



SCHOOL BULLYING AS A MODERATOR OF GENDER DIFFERENCES IN MATHEMATICS ACHIEVEMENT: EVIDENCE FROM TIMSS

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Abstract

The Trends in International Mathematics and Science Study (TIMSS) provides internationally comparable data on students' mathematics and science outcomes. The present study examines whether school bullying moderates gender differences in outcomes on the TIMSS mathematics test among fourth-grade students in Bosnia and Herzegovina. The sample consisted of 3,324 fourth-grade students (1,654 girls and 1,670 boys). Mathematics achievement was assessed using TIMSS plausible values, and analyses accounted for the complex survey design using the student sampling weights. Results showed a significant negative association between school bullying and mathematics achievement for both genders, as well as a significant gender $\times$ bullying interaction. Boys achieved higher scores at low and moderate levels of bullying, whereas girls outperformed boys under high bullying exposure. This pattern was consistent across all plausible mathematics values. The results suggest that efforts aimed at improving school social climate and reducing bullying may play an important role in promoting both students' academic achievement and their well-being.

Keywords: TIMSS, mathematics, gender, school bullying, Bosnia and Herzegovina

Introduction

The Trends in International Mathematics and Science Study (TIMSS) is a large-scale international assessment conducted at four-year intervals that measures students' achievement in mathematics and science and collects extensive contextual information about their learning environments (Mullis et al., 2015). In addition to assessing academic performance, TIMSS includes student, teacher, and school questionnaires that provide indicators of classroom practices, school climate, and student experiences, allowing researchers to examine how social and educational factors relate to achievement outcomes. Given its nationally representative samples and standardised design, TIMSS is well suited for investigating associations between school-related factors and student achievement across different educational contexts. Previous research using TIMSS data has identified multiple individual and school-level predictors of mathematics achievement, including students' attitudes and self-confidence, instructional practices, and perceptions of school safety, suggesting that everyday school experiences are related to academic performance (Çiftçi & Yildiz, 2019; Wardat et al., 2022).

Large-scale assessments are frequently used to examine gender differences in mathematics achievement. Overall, these differences tend to be small and do not show a consistent advantage for either boys or girls (Meinck & Brese, 2019; Reilly et al., 2019). However, gender gaps in mathematics performance are context-specific and differ by country, grade, and school setting. At the fourth-grade level, mean differences in mathematics achievement are often minimal or absent (Robinson & Lubienski, 2011), yet disparities may still appear in the distribution of performance, with boys more frequently represented at both the lower and upper ends of the achievement spectrum (Merkys et al., 2025). This suggests that average score comparisons may

mask meaningful subgroup differences (Fonseca et al, 2023). In addition, psychological factors such as mathematics anxiety and attitudes toward mathematics have been shown to differ by gender and may contribute to variation in achievement (Megreya et al., 2025). Together, these findings indicate that gender differences in mathematics achievement cannot be fully understood without considering contextual and psychosocial factors that may shape students' learning experiences.

Within educational research, school bullying is increasingly viewed as an important indicator of school social climate. Bullying victimization is linked to emotional distress and disengagement from school, both of which are detrimental to learning and academic performance (Murphy et al., 2022). In addition, negative emotional states such as fear and anxiety can inhibit classroom participation and disrupt learning processes, thereby reinforcing academic difficulties (Celdrán-Navarro et al., 2024). Perceived victimization also affects students' academic self-concept and overall academic engagement, further increasing their vulnerability to poor academic outcomes (Ladd et al., 2017). Consistent with these psychological and motivational mechanisms, a growing body of empirical evidence shows that exposure to bullying is associated with a range of adverse academic outcomes, including lower achievement, reduced school engagement, and poorer well-being. Students attending schools with higher levels of bullying tend to demonstrate lower academic performance (Strøm et al., 2013). These findings are further supported by a recent meta-analysis based on TIMSS data, which showed that bullied students achieve lower academic scores than their non-bullied peers, with this association being more pronounced in fourth grade than in eighth grade (Özyıldırım & Karadağ, 2024).

