



ASSESSMENT OF CHANGES IN COGNITIVE FUNCTION BETWEEN ADDICTED AND NON-ADDICTED ADOLESCENTS

Laxmi Devi^{1*} and Shalini Agrawal²^{1,2}School of Home Science, Department of Human Development and Family Studies,
Baba Sahab Bhimrao Ambedkar University, Lucknow-226 025.DOI: <http://dx.doi.org/10.24327/ijrsr.20261701.0117>

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ABSTRACT

The present study aimed to examine the changes in cognitive function among addicted and non-addicted adolescents in Lucknow, Uttar Pradesh. A purposive random sampling technique was employed to select 200 adolescents aged 15-18 years from urban schools. The Cognitive Ability Test - Group Mental Level Battery (CAT-GMLB) was used to assess five domains of cognitive function: awareness, memory, understanding, reasoning ability, and problem-solving ability. Results revealed that reasoning ability and problem-solving ability significantly varied across age groups, with older adolescents showing a decline in these areas. Gender differences were significant only in memory, where girls performed better than boys. The mean scores indicated moderate levels of awareness (M=2.139), memory (M=2.129), understanding (M=2.568), reasoning (M=2.251), and problem-solving ability (M=2.373). Correlation analysis showed that online gaming addiction was negatively associated with understanding ($r = -0.161, p < 0.05$) and problem-solving ability ($r = -0.200, p < 0.01$), suggesting that higher gaming addiction impairs these cognitive domains. Furthermore, cognitive components were positively inter-related, indicating overall coherence among mental abilities. The findings highlight the adverse cognitive effects of excessive gaming and emphasize the need for preventive measures to promote balanced gaming habits and cognitive well-being among adolescents.

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INTRODUCTION

Cognitive function refers to the mental processes by which individuals acquire knowledge and understanding, make decisions and perform various tasks. These functions include a wide range of intellectual abilities such as memory: the ability to store, retain and recall information, attention: the capacity to focus on specific stimuli or tasks, perception: the process of interpreting sensory information to understand the environment, reasoning: the ability to think logically, solve problems and make decisions, language: the ability to understand, produce and use language effectively for communication, executive functioning: Higher-level cognitive skills like planning, organizing, decision-making and self-control and processing speed: the ability to process information quickly and efficiently.

Decision-making and problem-solving abilities traditionally,

*Corresponding author: Laxmi Devi

School of Home Science, Department of Human
Development and Family Studies, Baba Sahab Bhimrao
Ambedkar University, Lucknow-226 02

video games help players develop their strategies and problem-solving abilities by having them solve progressively challenging problems under time pressure, which improves speed and decision-making abilities. Additionally, some studies have shown that playing video games helps young people become more creative.

The brain is mostly exercised when playing video games. Usually, it entails devising a plan to either survive or defeat the boss; building a structure or blowing it up. It is therefore regarded as a very active hobby, at least in terms of cognition. Numerous researchers and doctors have acknowledged it and the concepts of video games are still applied in training scenarios, rehabilitation and cognitive development activities. Game players are able to make better decisions and assess where and for how long their attention should be focused at any given moment because they possess quicker and more precise attentional skills.

A person capacity to think in three dimensions and make inferences about objects from sparse data is referred to as their spatial ability. A person with strong spatial skills may also be able to predict how an object would seem when rotated. These kinds of skills can be learned via. practice and are helpful in

a range of real-life scenarios. Math, science, technology and engineering all demand the ability to think spatially (Yadav, 2021).

A game which is played among many participants linked with a network system is termed an online game. Players can be connected to the internet or LAN (Local Area Network) and the network can be either wireless or wired. Bluetooth, Wi-Fi or 4G mobile broadband WiMAX or LTE are a few wireless connections. A massively multiplayer online game (MMOG) is an online game that can support thousands of players simultaneously. Players are connected through a network, allowing them to interact in an extensive virtual gaming world. Like persistent social and material worlds, virtual worlds here are loosely organized through open-ended (fantasy or imaginary) stories, leaving users with a lot of choice about what they can do. In order to interact, a person can control their own digital character, or “avatars,” not only with virtual game world objects but also with other players’ avatars (Rosangzuali, 2024).

