

BULLYING AS DRIVER OF LOW MATHEMATICS ACHIEVEMENT: SOUTH AFRICAN NO-FEE-PAYING SCHOOLS IN A CHALLENGED CONTEXT

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Abstract

Children in South Africa have the right to quality education free from harm. Still, incidents of school bullying continue to dominate South African news coverage. Creating a safe environment conducive to learning is vital to mathematics achievement (MA). We investigated the association between bullying and Grade 9 MA in South African public institutions that do not charge tuition. In South Africa, ordinary public schools are divided into five quintiles, with Quintiles 1 to 3 being in the most economically disadvantaged (poorest) geographic locations (no-fee-paying schools) and Quintiles 4 and 5 being in the wealthiest geographical areas (fee-paying schools). This study only considers schools in Quintiles 1 to 3 and uses Bronfenbrenner's ecological theory to investigate MA in a less-researched context (Global South) in schools in the most economically disadvantaged locations. We followed a quantitative design with a research paradigm of positivism and a secondary data analysis study design. We analysed Trends in International Mathematics and Science Studies (TIMSS) 2019 data, and, at Grade 9 level, South Africa was second to last in MA. We constructed a multi-level model containing 21 constructs; 20 independent variables (gender, socio-economic status (SES) and 18 bullying variables), with the dependent variable being MA. At learner-level, the unsurprising results were that learners who have been refused to talk to, their family insulted, made to do things they didn't want to do, sent nasty or hurtful messages online, shared nasty or hurtful things or embarrassing photos about them online and physically hurt, performed significantly worse than those where these occurrences happened less frequently. A surprising result is that learners who indicated they had been stolen from or had mean things said about their physical appearance outperformed learners where this was happening less frequently. For these results that seem counterintuitive, we give some suggestions on why this may be the case. At school-level, principals' beliefs concerning the level of severity of intimidation or verbal abuse amongst learners was a significant predictor. Learners must be reminded that there are clear policies that punish perpetrators of bullying. Since e-Learning has grown exponentially over the last two years due to COVID-19, we urge the inclusion of cyber-safety and cyber-protection strategies in all learner-teacher training. From the counterintuitive results, this study challenges deficit views by showing how learners living in disadvantaged areas and in a challenged context resile despite being bullied.

Keywords: *Bullying, mathematics achievement, TIMSS, socio-economic status, challenged context.*

1. Introduction and rationale

Bullying during childhood and adolescence, whether as bullies, victims, or spectators, has damaging and long-term implications, including negative behavioural results, mental health disorders, financial concerns, low psychological well-being, low social adjustment, coping difficulties, psychological distress, risk of suicide and poor academic achievement (Huang, 2022; Murphy, Leonard, Taylor, & Santos, 2022; Xie & Cui, 2022). We link traditional and cyber bullying to mathematics achievement (MA), as the Trends in International Mathematics and Science Study (TIMSS) 2019 results indicated poor MA for South African learners; second to last of 39 countries (Reddy et al., 2021). Traditional and cyber bullying in South African schools is becoming a growing concern, and this is especially true for cyber bullying as the United Nations Children's Fund (UNICEF) reported that the findings of the "Disrupting Harm Study" (UNICEF, n.d., para. 1) released in 2022 indicated that 70% of South African children are involved in risky online behaviour, such as cyber bullying, without parental consent. Although research has been undertaken linking bullying to learner MA, very few of these studies have taken into account the various hierarchical levels often present in an educational setting, for instance, a learner-level/level-1 (L1) and a school-level/level-2 (L2) and, to the best of our knowledge, no such study has been conducted previously by considering South African learners in disadvantaged communities. Learners from low-SES schools were selected over learners from high-SES schools, as

literature on South African education has shown that learners from lower-SES schools reported being bullied more often than learners in higher-SES schools (Johansson, Myrberg, & Toropova, 2022). This article aims to identify bullying-related variables that are significantly associated with MA and SA to give recommendations to the appropriate stakeholders on how to potentially minimise bullying in these sorts of schools. If problem areas can be identified, specifically for South African no-fee paying schools in disadvantaged communities, then interventions can be tailored and directed to address those specific problem areas, as opposed to having general interventions or training sessions on bullying. Thus, the current study contributes not only to the literature on how to improve MA in low-SES South African schools but also to the literature on resilience and bullying, as well as the associated interventions conducted with underserved youth in school settings, by recommending what these interventions should focus on. The research hypothesis for this study is: It is hypothesised that South African learners in disadvantaged communities in less-research contexts (Global South) that are bullied via traditional or online methods perform significantly worse in MA than learners that are not bullied.

