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Impact of Video Games on Problem-Solving and Logical Reasoning Abilities among Youth

Ms. Aarchie Kaushik
Undergraduate Student, MIE-SPPU Institute of Higher Education (Pune University, Qatar Campus)
E-mail: aarchiekaushik26@gmail.com

Dr. Sujata Bhau
Assistant Professor, MIE-SPPU Institute of Higher Education (Pune University, Qatar Campus)

Abstract

The domain of video game analysis is continuously developing, and current investigations offer more profound perceptions into how gaming affects cognitive growth. This study aimed to investigate the potential positive effects of video games on an individual's cognitive development, specifically focusing on problem-solving and logical reasoning skills. In-depth semi-structured interviews were conducted with eight experienced gamers aged 18 to 28 years (mean age = 21.1 years), to gather qualitative data on their gaming experiences and perceived benefits. Findings from the study revealed that strategic and puzzle-based games can effectively stimulate critical thinking and solution-oriented understanding. Participants reported that the complex challenges within these games encouraged them to develop new methods and approaches, ultimately leading to improved cognitive skills. Additionally, the immersive nature of video games reinforced their spatial awareness and visualization skills, which are valuable assets in various real-world contexts. The combined evidence from this research suggests that video games can serve as valuable tools for cognitive development. Educational institutions and governments should consider incorporating them into learning strategies to harness their potential benefits for individuals of all ages.

Key words: Video Games; Cognitive Development; Logical Reasoning; Problem-Solving

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Introduction

Video games are a popular leisure activity among youth which has expanded globally and gained a worldwide popularity by becoming a billion-dollar industry yearly (Bacon, 2011; Stockdale & Coyne, 2020). The majority of the individuals visualize video gaming as a normal recreational activity, which hardly interferes with their physical and psychosocial well-being (Stockdale & Coyne, 2020). A new dimension added to this area of research is the potential cognitive benefits of video games. Researchers have consistently argued that playing video games improves cognitive skills in humans (Green & Seitz, 2015) like enhancing processing of perceptual tasks (Buckley et al., 2010), facilitating attention skills (Green & Seitz, 2015), working memory tasks (Sungur & Boduroglu, 2012), creative thinking (Jackson & Games, 2015) and better ability towards multi-tasking (Feng et al., 2007). Among these is the growth of logical reasoning and problem-solving abilities which is particularly crucial for youngsters. Solving problems means recognizing and evaluating obstacles, generating creative solutions, and putting plans into action to achieve the desired results. On the other hand, logical reasoning entails using reasoning to draw conclusions, making decisions that can be defended and evaluating information critically. Building independence, making wise decisions, and accomplishing long-term objectives are fostered by these abilities. When played carefully and sparingly, video games can give youngsters a great chance to practice these abilities in an entertaining and interesting way (Mayer, 2019) and can support their entire development and equip them for the chances and challenges of the future by fostering imagination, critical thinking, and perseverance.

Green and Bavelier (2012) discovered that players of action video games scored better than non-players on a range of cognitive tasks, such as those involving decision-making, problem-solving, and concentration. In addition, they welcome the instant feedback that video games give during gameplay, allowing young players to grow from their errors and learn how to enhance their gameplay. Likewise, a lot of young people prefer the social component of video games since it helps them develop their interpersonal and collaborative abilities (Gallup, &

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Serianni, 2017; Urquizo, 2020). Griffiths (2012) explored the concept of video game addiction, delving into its historical context, contemporary manifestations, and potential future trends. The study highlighted the complex interplay between psychological, social, and technological factors that contribute to addictive gaming behaviors. It also emphasized the importance of recognizing the potential negative consequences of excessive gaming, such as impaired social relationships, academic performance, and mental health. However, the study acknowledged the potential benefits of video games, including improved cognitive skills, problem-solving abilities, and social interaction. This widespread appeal can be attributed to a variety of factors, such as improved graphics, captivating stories, technological advancements, and the social aspect of online gaming. Moreover, though previously video games have been associated with negative effects on individuals, particularly young people, Chaarani (2022) has questioned this idea and implied that video games tend to have positive cognitive effects when played in moderation. Furthermore, despite the widespread perception that video games are harmful for youth, recent evidence shows that they can be beneficial both cognitively and socially for them (Adachi & Willoughby, 2017).