Despite substantial evidence linking bullying to academic outcomes and extensive research on gender differences in mathematics achievement, empirical studies examining whether the association between bullying and mathematics achievement differs by gender remain limited, particularly in large-scale, nationally representative samples. At the same time, boys and girls differ in their patterns of bullying involvement: boys more often report direct forms of victimization and are more frequently classified as bully/victims, whereas girls are more likely to experience indirect forms of bullying and to be categorised as non-bully/non-victims (Obregon-Cuesta et al., 2022). Theoretical perspectives further suggest that gender differences in emotional regulation (Sanchis-Sanchis et al., 2020) and coping strategies (Kristensen & Smith, 2003) may lead to different academic consequences of bullying. Within a transactional stress framework (Lazarus & Folkman, 1984), bullying can be conceptualized as a chronic interpersonal stressor whose impact on academic functioning depends on students' cognitive appraisals and coping responses. Because emotional regulation and coping strategies differ by gender, the academic consequences of bullying may also vary for boys and girls. This perspective provides a theoretical basis for expecting bullying to moderate gender differences in mathematics achievement rather than merely showing a uniform negative association with academic learning.

This issue is particularly relevant for mathematics learning, which relies heavily on executive functions and emotional regulation (Bukva & Memisevic, 2025; Klein et al., 2019). Taken together, these considerations suggest that bullying may moderate the association between gender and mathematics achievement. Accordingly, the aim of the present study was to examine whether school bullying moderates the association between gender and fourth-grade mathematics achievement. Specifically, the study addressed the following research questions:

1. Are there gender differences in mathematics achievement among fourth-grade students?
2. Is exposure to bullying associated with mathematics achievement?
3. Does the association between bullying and mathematics achievement differ for boys and girls?

Research Methodology

Study Design

This study used a cross-sectional correlational design based on secondary analysis of data from the TIMSS 2023 assessment, which was administered during the spring of 2023. The data were collected by the IEA using standardized procedures across participating countries. The analyses examined associations between gender, school bullying, and mathematics achievement in a nationally representative sample of fourth-grade students.

Participants

The initial TIMSS sample comprised 3,391 fourth-grade students from Bosnia and Herzegovina. This sample size was determined by the TIMSS sampling design and reflects a nationally representative sample selected by the IEA using a two-stage stratified cluster sampling procedure. At the initial stage, schools are selected within strata defined by regional and institutional characteristics. Next, whole classes were chosen within those schools, and all students from the selected classes took part in the assessment (Martin & Mullis, 2019). Following the exclusion of cases with missing information on key variables, the final analytic sample consisted of 3,324 students (1,654 girls and 1,670 boys; $M=10.2$ years, $SD=0.4$ years).

Procedure

The assessment was administered digitally, following the group-adaptive testing framework implemented in TIMSS 2023 (Yin & Foy, 2021). This approach adapts the selection of test items to students' estimated proficiency levels, thereby enhancing measurement accuracy. The mathematics assessment consisted of test booklets that combined blocks of items varying in difficulty. Through the adaptive design, students with higher achievement levels were presented with a larger proportion of more challenging items, whereas students with lower achievement levels received a larger number of less difficult items. In addition to the mathematics test, students completed a questionnaire that collected information on contextual factors, including home learning resources, which were used as a proxy for SES, and experiences of school bullying. These questionnaire measures were designed to capture key aspects of students' learning environments that may be associated with mathematics achievement. All assessments were conducted under standardised conditions in accordance with TIMSS procedures, with trained administrators overseeing test administration. Data collection consisted of two separate mathematics testing blocks, each lasting 36 minutes and separated by a brief interval, followed by a student survey administered for about half an hour. Data collection took place during a designated testing window to ensure consistency across participating schools while allowing for necessary scheduling flexibility. This study is a secondary analysis of data collected as part of the TIMSS 2023 international assessment, which was designed and administered by the International Association for the Evaluation of Educational Achievement (IEA). Data collection, informed consent procedures, and ethical approvals were obtained by the IEA in accordance with its international research and ethical standards, and the authors of the present study were not involved in data collection and had no direct contact with participants. The TIMSS data are publicly available for research purposes through the IEA Data Repository and can be accessed by registered users in accordance with the IEA data use agreement. As the dataset is fully anonymised, no additional ethical approval or participant consent was required for the present study.

