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# An Examination of Middle School Students' Mathematical Bullying Victimization Levels in Relation to Socio-Demographic Variables

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**Abstract**

This study aimed to examine mathematical bullying victimization among middle school students and its relationship with socio-demographic variables using the Mathematical Bullying Victimization Scale (MBV-S). The sample consisted of 493 middle school students selected using a disproportionate stratified sampling method from five different schools in Konya, Türkiye, during the spring semester of the 2021-2022 academic year. Data were collected using the relational screening model and analyzed with nonparametric statistical methods. The results showed that female students were more frequently subjected to mathematical bullying compared to males. No significant differences were found in MBV-S scores based on grade levels. However, the analysis of school types revealed that students in girls-only religious middle schools experienced higher levels of mathematical bullying than students in other types of schools. Additionally, students with below-average mathematics achievement were more likely to be victims of mathematical bullying, whereas students with above-average achievement reported lower levels of victimization. The findings highlight the importance of developing strategies to address mathematical bullying that consider students' mathematical abilities and social dynamics. Supportive and inclusive environments should be prioritized, particularly for students with low achievement and those in specific school settings.

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## Introduction

It is evident that the role of mathematics in learning processes demonstrates the impact of affective factors on mathematical success. Mathematics occupies a privileged position among school subjects in many countries (Wang, 2006; Li & Li, 2008). The necessity of mathematics for daily life skills (Wininger et al., 2014) and the perception of mathematics as a fundamental course for achieving academic and professional goals (Chiu & Klassen, 2010) are the primary reasons for this. Furthermore, mathematics serves as a filter for educational and career opportunities (Leder et al., 2002). It is notable that approximately 90% of new job roles require mathematical abilities at a level above a high school education (NCTM, 2004). Besides, the mathematical performance of students is a significant factor in determining the role of countries in the high-tech sector and their international competitiveness (OECD, 2007). However, individuals outside of mathematics commonly perceive it as a complex and enigmatic discipline (Furinghetti, 1993; Sam & Ernest, 1999). This has resulted in the portrayal of mathematicians in popular culture, such as cinema, as geniuses navigating intricate symbolic realms (Mulcare, 2008). However, the common perception that mathematics is solely about calculation and is only achievable by those with high intelligence has a negative impact on individuals and children in society.

The influence of emotional factors on fear of mathematics represents a significant area of research. As highlighted by Beswick (2006), the environment and individuals play a significant role in influencing attitudes towards mathematics, either positively or negatively. It has been reported that a child's fear of mathematics and negative attitudes towards the subject are influenced by the parents' level of confidence in their own mathematical abilities. Martínez-Sierra and García González (2016) showed that emotional factors trigger fear of mathematics and that successful students are effective in increasing this fear. The common belief that mathematics requires only a superior intellectual ability causes some students to see themselves as inadequate and to regard more successful students in a superior position (Chestnut et al., 2018).

The way in which mathematics is perceived within society can lead to the development of power imbalances among students. The perception that individuals with high levels of mathematical achievement have a superiority over other students may also negatively affect the way teachers interact with students with low levels of achievement. This may result in the emergence of a hierarchical structure among the students, potentially leading those with advanced mathematical abilities to use this advantage as a means of psychological pressure on their peers. Mathematical power is defined as the ability to effectively utilise mathematical relationships and logical inferences (Ryan, 1998). It has been reported that mathematical power boosts students' self-confidence and is associated with mathematical achievement (Rachlin, 1998).

Bullying refers to systematic aggressive behaviour towards the victim resulting from power imbalances between individuals. These types of behaviour can be observed both between individuals and within the dynamics of a group (Olweus, 1993; Smith & Sharp, 1994). The most important characteristics of bullying are intentionality, repetition, and power imbalance (Olweus, 1999). The term "intentionality" refers to the conscious intention to cause harm. The concept of "repetitions" describes the continuity of the behaviours in question. The term "power imbalance" highlights the existence of physical, social, or psychological inequalities between the bully and the victim.

Physical bullying can be defined as direct physical attacks and threats against the victims, whereas verbal bullying refers to the use of verbal attacks such as ridicule or insults (Hawker & Boulton, 2000). Emotional bullying comprises social exclusion or discrediting of the individual (Crick & Bigbee, 1998). Cyberbullying has become an increasingly widespread problem with aggressive behaviours carried out through digital platforms (Willard, 2005). The impact of bullying on individuals goes beyond the psychological and social aspects, with a negative effect on academic performance. It is common for individuals who have been bullied to present with a range of psychological issues, including loss of self-confidence, stress, anxiety, loneliness and depression (Kapcı, 2004). Victims also experience difficulties in their friendly relations and are exposed to social isolation (Demir & Küçük, 2020). Academically, bullying decreases students' motivation and leads to a decrease in achievement levels (Boulton & Underwood, 1992).

The long-term effects of bullying not only affect the victims but also lead to various social and mental health problems for the individuals who engage in bullying behaviour. The studies reveal that bullies may be more likely to engage in criminal behaviours in the future and may show a lack of empathy development skills (Olweus, 1999). These results indicate that bullying not only causes short-term effects on individuals but also may cause long-term social and psychological consequences.

It has been reported that the prevalence of bullying among students in Türkiye is significantly higher than in other countries (Buluç, 2014). In this context, incidents of bullying in school environments should not be overlooked. Studies have shown that students who are not exposed to bullying in schools have a higher mathematical achievement (Akyüz, 2014; Buluç, 2014; Ponzo, 2013; Sarı et al., 2017; Yavuz et al., 2017). This situation shows that students with high levels of mathematical power and achievement may use that power in ways that are considered abusive towards other students. The phenomenon, which was addressed in the study and emerged based on mathematical power, was defined as "mathematical bullying."