The loss of control over gaming behaviour and the games priority over other interests and daily activities and the continuation of game playing despite its negative impacts were seen as symptoms. While Internet gaming addiction studies still has to be greatly scaled up, reports of the negative effects of internet gaming are collecting warrant for detailed and effective counter measures. The game industry has been growing steadily since the popularity of online games. Game genres are varied and split, ranging from arcade games, where a single player completes basic tasks to complex simulation games, where players collaborate to create strategies (Kim *et al.*, 2022).

A non-addicted online gamer is an individual who engages in online gaming for entertainment or leisure without experiencing the behavioural, psychological, or functional impairments typically associated with gaming addiction. Such gamers maintain healthy control over their gaming habits, do not display compulsive use, and are able to balance gaming with academic, social, and family responsibilities. They do not exhibit symptoms such as withdrawal, tolerance, loss of interest in other activities, or continued gaming despite negative consequences, which are criteria commonly linked to gaming disorder (American Psychiatric Association, 2013; World Health Organization, 2019). Overall, non-addicted gamers participate in gaming as a normal recreational activity that does not interfere with their well-being or daily functioning (Borgeset *et al.*, 2021).

MATERIALS AND METHODS

Objectives

To find out change in cognitive function of addicted and non-addicted adolescents.

Hypothesis

H₀-There exists no significant difference in cognitive function of adolescents according to age

Locale of the study

Sampling design and sample size

Purposive random sampling technique is adopted in sample

selection. The respondents comprise respondents belong to Adolescent’s age groups belonging to the urban area’s schools of selected area of Lucknow, Uttar Pradesh, India. Selection is carried out in two stages; in first stage, for the purpose of data collection, respondent in Lucknow were approached and in second stage, respondents from four zones were selected randomly in Lucknow by using the purposive random selection technique. The study will involve 200 Adolescent from school. The adolescent will age between 15-18 year.

TOOLS AND TECHNIQUES

General proforma and procedure

The self-assessed general profile is created and circulated to collect the general and foundational information if the participant. The survey method of research is a widely used approach in the social and behavioural sciences that involves collecting data from a large population using structured questionnaires or standardized tools.

The CAT-GMLB Scale (Cognitive Ability Test – Group Mental Level Battery) is a standardized psychological assessment tool designed to measure the general cognitive ability or mental level of individuals, particularly in group settings. It assesses various domains of intelligence such as reasoning, verbal ability, numerical ability, spatial visualization, and memory. Suitable for use in educational and vocational settings, the CAT-GMLB is often administered to school-aged children, adolescents, or adults to evaluate their intellectual functioning and cognitive strengths and weaknesses. The test is structured to be culture-fair and can be administered efficiently in groups, making it a valuable tool for large-scale assessments. The results help in academic placement, career guidance, and identifying individuals who may require special educational support or advanced enrichment programs.

Methods of data collection

Survey method

The survey method of research is a widely used approach in the social and behavioural sciences that involves collecting data from a large population using structured questionnaires or standardized tools. When employing scales like the CAT-GMLB (Cognitive Ability Test - Group Mental Level Battery), the survey method becomes particularly valuable for assessing cognitive abilities across diverse groups in a systematic and efficient manner.

RESULTS

Cognitive function of the respondent across age group

Awareness

The mean scores for awareness show a slight increase from 19.80 in the 15–16 age group to 21.56 in the 17–18 group. However, the ANOVA result ($F = 1.322$, $p = 0.269$) indicates that the difference is not statistically significant. This suggests that awareness levels remain relatively stable across mid-adolescence and do not differ meaningfully with age

Memory

Memory scores also do not vary significantly across age groups ($F = 0.376$, $p = 0.687$). The mean values (17.60, 16.71, and 17.11) are very close to each other.

