

The Influence of Gender and Online Game Addiction on Mathematical Problem-Solving Ability

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Abstract

In today's digital era, online game addiction is increasingly prevalent among adolescent students, potentially impairing cognitive abilities, including mathematical problem-solving, with variations in influence based on gender. This study aims to analyze the influence of gender and online game addiction on students' mathematical problem-solving abilities in sequences and series. Using a quantitative survey approach at MA Mazro'atul Huda Karanganyar, Demak Regency, of 30 12th-grade students selected by purposive sampling from a population of 97 students, the data were analyzed using independent t-tests, regression, and F-tests. The results showed significant differences in abilities based on gender ($p=0.037$), with female students being superior. Online game addiction had a significant negative effect partially and simultaneously on gender. Overall, online game addiction dominated the decline in these abilities. The significance of these results underscores the urgency of educational interventions to control online game exposure, especially in male students, to improve mathematical achievement and support quality learning in secondary schools.

Keywords: Gender, Online Game Addiction, Mathematical Problem-Solving Ability, Sequences and Series.

Abstrak

Di era digital saat ini, kecanduan game online semakin merebak di kalangan siswa remaja, berpotensi mengganggu kemampuan kognitif termasuk pemecahan masalah matematis, dengan variasi pengaruh berdasarkan gender. Penelitian ini bertujuan menganalisis pengaruh gender dan kecanduan game online terhadap kemampuan pemecahan masalah matematis siswa pada materi barisan dan deret. Menggunakan pendekatan kuantitatif survei di MA Mazro'atul Huda Karanganyar, Kabupaten Demak, terhadap 30 siswa kelas XII yang dipilih dengan purposive sampling dari populasi 97 siswa, data dianalisis melalui uji independent t-test, regresi, dan uji F. Hasil menunjukkan perbedaan signifikan kemampuan berdasarkan gender ($p=0,037$), dengan siswa perempuan lebih unggul, kecanduan game online berpengaruh negatif signifikan secara parsial dan simultan dengan gender. Secara keseluruhan, kecanduan game online mendominasi penurunan kemampuan tersebut. Signifikansi hasil ini menegaskan urgensi intervensi pendidikan untuk mengendalikan paparan game online, khususnya pada siswa laki-laki, guna meningkatkan prestasi matematis dan mendukung pembelajaran berkualitas di sekolah menengah.

Kata kunci: Gender, Kecanduan game online, Kemampuan pemecahan masalah matematis, Barisan dan deret.

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INTRODUCTION

Education plays a strategic role in the development of Indonesia's human resources through the mastery of science and technology, as mandated by the Regulation of the Minister of National Education No. 22 of 2006, which emphasizes mathematical problem-solving skills for application in daily life (Kemendikbud, 2006). However, the rapid growth of smartphone usage and online games such as *Mobile Legends*, *Free Fire*, and *PUBG* has become increasingly widespread, with approximately 30.5% of Indonesian internet users identified as gaming enthusiasts (Kemkominfo & AGI, 2022). This phenomenon, which affects nearly 90% of players under the age of 36, frequently leads to gaming

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addiction, resulting in reduced study time, declining academic achievement, and impaired eye health (Nico & Partners, 2022). From an Islamic perspective, this issue is further reinforced by Q.S. Al-A'raf: 31, which prohibits *israf* (excessiveness) (Agama, 2009) as well as the hadith narrated by Hasan-Tirmidzi concerning the importance of abandoning unbeneficial activities (Al-Albani, 1995). Consequently, online game addiction may threaten students' emotional, cognitive, and psychomotor balance.

Several previous studies have examined the influence of online gaming and gender on various aspects of mathematics education. Kautsar found that online gaming contributed approximately 30% to the academic achievement of students at MAN 3 Aceh Besar, with a high level of gaming addiction reported (Kautsar, 2019). Anisa Amelia concluded that there was no significant relationship between online game addiction and mathematical problem-solving ability among students of SMKN 2 Payakumbuh (Amelia, 2020). Widi Lestari demonstrated gender differences in mathematical problem solving, where male students excelled in understanding problems, while female students performed better in planning and evaluating solutions (Lestari et al., 2021). Furthermore, Usman confirmed that learning motivation significantly influenced students' problem-solving abilities in the topic of sequences and series (Usman et al., 2021). Among these studies, Kautsar's research is considered the most comprehensive because it quantitatively measured the intensity of gaming addiction using regression analysis. Nevertheless, previous studies generally focused on only one independent variable (either gender or online gaming), paid limited attention to the interaction between the two variables, and rarely examined specific mathematical topics such as sequences and series at the Islamic senior high school (*madrasah aliyah*) level.