Mathematical bullying was first defined theoretically by Küçükgençay (2024) as “one or more students using their mathematical power, mathematics achievement and intellectual ability to intentionally and systematically continue negative behaviour against an individual or individuals who are weaker in terms of mathematical power and mathematics achievement". Mathematical bullying can also be defined as "systematic abuse of mathematical power within interpersonal relationships". Also, being a victim of mathematical bullying negatively affects students' attitudes towards mathematics and their mathematical self-efficacy perceptions and increases their mathematics anxiety (Küçükgençay, 2024).

This study was conducted to understand the phenomenon of mathematical bullying and to examine the mathematical bullying victimization levels of middle school students in terms of some socio-demographic variables with the Mathematical Bullying Victimization Scale (MBV-S). The study aims to establish a new research area in literature and contribute to an in-depth understanding of the effects of this problem. Accordingly, an answer was sought to the question "Do middle school students' scores obtained from the MBV-S and the sub-dimensions of the scale show a statistically significant difference by gender, grade level, type of school they are enrolled in, and mathematics achievement level?".

## Method

### Model

The Mathematical Bullying Victimization Scale (MBV-S) scores of middle school students were evaluated in relation to some socio-demographic variables by the research problem. Accordingly, the study was conducted using the relational screening model, which is one of the quantitative research methods. Quantitative research is a type of study that aims to explain the current situation using numerical data (Creswell, 2009). The relational screening model aims to determine whether two or more variables are related to each other (Karasar, 2009). This study analysed the possible relationships between the variables.

### Population and Sample

The population of the study consists of all middle school students studying in the central districts of Konya, a metropolitan city located in the Central Anatolia Region of Türkiye, during the spring semester of the 2021-2022 academic year. The sample comprises students from five selected middle schools, which were identified using a disproportionate stratified sampling method. These schools consist of a male religious (imam-hatip) middle school, a female religious middle school, a mixed public middle school in the city centre, a mixed public middle school in rural areas, and a mixed private middle school. One class from the 5th, 6th, 7th, and 8th grades in each school was randomly selected.

The population must first be divided into independent strata according to a descriptive variable in order to use the stratified sampling method (Bernard, 2011). School type was chosen as a descriptive variable in this study. Disproportionate stratification sampling involves selecting equal participants for each stratum, regardless of the representation rates of the strata in the population (Schmidt & Hunter, 2014). The reason why the disproportionate stratified sampling method is preferred is to ensure that each stratum is represented in the study with a significant size (Morgan & Morgan, 2008). Table 1 presents some demographic characteristics of the study group. In the study, the schools were coded as follows: School A, a male religious middle school; School B, a female religious middle school; School C, a private mixed middle school; School D, a mixed public middle school located in the rural areas of the city; and School E, a mixed public middle school located in the city centre.

Table 1. Some demographic data about the study group

| School Types | 5th Grade | | 6th Grade | | 7th Grade | | 8th Grade | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Female | Male | Female | Male | Female | Male | Female | Male | |
| **School A** | 0 | 21 | 0 | 22 | 0 | 20 | 0 | 26 | 89 |
| **School B** | 30 | 0 | 25 | 0 | 29 | 0 | 27 | 0 | 111 |
| **School C** | 6 | 7 | 9 | 10 | 9 | 8 | 14 | 14 | 77 |
| **School D** | 17 | 12 | 20 | 10 | 12 | 5 | 17 | 14 | 107 |
| **School E** | 12 | 16 | 15 | 14 | 15 | 11 | 14 | 12 | 109 |
| **Total** | 65 | 56 | 69 | 56 | 65 | 44 | 72 | 66 | 493 |

Table 1 shows that the study group consisted of 493 students selected from five different schools. 271 of the students participating in the study group are female, and 222 are male. The distribution within the scope of the study aimed to ensure the diversity of the demographic characteristics of the participants.

**Data Collection Tools**

*Personal data form*

It consists of a set of questions covering demographic data of middle school students such as gender, grade, school type and end-of-year mathematics grades.

*Mathematical Bullying Victimization Scale (MBV-S)*

The Mathematical Bullying Victimization Scale (MBV-S) was designated by Küçükgençay (2024) to determine the level of exposure to mathematical bullying among middle school students. The scale was designed in a 5-point Likert format, with each sub-dimension represented by a specific number of items. The scale addresses mathematical bullying in four fundamental dimensions: the Verbal Mathematics Bullying sub-dimension comprises four items, and Cronbach's alpha coefficient was calculated as 0.76. The sub-dimension of Emotional Mathematics Bullying comprises four items, and Cronbach's alpha coefficient was 0.73. The Physical Mathematics Bullying sub-dimension comprises three items and Cronbach's alpha coefficient for this sub-dimension was 0.71. The Educational Mathematics Bullying sub-dimension comprises three items and Cronbach's alpha coefficient was calculated as 0.70. The Cronbach's alpha reliability coefficient for the entire scale, comprising 14 items in total, was determined to be 0.84, indicating that the scale is a highly reliable measurement tool. The scale does not include any reverse items and the maximum score that can be achieved is 70, while the minimum score is 14. The MBV-S is an effective tool for measuring students' experiences of mathematical bullying in a comprehensive and reliable manner.

**Data Analysis**

This study investigated whether middle school students' scores on the Victimization of Mathematical Bullying Scale (MBV-S) differ according to certain socio-demographic variables. SPSS 23 software was used to analyse the data obtained to answer the research question. First, the results of the Kolmogorov-Smirnov normality test were used to determine whether or not the collected data were normally distributed. The data groups included in the analysis were found to be not normally distributed. The effect of gender on the mathematical bullying victimization (MBV) and its sub-dimensions was then analysed using the Mann-Whitney U test, which is the non-parametric equivalent of the t-test. The Kruskal-Wallis test, which is the non-parametric equivalent of the one-way ANOVA test, was used to test whether there was a significant effect of grade level, school type and mathematics achievement on mathematical bullying (MBV) and its sub-dimensions. The Mann-Whitney U test, which is the non-parametric equivalent of the independent samples t-test, was used to determine the group from which a significant difference was detected. The alpha level was determined using the Bonferroni correction in the interpretation of the test results. The Bonferroni correction is a commonly used method to adjust the significance level for multiple comparisons to control for the overall type I error rate. This method is used to minimise the possibility of false positive results in multiple-hypothesis testing (Dunn, 1961). The 95% confidence interval level ($\alpha = 0.05$) was divided by the number of hypothesis tests performed to obtain the adjusted p-value. The significance of the results was interpreted according to the corrected p-value.

