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Article

Prediction of Academic Performance: Use of ICT at Home and School and Cyberbullying

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Abstract: Introduction: Post-pandemic, there has been significant investment in Information and Communication Technologies (ICT) in schools worldwide. Recent studies show a negative link between academic performance and issues like bullying and cyberbullying. **Objective:** This study aims to analyze and predict the relationship between PISA 2022 performance and bullying, cyberbullying, and ICT use at school and home in high (Level 6) and low (Level 1a) performance students. **Methodology:** A non-experimental, descriptive study using the PISA 2022 questionnaire. Participants: 613,744 students. Variables include: (i) Independent: (a) Bullying and cyberbullying (1–16 scale), (b) ICT use at school (1–7 scale), (c) ICT use at home (1–6 scale). (ii) Dependent: Scores in mathematics, reading, and science. Performance was dichotomized into: (i) Level 1a vs. Non-Level 1a (scores below 335 in Science and Reading, 358 in Math) and (ii) Level 6 vs. Non-Level 6 (scores above 708 in Science, 698 in Reading, 669 in Math). **Data Analysis:** Binary logistic regression was used to predict high performance based on predictors: (a) Bullying and cyberbullying, (b) ICT availability at school and home. **Results:** Online distress and cyberbullying increase the risk of low performance, with greater impact on low performers. **Conclusion:** Distress from online content and cyberbullying is a risk factor for academic performance. ICT access at home benefits academic results, while ICT use at school has varied effects depending on the subject.

Keywords: binary logistic regression; cyberbullying; performance; PISA 2022

1. Introduction

It is evident that significant investments have been made in Information and Communication Technologies (ICT) in educational institutions worldwide following the pandemic. Current studies have shown a non-positive association with academic performance and other consequences related to bullying and cyberbullying.

The interrelationship between Information and Communication Technologies (ICT), cyberbullying, and academic performance is a critical area of research.

Research indicates that the use of social networks is significantly related to academic performance, whereas Instagram does not show a direct and significant relationship with academic outcomes. This suggests that the impact of social networks on academic performance may vary depending on the platform (1).

Cyberbullying has been consistently shown to negatively affect academic performance. Studies reveal that cyberbullying victimization is associated with lower academic achievement and increased emotional distress, which can hinder students' ability to perform academically (1) (2) (3). Additionally, cyberbullying acts as a negative mediator between social media use and academic performance, exacerbating the adverse effects of excessive social media use on students' academic outcomes (1).

Several factors have been identified as predictors of cyberbullying perpetration and victimization. Risky ICT use, moral disengagement, and traditional bullying are significant predictors of cyberbullying behaviors (4). Additionally, factors such as age, gender, and the use of media platforms can moderate these relationships, influencing the likelihood of engaging in cyberbullying (5) (6). Psychological factors, such as self-esteem and antisocial behavior, also play a crucial role in shaping attitudes toward cyberbullying among university students (7).

Cyberbullying has profound emotional and social consequences, including increased emotional distress, anger, and feelings of helplessness among victims. These emotional impacts can further exacerbate academic challenges, as students struggle to cope with the psychological burden of cyberbullying (3) (8). The ability to adapt to university life and maintain positive relationships with peers

can mitigate some of these negative effects, highlighting the importance of supportive educational environments (9).

The complexity of cyberbullying and its impact on academic performance presents several challenges for researchers and educators. Developing predictive models and effective interventions requires a nuanced understanding of the various factors contributing to cyberbullying. Future research should focus on refining these models and exploring the role of ICT self-efficacy in preventing cyberbullying (10) (6). Additionally, it is necessary to implement comprehensive strategies that address both the technological and psychological aspects of cyberbullying to enhance students' academic and psychosocial well-being (7) (8).

In this context, we aim to analyze and predict the association between performance in the different competencies assessed in PISA 2022 and bullying and cyberbullying, as well as the availability and use of ICT at school and at home among high-achieving students (Level 6) and low-achieving students (Level 1a).

2. Materials and Methods

An ex-post-facto or non-experimental methodology was used. The study follows a descriptive design based on the application of a questionnaire.

2.1. Participants

A total of 613.744 students aged 15-16 participated in the PISA 2022 edition.