This indicates that age does not play a major role in influencing memory performance among adolescents in the present study. Memory appears to be equally developed across all three age categories.

Understanding

Understanding shows a similar pattern. Although the youngest group (15–16 years) has a slightly higher mean score (17.10), the ANOVA result ($F = 2.406, p = 0.093$) shows no significant difference. Therefore, understanding ability remains consistent across age groups, suggesting that comprehension-related skills do not undergo major changes within these narrow age ranges.

Reasoning Ability

A significant difference was observed in reasoning ability across the age groups ($F = 7.079, p = 0.001$). The mean scores decline steadily with age:

- a) 15–16 yrs: 20.30
- b) 16–17 yrs: 18.71
- c) 17–18 yrs: 17.57

This pattern indicates that younger adolescents exhibit better reasoning ability compared to older ones. The decline may be associated with increased exposure to online gaming, screen dependency, or academic stress as adolescents grow older. Thus, age exerts a significant influence on reasoning capacity.

- a) 15–16 yrs: 21.20
- b) 16–17 yrs: 20.00
- c) 17–18 yrs: 18.43

This decline suggests that higher-order cognitive abilities like decision-making and problem-solving become weaker as age increases within the adolescent group. Such decline may be linked to factors such as excessive gaming behaviour, stress, reduced attention span, or lifestyle changes. (table 1).

Cognitive function of the respondent across gender group

Awareness: The mean values for girls (21.1176) and boys (21.5913) are close, and the significance value (.291) indicates no statistically significant difference between genders.

Memory: The mean score for girls (17.5412) is slightly higher than boys (16.6609), and the significance value (.018) suggests a statistically significant difference. This indicates that gender may play a role in memory performance.

Understanding: The scores for girls (15.5412) and boys (15.3130) are nearly identical, with a significance value (.371), showing no significant difference between genders.

Reasoning Ability: Boys (18.6783) have a higher mean score than girls (17.1176), but the significance value (.226) suggests that this difference is not statistically significant.

Problem Solving Ability: The mean values for girls (19.0941) and boys (18.9043) are almost identical, and the significance value (.687) indicates no meaningful difference (table 2).

Table 1 Cognitive function of the respondent across age group

Sr.no	Componentage Group	Mean	DF value	F value	Sig.	Conclusion
1. Awareness						
1.	15-16	19.8000	199	1.3 22	.269	Non-Significant
2.	16-17	21.2453	199			
3.	17-18	21.5620	199			
2. Memory						
1.	15-16	17.6000	199	.37 6	.687	Non-Significant
2.	16-17	16.7170				
3.	17-18	17.1168				
3. Understanding						
1.	15-16	17.1000	199	2.4 06	.093	Non-Significant
2.	16-17	15.2075				
3.	17-18	15.3650				
4. Reasoning Ability						
1.	15-16	20.3000	199	7.0 79	.001	Significant
2.	16-17	18.7170				
3.	17-18	17.5766				
5. Problem solving ability						
1.	15-16	21.2000	199	5.5 32	.005	Significant
2.	16-17	20.0000				
3.	17-18	18.4307				

Problem-Solving Ability

Problem-solving ability also shows a statistically significant difference across age groups ($F = 5.532, p = 0.005$). The mean scores show a decreasing trend:

Distribution of Respondents on the basis of cognitive Ability

A. Awareness

Table 2 Cognitive function of the respondent across gender group

Sr.no	Component gender group	N value	Mean	t valve	F value	Sig value
1.	Awareness	85Girl 115Boy	21.1176 21.5913	-974 -995	1.119	.291
2.	Memory	85Girl 115Boy	17.5412 16.6609	1.749 1.691	5.657	.018
3.	Understanding	85Girl 115Boy	15.5412 15.3130	.623 .618	.805	.371
4.	Reasoning Ability	85Girl 115Boy	17.1176 18.6783	-4.043 -3.901	1.472	.226
5.	Problem solving Ability	85Girl 115Boy	19.0941 18.9043	.722 .716	.162	.687