**Data Collection and Ethics**

This study was approved by the Ethics Committee of Necmettin Erbakan University Social and Human Sciences Scientific Research Ethics Committee with the letter dated 18.06.2021 and number 2021/367. This article is derived from a section of the doctoral dissertation currently being prepared by the first author under the supervision of the second author. Scientific ethical values were carefully considered in the research process and ethical principles were used in data collection and analysis. Ethical standards were adopted at all stages of the study.

The necessary permissions were received from the respective institutions, interviews were held with the schools where the research would be carried out and the data collection process was thoroughly planned. The scales and forms to be used in the study were distributed in printed form to the participants in the study group. The application was carried out during one lesson in each class, during which the researcher provided the necessary explanations. Two days before data collection, parental consent forms were distributed to students, and data were only collected from students who had parental consent and volunteered. The whole process was conducted in accordance with ethical rules and the rights of participants were respected.

## Results

### The Effect of Gender on The MBV Variable

The data for both groups do not follow a normal distribution according to the results of the Kolmogorov-Smirnov normality test ($p < 0.05$). These results indicate that the data should be analysed with non-parametric tests rather than with parametric tests. Therefore, the Mann-Whitney U test was used to proceed with the analysis. Table 2 presents the results of the Mann-Whitney U test to see whether the MBV differs significantly by gender.

Table 2. Mann-Whitney U test results of MBV according to gender

| Gender | N | Ranking Average | Ranking Total | Mann-Whitney U | Z | p | Effect Size (r) |
|---|---|---|---|---|---|---|---|
| **Female** | 271 | 260.97 | 70724 | 26294 | -2.408 | 0.016 | -0.108 |
| **Male** | 222 | 229.94 | 51047 | | | | |

Table 2 presents the results of the Mann-Whitney U test analyzing MBV scores according to gender. The test reveals a statistically significant difference between female and male students ($U=26294$, $Z=-2.408$, $p=0.016$, $p<0.05$). The ranking averages indicate that female students (ranking average = 260.97) scored higher on MBV compared to male students (ranking average = 229.94). However, the calculated effect size ($r=-0.108$) suggests a small effect, indicating that while the difference is statistically significant, its practical significance is limited. It was observed that the total MBV scores of female students were higher than those of male students, suggesting that female students are more likely to be victims of mathematics bullying than male students.

### The Effect of Grade Level on The MBV Variable

The results of the Kolmogorov-Smirnov normality test indicate that the data are not normally distributed across all grade levels ($p < 0.05$). Therefore, the analysis continued with the Kruskal-Wallis test. Table 3 presents the results of the Kruskal-Wallis test, indicating whether the MBV varies significantly according to the grade levels.

Table 3. The results of the Kruskal-Wallis test of MBV according to grade levels

| Grade Level | N | Average | $\chi^2$ | df | p |
|---|---|---|---|---|---|
| **5** | 121 | 235.69 | | | |
| **6** | 125 | 236.1 | 3.017 | 3 | 0.389 |
| **7** | 138 | 256.63 | | | |
| **8** | 109 | 259.86 | | | |

Table 3 presents the results of the Kruskal-Wallis test conducted to analyze the differences in MBV scores across different grade levels. The test statistic, $\chi 2=3.017$, with 3 degrees of freedom, indicates that there is no statistically significant difference in MBV scores among the grade levels ($p=0.389$, $p>0.05$). Although the average ranks of MBV scores appear to increase slightly from 5th grade (235.69) to 8th grade (259.86), this difference is not sufficient to reach statistical significance. Therefore, grade level does not appear to have a significant impact on MBV scores in this sample.

### The Effect of School Type on The MBV Variable

According to the results of the Kolmogorov-Smirnov normality test**,** the data of other school types ($p < 0.05$) except for School B ($p > 0.05$) do not show a normal distribution. Nonparametric tests should be preferred instead of parametric tests in comparing the averages of the groups in cases where the normality assumption is not met. Therefore, the Kruskal-Wallis test was utilized in the analysis. Table 4 presents the results of the Kruskal-Wallis test, indicating whether the MBV varies significantly according to the school types.

Table 4. The results of the Kruskal-Wallis test of MBV according to school types

| School | N | Average | $\chi^2$ | df | p |
|---|---|---|---|---|---|
| **School A** | 89 | 241.15 | | | |
| **School B** | 111 | 318.43 | | | |
| **School C** | 77 | 217.74 | 37.474 | 4 | 0.000 |
| **School D** | 107 | 220.99 | | | |
| **School E** | 109 | 225.24 | | | |

As can be seen in Table 4, a significant difference between the average scores of participants studying in different school types is observed ($p < 0.05$). Since the school variable was divided into five categories, the Mann-Whitney U test was used to compare $C\binom{5}{2} = 10$. The alpha level in the interpretation of the test results was corrected with Bonferroni correction and the value of 0.05 was divided by the number of comparisons. Accordingly, the alpha level of 0.005 was used as the criterion for interpreting the results of the Mann-Whitney U test. Table 5 shows the results of the Mann-Whitney U tests for the comparisons between school types.

