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Impacto de la comprensión lectora en el aprendizaje de las matemáticas

Impact of Reading Comprehension on the learning of Mathematics

Impacto da compreensão da leitura na aprendizagem da matemática

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Resumen

En la actualidad, uno de los desafíos primordiales que enfrentan los estudiantes de niveles educativos primario y secundario es la deficiencia en la comprensión lectora, lo cual repercute de manera significativa en el proceso de aprendizaje de las matemáticas a escala nacional, como evidencian los resultados obtenidos en la evaluación PLANEA 2017 (Plan Nacional para la Evaluación de los Aprendizajes[1]). Por eso, en el presente estudio se procuró responder la siguiente interrogante: ¿cuál es la relación entre el nivel de comprensión lectora y el desempeño en matemáticas en alumnos de tercer año de la Escuela Secundaria Técnica nro. 71, ubicada en Torreón, Coahuila, México? Para responder esta pregunta se llevaron a cabo análisis estadísticos que comprendieron los siguientes pasos: 1) se evaluó la fuerza de asociación entre las variables de comprensión lectora (X) y matemáticas (Y), lo cual arrojó los siguientes resultados: la prueba de correlación de Rho de Spearman ($r_s = 0.391$) reflejó una correlación positiva baja, lo que indica que un incremento en la comprensión lectora se asocia con un aumento en el desempeño en matemáticas, aunque no necesariamente en la misma magnitud. Al respecto, cabe destacar que dicho coeficiente no establece una relación causal entre las variables, sino que ofrece una perspectiva sobre su comportamiento conjunto. 2) Se

[1] PLANEA (Plan Nacional Para La Evaluación De Los Aprendizajes), el cual se puede consultar en el link: https://planea.sep.gob.mx

observó que el promedio de aciertos en comprensión lectora (22.16) fue significativamente superior al promedio en matemáticas (19.06), y 3) se determinó la ecuación lineal de regresión de Y respecto a X, que proporciona una aproximación de la relación de dependencia entre ambas variables, expresada como Y=6.472 + 0.568 X. Esta ecuación indica que cuando el nivel de comprensión lectora (X) es igual a 1, el desempeño en matemáticas (Y) es 0.568. En términos más claros, por cada incremento de 10 aciertos en comprensión lectora, se proyecta un aumento de 5.68 aciertos en matemáticas.

Palabras clave: coeficiente de correlación, nivel de aprendizaje, significancia estadística, prueba de hipótesis, Rho de Spearman, regresión lineal.

Abstract

The problems that students at the basic Primary and Secondary level currently face are the lack of Reading Comprehension, which has an impact from our point of view on the learning of Mathematics at the national level, as indicated by the results of the PLANEA 2017 test. (National Plan for the Evaluation of Learning). The research question posed was the following: Identify what is the relationship between the level of learning of Reading Comprehension and Mathematics in third year students of the Technical Secondary School No. 71 of Torreon, Coahuila, Mexico? To provide an answer, the following statistical tests were carried out: 1) measure the strength of association between the variables Reading Comprehension (X) and Mathematics (Y), finding the following findings: Spearman's Rho test (rs=0.391) indicated by its direction is positive and due to its magnitude it is a low positive correlation, that is to say that while Reading Comprehension increases, mathematics also increases, although not in the same proportion, although said coefficient does not measure the cause-effect relationship, it does provide us with a clear idea of the behavior of both variables, 2) it was found that the average number of correct answers obtained in Reading Comprehension 22.16 is significantly higher than the average obtained in Mathematics 19.06, and 3) the linear equation of Y over the dependency relationship between both variables given by Y=6.472+0.568X, which tells us that when “X” (Reading Comprehension) is equal to 1 “Y” (Mathematics) is equal to 0.568, so that it is better understood for every 10 correct answers in Reading Comprehension there will be 5.68 correct answers in Mathematics.

Key words: Correlation coefficient, Learning level, Statistical significance, Hypothesis testing, Spearman's rho, Linear regression.

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Resumo

Atualmente, um dos principais desafios enfrentados pelos alunos dos níveis de ensino primário e secundário é a deficiência na compreensão da leitura, o que tem um impacto significativo no processo de aprendizagem da matemática à escala nacional, conforme evidenciado pelos resultados obtidos na avaliação do PLANEA 2017. (Plano Nacional de Avaliação da Aprendizagem). Portanto, no presente estudo procuramos responder à seguinte questão: qual a relação entre o nível de compreensão de leitura e o desempenho em matemática em alunos do terceiro ano do Ensino Médio Técnico nº. 71, localizado em Torreón, Coahuila, México? Para responder a essa questão foram realizadas análises estatísticas que incluíram as seguintes etapas: 1) avaliou-se a força de associação entre as variáveis de compreensão leitora (X) e matemática (Y), que gerou os seguintes resultados: o teste de correlação Rho de Spearman (r_s=0,391) refletiu uma correlação positiva baixa, indicando que um aumento na compreensão da leitura está associado a um aumento no desempenho em matemática, embora não necessariamente na mesma magnitude. Neste sentido, importa referir que este coeficiente não estabelece uma relação causal entre as variáveis, mas antes oferece uma perspetiva sobre o seu comportamento conjunto. 2) Observou-se que a média de acertos em compreensão leitora (22,16) foi significativamente superior à média em matemática (19,06) e 3) foi determinada a equação de regressão linear de Y em relação a X, que fornece uma aproximação de a relação de dependência entre ambas as variáveis, expressa como Y=6,472 + 0,568 Em termos mais claros, para cada aumento de 10 acertos na compreensão de leitura, projeta-se um aumento de 5,68 acertos em matemática.