The sampling technique used is a two-stage cluster sampling method. First, schools are selected (a minimum of 150 per country), followed by the selection of students (35 students per school).

Regarding inclusion criteria, students must be 15 years old and have completed at least six years of schooling. As for exclusion criteria, students with intellectual or physical disabilities cannot participate, and they must have a limited proficiency in the language of instruction (less than one year of schooling in the test language, which is the language of instruction).

PISA establishes six proficiency levels in mathematics, reading, and science. Level 2 is considered the minimum proficiency level that all students should achieve by the end of secondary education. Students at Level 2 can, in practical terms, use basic algorithms, apply simple scientific knowledge, and interpret straightforward texts.

Students who reach Level 5 or Level 6 are the highest performers. For instance, they can effectively work with mathematical models in complex situations, comprehend abstract texts, and interpret and evaluate complex experiments. This study focuses on Level 6 students.

2.2. Research Variables

The variables are classified according to their role in the study as follows:(i) Exogenous or independent variables: (a) Bullying and cyberbullying (Scale from 0 to 16). (b) Availability and use of ICT at school (Scale from 0 to 7). (c) Availability and use of ICT at home (Scale from 0 to 6). (ii) Endogenous or dependent variables: Scores in mathematical, reading, and scientific competencies. The variable has been dichotomized into: (a) Level 6 versus Non-Level 6: Participants who achieve Level 6 in all three competencies have a minimum score of 708 points in Science, 698 points in Reading, and 669 points in Mathematics. (b) Level 1a versus Non-Level 1a: Participants who achieve Level 1a in all three competencies have a minimum score of 335 points in Science, 335 points in Reading, and 358 points in Mathematics.

Table 1. Lower scores in both performance levels across the three PISA 2022 competencies.

Level	Reading	Mathematics	Science
1a	355	358	335
6	698	669	708

2.3. Data Collection Instrument

In the PISA assessments, both students and the schools they attend are evaluated through a cognitive test and a context questionnaire.

Regarding students (the focus of this study), assessments are conducted to evaluate their competency levels in Mathematics (the main competency), Reading and Science (secondary competencies), as well as Creative Thinking (an innovative competency) and optionally Financial Literacy (an

international competency). All competencies are assessed considering content, processes, and contexts.

The competency assessment is complemented by a questionnaire that gathers information on family background, study habits, attitudes, and motivation.

The design of these instruments varies depending on the year and the competencies assessed. Readers interested in further details are encouraged to consult the official website of the Ministry of Education and Vocational Training (International Assessments).

For this study, the following questionnaires have been selected to evaluate the different variables under investigation:

2.3.1. Distress from Online Content and Cyberbullying (ICTDISTR)

Students' self-reported levels of distress when encountering various online situations (e.g., "Finding online content inappropriate for my age", "Receiving unpleasant, vulgar, or offensive messages, comments, or videos") in question IC181 were scaled into the "**Distress from Online Content and Cyberbullying**" index.

Each item included five response options: "This did not happen to me", "Not at all distressing", "A little distressing", "Quite distressing", "Very distressing".

The values for this index range from 0 to 16, where "This did not happen to me" was recoded as a missing variable, while the remaining responses were coded as follows: "Not at all distressing" = 1, "A little distressing" = 2, "Quite distressing" = 3, "Very distressing" = 4. The total score was obtained by summing the values of all items (Table 2).

Table 2. Distress from Online Content and Cyberbullying (ICTDISTR). How did you feel the last time you encountered the following situations? (Select one response per row).

Situation	This did not happen to me	Not at all distressing	A little distressing	Quite distressing	Very distressing
I found online content that was inappropriate for my age.	☐	☐	☐	☐	☐
I found discriminatory content online (e.g., related to ethnicity, gender, sexual orientation, or physical appearance).	☐	☐	☐	☐	☐
I received unpleasant, vulgar, or offensive messages, comments, or videos.	☐	☐	☐	☐	☐
Information about me was publicly shared online without my consent.	☐	☐	☐	☐	☐

Note: Source: OECD.

2.3.2. Availability and Use of ICT in School (ICTAVSCH)

The availability of ICT in school was gathered from IC170, where students' frequency ratings on how often they use various digital resources at school (e.g., "Desktop or laptop computer," "Smartphone") were used to create the "ICT Availability in School" index. Each of the seven items in this question included six response options: "Never or almost never", "Approximately once or twice a month", "Approximately once or twice a week", "Every day or almost every day", "Several times a day", "This resource is not available to me at school".