Instrument

Mathematics Achievement

This study analysed TIMSS 2023 data, combining students' mathematics scores with information from contextual questionnaires. The mathematics test was delivered in digital format and included items from several curriculum areas, such as number, measurement and geometry, as well as data and probability. A group-adaptive testing design was applied to ensure that test items were matched to students' proficiency levels. Student performance was scored and scaled using the TIMSS international achievement scale ($M = 500$; $SD = 100$). Data preparation followed International Association for the Evaluation of Educational Achievement (IEA) guidelines to ensure data quality and comparability, allowing for valid analyses of mathematics achievement within Bosnia and Herzegovina and in relation to international benchmarks.

School Bullying

School bullying was measured using the TIMSS *Student Bullying* scale, which is based on students' self-reports of exposure to eleven specific bullying behaviours. Students indicated how frequently they experienced each behaviour (e.g., "*Made fun of me or called me names*," "*Left me out of their games or activities*," "*Hit or hurt me*"), with response options ranging from *never* to *at least once a week*. Responses were combined into an overall bullying score. Based on established TIMSS cut scores, students were classified into three bullying categories reflecting different levels of exposure. Students categorised as *Never* or *Almost Never* bullied reported that they had never experienced at least six of the eleven bullying behaviours and experienced the remaining behaviours only a few times per year on average. Students classified as *About Monthly* bullied represented an intermediate group, reporting occasional exposure to bullying behaviours. Students classified as *About Weekly* bullied reported more frequent victimization, indicating that they experienced at least six of the bullying behaviours once or twice per month on average, with the remaining behaviours occurring a few times per year. The scale was coded such that higher values indicated lower exposure to bullying.

Statistical Analysis

Mathematics achievement was the dependent variable, while gender, school bullying, and their interaction were included as predictors in the regression models. In the primary analyses, school bullying was operationalised as a continuous student-reported bullying score and was mean-centred prior to analysis to facilitate interpretation of main and interaction effects. In addition, supplementary analyses were conducted using the categorical bullying classification provided by TIMSS (low, moderate, and high exposure) to illustrate patterns of mathematics achievement across distinct levels of bullying. These analyses were used for descriptive and interpretative purposes and did not replace the primary continuous-variable models. In TIMSS, achievement is represented by multiple plausible values rather than a single observed test score, to reflect uncertainty in students' proficiency estimates. Therefore, although the primary models were estimated using the first plausible value, all regression models were re-estimated using the remaining plausible values to examine whether the results were consistent across imputations. The direction and magnitude of the parameter estimates were highly similar across plausible values, indicating that the findings were robust to the choice of plausible value. Regression models incorporated the TIMSS total student sampling weight to account for unequal probabilities of selection and to ensure nationally representative estimates. Consequently, the degrees of freedom reported for the regression models reflect the weighted population estimates

rather than the unweighted analytic sample size. Moderation effects were evaluated based on the statistical significance and direction of the gender $\times$ bullying interaction term. Statistical significance was assessed using a conventional alpha level of .05. All analyses were performed using IBM SPSS v.27 program for Windows (IBM, 2020).

Research Results

There was a negative association between school bullying (reverse-coded) and fourth-grade mathematics achievement. On average, students exposed to higher levels of bullying tended to achieve lower mathematics scores. Overall, gender differences in mathematics achievement were relatively small, although statistically significant, with boys achieving higher scores. Table 1 presents the results of the regression analysis examining gender and school bullying as predictors of mathematics achievement. The overall regression model was statistically significant, $F(3, 15410) = 357.0, p < .001$, explaining approximately 6.5% of the variance in fourth-grade mathematics achievement ($R^2 = .065$). Although the proportion of explained variance was modest, this magnitude is typical for large-scale educational studies examining individual and contextual predictors of achievement. The standard error of the estimate was 70.29 points, reflecting substantial variability in mathematics performance at this grade level. Notably, interaction between gender and bullying showed the strongest standardised effect in the model ($\beta = .19$), suggesting that boys and girls are affected differently by bullying in relation to their mathematics performance.