The Awareness domain assesses respondents' general knowledge and recognition of everyday concepts. The average mean score of 2.139 indicates a moderate level of awareness among the participants. Notably, items such as "Percentage of gold in 22 carat gold sample is" and "Music storage in computer file format is not created through" received higher mean scores, suggesting better familiarity with these topics. Conversely, questions like "Polio are spread through" had lower mean scores, highlighting areas where awareness could be improved.

B. Memory

The Memory domain evaluates the ability to recall facts and information. An average mean score of 2.129 suggests that respondents have a moderate capacity for memory recall. Higher mean scores on items like "A kilobyte is a unit of" indicate better retention of commonly encountered information, while lower scores on items such as "Environment Day is celebrated every year on" point to gaps in specific knowledge areas.

C. Understanding

Understanding involves comprehending concepts and making sense of information. With the highest average mean score among all domains, 2.568, this suggests that respondents are relatively proficient in interpreting and understanding information. Items like "A person can be called illiterate

who" and "Ice floats on water because" garnered higher mean scores, reflecting strong conceptual grasp. However, some items still showed room for improvement, indicating that while understanding is a strength, it is not uniformly distributed across all topics.

D. Reasoning Ability

This domain measures logical thinking and the ability to deduce conclusions. An average mean score of 2.2515 indicates a moderate level of reasoning skills among respondents. Higher scores on items like "The hands of clock coincide between 3 o'clock and 6 o'clock would be" suggest competence in certain logical tasks. However, lower scores on more complex reasoning problems point to potential areas for cognitive skill development.

E. Problem-Solving Ability

Problem-solving assesses the capacity to apply knowledge and reasoning to novel situations. An average mean score of 2.373 indicates that respondents are fairly adept at tackling problems, especially those grounded in real-life scenarios. Higher mean scores on items like "A car manufacturing factory produces 20

cars in 4 days..." demonstrate practical problem-solving skills. Nonetheless, variability in scores across different problem types suggests that while respondents can solve familiar problems effectively, unfamiliar or complex problems may pose challenges (table 3).

Table 3. Distribution of Respondents on the basis of cognitive Ability

A. Awareness			
Sr.no	Item number	Frequency (%)	Mean
1.	telecommunication the 'G' in 1G, 2G, 3G and 4G stand of	4(2.0)	1.9750
2.	A smart class room is a teaching space which has	6(3.0)	2.2250
3.	Polio is spread through	13(6.5)	1.4950
4.	The rainy season trigged the disease of	16(8.0)	2.3000
5.	Vitamin C is not rich in	19(9.5)	1.6550
6.	Percentage of gold in 22 carat gold sample is	22(11.0)	2.5350
7.	The electric current is measured through	23(11.5)	2.3400
8.	A butterfly tastes food by using its	20(10.0)	2.4750
9.	Leg before wicket is associated with	17(8.5)	1.9000
10.	Music storage in computer file format is not created through	32(16.0)	2.4900
Total Mean			21.3900
Average Mean			2.139
B. Memory			
Sr.no	Item number	Frequency (%)	Mean
1.	The escape velocity required for a rocket to leave earth is	4(2.0)	2.3700
2.	With reference to television LCD and LED plasma are	13(6.5)	1.5500

3.	Environment Day is celebrated every year on	7(3.5)	1.4250
4.	Earthquakes occur due to	9(4.5)	2.1600
5.	The logo of Red Cross Society is the sign of mathematical function	27(13.5)	2.1600
6.	Naturally occurring rocks contains the largest amount of	23(11.5)	2.1250
7.	The main constituent of Liquid Petroleum Gas (LPG)	44(22.0)	2.3100
8.	A kilo byte is unit of	14(7.0)	2.9350