The index was calculated as the number of items where a value different from "This resource is not available to me at school" was marked, yielding a range from 0 to 7. Items 2-4 were included in several previous versions of the ICT questionnaire (Table 3).

Table 3. Availability and Use of ICT in School (ICTAVSCH). During this school year, how often have you used the following digital resources in class? (Select one response per row).

[illegible]

A smartphone (i.e., a mobile phone with Internet access)	☐	☐	☐	☐	☐	☐
Tablets (e.g., iPad®, Samsung Galaxy®) or e-books (e.g., Kindle™, Tagus, BQ Cervantes)	☐	☐	☐	☐	☐	☐
Internet access (excluding smartphones)	☐	☐	☐	☐	☐	☐
School portal (for checking schedules, absences, etc.)	☐	☐	☐	☐	☐	☐
Educational games, applications, or computer programs, and other learning tools (e.g., online assistance CK-12™ or Mathalicious®)	☐	☐	☐	☐	☐	☐
A learning management system or school learning platform (e.g., Blackboard®, Edmodo®, Moodle®, Google® Classroom™)	☐	☐	☐	☐	☐	☐

Note: Source: OECD.

2.3.2. Availability and Use of ICT Outside School (ICTAVHOM)

The availability of ICT outside school was assessed using **IC171**, where students rated how often they use various digital resources outside of school (e.g., "Desktop or laptop computer," "Smartphone") to create the **"Use of ICT Outside School"** index.

Each of the six items in this question included the following six response options: *"Never or almost never"*, *"Approximately once or twice a month"*, *"Approximately once or twice a week"*, *"Every day or almost every day"*, *"Several times a day"*, *"This resource is not available to me outside of school"*.

For each of the six items, a score of **"0"** was assigned when students selected *"This resource is not available to me outside of school"*, while all other responses were coded as **"1"**. The index was calculated as the sum of the **0-1** designations across the six items where students marked a value different from *"This resource is not available to me outside of school"*, yielding a score ranging from **0 to 6**. Items 2-4 were included in several earlier versions of the ICT questionnaire (**Table 4**).

Table 4. Availability and Use of ICT Outside School (ICTAVHOM). In this course, how often have you used the following digital resources outside of class (e.g., at home or wherever you usually access digital resources)? (Select one response per row).

Resource	Never or almost never	Once or twice a month	Once or twice a week	Every day or almost every day	Several times a day	I do not have access to this resource outside of class
A desktop or laptop computer	☐	☐	☐	☐	☐	☐
A smartphone (i.e., a mobile phone with Internet access)	☐	☐	☐	☐	☐	☐
Tablets (e.g., iPad®, Samsung Galaxy®) or e-books (e.g., Kindle™, Tagus, BQCervantes)	☐	☐	☐	☐	☐	☐
Internet access (excluding smartphones)	☐	☐	☐	☐	☐	☐
Educational games, applications, or computer programs, and other learning tools (e.g., online assistance CK-12™ or Mathalicious®)	☐	☐	☐	☐	☐	☐
Video games or online games (e.g., those used with gaming consoles such as PlayStation 4® or Nintendo Wii®, online gaming platforms like Steam®, or gaming apps like Angry Birds®)	☐	☐	☐	☐	☐	☐

Note: Source: OECD.

2.4. Procedure and Timing

The PISA 2022 assessment was conducted by specialized personnel external to the educational institutions. The participants were 15-year-old students, belonging to the generation born in 2007.

2.5. Data Analysis

The analysis was performed using the PISA 2022 database for Spain. A binary logistic regression analysis was conducted, employing the logit model (Logistic Probability Unit) using the enter method.

3. Results

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

To predict the occurrence of low performance based on a series of predictor variables linked to various factors (Bullying and Cyberbullying; Availability and Use of ICT in School; Availability and Use of ICT at Home), we opted for the logit model (Logistic Probability Unit) using the enter method. This technique was chosen as the most suitable for addressing the research objective and best fitting the nature of the dependent variables (nominal, binary). The results are analyzed based on competency levels.

