

Does empathy and awareness of bullying affect the performance of Moroccan students in PISA?

Ilyas Tammouch¹, Abdelamine Elouafi¹, Soumaya Nouna²

¹Laboratory of Telecommunications Systems and Decision Engineering, Faculty of Science, Ibn Tofail University, Kenitra, Morocco

²Laboratory LAMSAD, Department of Mathematics and Informatics, Hassan First University of Settat, ENSA Berrechid, Berrechid, Morocco

Article Info

Article history:

Received Nov 10, 2024

Revised Jan 18, 2025

Accepted Jun 9, 2025

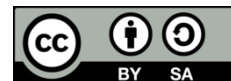
Keywords:

Academic performance
Double/debiased machine learning
Empathy
PISA
Socioemotional skills

ABSTRACT

Socioemotional skills, such as empathy and bullying awareness, play a pivotal role in shaping students' personal and academic development. These skills are increasingly recognized as critical factors influencing educational outcomes, particularly in addressing challenges like bullying that can hinder learning. This study examines the impact of empathy and bullying awareness on the academic performance of Moroccan students, using data from the 2018 Programme for International Student Assessment (PISA). To ensure robust causal inference in high-dimensional data, the double/debiased machine learning (DML) technique is employed. The findings reveal that higher levels of empathy and awareness of bullying significantly enhance performance across reading, mathematics, and science, with the most notable improvements observed in reading. These results remain consistent across various demographic and socioeconomic groups, highlighting their robustness. The study underscores the importance of integrating socioemotional learning into educational practices to foster academic success and create supportive school environments. By contributing to the growing evidence on non-cognitive skills in education, this research offers valuable insights for educators and policymakers seeking to improve student outcomes.

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Corresponding Author:

Ilyas Tammouch

Laboratory of Telecommunications Systems and Decision Engineering, Faculty of Science

Ibn Tofail University

14000 Kenitra, Morocco

Email: ilyas.tammouch@uit.ac.ma

1. INTRODUCTION

Bullying remains a pervasive issue in educational settings worldwide, manifesting in various forms such as physical, verbal, and cyberbullying, and it poses a significant challenge to student well-being and academic performance. This harmful conduct often involves aggressive or intentional behavior, characterized by a power imbalance between the aggressors and their victims. The impact of bullying is profound, leading to a range of emotional issues such as low self-esteem, anxiety, and emotional pain. These effects extend beyond personal distress, significantly impairing the academic abilities, personal life, career prospects, and social development of those targeted by bullying [1], [2]. In educational contexts, the repercussions of bullying can be seen in diminished academic performance, particularly in standardized assessments where the stress and anxiety induced by bullying can hinder students' ability to concentrate and perform to their full potential [3]-[5].

In the context of Morocco, where the issue of bullying is similarly prevalent, it is crucial to explore how factors such as empathy and a heightened awareness of bullying influence student performance, particularly in standardized assessments like the Programme for International Student Assessment (PISA). PISA, conducted every three years by the organization for economic cooperation and development (OECD), is a global assessment that evaluates the competencies of 15-year-old students in reading, mathematics, and science. The results of PISA are often used to gauge the quality and equity of educational outcomes across different countries, making it a critical tool for understanding student achievement in a global context [6]. Despite the significant attention bullying has received globally, there has been limited research specifically addressing the impact of empathy and awareness of bullying on the academic performance of Moroccan students in PISA.

This study seeks to address this gap by examining the relationship between empathy, awareness of bullying, and academic performance in the Moroccan context. Empathy, defined as the ability to understand and share the feelings of others, has been shown to play a crucial role in social interactions and can influence how students respond to and cope with bullying [7], [8]. A heightened awareness of bullying, on the other hand, can lead to more proactive measures to prevent and address bullying, thereby potentially reducing its negative impact on student well-being and academic performance. The proposed research aims to investigate the extent to which empathy and awareness of bullying predict performance in PISA domains: reading, science, and mathematics among a sample of Moroccan students. Additionally, the study will explore whether there are gender differences in empathy, awareness of bullying, and PISA performance among these students, as previous research has suggested that boys and girls may experience and respond to bullying differently [9]. Understanding the interplay between social dynamics, such as empathy and bullying awareness, and academic performance is crucial for fostering the holistic development of students. By investigating these relationships in the Moroccan context, this study aims to contribute to a more nuanced understanding of how social factors influence educational outcomes, thereby providing valuable insights for educators, policymakers, and researchers interested in improving student well-being and academic success in Morocco and beyond [10], [11].