Table 1
A Regression Analysis Predicting Mathematics Achievement

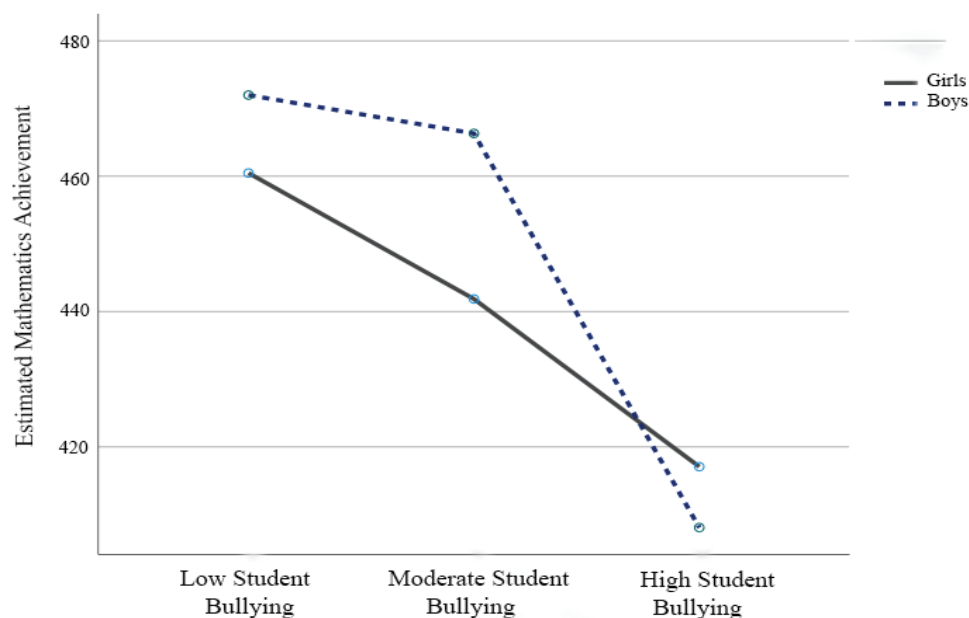
Predictors	<i>B</i>	<i>SEB</i>	β	<i>t</i>	<i>p</i>
Gender	9.1	1.1	.06	8.0	< .001
Bullying	2.2	0.8	.07	2.7	.006
Gen x Bull	3.6	0.5	.19	7.3	< .001

Note. Results are reported for the first plausible value of mathematics achievement (PV1). The same pattern of effects, including the interaction of gender and bullying, was observed across all plausible values.

To better illustrate the significant gender $\times$ bullying interaction, estimated marginal means of mathematics achievement were examined across levels of school bullying separately for boys and girls. As shown in Figure 1, mathematics achievement declined for both boys and girls as bullying increased, but the pattern of decline was not the same for the two groups.

Figure 1

Estimated Marginal Means of Fourth-Grade Mathematics Achievement by Gender Across Levels of School Bullying



As can be seen from Figure 1, among girls, mean mathematics achievement decreased from 460.5 points at low levels of bullying to 417.1 points at high levels of bullying, a difference of approximately 43 points on the TIMSS scale. Among boys, the corresponding decline was larger, with mean scores decreasing from 472.0 points under low bullying to 408.1 points under high bullying, a difference of approximately 64 points. At low and moderate levels of bullying, boys demonstrated higher mathematics achievement than girls. In contrast, under conditions of high bullying, girls outperformed boys in mathematics achievement.

Discussion

The aim of the present study was to examine whether school bullying moderates gender differences in fourth-grade mathematics achievement using data from TIMSS. Consistent with prior research (Graham, 2025; Huang, 2022; Nakamoto & Schwartz, 2010), these results indicated that school bullying was negatively associated with mathematics achievement for both boys and girls. Also, small gender differences in mathematics achievement were observed, with boys achieving slightly higher scores on average, aligning with findings from earlier studies (Grgić & Memisevic, 2025; Penner & Paret, 2008).

