more than four hours a day, particularly in the action-adventure genre, tend to have a high level of institutionalized stress in their personalities. However, playing these games has also been linked to an increase in their creativity when it comes to solving various problems. Additionally, gaming has a moderate impact on improving their decision-making speed and reaction times.

   This group of students interested in games tends to have a high introversion personality type. However, they maintain strong relationships with their families and do not prioritize computer games over family time. Additionally, these university students exhibit high self-confidence. It is noteworthy that 21% of our population possesses these personality traits, and research indicates that the impact of computer games on their creativity is significant.

2) Students at the university who are interested in gaming and play for 2 to 4 hours a day typically prefer the action-adventure genre. The level of stress institutionalized in their character is average, as is the overall game time. Engaging in gaming has enhanced their creativity in problem-solving. Additionally, playing games has had a moderate effect on strengthening their long-term memory and has increased their decision-making speed.

   A group of university students who are interested in gaming typically has an average introverted personality type. However, they maintain strong relationships with their families and do not prioritize computer games over family time. Additionally, these students exhibit very high self-confidence. It is noteworthy that 24% of our population displays these personality traits, and the influence of computer games on their creativity is significant.

3) University students who are interested in gaming and play for 2 to 4 hours a day, particularly in competitive genres, tend to have lower levels of institutionalized stress. This gaming routine also corresponds with a moderate average playtime. Engaging in these games has

significantly enhanced their creativity in problem-solving. Additionally, gaming has positively impacted their long-term memory and improved their decision-making speed.

This group of university students who are interested in gaming generally has an average introverted personality type. They maintain good relationships with their families and prioritize family time over computer games. Additionally, they possess moderate self-confidence. Approximately 8% of the population displays these personality traits, and research indicates that computer games have a significant positive impact on their creativity.

5 Conclusion

This study begins by addressing the topic of computer games, followed by an examination of creativity and personality traits among students, exploring various dimensions of these aspects. The research methodology is then outlined. Initially, data was collected from students with a strong interest in computer games through a questionnaire. Subsequently, the study utilized data mining techniques to analyze the gathered information after conducting preprocessing and data cleaning. The results were derived using the K-Means algorithm, which is part of the clustering family. A detailed explanation of the three identified clusters is provided.

The majority of the university students surveyed exhibit specific characteristics related to their interest in gaming. The results indicate that most students who are interested in gaming play for 2 to 4 hours a day, with action-adventure being their preferred game genre. These students tend to have a high level of institutionalized stress in their personalities, alongside the significant number of hours they dedicate to gaming.

Interestingly, playing games appears to enhance their creativity in problem-solving. The games have a moderate impact on improving their long-term memory and significantly boost their decision-making speed. Additionally, this group of gamers generally displays a moderate level of introversion; however, they maintain good relationships with their families, although they prefer not to play computer games with them. Ultimately, these students demonstrate very high self-confidence. Overall, this population exhibits these personality traits, and the influence of computer games on their creativity is deemed moderate.

This research can be extremely beneficial for entrepreneurs and anyone involved in the development of computer games. It can aid in creating effective and strategic plans to understand the impact of computer games on the personalities and creativity of teenagers and young adults.

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