3.1. High Performance (Level 6)

This study explores the relationship between various factors and academic performance, focusing on dependent and independent variables. The dependent variables include students' performance in reading, mathematics, and science, categorized as either high performance (Level 6) or not high performance (Not Level 6), with the distinction represented as dummy variables. Additionally, the study examines several independent variables that may influence academic outcomes. These include bullying and cyberbullying, measured on a scale from 0 to 16, as well as the availability and use of Information and Communication Technology (ICT) both in school (scale from 0 to 7) and at home (scale from 0 to 6). By analyzing these variables, the research aims to better understand the factors that contribute to students' academic success or challenges (see Table 5).

i) Dependent Variables: Performance (Reading, Mathematics, and Science): Yes (High Performance) and No (Not High Performance). The variable was dichotomized into: Level 6 vs. Not Level 6. Dummy Variable: YES – NO. Level 1a vs. Not Level 1a. Dummy Variable: YES – NO.

ii) Independent Variables: (a) Bullying and Cyberbullying (Scale from 0 to 16). (b) Availability and Use of ICT in School (Scale from 0 to 7). (c) Availability and Use of ICT at Home (Scale from 0 to 6).

The results of the probit models (β coefficients, summarized model data, and assigned cases for each model) are presented in Tables 4 (Reading), 5 (Mathematics), and 6 (Science).

Regarding model goodness-of-fit, it correctly classifies 97.7% of cases in Mathematics, 98.9% in Science, and 99.0% in Reading. The proposed model is accepted for all competencies.

According to the omnibus test: (i) The model presents a chi-square of 106.183, with 3 degrees of freedom and $p < 0.001$, indicating that it helps predict reading competency. (ii) The model presents a chi-square of 435.017 with 3 degrees of freedom and $p < 0.001$, indicating that it helps predict mathematical competency. (iii) The model presents a chi-square of 187.888, with 3 degrees of freedom and $p < 0.001$, indicating that it helps predict scientific competency.

The β coefficients indicate that the variables "Availability and Use of ICT in School" and "Availability and Use of ICT Outside of School" are positively related to high performance. In contrast, the variable "Distress from Online Content and Cyberbullying" is negatively related to the probability of achieving high performance.

Among all the selected variables, the one with the strongest explanatory power for high performance (Level 6) in the three competencies is "Availability and Use of ICT at Home" (its exponential of $b - \text{Exp}(b)$ is the farthest from 1). The results obtained are: (i) Reading [$\beta = .208$; $p < .001$]; (ii) Mathematics [$\beta = .350$; $p < .001$]; (iii) Science [$\beta = .224$; $p < .001$].

The relationship is positive and significant, indicating that greater access to and use of ICT at home increases the probability of reaching the highest level in reading, mathematics, and science.

Conversely, "Distress from Online Content and Cyberbullying" has less weight in determining the probability of high performance in all three competencies: (i) Reading [$\beta = -.014$; $p = .012$]; (ii) Mathematics [$\beta = -.032$; $p < .001$]; (iii) Science [$\beta = -.048$; $p < .001$].

Since the variable "Distress from Online Content and Cyberbullying" has negative and statistically significant coefficients in all three competencies (Reading, Mathematics, and Science), it can be

interpreted that a higher level of distress from online content and cyberbullying is associated with a lower probability of achieving high performance (Level 6) in the evaluated competencies.

We can conclude that students with high performance in all three competencies tend to have low levels of bullying and cyberbullying and high availability and use of ICT at home.

All logistic regression coefficients in the three competencies are significant; therefore, the three variables contribute significantly to predicting the probability of Y.

The constant expresses the value of the dependent variable when the independent variables are 0, which is not interpretable.

Additionally, the exponents of each β coefficient are included, expressing the change in "odds" (probability ratio of "occurrence" / "non-occurrence" of an event) when the independent variable increases by one unit. A value greater than 1.00 indicates an increase in the probability of occurrence (matching positive β coefficients). A value below 1.00 corresponds to variables with a negative β coefficient.

Thus, the variable with the greatest weight in the prediction equation is "Availability of ICT Outside of School" in all three competencies (Reading, Mathematics, and Science): (i) Reading [$\beta = .208$; $p < .001$]; (ii) Mathematics [$\beta = .350$; $p < .001$]; (iii) Science [$\beta = .224$; $p < .001$].