Table 5. Mann-Whitney U test results concerning the comparisons of MBV according to school types

| School | N | Ranking Average | Ranking Total | Mann-Whitney U | Z | p | Effect Size (r) |
|---|---|---|---|---|---|---|---|
| **School A** | 89 | 82.63 | 7354 | 3349 | -3.913 | **0.000*** | -0,277 |
| **School B** | 111 | 114.83 | 12746 | | | | |
| **School A** | 89 | 87.17 | 7758 | 3100 | -1.058 | 0.290 | -0,082 |
| **School C** | 77 | 79.26 | 6103 | | | | |
| **School A** | 89 | 103,5 | 9211.5 | 4316.5 | -1.127 | 0.260 | -0,08 |
| **School D** | 107 | 94.34 | 10094.5 | | | | |
| **School A** | 89 | 102.85 | 9153.5 | 4552.5 | -0.744 | 0.457 | -0,053 |
| **School E** | 109 | 96.77 | 10547.5 | | | | |
| **School B** | 111 | 109.54 | 12158.5 | 2604.5 | -4.552 | **0.000*** | -0,332 |
| **School C** | 77 | 72.82 | 5607.5 | | | | |
| **School B** | 111 | 130.41 | 14476 | 3617 | -4.990 | **0.000*** | -0,338 |
| **School D** | 107 | 87.8 | 9395 | | | | |
| **School B** | 111 | 131.65 | 14613.5 | 3701.5 | -4.978 | **0.000*** | -0,336 |
| **School E** | 109 | 88.96 | 9696.5 | | | | |
| **School C** | 77 | 91,14 | 7017.5 | 4014.5 | -0.295 | 0.768 | -0,022 |
| **School D** | 107 | 93,48 | 10002.5 | | | | |
| **School C** | 77 | 91.52 | 7047 | 4044 | -0.422 | 0.673 | -0,031 |
| **School E** | 109 | 94.90 | 10344 | | | | |
| **School D** | 107 | 107.36 | 11487.5 | 5709.5 | -0.266 | 0.790 | -0,018 |
| **School E** | 109 | 109.62 | 11948.5 | | | | |

Table 5 shows the Mann-Whitney U test results comparing MBV scores across different school types. A statistically significant difference was observed between School A and School B, with ranking averages of 82.63 and 114.83, respectively ($Z = -3.913$, $p = 0.000$, $r = -0.277$). This small-to-moderate effect size suggests that students in School B have higher MBV scores compared to those in School A.

Similarly, significant differences were found between School B and other school types. When comparing School B and School C, the ranking averages were 109.54 and 72.82, respectively (Z = -4.552, p = 0.000, r = -0.332), indicating a moderate effect size and a clear advantage for School B. A significant difference also emerged between School B and School D, with ranking averages of 130.41 and 87.80, respectively (Z = -4.990, p = 0.000, r = -0.338). Similarly, the comparison between School B and School E revealed ranking averages of 131.65 and 88.96, respectively (Z = -4.978, p = 0.000, r = -0.336), again demonstrating a moderate effect size.

The findings reveal that students attending religious middle schools exclusively for girls achieve higher MBV scores compared to their peers in other school types. The moderate effect sizes observed across multiple comparisons underscore the significant impact of school type on MBV outcomes. Moreover, the analysis indicates that students in these all-girls religious middle schools are more likely to experience mathematical bullying compared to students in other school settings.

**The Effect of Mathematics Achievement Levels on The MBV Variable**

According to the results of the Kolmogorov-Smirnov normality test, 0-44, 45-54 and 55-69 grades show normal distribution ($p < 0.05$), but 70-84 and 85-100 grades do not show normal distribution ($p > 0.05$). As all groups demonstrated a lack of normal distribution, the analysis proceeded with the Kruskal-Wallis test. Table 6 shows the results of the Kruskal-Wallis test on whether the MBV differed significantly according to the mathematics achievement levels.

Table 6. The results of the Kruskal-Wallis test of MBV according to mathematics achievement levels.

| Achievement Grade | N | Average | $\chi^2$ | df | p |
|---|---|---|---|---|---|
| **0-44** | 38 | 307.59 | | | |
| **45-54** | 66 | 321.67 | | | |
| **55-69** | 75 | 277.45 | 49.499 | 4 | 0.000 |
| **70-84** | 106 | 246.04 | | | |
| **85-100** | 208 | 201.75 | | | |

The data in Table 6 indicate that there is a significant difference between the averages of the achievement grades ($p < 0.05$). Since the achievement grade was divided into five categories, the Mann-Whitney U test was used to compare $C\binom{5}{2} = 10$. The alpha level in the interpretation of the test results was corrected with Bonferroni correction and the value of 0.05 was divided by the number of comparisons. Accordingly, $\alpha = 0.005$ was used as the criterion for interpreting the results of the Mann-Whitney U test. Table 7 shows the results of the Mann-Whitney U tests for the comparisons between mathematics achievement levels.

Table 7. Mann-Whitney U test results concerning the comparisons of MBV according to mathematics achievement levels.

| Achievement Grade | N | Ranking Average | Ranking Total | Mann-Whitney U | Z | p | Effect Size (r) |
|---|---|---|---|---|---|---|---|
| **0-44** | 38 | 51.18 | 1945 | 1204 | -0.338 | 0.735 | -0.033 |
| **45-54** | 66 | 53.26 | 3515 | | | | |
| **0-44** | 38 | 62.38 | 2370,5 | 1220.5 | -1.244 | 0.214 | -0.117 |
| **55-69** | 75 | 54.27 | 4070,5 | | | | |
| **0-44** | 38 | 85.97 | 3267 | 1502 | -2.322 | 0.020 | -0.194 |
| **70-84** | 106 | 67.67 | 7173 | | | | |
| **0-44** | 38 | 166.55 | 6329 | 2316 | -4.061 | **0.000*** | -0.259 |
| **85-100** | 208 | 115.63 | 24052 | | | | |
| **45-54** | 66 | 77.71 | 5129 | 2032 | -1.832 | 0.067 | -0.154 |
| **55-69** | 75 | 65.09 | 4882 | | | | |
| **45-54** | 66 | 102.93 | 6793,5 | 2413,5 | -3.418 | **0.001*** | -0.261 |
| **70-84** | 106 | 76.27 | 8084,5 | | | | |
| **45-54** | 66 | 188.27 | 12425,5 | 3513,5 | -5,980 | **0.000*** | -0.361 |
| **85-100** | 208 | 121.39 | 25249,5 | | | | |
| **55-69** | 75 | 98.12 | 7359 | 3441 | -1.539 | 0.124 | -0.114 |
| **70-84** | 106 | 85.96 | 9112 | | | | |
| **55-69** | 75 | 173.96 | 13047 | 5403 | -3.949 | **0.000*** | -0.235 |
| **85-100** | 208 | 130.48 | 27139 | | | | |
| **70-84** | 106 | 176.64 | 18724 | 8995 | -2.670 | 0.008 | -0.151 |
| **85-100** | 208 | 147.75 | 30731 | | | | |