These limitations reveal a significant gap in understanding how gender and online gaming simultaneously influence students' mathematical problem-solving abilities, particularly in the context of *madrasah aliyah* students whose educational environment emphasizes a balance between worldly and spiritual values. Therefore, this study aims to analyze the effects of gender, online gaming, and the interaction between these variables on students' mathematical problem-solving abilities in the topic of sequences and series at MA Mazro'atul Huda Karanganyar. The novelty of this study lies in its integrative model, which may serve as a foundation for developing inclusive learning strategies based on effective game-time management to improve students' mathematical skills.

METHODS

This study employed a quantitative approach using a survey method to examine the effects of gender (male and female) and the level of online game addiction (low, moderate, and high) on students' mathematical problem-solving abilities. The research participants consisted of 30 twelfth-grade students of MA Mazro'atul Huda Karanganyar (15 male and 15 female students), selected through purposive sampling from a population of 97 twelfth-grade students. The selection criteria were: (1)

students actively playing online games, and (2) students who had studied the topic of sequences and series (Arikunto, 2010). The study was conducted in February 2024.

Data were collected using two main instruments that had been validated by experts (two university lecturers). The first instrument was an online game addiction questionnaire consisting of 25 items measured on a four-point Likert scale (always, often, rarely, and never), including both positive and negative statements. The questionnaire was developed based on the indicators of salience, tolerance, withdrawal, conflict, and relapse, with score classifications categorized into low, moderate, and high levels of addiction. The second instrument was a mathematical problem-solving test consisting of four contextual essay questions on arithmetic and geometric sequences and series. Students' responses were assessed according to Polya's problem-solving stages, namely understanding the problem, devising a plan, carrying out the plan, and reviewing the solution. The maximum score was 48 points and was converted into a scale of 0–100 using the formula: $N = \left(\frac{\text{obtained score}}{48} \right) \times 100$. The results were then classified into categories ranging from excellent to very poor. Gender data were obtained from the school attendance records. Prior to the main study, the instruments were piloted on 18 students from class XI B to determine validity, reliability, discrimination index, and difficulty level using Microsoft Excel 2010 (Sugiyono, 2019).

Data analysis included prerequisite tests consisting of linearity, normality using the Shapiro–Wilk test, heteroscedasticity using scatterplot analysis, and multicollinearity with the criterion of $VIF < 10$. Hypothesis testing involved an independent sample t-test for gender differences, simple regression and correlation analysis for online gaming variables, and multiple regression analysis through partial t-tests and simultaneous F-tests. All statistical analyses were conducted using SPSS version 26.0 at a significance level of 0.05 (Ghozali, 2018).

RESULTS AND DISCUSSION

Preliminary Data Analysis

This study examined the influence of gender and online game addiction on the mathematical problem-solving abilities of twelfth-grade students at MA Mazro'atul Huda Karanganyar. The sample consisted of 30 students, including 15 male and 15 female students who actively played online games. Prior to hypothesis testing, the research instruments were subjected to validity, reliability, discrimination, and difficulty analyses.

Table 1 Instrument Testing Result

Instrument	Number of Items	Validity	Reliability	Difficulty Level
			(Cronbach's Alpha)	

Online Game Addiction Questionnaire	25	All items valid ($r_{xy} > 0.468$)	0.948	Moderate
Mathematical Problem-Solving Test	4	All items valid ($r_{xy} > 0.468$)	0.511	Moderate (0.578- 0.700)

The results indicate that both instruments met the criteria of validity and reliability and were therefore appropriate for data collection. Furthermore, prerequisite tests confirmed that the data satisfied the assumptions required for regression analysis. The linearity test showed a significance value of 0.135 (> 0.05), indicating a linear relationship between variables. The normality test using Shapiro–Wilk produced significance values greater than 0.05, suggesting normally distributed data. The scatterplot analysis indicated no heteroscedasticity, while the multicollinearity test showed a Variance Inflation Factor (VIF) value of 1.558 (< 10) and a tolerance value of 0.642 (> 0.10), confirming the absence of multicollinearity.