Hubana (2022) comprehended that playing games with puzzles can improve logical reasoning skills by promoting mental operations including pattern recognition, deduction, and inference. This lends additional support to the idea that playing video games can help with cognitive growth. These abilities are essential for scholastic achievement, career advancement, and personal development. They encourage people to think critically, make informed choices, and effectively address obstacles. Puzzles, barriers, and strategic choices that demand for critical thinking and innovative problem-solving are frequently offered to players in games like Minecraft, Pot Man, and Pacify. As they advance through the games, players gain the ability to think critically, try out various strategies, and deconstruct difficult problems into smaller and more manageable steps. Experienced gamers are more proficient in making quick decisions under pressure and are less likely to suffer from cognitive biases. This stimulating activity has the potential to enhance cognitive abilities and foster a growth mindset (Hauser, Kahneman &

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Tversky, 2009). As Tichon (2016) argues, video games can foster a sense of mastery and competence by providing players with opportunities to overcome challenges and achieve goals. This can boost self-esteem and motivation, leading to increased engagement and persistence in other areas of life. Resilience and problem-solving abilities can be enhanced by this iterative process of trial and error. Although video games have ingrained themselves into contemporary culture, especially among young adults, a thorough grasp of how they affect cognitive abilities is still elusive.

However, there are also several substantial drawbacks associated with gaming, such as insomnia, irregular schedules, inactive lifestyle, passive aggression, and an irritable disposition (Alghamdi et al., 2024; Lam, 2014; Yang et al., 2014; Young & De Abreu, 2010). Other serious problems include social isolation, melancholy, anxiety, gaming disorders, etc. (Alrahili et al., 2023; Fam, 2018). This eventuates the relevance of playing games responsibly and recommends moderation as a means of reducing these possible negative effects. Nonetheless, more thorough research is vitally required to clarify the complex relationship between cognitive abilities and video games. Further research is prudent to fill up these knowledge gaps by offering insightful directions about the possible advantages and disadvantages of gaming. Thereby empowering people and decision-makers to make wise choices regarding gaming behaviors and instructional strategies. Based on the above facets, the present study aims to investigate the cognitive benefits of video games among youth by adopting a qualitative approach.

Methodology

Sample

The current study used a qualitative and interpretive approach to evaluate the influence of video games on problem-solving and logical reasoning abilities among young adults aged between 18 to 28 years. Purposive and snowball sampling technique was used for data collection. Eight participants (males = 6; females = 2) from India were selected based on their

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PlayStation or PC gaming experience. The mean age of the sample was 21.1 years. The participants have been labelled with alphabets A, B, C, D, E, F, G, and H to ease the discussion segment of this study and ensure their anonymity.

Procedure

A semi-structured in-depth interview technique was used to collect comprehensive and detailed participant data. This methodology facilitated the researchers for obtaining thorough grasp of participants' video gaming experiences and how they perceived the impact of such experiences on their cognitive abilities. The use of semi-structured interviews was considered appropriate since it allowed for both standardized data collection and unplanned exploration of new themes by striking a balance between planned and unplanned questions. To facilitate participant engagement, the researchers employed a diverse range of platforms to connect with participants and schedule convenient interview times. Interviews were held in a confined ambiance, either in person or online, to prevent distractions and ensure maximum attentiveness. Six of the eight interviews were done online, and the other two were carried out offline lasting approximately 20 to 30 minutes each. Prior to commencing the interview, informed consent was obtained from all participants to record their responses, and they were assured about the confidentiality of the data. The collected data was meticulously transcribed verbatim, and participant anonymity was maintained throughout the research process. No incentives were provided to the participants.

Data Analysis

Thematic analysis was used to discover patterns in interview data on logical reasoning and problem-solving abilities, focusing on popular video games such as Grand Theft Auto and Minecraft. This process involved two steps. First, the data was coded by highlighting keywords and phrases. After that, these codes were divided into broader categories. Subsequently, the themes were examined in context with their connections to the current research body. This approach allowed for a deeper comprehension of the potential impact of these games on cognitive development and problem-solving skills.

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Results and Discussion

Based on employment of thematic analysis, three key themes emerged from the analysis: enhanced problem-solving abilities among youth, improved logical reasoning abilities, and role of moderation. The above-mentioned themes are discussed below in detail.