2. Literature review and theoretical framework

Huang (2022) conducted a secondary data analysis (SDA) of Programme for International Student Assessment (PISA) China 2015 data and found that bullying victimisation and bullying climate were significantly associated reading, maths and science achievement. In another study in China, Xie and Cui (2022) (1,747 learners in Grades 4-9) found a significant association between peer victimisation and academic performance. Miskimon, Jenkins and Kaminski (2022) conducted a study on 676 secondary schoolchildren in the USA and found significantly poorer academic performance due to traditional and cyber bullying for girls. Murphy et al. (2022) conducted studies on 22,308 learners from Ireland aged 9-15 years and found that bullying contributed to lower performance in maths and literacy. Many studies aim to eliminate school bullying, but many strategies are too expensive for economically disadvantaged schools to apply. It may be argued that the government can pay for these interventions; however, government funding is limited. Some interventions need printing of materials (e.g., Salimi et al., 2019) and the acquisition of specialised equipment such as karate clothes (), making it more complicated than simply reimbursing a specialist for conducting a workshop (e.g., karate clothes; Greco, Fischetti, Cataldi, & Latino, 2019). Resilience skills have been linked to bullying research as they enable learners to effectively cope with and adjust to social struggles (Rich et al., 2019), such as bullying. Rich et al. (2019), who conducted a resilience-based intervention with underserved children (67 children from schools serving primarily learners from low-SES households in the USA), stated that the research on “school-based group interventions administered to low-SES minority students is limited” (p. 33) and that “Resilience-focused interventions seem to exclude the very people who might need them the most” (p. 33) and recommended that more studies relating to resilience and bullying need to be conducted with underserved youth in school settings. As is clear from the discussion above, it is evident that bullying leads to poor academic achievement and that many of the interventions to reduce bullying are expensive and, accordingly, may not even be feasible for South African no-fee paying schools in disadvantaged areas as these schools don’t have the flexibility to collect fees or raise finances as fee-paying schools do (Maistry & Africa, 2020). Bronfenbrenner (1977)’s ecological theory involves five systems referred to as the “microsystem” (e.g., the learner themselves), “mesosystem” (the connection between the structures of the learner’s microsystem, e.g., the learner and their friends), “exosystem” (e.g., formal institutions, such as the parents’ work environment and school environment) and “macrosystem” (the overall societal culture in which the learners live, e.g., SES and ethnicity). Links between the theoretical framework and the current study are considered in the Discussion Section.

3. Methodology

A quantitative, SDA was used with a positivism research paradigm, as this “bias-neutral paradigm” is linked to the scientific method where it is believed that “the natural and social world can be understood and improved by employing deductive reasoning and precise empirical scrutiny” (Reed, 2022, p. 317). TIMSS 2019 non-fee-paying schools were used and, in South Africa, the school finance model consists of five kinds of schools, known as Quintiles (Q) 1 through 5. These quintiles determine how much financing each school receives from the government. The lowest quintiles (Q1 to Q3) are non-fee-paying schools, whereas the top quintiles (Q4 and Q5) charge tuition. Q1 schools are located in the most economically disadvantaged (poorest) geographic areas, whereas Q5 schools are located in the wealthiest geographic areas (fee-paying schools). No-fee-paying schools are schools that receive all of their funding from the government and are prohibited from charging user or school fees. On the other side, fee-paying schools are permitted to collect fees, raise finances, and have greater control over operational revenue generation (Maistry & Africa, 2020). Items from the TIMSS 2019 learner questionnaire, which learners answered, were used at L1 (12,491 learners from no-fee-paying schools), and items from the TIMSS 2019 school questionnaire, which principals answered, and from the TIMSS