Total Mean **17.0350**

Average Mean **2.129375**

C. Understanding

Sr.no	Item number	Frequency (%)	Mean
1.	Beggars should not be given alms because	7(3.5)	2.1950
2.	Deaf is also dumb because	7(3.5)	2.6200
3.	A person can be called illiterate who	10(5.0)	2.8850
4.	Which one of the given responses would be a meaningful order of the following:	27(13.5)	2.3000
5.	Ice floats on water because	35(17.5)	2.7650
6.	When a bell rings in a vacuum, a man can hear	32(16.0)	2.6450

Total Mean **15.4100**

Average Mean **2.56833**

D. Reasoning Ability

Sr.no	Item number	Frequency (%)	Mean
1.	Namita and Samita are brilliant and studious. Amita and Kavita are obedient and irregular Babita and Namita are irregular but brilliant. Samita and Kavita are regular and obedient. Among them.....is brilliant, regular and obedient and studious	3(1.5)	1.6150
2.	A, B and Care sisters. D is the brother of E and E is the daughter of B. A is related to D as	6(3.0)	2.0200

3.	There are five books A, B, C, D and E. Book C lies above D. Book E is below A, D is above A and B is below E. The book lies at bottom is	4(2.0)	1.8000
4.	If London is coded as MPOEPO, then Delhi will be coded as	7(3.5)	2.6450
5.	When all the numbers from 1 to 100 are written, then the digit 3 is written	16(8.0)	2.4750
6.	The hands of clock coincide between 3'0 clock and 6'0 clock would be	4(2.0)	2.7600
7.	The next term of the sequence is 121, 144, 169, 196, 225	34(17.0)	2.1550
8.	Sita has 36 notes of Rs 1000. The denomination of first note in serial number is 13964 then the number of last notes will be	26(13.0)	2.5450

Total Mean **18.012**

Average Mean **2.2515**

E. Problem solving ability

Sr.no	Item number	Frequency (%)	Mean
1.	The age of a man is 4 times that of his son. Five years ago, the man was nine times as old as his son was at that time. The present age of the man is	4(2.0)	2.3600
2.	Rajan walked 50 meters towards East, took a right turn and walked 60 meters. Then he took a left turn and walk 50 meters. Now from the starting point, he is in	3(1.5)	2.2750
3.	Rita covers a fixed distance at a speed of 80 km/h and returns at a speed of 20 km/h at the same place. Her average speed during the whole journey is	8(4.0)	2.2850
4.	The sum of a two-digit number is 9. If 27 is added to number, the digits are reversed. The number is	4(2.0)	2.2900

5.	The sum of a two-digit number is 9. If 27 is added to number, the digits are reversed. The number is	9(4.5)	2.4750
6.	Mohini obtained 90 marks in English, 84 in Algebra, 75 in science and 76 in Music. If the subject has following weights	23(11.5)	2.3650
7.	A car manufacturing factory produces 20 cars in 4 days. If 3 such factories produce cars for 6 days at same rate, then the number of total cars produced would be	23(11.5)	2.5000
8.	On the order of five articles, a shopkeeper receives an extra article free. In such a situation, he is equivalent to getting the discount of	15(7.5)	2.4350
Total Mean			18.985
Average Mean			2.373125

Average score for cognitive ability

1. Awareness The average mean score for the awareness domain is 3.529, indicating a moderate level of awareness among adolescents. This suggests that while adolescents may have a general understanding of their environment and daily activities, their awareness could be impacted by excessive gaming, which often leads to reduced engagement with real-world events and responsibilities.

2. Memory The memory domain exhibits a higher average mean score of 19.1643, suggesting significant challenges in memory retention and recall among adolescents with high gaming addiction levels. This aligns with findings from a study conducted on Lebanese children, which reported that higher addiction to video gaming was significantly associated with worse episodic memory, problem-solving, and attention skills. The constant stimulation and rapid information processing in games may impair the brain’s ability to consolidate and retrieve information effectively.