Conversely, "Distress from Online Content and Cyberbullying" significantly decreases the probability of achieving high performance in all three evaluated competencies: (i) Reading [$\beta = -.014$; $p = .012$]; (ii) Mathematics [$\beta = -.032$; $p < .001$]; (iii) Science [$\beta = -.048$; $p < .001$].

Table 5. Variables in the equation (Level 6).

		β	Standard error	Wald	gl	Sig.	Exp(B)	95% C.I. for EXP(β)	
								Lower	Higher
Reading	Distress from online content and cyberbullying	-.014	.006	6.321	1	.012	.986	.975	.997
	Availability and Usage of ICT at School	.036	.018	3.884	1	.049	1.037	1.000	1.075
	Availability and Usage of ICT at Home	.208	.031	45.57	1	<.001	1.231	1.159	1.308
	Constant	-5.926	.175	1147.49	1	<.001	.003		
Mathematics	Distress from online content and cyberbullying	-.032	.004	71.490	1	<.001	.969	.962	.976
	Availability and Usage of ICT at School	-.039	.011	12.922	1	<.001	.962	.942	.983
	Availability and Usage of ICT at Home	.350	.023	238.641	1	<.001	1.418	1.357	1.483
	Constant	-5.279	.128	1694.914	1	.000	.005		
Science	Distress from online content and cyberbullying	-.048	.006	72.396	1	<.001	.953	.943	.964
	Availability and Usage of ICT at School	.028	.018	2.546	1	.111	1.029	.994	1.065
	Availability and Usage of ICT at Home	.224	.031	53.302	1	<.001	1.251	1.178	1.328
	Constant	-5.694	.173	1083.391	1	<.001	.003		
a. Variables specified in Step 1: Distress from online content and cyberbullying, Availability and Usage of ICT at School, Availability and Usage of ICT at Home.									

Note: Source: OECD. $p < 0.05$ // $p < 0.01$ // $p < 0.001$.

3.2. Low Performance (Level 1a)

This study investigates the factors influencing academic performance by analyzing both dependent and independent variables. The dependent variables focus on students' performance in reading, mathematics, and science, with an emphasis on distinguishing between high performance (Level 1a) and non-high performance (Non-Level 1a). These categories are represented as dummy variables (YES – NO) for clear analysis. The independent variables under consideration include bullying and cyberbullying, measured on a scale from 0 to 16, and the availability and use of Information and Communication Technology (ICT) at both school (scale of 0 to 7) and home (scale of 0 to 6). By examining these variables, the research aims to uncover the potential relationships between these factors and academic achievement, providing valuable insights into how external influences may affect student performance (see Table 6).

i) Dependent variables: Performance (Reading, Mathematics, and Science): Occurrence (high performance) and Non-occurrence (non-high performance). The variable has been dichotomized into: Level 1a vs. Non-Level 1a. Dummy Variable: YES – NO.

ii) Independent variables: (a) Bullying and Cyberbullying (Scale of 0 to 16); (b) Availability and Use of ICT at School (scale of 0 to 7); (c) Availability and Use of ICT at Home (scale of 0 to 6).

The results of the probit models (β coefficients, summarized model data, and the cases assigned to each model) are presented in summary in Tables 8 (Reading), 9 (Mathematics), and 10 (Science).

According to the omnibus test: (i) The model presents a chi-square of 959.228, with 3 degrees of freedom and a p-value < 0.000 , indicating that it helps predict reading competence. (ii) The model presents a chi-square of 1027.087, with 3 degrees of freedom and a p-value < 0.001 , indicating that it helps predict mathematical competence. (iii) The model presents a chi-square of 1526.261, with 3 degrees of freedom and a p-value = 0.000, indicating that it helps predict scientific competence.

Regarding the goodness of fit, the model classifies 82.7% of the cases in Reading, 81.4% in Mathematics, and 82.4% in Science correctly. We accept the proposed model for all competencies.

Thus, the variable with the greatest weight in the prediction equation is "Availability of ICT at Home" in all three competencies (Reading, Mathematics, and Science): (i) Reading [$\beta=.118$; $p<.001$]; (ii) Mathematics [$\beta=.081$; $p<.001$]; (iii) Science [$\beta=.136$; $p<.001$].