In addition, a significant interaction was observed between gender and school bullying in relation to mathematics achievement. The results demonstrate that gender differences in mathematics achievement vary depending on students' exposure to bullying. Boys outperformed girls in mathematics achievement when bullying levels were low or moderate. In contrast, girls achieved higher mathematics scores when bullying was high. It is important to note that mathematics achievement decreased as bullying increased for both boys and girls, suggesting that bullying is harmful for all students, even though its impact differs by gender. This study suggests that bullying may be more strongly associated with lower mathematics performance among boys than among girls.

One possible explanation relates to gender differences in emotional regulation and coping strategies. Previous research shows that girls tend to use emotion regulation strategies more often than boys, which may help protect their academic performance when facing negative social experiences (Sanchis-Sanchis et al., 2020). Another factor that may contribute to better adjustment among girls is their greater tendency to seek social support when facing adverse experiences (Zimmermann & Iwanski, 2014). Additionally, girls often report higher empathy, better communication, and more social support, which may help them stay engaged in school when the environment is challenging (Sun & Stewart, 2007). Generally, a disruptive school climate negatively affects academic achievement (Blank & Shavit, 2016). Ongoing peer bullying can disturb classroom activities, lower students' engagement, and make it harder for students to focus on academic tasks. In addition to its impact on learning outcomes, bullying has been linked to negative long-term health consequences, including dysregulation of cortisol and increased inflammation, which may elevate the risk of illness and disease later in life (Schacter, 2021). Bullying involvement has also been associated with mental health problems and sleep problems (Hysing et al., 2021). These findings underline the importance of addressing school bullying in educational contexts, given its relevance for both academic outcomes and students' long-term health.

From a school-based perspective, the present findings point to the importance of bullying prevention efforts that address the broader social climate of classrooms, particularly in the early years of schooling. It is encouraging that bullying prevention programmes are effective in decreasing bullying and victimization. A systematic review has shown that approximately half of the studies examining bullying perpetration (11 out of 22) and about two-thirds of the studies focusing on bullying victimization (18 out of 27) reported statistically significant programme effects (Evans et al., 2014). However, the magnitude and sustainability of these effects vary considerably across programmes, suggesting that effectiveness is shaped by multiple interacting factors operating at the individual, classroom, school, and family levels. Teachers are considered key figures in the effectiveness of antibullying programmes, and their intervention is crucial in stopping bullying behaviour when it occurs. Teachers' attitudes, self-efficacy, and knowledge are determinants of the programme effectiveness (van Verseveld et al., 2019). Bullying prevention programmes are more effective when they move beyond student-focused activities and adopt a broader, school-wide approach. Programmes that actively involve parents through meetings, training, and communication with teachers are more likely to reduce bullying (Kolbert et al., 2014).

Overall, the findings suggest that bullying is linked to both lower mathematics achievement and gender differences in performance. The interaction of gender and bullying indicates that negative school environments may affect boys' learning more strongly than girls', although achievement declines for both genders as bullying increases. These results support the view that bullying should be considered not only as an interpersonal issue, but also as a classroom- and school-level factor relevant for educational equity. These findings suggest that efforts to improve mathematics achievement, particularly in the early grades, should consider school climate and peer relations alongside instructional quality. Interventions aimed at reducing bullying may yield not only academic benefits, but also the benefits to the overall students' well-being. Given the differential sensitivity observed between boys and girls, prevention strategies may benefit from being responsive to gender-related differences in coping and adjustment, without reinforcing stereotypical assumptions.