Theme 1- Enhanced Problem-Solving Abilities among Youth

Participants in this research agreed that video games are not just a mere entertainment, but they also contribute to the development of problem-solving abilities among youth. The diverse challenges presented by games, from single-player puzzles to collaborative multiplayer experiences can equip players with the ability to approach and overcome obstacles in the real world. Several instances of games that call for strategic planning, analytical thinking, and flexibility were shared. Most subjects focused on video games including battle royale games, GTA, Valorant, Hitman, Fortnite, PUBG, Minecraft, Dota 2, horror games, story-based games, etc. These games often offer players the chance to solve intricate puzzles, make strategic decisions, counter the enemy, and overcome obstacles, all of which can improve cognitive functions.

"Video games for example like battle royale, FPS games, and Fortnite involve thinking of various strategies to outsmart the opponents." **(Participant D, 18 years old, Male)**

"These specific types of video games come with a lot of different combinations and permutations." **(Participant C, 22 years old, Male)**

"***As a gamer myself, I think video games generate more positive outcomes than negative outcomes.***" **(Participant B, 28 years old, Male)**

Moreover, respondent B argued that many video games are designed to enhance cognitive development and skill acquisition. For instance, games like "Are You Smarter Than a 5th Grader?" present players with diverse puzzles and challenges across subjects like math, science,

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language arts, and history. Solving these problems requires creative and innovative application of knowledge and skills. Additionally, games like "Buckshot Roulette" demand quick decision-making under pressure, forcing players to weigh risks and rewards. On the other hand, games like "Valorant" necessitate strategic planning, understanding opponent tactics, and adapting to changing circumstances. These games foster strategic thinking and adaptability. These observations align with Choi et al. (2020) and GomezRomero-Borquez et al. (2024) who comprehended that different video game genres, such as puzzle, strategy and action games, can stimulate various cognitive processes, including problem-solving, strategic thinking, and decision-making.

One of the gamers (participant E) offered a nuanced viewpoint, arguing that video games tend to foster emotional intelligence in addition to improving problem-solving abilities. He stated that morally challenging decisions in video games like Spider-Man can help players develop empathy and an understanding of consequences. This demonstrates how video games have a complex effect on emotional and cognitive development.

"***Problem-solving can also help in building your emotional quotient and how to make empathetic decisions in a way.***" **(Participant E, 18 years old, Male)**

Further, participant G offered an interesting take on problem-solving, suggesting that the challenge of overcoming obstacles in games can be a powerful motivator. She argued that the frustration of failure can drive players to experiment with different strategies and ultimately find solutions. This highlights the importance of perseverance and learning from mistakes, which are essential components of effective problem-solving.

"*It is fun when I don't find clues at times while playing escape rooms, it fuels the urge to keep on going until I find it.*" (Participant G, 21 years old, Female)

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Some respondents' answers highlight how game design might help develop problem-solving abilities. Battle royale games that demand gamers to think strategically, adjust to changing conditions, and make immediate decisions can greatly improve cognitive ability. Game developers can boost problem-solving skills by creating experiences that include difficult riddles, strategic quandaries, and dynamic landscapes.

"***Because the main structure or layout of all the video games are similar i.e., they have a goal to reach and to reach that goal you have to overcome obstacles of different difficulties."*** **(Participant H, 20 years old, Female)**

Moreover, gamers highlighted the benefits of both multiplayer and single-player video games in enhancing problem-solving skills. Multiplayer games, in particular, foster interpersonal abilities and strategic thinking by requiring cooperation, competition, and effective communication. Players learn to adapt to different play styles, anticipate opponents' moves, and develop creative solutions to overcome challenges.

"Multiplayer games help in developing efficient teamwork and better communication skills with one another which automatically makes the obstacles a bit easier to solve and also sharpens our problem-solving skills." **(Participant A, 23 years old, Male)**

Contrary, single-player games contribute to the development of individual skills such as mathematical reasoning, spatial awareness, and critical thinking. These games often involve solving complex puzzles, navigating intricate environments, and making strategic decisions and increasing attention span. Unlike multiplayer games, where skills are shared and collaborative, single-player games focus on individual problem-solving and cognitive abilities.