3. Understanding With an average mean score of 17.97833, the understanding domain reflects moderate difficulties in comprehending and interpreting information. This could be attributed to the fast-paced nature of online games, which may hinder the development of deeper cognitive processing required for understanding complex concepts.

4. Reasoning Ability The reasoning ability domain has an average mean score of 20.2635, indicating notable challenges in logical thinking and decision-making processes. Excessive gaming can lead to a preference for immediate rewards and quick decision-making, potentially compromising the development of critical reasoning skills necessary for real-life

problem-solving.

5. Problem-Solving Ability The highest average mean score is observed in the problem-solving ability domain at 21.358125, highlighting significant difficulties in this area. This may result from the structured and often repetitive problem-solving scenarios in games, which do not translate effectively to the unpredictable and complex problems encountered in everyday life. (Fig. 3.1)

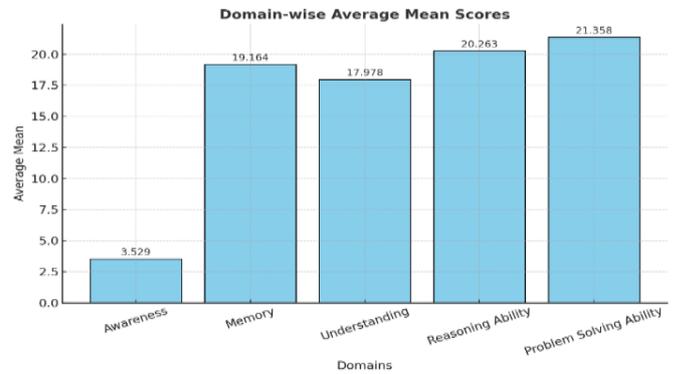


Fig.1. Mean score of cognitive Ability under the different components.

Online gaming addiction of the frequency

The data indicates that a significant proportion of the participants (29.5%) are not addicted to online gaming, suggesting that most individuals in the sample maintain healthy gaming habits. However, 11.0% are moderately addicted, and 5.5% are highly addicted, highlighting that a notable minority may be at risk for negative consequences related to excessive gaming. These findings suggest a need for awareness and possible intervention strategies to prevent moderate use from escalating into high addiction levels. (fig3. 2)

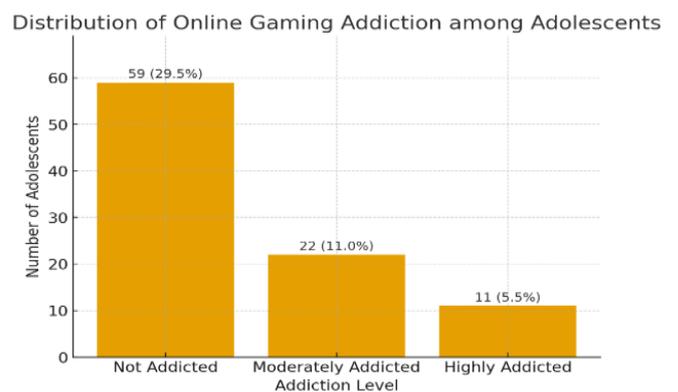


Fig. 2. Online gaming addiction of the frequency

Correlation studies

A very weak negative correlation was found between online gaming addiction and awareness ($r = -.028$), suggesting that higher gaming addiction is associated with slightly lower awareness, but the relationship is not statistically significant. The correlation between online gaming addiction and memory ($r = -.080$) and reasoning ability ($r = -.048$) is also weak and non-significant, indicating minimal impact of gaming addiction on these functions.

However, a significant negative correlation was found

between *online gaming addiction and understanding ($r = -.161$) **, meaning adolescents with higher addiction levels tend to have lower levels of comprehension and conceptual clarity. Similarly, problem-solving ability showed a significant negative correlation ($r = -.200$) with online gaming addiction, implying that as addiction increases, the ability to solve problems effectively decreases. This aligns with existing literature suggesting that excessive gaming may impair higher-order cognitive processes such as decision-making and logical reasoning.