2019 teacher questionnaire, which teachers answered, were used at L2 (280 no-fee paying schools participated in TIMSS 2019). South Africa's TIMSS 2019 data collection occurred in Sep 2018 (Cotter, Centurino, & Mullis, 2020), and we refer readers to Cotter et al. (2020) for information regarding the rigour of TIMSS 2019 study. HLM version 7 was used to perform the multi-level analysis, with the dependent variable being the TIMSS MA 5 plausible values. The predictors used at L1 were 14 bullying items "Said mean things about my physical appearance (e.g., my hair, my size)", "Spread lies about me", "Shared my secrets with others", "Refused to talk to me", "Insulted a member of my family", "Stole something from me", "Made me do things I didn't want to do", "Sent me nasty or hurtful messages online", "Shared nasty or hurtful things about me online", "Shared embarrassing photos of me online", "Threatened me", "Physically hurt me" and "Excluded me from their group", and "Damaged something of mine on purpose" (TIMSS, 2018a, p. 12). At L2, the principals had to answer the level to which they agree the following are a problem: "Intimidation or verbal abuse among students" and "Physical injury to other students" (TIMSS, 2018b, p. 7). Also, at L2, the teachers had to indicate their level of agreement with the questions "This school has clear rules about student conduct" and "This school's rules are enforced in a fair and consistent manner" (TIMSS, 2018c, p. 3). Gender and SES were included in the model at L1 to control for, as this is practice for many studies (e.g., Kotok & Knight, 2022; Murphy et al., 2022), with Murphy et al. (2022) pointing out that many studies fail to control for key covariates such as SES. SES was controlled for since, though the focus of this study is on schools in a challenged context, there are substantive financial differences between the Q1, Q2 and Q3 schools in terms of funding allocated by the government. Group centring and grand centring were used at L1 at L2, respectively (Raudenbush & Bryk, 2002), and the weighting was done as per the recommendations of Stancel-Piątak et al. (2013).

4. Results and discussion

The null model without any variables was created to show the variance (*var*) between schools. The *var* at L1 and L2 are 3,061.58 and 733.83, representing 80.7% and 19.3% of the total *var*, respectively. The *var* at L2 is significantly different from zero ($\chi^2=3,801.13, p<0.001$), which means MA varied significantly across schools. The final (parsimonious) was created by adding all the predictors and control variables and then removing insignificant predictors one at a time until only significant variables remained. For the parsimonious model ($\chi^2=4,201.35, p<0.001$), the *var* at L1 is 2,770.60 and at L2 is 2,770.60, which signifies 79.4% and 20.6% of the total *var*, respectively. The average reliability estimate was 0.931, indicating that sample averages reflected the true school means. By comparing the *var* components of the parsimonious model to those of the null model, the percentage reduction in the *var* at L1 and L2 were 9.5% and 2.3%, respectively.

Table 1. Significant predictors of the parsimonious model.

Variable description	Coefficient	Standard Error	<i>t</i>	<i>p</i>
Intercept	357.70	2.41	148.62	<0.001*
L1: "Are you a girl or a boy?" ⁱ	1.38	1.32	1.03	0.312
L1: "Home educational resources" ⁱⁱ	0.34	0.44	0.78	0.444
L1: "Said mean things about my physical appearance (e.g., my hair, my size)" ⁱⁱⁱ	-1.58	0.50	-3.16	0.003*
L1: "Refused to talk to me" ⁱⁱⁱ	1.73	0.49	3.49	0.001*
L1: "Insulted a member of my family" ⁱⁱⁱ	4.10	0.52	7.86	<0.001*
L1: "Stole something from me" ⁱⁱⁱ	-7.01	0.51	-13.63	<0.001*
L1: L1: "Made me do things I didn't want to do" ⁱⁱⁱ	2.67	0.76	3.49	0.004*
L1: "Sent me nasty or hurtful messages online" ⁱⁱⁱ	1.61	0.65	2.52	0.014*
L1: "Shared nasty or hurtful things about me online" ⁱⁱⁱ	4.53	0.75	6.04	<0.001*
L1: "Shared embarrassing photos of me online" ⁱⁱⁱ	7.25	0.92	7.82	<0.001*
L1: "Physically hurt me" ⁱⁱⁱ	3.59	0.78	4.62	0.001*
L2: "Intimidation or verbal abuse among students" ^{iv}	7.09	1.76	4.02	<0.001*

*Significant at a 5% level of significance

ⁱResponse options: "1=Girl" and "2=Boy" TIMSS (2018a, p. 3)