"***Problem solving specifically in single player video games helps in better focusing and provides good concentration abilities since everything is on you and how you carry out the***

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***game and implement the strategy.*" (Participant F, 19 years old, Male)**

Participants H and A highlighted the benefits of open-world games in developing problem-solving skills. These games offer players a high degree of freedom to explore, experiment, and overcome challenges in their way. By providing a vast and immersive world, these games can encourage players to think creatively, solve complex problems, and develop a sense of independence. This aligns with research by Giatzoglou (2024), who demonstrated the potential of virtual reality (VR) in assessing cognitive functions, including problem-solving and hand-eye coordination. While the study focused on a specific VR task, it highlights the broader potential of immersive gaming experiences to enhance cognitive abilities.

When presented with a hypothetical scenario of being stuck in a video game, participants exhibited diverse problem-solving strategies. Subjects A, B, and C demonstrated a comprehensive approach, considering options such as exploring the game environment, employing trial and error, seeking external help through online resources or gameplay videos, and, as a last resort, taking a break. In contrast, Subjects D, G, and F favored more self-reliant strategies, prioritizing exploration and trial and error over external assistance or giving up. Subject E, on the other hand, expressed a preference for taking a break when faced with overwhelming challenges, suggesting a more flexible and adaptive approach to problem-solving. These varied responses highlight the diverse ways in which individuals approach obstacles and the influence of personal preferences and gaming experiences on problem-solving strategies.

Theme 2- Improved Logical Reasoning Abilities

This study also examines the respondents' perspectives on how playing video games has impacted their capacity for logical reasoning. It explores how these points of view are related to one another, the particular effects on each topic, the evident differences in approaches, and the potential benefits that arise. Participants (A, C, D and E) agreed that video games improve

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logical reasoning. They highlighted particular games that have improved their critical thinking, pattern detection, and creative thinking techniques. This convergence raises the possibility that playing video games enhances one's capacity for logical thinking.

Participant G posited that certain video games, notably escape room simulations, can cultivate valuable cognitive skills, particularly an enhanced attention to detail and improved inductive reasoning. She recounted that, prior to engaging in these games, she frequently overlooked minor details in her daily life. However, she now demonstrates a significantly heightened awareness of subtle nuances, a development that has positively influenced her interpersonal relationships. This improvement in inductive reasoning, fostered by the games' puzzle-solving nature, allowed her to draw connections between seemingly disparate pieces of information. As a commerce student whose work centers on data analysis, this refined attention to detail and improved inductive reasoning has proven invaluable. She stated that it enabled her to effectively distinguish accurate data from outdated information and to identify potential oversights in her calculations by recognizing patterns and drawing logical conclusions.

"Logical reasoning abilities are important because it helps you in not only excelling in the gaming world but also your real world." **(Participant G, 21 years old, Female)**

Furthermore, Participant E argued that video games can enhance planning and prioritization skills. He cited specific examples from the Spider-Man game, noting that certain time-sensitive missions require players to develop a strategic approach. These missions necessitate creating a plan or blueprint of essential tasks, prioritizing them based on various factors. This process involves considering multiple aspects before finalizing the plan. Additionally, he stated that he applied these same principles to his academic life by organizing his time, creating schedules, and prioritizing assignments based on importance. This structured approach, he suggested, brings clarity and ease to his academic work by providing a clear understanding of what needs to be done and how to approach it. In this way, he believes the game has contributed to improved

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logical reasoning abilities.

"So making a draft or a blueprint of tasks that are important is necessary and I need to make it according to which tasks are supposed to be my priorities and you need to look into different aspects and consider a bunch of things before finalizing the blueprint." **(Participant E, 18 years old, Male)**

In addition to this, participant H affirmed that logical reasoning is significantly enhanced through the engagement with games like The Witness and Talos Principle. She attributed this improvement to the reflective nature of these games, necessitating careful consideration of each action. This perception goes along with Cappuccio's (2013) argument that video games can be used as a tool for developing critical thinking skills. Moreover, she underlined the effectiveness of survival games, such as Minecraft, in stimulating logical reasoning abilities. These gaming experiences have practical applications in real-life scenarios, as exemplified by the subject's improved camping skills, including bonfire construction and the selection of suitable firewood. She also proclaimed that her hiking experiences have benefited from the knowledge gained in these games, such as using natural resources for first aid and wound care.