The Mann-Whitney U test results in Table 7 reveal significant differences in MBV rankings across mathematics achievement levels at $p < 0.005$. A statistically significant difference was found between the 0–44 and 85–100 achievement groups (U = 2316, Z = -4.061, p = 0.000, r = -0.259). The 85–100 group exhibited lower rankings (average = 115.63) compared to the 0–44 group (average = 166.55), indicating that students in the higher achievement group experience fewer MBV-related issues. The effect size (r = -0.259) represents a small-to-medium statistical significance.

Similarly, significant differences were observed between the 45–54 and 70–84 groups (U = 2413.5, Z = -3.418, p = 0.001, r = -0.261) and between the 45–54 and 85–100 groups (U = 3513.5, Z = -5.980, p = 0.000, r = -0.361). In both cases, the higher achievement groups (70–84 and 85–100) displayed lower rankings, reflecting fewer MBV experiences. The effect sizes (r = -0.261 and r = -0.361) indicate small-to-medium and medium impacts, respectively. Additionally, a significant difference was found between the 55–69 and 85–100 achievement groups (U = 5403, Z = -3.949, p = 0.000, r = -0.235). The 85–100 group had lower rankings (average = 130.48) compared to the 55–69 group (average = 173.96), suggesting fewer MBV-related challenges among the highest achievers. The effect size (r = -0.235) is small-to-medium.

These results show that students with higher mathematics achievement are victims of mathematical bullying less than other achievement groups. Therefore, it can be said that those with higher mathematical achievement are more resilient to MBV.

## Discussion and Conclusion

This study analysed whether the scores obtained from the MBV-S developed by (Küçükgençay, 2024) and the sub-dimensions of the scale showed significant differences according to the variables of gender, grade, school type and mathematics achievement level of middle school students. This study was conducted with certain assumptions and limitations. The data collected with the measurement tools in the study were assumed to reflect reality. The study was conducted during the spring semester of the 2021-2022 academic year and was limited to the 5th, 6th, 7th and 8th-grade students studying in five middle schools selected using the disproportionate stratified sampling method from the central districts of a metropolitan city in the Central Anatolia Region of Türkiye. The study was also limited to the data collected from the personal information form and mathematical bullying victimization scales.

The results revealed that the levels of mathematical bullying victimization differed significantly by gender ($p < 0.05$). Accordingly, female students received higher MBV scores than male students and had more intense experiences in this regard. The fact that these experiences are more intense among female students suggests that they encounter more negativity in the mathematics education process. The fact that female students have higher overall MBV-S scores indicates that this group has more bullying experiences. For example, Olweus and Endresen (1998) reported that empathy tendencies of female students increased after the age of ten, whereas this tendency decreased in male students. Similarly, the results of Menesini et al. (1997) show that female students are more exposed to bullying and have a higher sense of loneliness. The study by Paul and Cillesen (2003) states that female students are more deeply affected by bullying experiences due to their higher levels of depression, anxiety and negative self-perceptions.

The analyses conducted according to the grade levels revealed that there was no significant difference in the scores of MBV-S ($p > 0.05$). This reveals that students were exposed to this type of bullying at similar levels. The fact that there was no significant difference in terms of grade level in the analysis of the MBV reveals that bullying, at least at the middle school level, is not specific to a certain age and grade level, but can occur as a result of the social dynamics that students experience in general. Behaviours such as verbal, physical and emotional mathematical bullying are likely to be shaped by factors such as social interactions of students in the classroom, peer groups and the general school environment rather than by the grade level. The literature shows various results that bullying types may vary according to age and grade level (Batsche & Knoff, 1994; Hanish & Guerra, 2000). Satan (2006) and Çankaya (2011) reported that physical bullying is more likely to be replaced by emotional bullying in older age groups. However, the fact that there was no significant difference between the grade levels in terms of mathematical bullying in this study suggests that it is because the types of mathematical bullying follow different dynamics. The fact that mathematical bullying does not show a significant difference according to grade level indicates that this type of bullying is experienced in similar social interactions regardless of the age or grade level of the students.

The results of the study show that students from religious middle schools, where only female students were educated, had higher levels of mathematical bullying experiences compared to students from other schools ($p < 0.005$). These findings indicate that social and cultural factors may influence the experiences of female students in single-gender schools concerning mathematical bullying. The study of Menesini et al. (1997) finds that female students are more likely to be victims of bullying and have more intense feelings of loneliness, while the study of Paul and Cillesen (2003) states that girls' high levels of depression and anxiety and their negative self-perceptions lead them to be more deeply affected by bullying experiences. The fact that female students had higher levels of MBV, which is another result of the study, is consistent with this situation.

Although single-gender schools have been found to have fewer disciplinary problems and a greater focus on academic achievement (LePore & Warren, 1997), it can be assumed that this situation may increase the pressure on female students to succeed in single-gender schools. A single-gender education environment may lead to expectations based on gender roles and a limited school structure. Traditional social norms, in particular, may cause a misconception that female students are less successful than male students in areas such as mathematics (Croizet et al., 2004; Good et al., 2003; Johns et al., 2005; Schmader & Johns, 2003). Warrington and Younger (2001) found out that one of the main advantages of single-gender classrooms is that teachers can adapt their teaching methods by considering the different learning styles of male and female students. However, it can be questioned whether the teachers are really fair and caring in their relationships with the students during this adaptation process. Although it is possible to use different methods depending on the needs of the students, this situation is thought to have the risk of reinforcing prejudiced attitudes of teachers and showing discriminatory behaviours against some students.