2. LITERATURE REVIEW

The challenges of the 21st century demand that young people develop a broad range of skills that extend beyond traditional academic competencies. While literacy and numeracy remain critical, these cognitive skills represent only a portion of what is necessary for a successful life. Recent research underscores the importance of socioemotional skills traits that involve the psychological and emotional aspects of the individual in fostering personal, academic, and professional success [12], [13]. Among these socioemotional skills, empathy and awareness of bullying have emerged as particularly significant, especially in the context of their impact on academic performance.

Bullying, which includes behaviors such as physical aggression, verbal harassment, and cyberbullying, has been recognized as a pervasive issue in educational settings worldwide [14]. These behaviors mirror broader issues found in digital and physical spaces, as highlighted in studies on harmful behaviors like toxic comment detection and the nuanced forms bullying can take in different contexts [15], [16]. The detrimental effects of bullying extend far beyond the immediate harm to victims, influencing their emotional well-being, social relationships, and academic outcomes. Research shows that students who experience bullying often suffer from lower self-esteem, anxiety, and depression, all of which can negatively impact their ability to perform academically. Furthermore, bullying can create a hostile school environment that hinders learning and reduces overall academic engagement.

In this context, empathy and awareness of bullying are crucial socioemotional skills that can play a protective role in educational settings. Empathy, the ability to understand and share the feelings of others, has been shown to reduce bullying behaviors and increase prosocial actions among students [17]. Awareness of bullying, including recognizing its forms and understanding its consequences, can empower students to take action against bullying and create a more supportive and inclusive school environment [18], [19]. Furthermore, the relationship between socioemotional skills and academic performance has been explored in various international studies. For example, Brunello and Schlotter [20] used data from the PISA to demonstrate that higher scores on cognitive tests are influenced not only by cognitive abilities but also by socioemotional factors such as motivation, perseverance, and social skills. These findings highlight the importance of considering both cognitive and non-cognitive skills when evaluating student performance. In a study focusing on Brazilian students, Pereira [21] applied double/debiased machine learning (DML) techniques to analyze the role of empathy and awareness of bullying on academic outcomes in PISA [22]. Their findings indicate that students who are more empathetic or more aware of bullying tend to perform better in reading, mathematics, and science, with the most significant improvement observed in reading. These results remained consistent across different segments of the population, such as gender and the size of

the locality. Moreover, the performance boost was particularly notable among girls and students residing in regions with more than one million inhabitants. This study underscores the importance of socioemotional skills as a driver of educational success, particularly in contexts where bullying is prevalent.

In the context of Morocco, where research on the impact of bullying and socioemotional skills on academic performance is still emerging, it is essential to investigate how empathy and awareness of bullying influence educational outcomes. Studies in other countries have provided valuable insights. For instance, Gutierrez *et al.* [23] examined the effects of an anti-bullying intervention in Peruvian urban schools, which included raising students' awareness of bullying and encouraging them to oppose it. The intervention not only reduced bullying but also led to significant improvements in student performance on standardized tests, suggesting a strong link between a supportive school environment and academic success. National studies within Morocco, while limited, have begun to shed light on these dynamics. Guo *et al.* [24] conducted research in Recife, Brazil, demonstrating that socioemotional skills, particularly those related to empathy and bullying awareness, significantly enhance academic performance among students. Similarly, Guo *et al.* [24] found that socioemotional traits like openness to new experiences and conscientiousness are closely linked to student achievement in subjects such as mathematics and language arts.