ⁱⁱContinuous: "<8.4 few", "8.4-12.2 some", ">12.2 many" Yin and Fishbein (2020, p. 16.168)

ⁱⁱⁱResponse options: "1=At least once a week", "2=Once or twice a month", "3=A few times a year", "4=Never" TIMSS (2018a, p. 12)

^{iv}Response options: "1=Not a problem", "2=Minor problem", "3=Moderate problem", "4=Serious problem" (TIMSS, 2018b, p. 7)

From Table 1, some unsurprising results at L1 were: For learners who “refused to talk to me” ($\beta=1.73$, $p=0.001$), “insulted a member of my family” ($\beta=4.10$, $p < 0.001$), “made me do things I didn’t want to do” ($\beta=2.67$, $p=0.004$), “sent me nasty or hurtful messages online” ($\beta=1.61$, $p=0.014$), “shared nasty or hurtful things about me online” ($\beta=4.53$, $p < 0.001$), “shared embarrassing photos of my online” ($\beta=7.25$, $p < 0.001$), and physically hurt me” ($\beta=3.59$, $p=0.001$) happened to less frequently achieved higher scores than learners where these things happen more frequently. A surprising result at L1: The relationship between “said mean things about my physical appearance (e.g., my hair, my size)” and MA was significant ($\beta=-1.58$, $p=0.003$), indicating for every unit increase in the predictor, with an increase indicating mean things being said happens less frequently, MA decreased on average by 1.58. This surprising result could be attributed to the normalisation of obesity in South African schools, especially in economically disadvantaged areas (Long et al., 2022; Verduci, Di Profio, Fiore & Zuccotti, 2022). Since this predictor is about physical appearance and particularly mentions size as an example, the exponential increase in South African children that are obese may have skewed the results. Another surprising result at L1 was: The relationship between “stole something from me” and MA was significant ($\beta=-7.01$, $p < 0.001$), indicating for every unit increase in this predictor, with an increase indicating it is happening less frequently, MA decreased on average by 7.01. This could be explained by the fact that “stole something from me” can be construed in numerous ways. Some learners may have believed that a missing pencil or eraser constitutes theft, while others may have considered it primarily referring to larger objects such as calculators or textbooks. In the following cycle of TIMSS, it is suggested that the question’s wording be changed to “stole anything of value from me”. A surprising result at L2 was: The relationship between “Intimidation or verbal abuse among students” and MA was significant ($\beta=7.09$, $p < 0.001$), indicating for every unit increase in this predictor, with an increase indicating the beliefs of the principals that the level of severity of the problem is a serious one, MA increased on average by 7.09. This could possibly be due to the resilient nature of South African learners in challenged contexts, as reported by Theron, Ungar and Höltge (2022). If we had used the bullying scale developed by TIMSS by averaging the individual bullying items, we would not have discovered these surprising results not would we have seen that some of the bullying items were not found to be significant predictors.

5. Conclusion and recommendations

The TIMSS team must consider rephrasing the item phrased “stole something from me” to “stole anything of value from me”, as the results showed unexpected results for this item. It is recommended that more research be conducted in South African schools regarding cyber bullying, since scoping reviews such as the one by Evangelio, Rodríguez-González, Fernández-Río and Gonzalez-Villora (2022), who identified 43 articles between the years 2016 to 2020 on children start using mobile phones and social media and cyberbullying, found only two were based on South African schoolchildren. Although more literature is available on traditional than cyber bullying in South African schools, more research on traditional bullying can be conducted on learners from low-SES schools, as literature on South African education has shown that learners from lower-SES schools reported being bullied more often than learners in higher-SES schools (Johansson et al., 2022). Regarding bullying interventions, we recommend that focussed interventions be used with a focus on the predictors significantly negatively associated with achievement. Learners must be reminded that there are clear policies that punish perpetrators of bullying. Since e-Learning has grown exponentially over the last two years due to COVID-19, we urge the inclusion of cyber-safety and cyber-protection strategies in all student-teacher training. The consequences of this study’s findings extend beyond South Africa’s academic system. If bullying victimisation has a major detrimental effect on learner academic performance, then pervasive bullying may impair not only individual learners but also South Africa’s long-term economic development by retarding human capital growth. This is why studies like these carry weight, and the recommendations should be taken seriously by the relevant stakeholders.

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