Several limitations should be acknowledged when interpreting these results. First, the cross-sectional design of the TIMSS data prevents causal conclusions regarding the direction of the associations between bullying and mathematics achievement. Second, bullying was assessed using student self-reports, which may be affected by reporting biases, social desirability, and individual differences in how bullying behaviours are perceived and interpreted (Koca Guler &

Gokalp Yavuz, 2025). Additionally, this study relied on a broad, composite measure of bullying, which does not allow differentiation between specific forms of bullying (e.g., physical, verbal, relational). Different types of bullying may have distinct associations with academic outcomes, which could not be examined within the current analytic framework. Another limitation is that boys and girls may differ in how they report bullying, with some forms being captured better than others by self-report measures (Sawyer et al., 2008). Next, the present analyses did not explicitly model the full hierarchical structure of the TIMSS data (students nested within classes and schools). Although the use of sampling weights supports population-representative estimates, future studies should apply multilevel modelling to examine whether the interaction of gender and bullying varies across schools or educational contexts. Finally, the use of data from a single country, Bosnia and Herzegovina, limits the extent to which the findings can be generalised to other educational systems, highlighting the need for replication in other national contexts. Future research would benefit from longitudinal designs that allow examination of developmental trajectories and causal relations between bullying and academic achievement over time, as well as from multi-informant approaches incorporating reports from teachers, parents, and peers. In addition, examining classroom- and school-level protective factors, such as teacher support and peer norms, could help clarify why some students remain academically successful despite adverse social experiences.

Conclusions and Implications

This study demonstrates that school bullying is associated with lower mathematics achievement and, importantly, that this association differs between boys and girls. Previous studies have linked bullying to academic outcomes. The present findings add to this literature by showing that this association differs between boys and girls in fourth grade. These results highlight that peer relations and school climate play an important role in shaping early academic trajectories in a gender-sensitive manner. Therefore, in addition to effective educational practices, improving mathematics achievement in the early grades should include both anti-bullying measures and social-emotional support. At the same time, the findings should be interpreted with caution due to the cross-sectional design and reliance on self-report measures. Future studies using longitudinal data are needed to examine the directionality of the associations between bullying and academic achievement and to assess whether gender differences in these associations persist over time. Additionally, incorporating reports from teachers, parents, and peers, as well as school-level indicators of prevention and support programmes, would provide a more comprehensive understanding of how schools can reduce the academic risks associated with bullying.

Declaration of interest

The authors declare no competing interests.

References

- Blank, C., & Shavit, Y. (2016). The association between student reports of classmates' disruptive behavior and student achievement. *AERA Open*, 2(3), 1–17. <https://doi.org/10.1177/2332858416653921>
- Bukva, A., & Memisevic, H. (2025). The relationship between executive functions and mathematics achievements in early-grade elementary students. *Child Neuropsychology*, 31(4), 635–648. <https://doi.org/10.1080/09297049.2024.2421222>
- Celdrán-Navarro, M. d. C., Jiménez-Ruiz, I., Leal-Costa, C., Moore, J., & López-Barranco, P. J. (2024). Attitudes, self-confidence, and knowledge of primary care professionals towards school bullying. *Healthcare*, 12(12), Article 1230. <https://doi.org/10.3390/healthcare12121230>