The Moroccan context offers a unique opportunity to further explore these relationships, particularly in relation to how socioemotional skills like empathy and awareness of bullying affect performance in PISA assessments. As research continues to evolve, it is becoming increasingly clear that fostering these skills is not only important for reducing bullying but also for enhancing overall academic achievement. By understanding and developing socioemotional competencies, educators and policymakers can create more supportive and effective learning environments that help students succeed both academically and personally.

3. DATA AND METHODS

3.1. Data

This study utilizes data from the PISA 2018, which can be accessed through the OECD database (available at <https://www.oecd.org/pisa/data/2018database/>). PISA, conducted by the OECD, is a large-scale international assessment designed to evaluate the knowledge and skills of 15-year-old students nearing the end of their compulsory education. The primary objective of PISA is to assess how well students are prepared to meet real-world challenges and to gauge the effectiveness of different educational systems across the globe. The 2018 cycle of PISA focused heavily on reading literacy, but also included comprehensive evaluations of students' abilities in mathematics and science. Additionally, the assessment gathered detailed information about students' socioeconomic backgrounds, learning environments, and attitudes towards learning [6]. This rich dataset provides a unique opportunity to explore the competencies necessary for success in the 21st century, including both cognitive skills and the use of information and communication technology (ICT). By analyzing these data, researchers and policymakers can gain valuable insights into the factors that influence educational outcomes and the effectiveness of various educational practices worldwide [25], [26].

3.1.1. Variables

This study employs the average plausible values for math, science, and reading scores from the PISA assessment as the dependent variable. PISA measures students' capacity to apply knowledge in practical contexts. The use of plausible values allows for a nuanced representation of academic performance. Wu [27] asserts, academic performance should reflect students' cognitive abilities. Since these abilities are not directly measurable, plausible values serve to capture the range of possible outcomes around the observed scores. This methodology addresses uncertainties related to test content, conceptual difficulty, testing conditions, and the students' mental and physical state during the assessment. Table 1 provides a detailed summary of the key variables used in this study. The table highlights the dependent variables plausible values for math, reading, and science scores as well as the treatment variables related to affective empathy, motivational empathy, and awareness of bullying. These variables are crucial for understanding the relationship between empathy, awareness of bullying, and academic performance.

3.2. Methods

3.2.1. Data preprocessing

The data was prepared for analysis by cleaning, which involved removing rows where the independent variables were marked as 5 ('Valid Skip'), 7 ('Not Applicable'), 8 ('Invalid'), or 9 ('No Response').

Table 1. Descriptive statistics

| | Variables | Label |
|---------------------|---|--|
| Dependent variables | Y1 - pvl math: math score. Y2 - pvl read: reading score. Y3 - pvl scie: science score. | |
| Treatment variables | t1: Affective empathy. t2: Affective empathy. t3: Affective empathy. t4: Motivational empathy. t5: Awareness of bullying. | 1 if the student agrees or strongly agrees that it makes them angry to see that no one defends students from bullying, 0 otherwise. 1 if the student agrees that they feel bad when they see other student(s) bullying, 0 otherwise. 1 if the student agrees that he/she likes it when another student defends bullying victims, 0 otherwise. 1 if the student agrees that it is a good action to help students who cannot defend themselves, 0 otherwise. 1 if the student agrees or strongly agrees that it is wrong to participate in bullying, 0 otherwise |

3.2.2. Methodology

Understanding the impact of empathy and awareness of bullying on performance is challenging due to the non-random acquisition of these attributes. Factors such as parental involvement can simultaneously affect both the development of these skills and academic outcomes. These influencing factors, known as confounders, must be accounted for to accurately determine causal relationships.

To illustrate, consider an intervention applied to one group compared to a control group that did not receive the intervention. The effects of this intervention are assessed by observing the outcomes in both groups. Each participant, denoted as $i = 1, \dots, n$, has a potential outcome Y_{ti} , where the binary variable T_i equals 1 if the participant received the intervention and 0 if they did not. However, only one of these potential outcomes can be observed for each participant, while the alternative outcome remains unobservable. This issue exemplifies the fundamental challenge of causal inference [28].