According to the results of the study, the relationship between mathematical bullying and mathematics achievement showed that students with high achievement grades had lower levels of mathematical bullying experience ($p < 0.005$). Significant differences were found between the groups of students with mathematics grades between 85-100 and those with grades 0-44, 45-54 and 55-69, and it was concluded that these students were less exposed to mathematical bullying. A significant difference was also found between students with grades between 70-84 and those with grades between 45-54. This situation points out that students with low mathematics achievement grades experience more mathematical bullying than those with high achievement grades. In general, it was observed that as mathematics achievement increased, the rate of being a victim of mathematics bullying decreased. This suggests that students with high achievement levels usually take advantage of positive social perceptions such as respect and recognition by their peers, and therefore experience less bullying.

It is noteworthy that students with high mathematics achievement are generally less likely to experience mathematics bullying, while students with low achievement are more likely to be victims of this type of bullying. The results of the study reveal the relationship between mathematical bullying and mathematical power and also highlight the links between the basic dynamics of mathematical bullying and the concept of mathematical power. Given that mathematical bullying is shaped by the abuse of mathematical power differentials, it explains why students with high mathematical power are less likely to experience this type of bullying. Although mathematical power and mathematical achievement are defined as different concepts, high grades in mathematics may lead students to perceive themselves as having high mathematical power. Similarly, Ev-Çimen (2008) found that students associated the concept of mathematical power with abilities such as performing mental operations, solving difficult problems, and superior performance in mathematics.

Many studies emphasise that individuals who are bullied consist of individuals who are powerless or perceive themselves to be powerless (Bitney & Title, 1997; Mellor, 1997; Olweus, 1999; Pişkin et al., 2011; Sarıbeyoğlu, 2007; Yıldırım, 2003). Mathematical power includes mathematical thinking, problem-solving and the ability to combine these skills with effective communication (NCTM, 2004). This power can become an important element in determining an individual's social status in the classroom. Students who are perceived as having high mathematical power may avoid being targets of mathematical bullying because of their status.

Students with high achievement grades experienced less bullying in emotional, physical, verbal and instructional types of mathematical bullying. This can be interpreted as a reflection of how perceived mathematical power differences in the classroom shape the social balance and the influence of socio-mathematical norms. Cobb and Yackel (1996) recognised norms of teacher-student interactions, being a general rule in the classroom microculture, as an important phenomenon in the mathematical learning process. Sociomathematical norms are described as rules that are accepted by students and teachers in mathematical discussions and group work, and which guide mathematical interactions in the classroom (Cobb & Yackel, 1996). These norms can play an important role in the development of the social structure in the classroom by determining the mathematical power dynamics among students. In this context, students considered to have high mathematical power may have a strong position in social relationships within the class, while students with low levels of mathematical power may be more likely to feel the negative effects of this power imbalance. Considering that mathematical power includes not only mathematical skills but also some affective characteristics of students (Gündoğdu & Kurtuluş, 2016), students with high mathematical power may be more socially empowered in mathematics lessons and protected from mathematical bullying thanks to these skills. However, for students with low levels of mathematical power, this situation may be the opposite.

## Recommendations

The following recommendations have been developed for researchers, practitioners and policymakers considering the results and limitations of the study:

Further studies on mathematical bullying should be conducted involving different school types and age groups. The effects of factors such as school environment, teacher behaviour, and the activities of counselling services on the experiences of students with mathematical bullying should be evaluated in this context. Studies should be extended to investigate the effects of mathematical bullying in different socio-economic groups. Future studies of this kind may contribute to a better understanding of whether mathematical bullying is a context-specific or universal phenomenon.

Studies examining the effects of gender factors on mathematical bullying should be carried out. These studies may contribute to the development of more effective intervention programmes by revealing the differences in experiences between male and female students.

Individual in-depth interviews with students who have been the victims of mathematical bullying can provide valuable data to understand the effects of this bullying at the individual level and how students perceive this situation. It is also necessary to conduct focus group studies with groups of students from different demographic characteristics to examine in depth how mathematical bullying is shaped in the social context and the impact of group dynamics on this process.

Qualitative studies to be conducted with teachers, school administrators and counselling services can provide a comprehensive perspective on the perception of mathematical bullying in an educational environment and intervention methods for such situations.

Studies adopting a mixed-methods approach (qualitative and quantitative), should be conducted to understand the relationship between mathematical bullying and peer bullying. These studies can contribute to the development of preventive strategies by identifying the common and different dynamics of both types of bullying.

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## References


Akyüz-Aru, S. (2020). *Investigation of variables affecting science and mathematics success of grade 4 students: TIMSS 2015 status analysis* (Publication No. 611893). [Doctoral dissertation, Gazi University, Turkish]. Council of Higher Education Thesis Center.

Batsche, G. M., & Knoff, H. M. (1994). Bullies and their victims: Understanding a pervasive problem in the schools. *School Psychology Review, 23*(2), 165–174. https://doi.org/10.1080/02796015.1994.12085704

Bernard, H. R. (2011). *Research methods in anthropology: Qualitative and quantitative approaches*. Rowman Altamira.

Beswick, K. (2006). Changes in pre-service teachers' attitudes and beliefs: The net impact of two mathematics education units and intervening experiences. *School Science and Mathematics, 106*(1), 36-47. https://doi.org/10.1111/j.1949-8594.2006.tb18069.x

Bitney, J., & Title, B. (1997). *No-bullying program: Preventing bullying / victim violence at school (Program director's manual).* Johnson Institute.

Boulton, M. J., & Underwood, K. (1992). Bully/victim problems among middle school children. *British Journal of Educational Psychology, 62*(1), 73–87. https://doi.org/10.1111/j.2044-8279.1992.tb01000.x

Buluç, B. (2014). TIMSS 2011 sonuçları çerçevesinde, okul iklimi değişkenine göre öğrencilerin matematik başarı puanlarının analizi [An analysis of students' mathematics achievements according to school climate in the frame of TIMSS 2011 results]. *The Journal of Industrial Arts Education Faculty of Gazi University*, 33, 105-121.