Table 2. Descriptive Statistics of Research Variables

Variable	Male Students	Female Students	Category
Online Game Addiction	57.73	49.33	Moderate – Low
Mathematical Problem-Solving Ability	69.50	80.17	Fair - Good

The findings reveal that male students exhibited a higher level of online game addiction than female students. Conversely, female students demonstrated better mathematical problem-solving abilities. Overall, students' mathematical problem-solving performance was categorized as good, despite the majority experiencing moderate levels of gaming addiction.

The Effect of Gender on Mathematical Problem-Solving Ability

The independent sample t-test demonstrated a significant effect of gender on mathematical problem-solving ability, with a significance value of 0.037 (< 0.05). Female students achieved higher scores than male students, indicating better performance in solving mathematical problems.

The partial regression equation is presented as follows:

$$\hat{Y} = 161,964 + 3,930 X_1$$

Although the regression coefficient for gender was positive ($\beta_1 = 3.930$), the partial t-test result ($t = 0.976 < 2.052$) indicated that gender was not statistically significant within the multiple regression

model. This finding suggests that gender alone is not the dominant predictor of students' mathematical problem-solving ability when combined with other variables.

These findings are consistent with the theory of gender differences in mathematical cognition proposed by Hyde et al. (2008), which explains that female students tend to demonstrate greater accuracy and systematic reasoning in step-by-step problem solving, whereas male students are generally more intuitive but more susceptible to computational errors. The results also align with the study conducted by Gallagher et al. (2000) and Murtafiah & Amin (2018), which found that male students tended to excel in initial analytical stages, while female students performed better in planning and verification stages. In this study, the dominance of male students in online gaming activities may have reduced their learning focus and academic engagement.

However, Nurkidam (2016) and Zander et al. (2020) emphasized that female students generally demonstrate lower levels of self-confidence in mathematics learning. In the present study, the higher intensity of online gaming among male students may have reduced their academic focus and learning engagement. These findings suggest that gender is not an independent dominant predictor of mathematical problem-solving ability; rather, it interacts with behavioral factors such as online gaming habits. Therefore, this study supports the implementation of collaborative pedagogical approaches, as proposed by Nurlita et al. (2023), to reduce disparities in students' mathematical achievement. From a pedagogical perspective, these findings imply that gender differences in mathematical problem solving are strongly associated with behavioral factors, particularly gaming habits. Therefore, collaborative and inclusive learning approaches are needed to reduce disparities in students' mathematical achievement.

The Effect of Online Game Addiction on Mathematical Problem-Solving Ability

Simple linear regression analysis revealed a significant negative effect of online game addiction on mathematical problem-solving ability. The regression model is expressed as follows:

$$\hat{Y} = 158,888 - 1,570X_2$$

The regression coefficient ($\beta_2 = -1.570$) indicates that every one-unit increase in online game addiction reduces students' mathematical problem-solving ability by 1.570 points. The statistical results showed that $F = 46.748 (> 4.20)$, $t = -6.837 (> 2.048)$, and the correlation coefficient was $r = 0.791$, indicating a strong negative relationship. The coefficient of determination was 62.5%, meaning that online game addiction explained 62.5% of the variance in students' mathematical problem-solving ability.

Table 3 Simple Regression Analysis Result

Variable	Regression Coefficient	T value	F value	Correlation (r)	R ²
Online Game Addiction	-1.570	-6.837	46.748	0.791 (strong)	62.5%

These findings support the Cognitive Load Theory proposed by John Sweller (Sweller & Chandler,

1991), which argues that excessive cognitive stimulation may overload working memory and reduce students' ability to transfer knowledge effectively into mathematical contexts. Excessive gaming activities may consume students' attention and concentration, thereby limiting their capacity to solve mathematical problems systematically.