The scenario in this article deals with the five levels of treatment defined in Table 2. Satisfying conditional independence requires observing all the variables that influence the student to undergo the treatment (which in this study is being more empathetic or more aware of bullying), as well as the outcomes of interest simultaneously. To satisfy this premise, we considered all the factors that promote the development of these socio- emotional skills, which were discussed in the introduction and in the literature review. Thus, the controls used will be the characteristics of the students, their personality traits, whether they have been victims of bullying, whether they have been looked after in pre-school. At the level of the guardian, we considered the environment provided by them, their view of social problems, their level of education, their monitoring of their children's childhood and adolescence and the interaction between the guardian and the school. The controls at school level were school structure, characteristics, functioning and climate. It should be noted that not only the raw variables were used as controls, but also their transformations (interactions and second-order powers). To this deed we used DML technique:

3.2.3. Double/debiased machine learning

DML is an advanced econometric technique designed to estimate causal parameters in high-dimensional settings where traditional methods might struggle. The method extends the classical approach to instrumental variable estimation and generalizes it to settings involving high-dimensional nuisance parameters that need to be controlled for accurately estimating the treatment effect [29]. The key innovation of DML is its ability to reduce the bias that typically arises in machine learning models when estimating treatment effects by employing a procedure known as double or debiasing [30]. This approach builds on the work by Chernozhukov *et al.* [31], who demonstrated that by combining machine learning techniques with a debiasing step, one could obtain consistent and asymptotically normal estimators for the treatment effect, even in the presence of high-dimensional covariates.

Mathematically, the DML procedure can be summarized by considering the partially linear model:

$$Y = D\theta_0 + g_0(X) + \epsilon \quad (1)$$

where Y is the outcome variable, D is the treatment variable, X represents the covariates, $g_0(X)$ is an unknown function of the covariates, and ϵ is the error term. The parameter of interest is θ_0 , which represents the causal effect of the treatment D on the outcome Y . In high-dimensional settings, estimating θ_0 , directly is challenging due to the complexity introduced by the function $g_0(X)$ [32], [33].

The DML technique addresses this challenge through a two-step process. In the first step, machine learning models are used to estimate the nuisance parameters specifically, the conditional expectation functions $E[Y | X]$ and $E[D | X]$. These estimations are used to construct orthogonalized versions of the outcome and treatment variables:

$$\tilde{Y} = Y - \hat{g}_0(X) \quad (2)$$

$$\tilde{D} = D - \hat{m}_0(X) \quad (3)$$

where $\hat{g}_0(X)$ and $\hat{m}_0(X)$ are the machine learning-based predictions for Y and D , respectively. In the second step, the treatment effect θ_0 is estimated using the orthogonalized variables \tilde{Y} and \tilde{D} , typically via ordinary least squares (OLS). This orthogonalization ensures that the estimation of θ_0 is less sensitive to errors in the first-stage nuisance parameter estimates, thereby reducing bias.

One of the core strengths of DML is its flexibility in incorporating various machine learning algorithms, such as Lasso, random forests, or neural networks, to model the nuisance parameters [34]. This adaptability is crucial in modern datasets where the number of covariates may be large or where the relationships between variables are complex and non-linear. By leveraging the predictive power of machine learning algorithms while maintaining the inferential properties of classical econometrics, DML offers a powerful tool for causal inference in contemporary empirical research [35], [36]. Moreover, the theoretical properties of DML have been rigorously established. Chernozhukov *et al.* [31] proved that under suitable regularity conditions, the DML estimator for θ_0 is \sqrt{n} -consistent and asymptotically normal, which allows for valid statistical inference using standard methods. This result is particularly valuable for researchers who need to quantify the uncertainty around their estimates or who wish to construct confidence intervals for treatment effects [37], [38]. In practice, DML has been applied in various fields, including economics, finance, and epidemiology, where researchers need to account for high-dimensional confounders while estimating causal effects. The technique has also been integrated into software packages, making it accessible to practitioners who are not necessarily experts in econometrics or machine learning [39], [40].