- Çiftçi, S. K., & Yildiz, P. (2019). The effect of self-confidence on mathematics achievement: The meta-analysis of trends in international mathematics and science study (TIMSS). *International Journal of Instruction*, 12(2), 683–694.
- Evans, C. B. R., Fraser, M. W., & Cotter, K. L. (2014). The effectiveness of school-based bullying prevention programs: A systematic review. *Aggression and Violent Behavior*, 19(5), 532–544. <https://doi.org/https://doi.org/10.1016/j.avb.2014.07.004>
- Fonseca, J., Bahrawar, L., Dubeck, M. M., Sitabkhan, Y., Cummiskey, C., & Undakt, D. (2023). *Girls have academic advantages and so do boys: A multicountry analysis of gender differences in early grade reading and mathematics outcomes* (RTI Press Publication No. RR-0049-2305). RTI Press. <https://doi.org/10.3768/rtipress.2023.rr.0049.2305>
- Graham, M. A. (2025). Traditional bullying and cyberbullying as main drivers of low mathematics achievement in South African schools: Evidence from TIMSS 2019. *Education Inquiry*, 16(2), 157–176. <https://doi.org/10.1080/20004508.2023.2173122>
- Grgić, T., & Memisevic, H. (2025). Predicting early academic achievement: The role of teacher ratings, cognitive and motor skills, and gender. *Multidisciplinarni Pristupi u Edukaciji i Rehabilitaciji*, 7(10), 15–32. <https://doi.org/10.59519/mper7202>
- Huang, L. (2022). Exploring the relationship between school bullying and academic performance: the mediating role of students' sense of belonging at school. *Educational Studies*, 48(2), 216–232. <https://doi.org/10.1080/03055698.2020.1749032>
- Hysing, M., Askeland, K. G., La Greca, A. M., Solberg, M. E., Breivik, K., & Sivertsen, B. (2021). Bullying involvement in adolescence: Implications for sleep, mental health, and academic outcomes. *Journal of Interpersonal Violence*, 36(17–18), NP8992–NP9014. <https://doi.org/10.1177/0886260519853409>
- IBM Corp. (2020). *IBM SPSS Statistics for Windows* (Version 27) [Computer software]. IBM Corp.
- Klein, E., Bieck, S. M., Bloechle, J., Huber, S., Bahnmueller, J., Willmes, K., & Moeller, K. (2019). Anticipation of difficult tasks: Neural correlates of negative emotions and emotion regulation. *Behavioral and Brain Functions*, 15(1). <https://doi.org/10.1186/s12993-019-0155-1>
- Koca Guler, B., & Gokalp Yavuz, F. (2025). Data mining on the fundamental factors influencing mathematics achievement: traditional and modern perspectives. *European Journal of Education*, 60(4), Article e70281. <https://doi.org/https://doi.org/10.1111/ejed.70281>
- Kolbert, J. B., Schultz, D., & Crothers, L. M. (2014). Bullying prevention and the parent involvement model. *Journal of School Counseling*, 12(7), 1–20.
- Kristensen, S., & Smith, P. K. (2003). The use of coping strategies by Danish children classed as bullies, victims, bully/victims, and not involved, in response to different (hypothetical) types of bullying. *Scandinavian Journal of Psychology*, 44(5), 479–488. <https://doi.org/10.1046/j.1467-9450.2003.00369.x>
- Ladd, G. W., Ettekal, I., & Ladd, G. W. (2017). Peer victimization trajectories from kindergarten through high school: Differential pathways for children's school engagement and achievement?. *Journal of Educational Psychology*, 109(6), 826–841. <https://doi.org/10.1037/edu0000177>
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer Publishing.
- Martín, M. O. and Mullis, I. V. S. (2019). TIMSS 2015: Illustrating advancements in large-scale international assessments. *Journal of Educational and Behavioral Statistics*, 44(6), 752–781. <https://doi.org/10.3102/1076998619882030>
- Megreya, A. M., Hassanein, E. E., Al-Emadi, A. A., & Szűcs, D. (2025). Math anxiety mediates the association between gender and STEM-related attitudes: Evidence from a large-scale study. *Acta Psychologica*, 253, Article 104689. <https://doi.org/10.1016/j.actpsy.2025.104689>
- Meinck, S., & Brese, F. (2019). Trends in gender gaps: using 20 years of evidence from TIMSS. *Large-scale Assessments in Education*, 7, 1–23. <https://doi.org/10.1186/s40536-019-0076-3>
- Merkys, G., Vaitkevičius, S., Bubeliene, D., & Sakalauskas, L. (2025). Differences in mathematical and verbal achievement between girls and boys: The heuristic potential of the structural typing approach in large-scale studies. *European Journal of Education*, 60(1), Article e12802. <https://doi.org/https://doi.org/10.1111/ejed.12802>
- Mullis, I. V., Martin, M. O., & Jones, L. (2015). Third international mathematics and science study (TIMSS). In *Encyclopedia of science education* (pp. 1075–1079). Springer.