"I think that games like the Witness and Minecraft have contributed to my logical-reasoning skills." **(Participant H, 20 years old, Female)**

According to both respondents A and E, playing video games can improve one's ability for logical thinking. Participant A pointed out games like Hitman, which require deductive reasoning, spatial awareness, and pattern recognition. Respondent E emphasized how playing games like Clash of Clans requires tactics, analysis, and patience, skills that may be applied in the real world to increase patience and critical thinking.

"Playing video games aids in efficient communication and cooperation in the real world compared to thinking out of the box ideas." **(Participant A, 23 years old, Female)**

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Correspondingly, respondent B specifically highlighted the role of horror video games like Madison, From the Darkness, and Suite 776. These games often present players with complex puzzles and riddles that require critical thinking and problem-solving abilities. By engaging in these challenges, players can hone their cognitive skills, such as cause-and-effect reasoning, analogical reasoning, and abductive reasoning. These skills, developed through gameplay, can be applied to real-world scenarios, enhancing overall logical thinking. A broader perspective was acknowledged by Participant D emphasized the importance of learning from failures and setbacks, a valuable lesson often reinforced through gameplay. By experiencing virtual defeats and overcoming obstacles, players can cultivate resilience and a growth mindset. This ability to persevere in the face of adversity can be a powerful tool for personal and professional development.

"Video games have taught me how to face a loss. For instance, if I have failed the task then instead of quitting the game, I would replay the whole game and this time I would use different skills like critical thinking, analyzing my mistakes and then implementing logical reasoning skills and complete the task more efficiently." **(Participant D, 18 years old, Male)**

Respondent C's experience also demonstrated how playing video games might improve one's ability for logical reasoning. Dota 2, with its wide hero pool and distinctive abilities, encourages players to develop a thorough grasp of their heroes and devise imaginative strategies to overcome enemies. In the end, this ongoing testing and alteration strengthens logical reasoning by refining critical thinking and pattern recognition skills. This is directly related to the computer engineering course of Participant C. His engineering program focuses significantly on algorithms, which necessitate effective data sorting and processing solutions. Similar to Dota 2 strategy, where players analyze hero abilities, itemize to counter specific skills, and select heroes based on team composition, he examined many algorithms to determine the most effective solution for a given problem. This aligns with Alwhaibi's (2024) study, which found a positive association between video game engagement and creative problem-solving

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skills. His experience exemplifies how video game strategies can translate to real-world problem-solving approaches, particularly in fields like computer engineering where creative solutions are essential.

"If you want to tackle the problem with unique solutions or want to have pattern recognition skills or be able to think critically and become observant, then you need to keep on playing such games to get a hold of such skills." **(Participant C, 22 years old, Male)**

This ability has more practical applications. For example, when creating an app, if the Participant runs into a bug and has to address it, then he needs to appraise alternative approaches (e.g., A+D instead of A+B) to discover which produces the most effective outcomes, much like analyzing alternative hero combinations in Dota 2. This demonstrates how playing video games can help develop a logical reasoning ability that applies to real-world situations and goes beyond the virtual world.

It is interesting to draw attention to the fact that participants also underscored the contributions of educational institutions incorporating video games, since they have the potential to impart cognitive skills training to students in an enjoyable way.

"I think children should be taught to play video games that are mainly focused on influencing their cognitive skills including logical reasoning." **(Participant B, 28 years old, Male)**

Theme 3- Role of Moderation

Respondents in the current investigation asserted the significance of balance in video game intake. Although they acknowledged the potential advantages of gaming, like social interaction, stress release, and skill development, they also pointed out the risk of playing excessively. This notion is supported by authors Barlett, Anderson, and Swing (2009), who found that playing

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video games had a positive as well as negative impact. While violent video games are often connected to aggressive behaviour, non-violent games can provide possibilities for the development of knowledge and abilities. Therefore, it is essential to comprehend the particular context of gaming, including the kind of game, how long it is played, and the reasons behind it, to ascertain the overall effect on well-being.