The results are also consistent with the findings of Hamranani et al. (Hamranani, Kusumaningrum, Permatasari, & Setyawan, 2021), who reported that moderate and high levels of gaming addiction negatively affected students' academic performance, particularly among male students. Similarly Aulya et al. (2024) and Nguyen et al. (2022) found that male students generally demonstrated higher levels of online game addiction compared to female students.

The Simultaneous Effect of Gender and Online Game Addiction

Multiple regression analysis demonstrated that gender and online game addiction simultaneously influenced mathematical problem-solving ability. The regression equation is presented below:

$$\hat{Y} = 161,964 + 3,930X_1 - 1,738X_2$$

The statistical analysis yielded $R = 0.799$, indicating a strong relationship between the independent variables and mathematical problem-solving ability. The simultaneous F-test showed $F = 23.811$ (> 3.35) with a significance value of 0.000 (< 0.05), confirming that gender and online game addiction collectively affected students' mathematical problem-solving ability. The coefficient of determination (R^2) was 63.8%, meaning that 63.8% of the variance in mathematical problem-solving ability could be explained by the two independent variables, while the remaining 36.2% was influenced by other factors not examined in this study.

Table 4. Multiple Regression Analysis Results

Variable	Regression Coefficient	T value	Significance
Gender	3.930	0.976	Not Significant
Online Game Addiction	-1.738	-6.057	Significant

Table 5 Multiple Regression Analysis Model Summary and Value

Model Summary	Value
R	0.799
R^2	63.8%
F value	23.811
Significance	0.000

The findings indicate that online game addiction was the dominant predictor of students' mathematical problem-solving ability, whereas gender functioned as a moderating factor through behavioral interactions. This result enriches Social Cognitive Theory developed by Albert Bandura (Bandura, 1986), emphasizing that social and behavioral factors interact in shaping students' academic performance.

This study highlights that, within the context of Islamic schools such as MA Mazro'atul Huda Karanganyar, online games are not merely a form of entertainment but may also become cognitive risks when used excessively. The findings suggest the importance of integrating digital literacy education and healthy gaming-time management into school curricula. Limiting gaming duration, for example to less than two hours per day, and incorporating educational games related to sequences and series may help reduce the negative effects of gaming addiction while promoting students' mathematical engagement. In addition, teachers should implement gender-responsive learning interventions, such as strengthening female students' academic confidence and providing greater supervision and learning guidance for male students who are more intensively involved in online gaming activities.

Overall, this study contributes to the empirical literature on mathematics education in Indonesian Islamic schools by presenting an integrative multiple regression model that confirms the simultaneous influence of gender and online game addiction on mathematical problem-solving ability. The findings support the paradigm of "digital moderation" in mathematics education, suggesting that balanced gaming behavior may provide positive experiences, whereas excessive gaming addiction produces dominant negative effects on students' cognitive performance.

CONCLUSION

This study concludes that gender has a significant effect on students' mathematical problem-solving ability in the topic of sequences and series. Female students achieved higher average scores (80.167) than male students (69.500), with a significance value of 0.037 (< 0.05). These differences may be influenced by variations in learning strategies, motivation, and educational environments. In addition, online game addiction demonstrated a significant negative effect on mathematical problem-solving ability, as indicated by the regression coefficient showing a decrease in students' performance for each unit increase in addiction level, with a coefficient of determination of 62.5%.

Furthermore, gender and online game addiction simultaneously had a significant effect on students' mathematical problem-solving ability ($F_{\text{count}} = 23.811 > F_{\text{table}} = 3.35$; $R^2 = 63.8\%$), although gender was not statistically significant in the partial regression analysis. These findings answer the research problem by confirming that both variables contribute to variations in students' mathematical problem-solving ability, while the remaining 36.2% is explained by other factors outside the scope of this study.

The practical implications of this study emphasize the importance of effective time management in online gaming among students. Teachers and schools are encouraged to integrate digital media and

educational games into mathematics learning while strengthening digital literacy programs. Parents are also expected to enhance supervision and communication regarding students' gaming activities. However, this study was limited by its relatively small sample size. Therefore, future research is recommended to involve broader samples from different school contexts and to develop innovative learning models that integrate online games constructively to improve students' mathematical problem-solving abilities.

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