Since we are predicting low academic performance and the variable "Availability of ICT at Home" has a negative relationship with the evaluated competencies (Reading, Mathematics, and Science), it can be interpreted that greater access to ICT at home is associated with poorer academic performance in these areas.

On the other hand, “Availability of ICT at School” has a lower weight in the probability of having low performance in all three evaluated competencies: (i) Reading [$\beta = -.008$; $p < .047$]; (ii) Mathematics [$\beta = .000$; $p = .924$]; (iii) Science [$\beta = -.001$; $p = .713$].

The coefficient is almost zero, indicating that the availability of ICT at school does not have a significant effect on performance in the three analyzed competencies. Additionally, the p-value is very high, suggesting that the relationship is not statistically significant except for the reading competency.

The variable "Distress from Online Content and Cyberbullying" on the other hand, has a positive weight (the highest of all variables) in the probability of having low performance in all three evaluated competencies: (i) Reading [$\beta = .023$; $p < .001$]; (ii) Mathematics [$\beta = .035$; $p < .001$]; (iii) Science [$\beta = .030$; $p < .001$].

The results show that the greater the distress from online content and cyberbullying, the higher the probability of achieving low academic performance.

Table 6. Variables in the equation (Level 1a).

		β	Standard error	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(β)	
								Lower	Higher
Reading	Distress from online content and cyberbullying	.023	.001	273.511	1	<.001	1.024	1.021	1.027
	Availability and Usage of ICT at School	.008	.004	3.936	1	.047	1.008	1.000	1.017
	Availability and Usage of ICT at Home	-.118	.005	499.892	1	<.001	.888	.879	.898
	Constant	-1.122	.028	1588.009	1	.000	.326		
Mathematics	Distress from online content and cyberbullying	.035	.001	646.514	1	<.001	1.035	1.033	1.038
	Availability and Usage of ICT at School	.000	.004	.009	1	.924	1.000	.992	1.008
	Availability and Usage of ICT at Home	-.081	.005	234.735	1	<.001	.923	.913	.932
	Constant	-1.267	.028	2030.107	1	.000	.282		
Science	Distress from online content and cyberbullying	.030	.001	457.547	1	<.001	1.030	1.028	1.033
	Availability and Usage of ICT at School	-.001	.004	.135	1	.713	.999	.991	1.007
	Availability and Usage of ICT at Home	-.136	.005	688.862	1	<.001	.873	.864	.882
	Constant	-.988	.027	1294.533	1	<.001	.372		

a. Variables specified in Step 1: Distress from online content and cyberbullying, Availability and Usage of ICT at School, Availability and Usage of ICT at Home.

Note: Source: OECD; $p < 0.05$ // $p < 0.01$ // $p < 0.001$.

The coefficient of the variable "Distress from online content and cyberbullying" is positive and statistically significant in all the assessed competencies (Reading, Mathematics, and Science). This indicates that greater distress from online content and cyberbullying is associated with a higher likelihood of academic underperformance.

Given that the β values are the highest among all the variables, it can be interpreted that the impact of this variable on academic performance is relevant and considerable. Moreover, the low p-value ($< .001$) confirms that this relationship is not due to chance and that the effect is statistically significant.

In summary, distress caused by online content and cyberbullying represents a significant risk factor for low academic performance, suggesting the need for prevention and support strategies to mitigate its effects on students.

3.3. Comparative Analysis: Low Performance vs. High Performance

This section explores the factors that predict both high and low academic performance. The data reveal that the most significant predictor of high performance is the availability and usage of ICT at home, which shows strong positive correlations with reading, mathematics, and science scores. In contrast, while the use of ICT at school positively impacts reading and science, it has a slight negative effect on mathematics. Additionally, distress from online content and cyberbullying is associated with lower performance across all subjects. On the other hand, for students with low performance, a lack of access to ICT at home is linked to poorer outcomes, while the availability of ICT at school does not seem to play a significant role. Distress from online content and cyberbullying, however, is positively associated with low performance, suggesting that these factors may contribute to lower academic achievement.

i) Factors that Predict High Performance: The data show that the factor with the greatest positive influence on high performance is the availability and usage of ICT at home, with values of 0.208 in Reading, 0.350 in Mathematics, and 0.224 in Science. That is, access to technology at home is strongly related to better performance in all areas.