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- Murphy, D., Leonard, S., Taylor, L. K., & Santos, F. H. (2022). Educational achievement and bullying: The mediating role of psychological difficulties. *British Journal of Educational Psychology*, 92(4), 1487–1501. <https://doi.org/10.1111/bjep.12511>
- Nakamoto, J., & Schwartz, D. (2010). Is peer victimization associated with academic achievement? A meta-analytic review. *Social Development*, 19(2), 221–242. <https://doi.org/10.1111/j.1467-9507.2009.00539.x>
- Obregon-Cuesta, A. I., Mínguez-Mínguez, L. A., León-del-Barco, B., Mendo-Lázaro, S., Fernández-Solana, J., González-Bernal, J. J., & González-Santos, J. (2022). Bullying in adolescents: differences between gender and school year and relationship with academic performance. *International Journal of Environmental Research and Public Health*, 19(15), Article 9301.
- Özyıldırım, G., & Karadağ, E. N. (2024). The effect of peer bullying on academic achievement: A meta-analysis study related to the results of TIMSS and PIRLS. *Psychology in the Schools*, 61(5), 2185–2203. <https://doi.org/10.1002/pits.23159>
- Penner, A. M., & Paret, M. (2008). Gender differences in mathematics achievement: Exploring the early grades and the extremes. *Social Science Research*, 37(1), 239–253. <https://doi.org/https://doi.org/10.1016/j.ssresearch.2007.06.012>
- Reilly, D., Neumann, D., & Andrews, G. (2019). Investigating gender differences in mathematics and science: Results from the 2011 Trends in Mathematics and Science survey. *Research in Science Education*, 49, 25–50. <https://doi.org/10.1007/s11165-017-9630-6>
- Robinson, J. P., & Lubienski, S. T. (2011). The development of gender achievement gaps in mathematics and reading during elementary and middle school. *American Educational Research Journal*, 48(2), 268–302. <https://doi.org/10.3102/0002831210372249>
- Sanchis-Sanchis, A., Grau, M. D., Moliner, A.-R., & Morales-Murillo, C. P. (2020). Effects of age and gender in emotion regulation of children and adolescents. *Frontiers in Psychology*, Article 11. <https://doi.org/10.3389/fpsyg.2020.00946>
- Sawyer, A. L., Bradshaw, C. P., & O'Brennan, L. M. (2008). Examining ethnic, gender, and developmental differences in the way children report being a victim of “bullying” on self-report measures. *Journal of Adolescent Health*, 43(2), 106–114. <https://doi.org/https://doi.org/10.1016/j.jadohealth.2007.12.011>
- Schacter, H. L. (2021). Effects of peer victimization on child and adolescent physical health. *Pediatrics*, 147(1). Article e2020003434. <https://doi.org/10.1542/peds.2020-003434>
- Strøm, I. F., Thoresen, S., Wentzel-Larsen, T., & Dyb, G. (2013). Violence, bullying, and academic achievement: A study of 15-year-old adolescents and their school environment. *Child Abuse & Neglect*, 37(4), 243–251. <https://doi.org/10.1016/j.chiabu.2012.10.010>
- Sun, J., & Stewart, D. (2007). Age and gender effects on resilience in children and adolescents. *International Journal of Mental Health Promotion*, 9(4), 16–25. <https://doi.org/10.1080/14623730.2007.9721845>
- van Verseveld, M. D. A., Fekkink, R. G., Fekkes, M., & Oostdam, R. J. (2019). Effects of antibullying programs on teachers' interventions in bullying situations. A meta-analysis. *Psychology in the Schools*, 56(9), 1522–1539. <https://doi.org/https://doi.org/10.1002/pits.22283>
- Wardat, Y., Belbase, S., Tairab, H., Takriti, R. A., Efstratopoulou, M., & Dodeen, H. (2022). The influence of school factors on students' mathematics achievements in Trends in International Mathematics and Science Study (TIMSS) in Abu Dhabi Emirate schools. *Education Sciences*, 12(7), Article 424.
- Yin, L., & Foy, P. (2021). TIMSS 2023 Assessment Design. *TIMSS 2023 Assessment Frameworks*, 71.
- Zimmermann, P., & Iwanski, A. (2014). Emotion regulation from early adolescence to emerging adulthood and middle adulthood: Age differences, gender differences, and emotion-specific developmental variations. *International Journal of Behavioral Development*, 38(2), 182–194. <https://doi.org/10.1177/0165025413515405>

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