On the other hand, the cognitive domains show strong positive correlations among themselves. Awareness is positively associated with memory ($r = .382$ **), understanding ($r = .240$ **), reasoning ability ($r = .200$ **), and problem-solving ability ($r = .242$ **). Memory also has strong positive correlations with understanding ($r = .363$ **), reasoning ($r = .321$ **), and problem-solving ability ($r = .253$ **). The strongest relationships were found between reasoning and understanding ($r = .516$) and reasoning and problem solving ($r = .518$)**, indicating these cognitive skills develop interdependently. (table3.6).

Table 3 Pearson Correlation cognitive function of addicted and non-addicted adolescents.

	Online gaming addiction	Awareness	Memory	understanding	Reasoning Ability	Problem solving ability
Online gaming addiction	1					
Awareness	-.028	1				
Memory	-.08	.382**	1			
understanding	-.161*	.240**	.363**	1		
Reasoning Ability	-.048	0.200**	.321**	.516**	1	
Problem solving ability	-0.200**	0.242**	.253**	.549**	.518**	1

DISCUSSION

These findings align with previous research by Samsidaret al, (2023)and Kaur, (2020)both of which also reported significant gender differences in gaming addiction. Males appear to be more vulnerable to gaming addiction, potentially due to their tendency to engage in competitive and high-risk games, such as shooting and action genres. Additionally, many online games are designed with features that particularly appeal to males, especially adolescent boys. In contrast, girls tend to use the internet more for social interaction. Studies also show that boys typically spend more time playing games each day than girls, making it unsurprising that males are more prone to gaming addiction across all age groups. (Ramli et al,2025).

Based on the findings of this study, significant gender differences were identified in relation to gaming addiction. Male students were more likely to experience emotional disturbances, learning impairments, sleep disturbances, and disruptions in daily activities, whereas female students tended to report milder disturbances. Gender differences were also observed in the severity levels of gaming addiction, with the proportion of male students experiencing moderate addiction being the highest. Conversely, a greater proportion of female students were categorized as not experiencing gaming addiction.

Internet gaming addiction is often negatively associated with student learning and motivation. Gaming addiction adversely affects students’ behavioural, emotional, and cognitive engagement, leading to significant negative impacts across all dimensions of learning engagement. The results of research model validation indicate that behavioural, emotional, and cognitive engagement all contribute to reduced academic achievement motivation. Cognitive engagement was the most influential factor in students’ academic achievement, with emotional engagement also playing a crucial role(Jang et al,2021).

CONCLUSION

Overall findings revealed that reasoning ability and problem-solving ability significantly declined with increasing age, while awareness, memory, and understanding showed no notable age-related variation. Gender analysis indicated that girls performed better in memory tasks, whereas boys showed slightly higher reasoning scores, though the difference was not significant. Correlation analysis demonstrated a negative relationship between online gaming addiction and key cognitive abilities,

particularly understanding and problem-solving. Positive inter-correlations among all cognitive domains highlight their interdependence in intellectual performance. Overall, the results indicate that increased online gaming adversely affects cognitive function, leading to decreased reasoning and problem-solving capacity among adolescents.

The study emphasizes the importance of promoting healthy gaming habits, parental supervision, and school-based awareness programs. Encouraging balanced technology use and incorporating cognitive skill-enhancing activities in education may help mitigate the negative cognitive impacts of excessive online gaming among adolescents.

Authors Contribution

In this manuscript, **L.D.** contributed in conducting whole research, writing of manuscript, data analysis, presentation of data and **S.A.** contributed in editing of the manuscript, in data analysis and guide time to time for efficient conducting of this research.

Conflict of Interest

Author hereby declares that there is no conflict of interest exist in this manuscript. Author also declares that, the manuscript is written and data presented is original.

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