On the other hand, the availability and usage of ICT at school also has a positive impact on Reading (0.036) and Science (0.028), although it has a slight negative effect on Mathematics (-0.039).

In contrast, distress from online content and cyberbullying has a negative effect on all areas, with values of -0.014 in Reading, -0.032 in Mathematics, and -0.048 in Science, suggesting that students who experience more distress from these factors tend to achieve lower performance.

ii) Factors that Predict Low Performance: For students with low performance, it is observed that the availability and usage of ICT at home has a negative relationship in all areas (-0.118 in Reading, -0.081 in Mathematics, and -0.136 in Science), indicating that students with less access to technology at home tend to perform worse. Furthermore, the availability and usage of ICT at school shows values close to zero, suggesting that it is not a determining factor for low performance. Finally, distress from online content and cyberbullying has positive values (0.023 in Reading, 0.035 in Mathematics, and 0.030 in Science), indicating that students with higher distress tend to belong to the low-performance group (Table 7).

Table 7. Comparative of the β Values in the Different Proposed Models.

Performance	Distress from Online Content and Cyberbullying	Availability and Use of ICT at School	Availability and Use of ICT at Home
Reading			
High (Nevel 6)	-.014	.036	.208
Low (Nevel 1a)	.023	.008	-.118
Mathematics			
High (Nevel 6)	-.032	-.039	.350
Low (Nevel 1a)	.035	.000	-.081
Science			

High (Nevel 6)	-.048	.028	.224
Low (Nevel 1a)	.030	-.001	-.136
Codes	Risk Factors	Protective Factors	Non-Determinant Factor

The common factor that contributes to increasing the risk of low performance is distress from online content and cyberbullying, as it has a negative effect on academic performance in both high and low-performing students. In high-performing students, this distress decreases their performance, while in low-performing students, its presence is more frequent, suggesting it is associated with lower academic achievement.

On the other hand, the factor that helps reduce the risk of low performance is the availability and use of ICT at home, as it is positively associated with high performance in all areas. That is, students who have access to technology at home are more likely to achieve better results in reading, mathematics, and science.

4. Discussion

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

Based on the obtained data, it was observed that the variables predicting high academic performance in the evaluated levels vary depending on the subject analyzed. First, the variable distress from online content and cyberbullying showed an inverse relationship with performance in Mathematics ($\beta = -0.032, p < 0.001$) and Science ($\beta = -0.048, p < 0.001$), indicating that a higher level of distress decreases the likelihood of better performance in these areas. In the case of Reading, although the relationship is also negative, its effect is weaker ($\beta = -0.014, p = 0.012$).

On the other hand, the availability and use of ICT at home were identified as a factor that increases the likelihood of achieving better results in all the subjects evaluated. Its effect is most pronounced in Mathematics ($\beta = 0.350, p < 0.001$), followed by Science ($\beta = 0.224, p < 0.001$) and Reading ($\beta = 0.208, p < 0.001$). This suggests that access to technological resources at home can be a determining factor in academic performance.

Regarding the availability and use of ICT at school, its impact is not uniform across all areas. In Reading, it was identified as a positive predictor of performance ($\beta = 0.036, p = 0.049$), while in Mathematics, a significant negative relationship was found ($\beta = -0.039, p < 0.001$), suggesting that greater use of ICT at school might be associated with lower performance in this subject. In Science, although the relationship is positive ($\beta = 0.028$), it did not reach statistical significance ($p = 0.111$), indicating that its effect in this area is inconclusive.

In summary, the results suggest that distress from online content and cyberbullying acts as a risk factor for academic performance, while access to ICT at home favors results in all evaluated areas. However, the use of ICT at school shows a differentiated impact depending on the subject, with a negative effect in Mathematics and a positive one in Reading. These findings highlight the importance of considering the context in which students access and use digital technologies, as well as the need for strategies that reduce the negative impact of cyberbullying on academic performance.

Regarding the prediction of low performance, the results show that the variables influencing academic performance vary according to the subject evaluated.