"A person playing video games for long hours, makes him addicted to that short term dopamine and nothing other than playing will bring him the same amount of satisfaction." **(Participant H, 20 years old, Female)**

Along with addressing the potential benefits of playing video games in moderation, participant A discussed the possible drawbacks for gamers, including disrupted sleep patterns, schedule imbalances, missing opportunities, etc. Respondent H also criticized gamers who spend a lot of time sitting still and playing games without moving much, as this might result in weight gain, eye strain, muscle weakness, bad posture, and other health problems. Additionally, participant E emphasized that sometimes when individuals fail to overcome the challenge or defeat their opponents in battle royale games, they become anxious and destructive. It posits a detrimental effect on their mental health, leading to severe gaming disorders. Comparably, respondent H argued that playing violent or addictive video games like PUBG, Free Fire, Valorant, Fortnite, and many more increases the risk for psychiatric disorders including ADHD and autism. Nonetheless it's important to consider that excessive gaming might have a detrimental impact on mental health.

Many players engage in over five hours of video game play each day. However, respondents A, C, D, E, and H shared that they only play video games for two to three hours every day, while subjects G, and F reported that they spend about 10 to 15 hours on a daily basis when they have no other important commitments. Though when they are occupied with tasks and have deadlines to meet, both the respondents asserted that they reduce their video gaming duration to less than

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ten hours. Nevertheless, most of the participants also stated that their jobs, education, and other commitments currently prevent them from having enough time to play video games. The total amount of time spent on gaming in the past has drastically changed for them. A recent systematic review by Tholl et al. (2022) highlighted the negative impact of video games on physical health of players. The authors reported that spending an excessive amount of time playing video games (more than 3 hours a day) is a significant predictor of health issues like musculoskeletal disorders. Similarly, Chan et al. (2022) recognized that online gaming is significantly associated with lifestyle related outcomes like poor nutrition, lack of physical activity and low quality of sleep.

Respondents A and E proclaimed how playing video games in moderation is important, since this leaves a person with enough time to complete other tasks. More specifically, Subject A disclosed that they only play video games after finishing all of their assignments effectively. While Subject E organized a time slot with acquaintances and regularly looked forward to playing video games between the set time.

"I often find that playing for a short while also increases my drive in the other activities; I end up having better focus in studies as well as driving too." **(Participant A, 23 years old, Male)**

"We always looked forward to 9 o'clock because that was time with friends rather than just playing games." **(Participant E, 18 years old, Male)**

Conclusion

In a nutshell, this study explored the relationship between video games and cognitive development through thematic analysis, revealing three key themes: enhanced problem-solving abilities, improved logical reasoning abilities, and the importance of moderation. Previously, video games were primarily viewed as a source of entertainment, but this research suggests they can offer a range of cognitive benefits. The analysis highlighted how video games can strengthen problem-solving skills. Participants described overcoming challenges in various game genres, including puzzles, strategy games, and open-world experiences. This is in line with research

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suggesting that video games can enhance cognitive abilities like planning, processing speed, and decision-making. Furthermore, the study found that video games can improve logical reasoning abilities. Participants pointed out games that require critical thinking, pattern recognition, and strategic analysis. This can translate to real-world benefits, such as improved decision-making in various aspects of life. However, the importance of moderation was a recurring theme. While acknowledging the potential benefits of video games, participants also discussed potential drawbacks of excessive gaming, such as disrupted sleep patterns, social isolation, and negative impacts on mental health. The findings suggest that video games can be a valuable tool for cognitive development, but it is also crucial to find a healthy balance to maximize benefits and minimize risks. Overall, this study sheds light on the evolving role of video games.

Implications, Limitations and Future Directions

The study's limited sample size and qualitative research methodology may restrict the findings' generalizability and the capacity to establish definite causal links. Furthermore, the qualitative method is subjective and susceptible to researcher bias, even though it is useful for producing deep insights. Future research should delve into the long-term effects of video games on cognitive skills and brain function, investigating whether sustained gameplay can induce lasting changes in brain plasticity and improve cognitive performance beyond gaming sessions. To maximize cognitive benefits, individuals should seek out games that challenge their minds and promote strategic thinking, problem-solving, and creativity. It is crucial to maintain a balanced lifestyle by avoiding excessive gaming and engaging in a variety of activities that stimulate both mind and body. Setting specific screen time limits for children can help ensure a healthy equilibrium between gaming and other essential activities, promoting overall well-being.

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