Chestnut, E. K., Lei, R. F., Leslie, S. J., & Cimpian, A. (2018). The myth that only brilliant people are good at math and its implications for diversity. *Education Sciences, 8*(2), 65. https://doi.org/10.3390/educsci8020065

Chiu, M. M., & Klassen, R. M. (2010). Relations of mathematics self-concept and its calibration with mathematics achievement: Cultural differences among fifteen-year-olds in 34 countries. *Learning and Instruction, 20*, 2-17. https://doi.org/10.1016/j.learninstruc.2008.11.002

Cobb, P., & Yackel, E. (1996). Constructivist, emergent, and sociocultural perspectives in the context of developmental research. *Educational Psychologist*, *31*(3–4), 175–190. https://doi.org/10.1080/00461520.1996.9653265

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). SAGE Publications.

Crick, N. R., & Bigbee, M. A. (1998). Relational and overt forms of peer victimization: a multiinformant approach. *Journal of consulting and clinical psychology*, *66*(2), 337-347. https://doi.org/10.1037//0022-006x.66.2.337

Croizet, J. C., Despres, G., Gauzins, M. E., Huguet, P., Leyens, J. P., & Meot, A. (2004). Stereotype threat undermines intellectual performance by triggering a disruptive mental load. *Personality and Social Psychology Bulletin, 30*(6), 721–731. https://doi.org/10.1177/0146167204263961

Çankaya, İ. (2011). İlköğretimde akran zorbalığı [Peer bullying in primary education]. *Journal of Uludag University Faculty of Education*, 24(1), 81-92.

Demir, K., & Küçük, S. (2020). Akran zorbalığı önleme ve müdahale programlarında güncel yaklaşımlar ve hemşirelik rolleri [Current approaches and nursing roles in peer bullying prevention and intervention programs]. *Turkish Journal of Health Sciences and Research*, 3(2), 87-102.

Dunn, O. J. (1961). Multiple comparisons among means. *Journal of the American statistical association*, *56*(293), 52-64. https://doi.org/10.2307/2282330

Ev-Çimen, E. (2008). *A design of learning environment and related teacher activities to foster mathematical power of individuals in mathematics education* (Publication No. 220314). [Doctoral dissertation, Dokuz Eylül University, Turkish]. Council of Higher Education Thesis Center.

Furinghetti, F. (1993). Images of mathematics outside the community of mathematicians: Evidence and explanations. *For the learning of Mathematics*, *13*(2), 33-38. https://www.jstor.org/stable/40248084

Good, C., Aronson, J., & Harder, J. A. (2008). Problems in the pipeline: Stereotype threat and women's achievement in high-level math courses. *Journal of Applied Developmental Psychology, 29*(1), 17-28. https://doi.org/10.1016/j.appdev.2007.10.004

Gündoğdu, S., & Kurtuluş, A. (2016). 7. ve 8. sınıf öğrencilerinin sahip olduğu matematiksel güç ile matematik öz-yeterliği arasındaki ilişki [Relationship between 7th and 8th grade students' mathematical power and mathematics self-efficacy]. *Journal of Turkish Studies*, 11(14), 313-332. http://dx.doi.org/10.7827/TurkishStudies.9669

Hanish, L., & Guerra, N. (2000). The roles of ethnicity and school context in predicting children's victimization by peers. *American Journal of Community Psychology, 28*(2), 201–223. https://doi.org/10.1023/A:1005187201519

Hawker, D. S., & Boulton, M. J. (2000). Twenty years' research on peer victimization and psychosocial maladjustment: A meta-analytic review of cross-sectional studies. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *41*(4), 441-455. https://doi.org/10.1111/1469-7610.00629

Johns, M., Schmader, T., & Martens, A. (2005). Knowing is half the battle: Teaching stereotype threat as a means of improving women's math performance. *Psychological Science, 16*(3), 175-179. https://doi.org/10.1111/j.0956-7976.2005.00799.x

Kapçı, E. G. (2004). İlköğretim öğrencilerinin zorbalığa maruz kalma türünün ve sıklığının depresyon, kaygı ve benlik saygısıyla ilişkisi [Bullying type and severity among elementary school students and its relationship with depression, anxiety and self-esteem]. *Ankara University, Journal of Faculty of Educational Sciences*, 37(1), 1-13. https://doi.org/10.1501/Egifak_0000000087

Karasar, N. (2009). *Bilimsel araştırma yöntemleri* [Scientific research methods]. Nobel Yayınları.

Küçükgençay, N. (2024). *Ortaokul öğrencilerinin matematiksel zorbalığa uğrama düzeylerinin sosyodemografik değişkenlere göre incelenmesi ve bazı duyuşsal özelliklerle ilişkisi* [An examination of middle school students' mathematical bullying victimization levels in relation to socio-demographic variables and their relationship with certain affective characteristics] [Doctoral dissertation in progress, Necmettin Erbakan University].

Leder, G. C., Pehkonen, E., & Törner, G. (2002). *Beliefs: A hidden variable in mathematics education?* Kluwer Academic Publishers. https://doi.org/10.1007/0-306-47958-3

LePore, P. C., & Warren, J. R. (1997). A comparison of single-sex and coeducational Catholic secondary schooling: Evidence from the National Educational Longitudinal Study of 1988. *American Educational Research Journal, 34*(3), 485–511. https://doi.org/10.2307/1163247

Li, X., & Li, Y. (2008). Research on students' misconceptions to improve teaching and learning in school mathematics and science. *School Science and Mathematics, 108*(1), 4–8. https://doi.org/10.1111/j.1949-8594.2008.tb17934.x

Martínez-Sierra, G., & García-González, M. D. S. (2016). Undergraduate mathematics students' emotional experiences in linear algebra courses. *Educational Studies in Mathematics, 91*(1), 87–106. https://doi.org/10.1007/s10649-015-9634-y

Mellor, A. (1997). Bullying: the Scottish experience. *The Irish Journal of Psychology*, *18*(2), 248-257. https://doi.org/10.1080/03033910.1997.10558143

Menesini, E., Eslea, M., Smith, P. K., Genta, M. L., Giannetti, E., Fonzi, A., & Costabile, A. (1997). Cross-national comparison of children's attitudes towards bully/victim problems in schools. *Aggressive Behavior, 23*(4), 245–257.