First, distress from online content and cyberbullying is associated with lower performance in all areas. Its effect is most significant in Mathematics ($\beta = 0.035, p < 0.001$) and Science ($\beta = 0.030, p < 0.001$), while in Reading, although it also has a negative impact, its magnitude is smaller ($\beta = 0.023, p < 0.001$). This suggests that students who experience high levels of distress due to online content and cyberbullying are less likely to achieve good academic results.

On the other hand, the availability and use of ICT at home is identified as a key factor for academic performance. In all evaluated subjects, its effect is positive and significant. Its greatest impact is observed in Science ($\beta = -0.136, p < 0.001$), followed by Mathematics ($\beta = -0.081, p < 0.001$) and Reading ($\beta = -0.118, p < 0.001$). These results indicate that access to technology at home supports learning and improves academic outcomes.

Regarding the availability and use of ICT at school, the results show a variable impact depending on the subject. In Reading, its effect is positive and significant ($\beta = 0.008, p = 0.047$), suggesting that the use of ICT in the school environment may improve performance in this area. In Mathematics, no

significant relationship was found ($\beta = 0.000$, $p = 0.924$), while in Science, its effect is practically null and not significant ($\beta = -0.001$, $p = 0.713$), indicating that its influence in these subjects is not relevant.

In conclusion, the findings highlight distress from online content and cyberbullying as a risk factor that negatively impacts performance in all evaluated areas. In contrast, the use of ICT at home supports learning and improves results in Reading, Mathematics, and Science. However, the use of ICT at school shows a positive impact on Reading but does not have a significant effect on Mathematics and Science. These results emphasize the importance of promoting a safe digital environment for students and optimizing the use of technology both at home and at school to improve academic performance.

5. Conclusions

The results suggest that, in some contexts, access to technology at home does not improve academic performance and, in some cases, may even harm it. This could be due to the non-educational use of ICT, lack of supervision, and over-reliance on technology instead of traditional learning methods. It is essential to promote strategies for the educational use of ICT, ensuring that they do not become a distraction or barrier to learning (11).

When ICT is used without proper guidance, it can reduce academic performance. The lack of supervision and use for recreational purposes negatively affects learning. This highlights the need for policies that encourage structured and supervised use of technology at home (12) (13).

On the other hand, the results from level 6 show that the proper use of ICT at home can improve performance, especially in mathematics and science. To achieve this, it is crucial that students receive guidance on the educational use of ICT, supported by teachers and parents, thus maximizing its benefits (14).

Online bullying and digital stress are factors that negatively affect academic performance, especially in mathematics. The implementation of cyberbullying prevention programs and emotional support is crucial to ensuring a safe digital environment that promotes learning (15).

Educational policies have a limited impact on the use of ICT outside the classroom, as factors such as socioeconomic status and resource availability play an important role. It is necessary to offer more opportunities to integrate ICT into learning, ensuring that they are used productively and without the risks of addiction or cyberbullying (16).

The study has some limitations, such as the lack of control over contextual factors and the cross-sectional nature of the analysis. In the future, longitudinal studies will be conducted to assess the long-term impact of ICT on academic performance, as well as explore the effect of different pedagogical strategies.

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Informed Consent Statement: Not applicable. We would like to inform you that this requirement does not apply in this study when using open-access databases. Specifically, the data available on the website of the Organisation for Economic Co-operation and Development (OECD) can be used without additional restrictions. You can access these databases through the following link: <https://www.oecd.org/en/data/datasets/pisa-2022-database.html>

Data Availability Statement: We are attaching the syntax and the obtained results for your reference.

Conflicts of Interest: The authors declare no conflicts of interest

Abbreviations

The following abbreviations are used in this manuscript:

OECD Organisation for Economic Co-operation and Development
PISA 2022 Programme for International Student Assessment

Appendix A

The annexes will include the results of the contingency table analysis (CROSSTABS) applied to the data from *ConjuntoDatos1*. This analysis will examine the relationship between performance

levels in mathematics, reading, and science for levels 6 and 1A, based on variables related to access and use of information technology (ICTDISTR, ICTAVSCH, ICTAVHOM).

Key statistics such as Chi-square, contingency coefficients (CC, Phi, Lambda, among others), as well as association and concordance measures (ETA, Gamma, Kendall's Tau) will be presented. Additionally, tables with the counts of each variable combination and bar charts will be included to facilitate visual interpretation of the results.

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