4. RESULTS AND DISCUSSION

This section explores the relationship between socioemotional factors, affective empathy, motivational empathy, and bullying awareness, and academic performance in Mathematics, reading, and science. Using the DML penalized linear regression (PLR) method, the results presented in Table 2 reveal statistically significant positive associations across all domains. The coefficients for each treatment variable are robust, with p-values consistently below 0.001, indicating the strength and reliability of the findings. Furthermore, the relatively small standard errors reflect the precision of these estimates, ensuring confidence in the conclusions.

Table 2. Impact of socioemotional factors on academic performance: DML PLR analysis

| Outcome variable | Treatment variable | Coefficient | Std Error | p-value |
|------------------|--------------------|-------------|-----------|---------|
| PV1MATH | t1 | 10.485 | 2.265 | < 0.001 |
| PV1MATH | t2 | 11.395 | 2.701 | < 0.001 |
| PV1MATH | t3 | 19.331 | 2.264 | < 0.001 |
| PV1MATH | t4 | 13.635 | 2.523 | < 0.001 |
| PV1MATH | t5 | 12.087 | 2.455 | < 0.001 |
| PV1READ | t1 | 13.296 | 2.101 | < 0.001 |
| PV1READ | t2 | 16.657 | 2.447 | < 0.001 |
| PV1READ | t3 | 19.331 | 2.264 | < 0.001 |
| PV1READ | t4 | 15.523 | 2.370 | < 0.001 |
| PV1READ | t5 | 15.764 | 2.256 | < 0.001 |
| PV1SCIE | t1 | 7.150 | 2.019 | < 0.001 |
| PV1SCIE | t2 | 11.100 | 2.335 | < 0.001 |
| PV1SCIE | t3 | 14.872 | 2.438 | < 0.001 |
| PV1SCIE | t4 | 11.171 | 2.393 | < 0.001 |
| PV1SCIE | t5 | 10.859 | 2.282 | < 0.001 |

Table 2 provides the coefficients, standard errors, and p-values for the associations between the socioemotional factors (t1–t5) and the academic performance outcomes (mathematics, reading, and science). The results show that affective empathy, motivational empathy, and bullying awareness all exhibit significant positive effects on academic performance across subjects. For instance, in mathematics (PV1MATH), the appreciation for defending victims (t3) shows the highest coefficient (19.331), suggesting a strong positive effect on student performance. Similar patterns are observed in reading and Science, where the coefficients for variables such as t3 and t4 remain substantial across all outcomes. The analysis shows that affective empathy plays a particularly important role in academic performance. Variables such as the anger at the lack of defense (t1), discomfort from witnessing bullying (t2), and appreciation for others defending victims (t3)

exhibit substantial positive effects, with the highest coefficient of 19.331 observed for t3 in reading. These results suggest that students who value prosocial actions, such as defending victims of bullying, tend to achieve better academic outcomes. This pattern underscores the significant role of emotional sensitivity in promoting academic engagement and performance, which aligns with previous research indicating a strong link between empathy and enhanced academic involvement [10].