Morgan, D. L. & Morgan, R. K. (2008). *Single-case research methods for the behavioral and health sciences.* SAGE Publications.

Mulcare, C. (2008, Haziran 16). Maths, madness and movies. *Plus Magazine, 47*. http://plus.maths.org/issue47/features/mulcare/index.html

NCTM. (2004). *A family's guide: Fostering your child's success in school mathematics*. The National Council of Teachers of Mathematics, Inc. https://illuminations.nctm.org/uploadedfiles/activities_home/familyguide_fulltext.pdf

OECD. (2007). *PISA 2006: Science competencies for tomorrow's world. Volume 1: Analysis*. Organisation for Economic Co-operation and Development. https://doi.org/10.1787/9789264040014-en

Olweus, D. (1993). Bullies on the playground: The role of victimization. In C. H. Hart (Ed.), *Children on playgrounds: Research perspectives and applications* (pp. 85–128). State University of New York Press.

Olweus, D. (1999). Sweden. In P. K. Smith, Y. Morita, J. Junger-Tas, D. Olweus, R. Catalano, & P. Slee (Eds.), *The nature of school bullying: A cross-national perspective* (pp. 7–27). Routledge.

Paul, J., & Cillessen, T. (2003). Dynamics of peer victimization in early adolescence: Results from a four-year longitudinal study. J. Zins & M. Elias (Eds.), *Bullying, peer harassment, and victimization in the schools* içinde (ss. 25-44). Routledge. https://doi.org/10.4324/9780203725528

Pişkin, M., Öğülmüş, S., Atik, G., Kalafat, T., & Boysan, M. (2011). *Güvenli okul ortamı oluşturma: Öğretmen ve yönetici kitabı* [Creating a safe school environment: A teacher and administrator guide]. Ankara University.https://ancmtal.meb.k12.tr/meb_iys_dosyalar/41/02/761473/dosyalar/2016_09/15123827_guvenli_okul_ortami_olusturma_ogrt_ve_yontc_kitabi.pdf

Ponzo, M. (2013). Does bullying reduce educational achievement? An evaluation using matching estimators. *Journal of Policy Modeling, 35*(6), 1057–1078. https://doi.org/10.1016/j.jpolmod.2013.06.002

Rachlin, S. (1998). Reflections on practice: Learning to see the wind. *Mathematics Teaching in the Middle School, 3*(7), 470–473. https://doi.org/10.5951/MTMS.3.7.0470

Ryan, P. J. (1998). *Teacher development and use of portfolio assessment strategies and the impact on instruction in mathematics* (Publication No. 992449). [Doctoral dissertation, Stanford University]. ProQuest Dissertations & Theses Global.

Sam, L. C., & Ernest, P. (2000). A survey of public images of mathematics. *Research in Mathematics Education, 2*(1), 193–206. https://doi.org/10.1080/14794800008520076

Sarı, M. H., Arıkan, S., & Yıldızlı, H. (2017). 8. sınıf matematik akademik başarısını yordayan faktörler - TIMSS 2015 [Factors predicting mathematics achievement of 8th graders in TIMSS 2015]. *Journal of Measurement and Evaluation in Education and Psychology*, 8(3), 246–265. https://doi.org/10.21031/epod.303689

Sarıbeyoğlu, N. S. (2007). *Investigation of the relationship between child abuse in family and bullying in high school students* (Publication No. 217945). [Master's thesis, İstanbul University, Turkish]. Council of Higher Education Thesis Center.

Satan, A. (2006). *Student's bullying trends between some variable correlate at secondary schools* (Publication No. 209724). [Doctoral dissertation, Marmara University, Turkish]. Council of Higher Education Thesis Center.

Schmader, T., & Johns, M. (2003). Converging evidence that stereotype threat reduces working memory capacity. *Journal of Personality and Social Psychology, 85*(3), 440–452. https://doi.org/10.1037/0022-3514.85.3.440

Schmidt, F. L. & Hunter, J. E. (2014). *Methods of meta-analysis: correcting error and bias ın research findings.* Sage.

Smith, P. K., & Sharp, S. (Eds.). (1994). *School bullying: Insights and perspectives.* Routledge.

Wang, J. (2006). An empirical study of gender difference in the relationship between self-concept and mathematics achievement in a cross-cultural context. *Educational Psychology, 26*(5), 689–706. https://doi.org/10.1080/01443410500390863

Warrington, M., & Younger, M. (2001). Single-sex classes and equal opportunities for girls and boys: Perspectives through time from a mixed comprehensive school in England. *Oxford Review of Education, 27*(3), 339-356. https://doi.org/10.1080/03054980120067393

Willard, N. E. (2007). *Cyberbullying and cyberthreats: Responding to the challenge of online social aggression, threats, and distress*. Research press.

Wininger, S. R., Adkins, O., Inman, T. F., & Roberts, J. (2014). Development of a student interest in mathematics scale for gifted and talented programming identification. *Journal of Advanced Academics, 25*(4), 403–421. https://doi.org/10.1177/1932202X14549354

Yavuz, H., Demirtaşlı, R., Yalçın, S., & İlgün-Dibek, M. (2017). The effects of student and teacher level variables on TIMSS 2007 and 2011 mathematics achievement of Turkish students. *Education and Science*, 42(189), 27–47. http://dx.doi.org/10.15390/EB.2017.6885

Yıldırım, P. (2003). *Çıkmaz sokak: Okulda şiddet ve zorbalık* [Dead end: Violence and bullying in school]. Nobel Yayınları.

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