Motivational empathy, captured through the belief in helping those who cannot defend themselves (t4), also shows significant positive associations with performance across all subjects. This suggests that students motivated by altruistic values not only develop stronger interpersonal relationships but also experience better academic outcomes. Similarly, awareness of bullying (t5), measured as the recognition of the wrongness of participating in bullying, demonstrates a meaningful impact on performance, particularly in reading and mathematics. This indicates that fostering a deeper understanding of bullying's consequences can contribute positively to students' academic success. To confirm the robustness of these results, additional validation techniques were applied. The DML framework incorporates cross-validation, reducing the risk of overfitting and ensuring that the observed associations are genuine and not artifacts of the dataset. Furthermore, stratified analyses across demographic and socioeconomic groups demonstrated consistent results, suggesting that the effects of socioemotional factors are universal across diverse student populations. The effect sizes are not only statistically significant but also practically meaningful; for example, the positive impact of t3 on reading (+19.331) underscores the substantial role of empathy in enhancing literacy outcomes. These findings emphasize the critical role of socioemotional skills in academic success, underscoring the need to integrate empathy-building and anti-bullying initiatives into school curricula. By cultivating these skills, schools can create supportive and inclusive learning environments that foster both academic and personal growth. This study contributes to the growing body of research that highlights the importance of non-cognitive skills in education, offering valuable insights for educators and policymakers aiming to enhance student performance. The robust and consistent results across subjects confirm that addressing socioemotional factors can significantly benefit students' educational outcomes, particularly in contexts where bullying and social challenges are prevalent. Future studies may explore how empathy training in school curricula enhances academic outcomes and how anti-bullying interventions improve engagement and achievement by fostering awareness of bullying's consequences.

5. CONCLUSION

This study examined the impact of socioemotional skills, particularly empathy and bullying awareness, on academic performance in Morocco, using data from PISA 2018. Our findings provide conclusive evidence that these socioemotional factors are significantly associated with improved academic outcomes, particularly in mathematics, reading, and science. By employing double machine learning (DML) techniques, the research ensured robust estimates by controlling for various confounding factors. The results underscore the importance of integrating programs that cultivate empathy and raise bullying awareness into school curricula. Such initiatives are critical for fostering safer, more inclusive learning environments that enhance student well-being while significantly improving academic outcomes. Future research could further explore how these programs directly influence bullying reduction, providing a deeper understanding of the mechanisms behind these positive educational impacts.

FUNDING INFORMATION

Authors state no funding involved.

AUTHOR CONTRIBUTIONS STATEMENT

| Name of Author | C | M | So | Va | Fo | I | R | D | O | E | Vi | Su | P | Fu |
|--------------------|---|---|----|----|----|---|---|---|---|---|----|----|---|----|
| Ilyas Tammouch | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | | ✓ | |
| Abdelamine Elouafi | | ✓ | ✓ | | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| Soumaya Nouna | ✓ | | ✓ | ✓ | ✓ | ✓ | | | ✓ | | ✓ | | ✓ | |

C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nterpretation

R : **R**esources

D : **D**ata Curation

O : **O**riginal Draft

E : **E**diting

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest related to this work.

DATA AVAILABILITY

The data that support the findings of this study are openly available in the OECD PISA 2018 database at <https://www.oecd.org/pisa/data/2018database/>.




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BIOGRAPHIES OF AUTHORS






Dr. Ilyas Tammouch    is a distinguished researcher at Ibn Tofail University, located in Kenitra, Morocco. His scientific interests are varied and cover areas such as machine learning, deep learning, data analysis, evaluation systems. He can be contacted at email: ilyas.tammouch@uit.ac.ma.



Abdelamine Elouafi    is currently a doctoral candidate at Ibn Tofail University, located in Kenitra, Morocco. Concurrently, he serves as a secondary school teacher at the Ministry of Education in Morocco. He earned his master's degree in decision-making informatics in 2019 from Sultan Moulay Slimane University in Beni Mellal, Morocco. Additionally, in 2016, he obtained a professional teaching license from the Higher Normal School of Fes, showcasing his commitment to education. In 2014, he achieved a license degree in computer engineering, electronics, and automation from Sultan Moulay Slimane University. His scientific interests are diverse, spanning areas such as machine learning, deep learning, data analysis, and system evaluation. He can be contacted at email: abdelamine.elouafi@uit.ac.ma.



Soumaya Nouna    is a researcher at the systems analysis and modelling and decision support research laboratory at Hassan First University in Settati. She is an expert in mathematics, ML, and DL. A doctoral researcher in mathematics and computer science, she brings a wealth of experience to her field. Her skills include the analysis of differential equations, and ML algorithms. She is also the author of numerous research articles and is constantly seeking to advance in her areas of expertise. She can be contacted at email: s.nouna@uhp.ac.ma.