Palavras-chave: coeficiente de correlação, nível de aprendizagem, significância estatística, teste de hipóteses, Rho de Spearman, regressão linear.

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Introduction

It is of utmost importance to delve into the repercussions of reading comprehension deficiency in our students and its influence on the mathematics learning process. This concern arises because the majority of students face difficulties in performing basic mathematical operations tasks, which are fundamental skills not only in the educational field, but also in everyday activities. Therefore, it is crucial to address this problem from various perspectives and look for intervention alternatives that contribute to the educational development of young people.

In the Mexican context, the PLANEA test emerges as a public policy with the purpose of evaluating the extent to which students manage to master a set of essential learning at the end of secondary education, particularly in the fields of reading comprehension and mathematics. This evaluation is applied at the national level in all schools of the basic education subsystem, and is aimed at third-year high school students. The results of these tests, broken down by state, campus and student, are available online through the following link: https://planea.sep.gob.mx.

It is important to highlight that all these evaluations are based on a quantitative scale, as they focus on the number of correct answers, the score or the grade obtained, and attempt to evaluate the performance of the group or the individual student (the latter is the object of our research).). Among the previous research found on this topic, the following stand out. For example, López (2021) presented a bachelor's thesis called *Reading Comprehension and Mathematics. Pearson's test* , where he found that r = 0.426, that is, a positive relationship; In fact, due to its magnitude, it can be indicated that it is a medium positive correlation.

Likewise, the findings of Marchena and Quiroga (2005) demonstrate an association between the lack of reading comprehension and the inability to solve mathematical problems. That research indicated that students' difficulty understanding what was asked of them in math problems was directly related to their limited reading comprehension, which hindered their ability to perform math operations.

On the other hand, Bastiand (2012) examined the relationship between reading comprehension and mathematical problem solving, and found that there is a significant correlation between both skills. According to the results, significant learning in reading comprehension contributes to a better ability to solve mathematical problems , which underlines the crucial importance of developing effective reading comprehension skills for success in this science.

Likewise, in a study carried out by Cubas (2007), students' attitudes towards reading comprehension and its possible influence on problem solving were explored. The results suggested that there is a low interest in reading among young people, which in turn may negatively affect their willingness to understand and solve mathematical problems.

Now, this theoretical review highlights the notable concentration of research in Lima, Peru, compared to the small number of studies in Mexico on the topic of this work. This disparity constitutes a crucial point to explore alternatives that address this important problem in the educational field.

Theoretical framework

According to the Royal Spanish Academy, reading can be conceived as the action of reading and the interpretation of the meaning of a text. This leads us to question whether students really read today and if they are capable of making an adequate interpretation of the textual content.

Goodman (1982), for his part, proposes that reading is a psycholinguistic process of guessing, in which thought and language interact continuously. This author maintains that there is a unique reading process, applicable to all languages from a universal and multilingual perspective.

On the other hand, (Bolívar and Guevarra, 2000) and (Chavez-Duque et al. 2022) define reading as a process self-directed by the reader, which extracts from the text a meaning previously encoded by the writer. According to these authors, reading involves a series of essential factors and elements that generate a diversity of strategies to solve the problems that arise during said act.

Bautista (2015) states that reading is an experience that involves the reader's interaction with the text they are reading. This approach highlights that reading is not only about understanding the text, but also about engaging with it, criticizing it, and moving beyond the ideas expressed. For his part, Freire (1989) maintains that reading goes beyond the mere decoding of words or written languages, so it includes the interpretation of images and designs. For Freire, furthermore, reading implies a relationship between the subject and the object, as well as the interpretation of the code that is given to the text through the senses.

Ramírez (August 21, 2017) highlights that at the high school or undergraduate levels, the concept of understanding is broader, as it encompasses the ability to

understand, justify or analyze. It also points out that the skills necessary for reading comprehension at these educational levels include the use of prior knowledge, anticipation, prediction, observation, monitoring, inference, paraphrase, analysis and conclusion. Thus, reading comprehension manifests itself at different levels of depth, since readers perceive and understand the text differently. In addition to this, the author explains that the implementation of appropriate strategies can improve the understanding process.

In accordance with the last idea, Garavito (2008) implemented a program to improve reading comprehension for four months, which demonstrated the importance of developing this skill when facing a text.

Methodology

The methodology used in this research adopted a quantitative correlational approach, with a non-experimental and cross-sectional design. Likewise, a pilot test was carried out using the data generated by the PLANEA 2017 test, which was administered to third grade students of Technical Secondary School no. 71 Adolfo López Mateos, located in Torreón, Coahuila.

The sample was made up of 113 students, selected randomly, of whom both correct and incorrect responses were recorded in the areas of reading comprehension and mathematics.

Data processing was carried out using the SPSS statistical package (Statistical Package for Social Sciences), version 25, to obtain the corresponding tables. In addition, the figures were prepared using the Office Excel spreadsheet.

Results

In order to select the most appropriate test statistic to evaluate the strength of association between the variables, a normality analysis was carried out for both variables using the SPSS statistical *software* . The results obtained were the following:

Table 1. Normality test

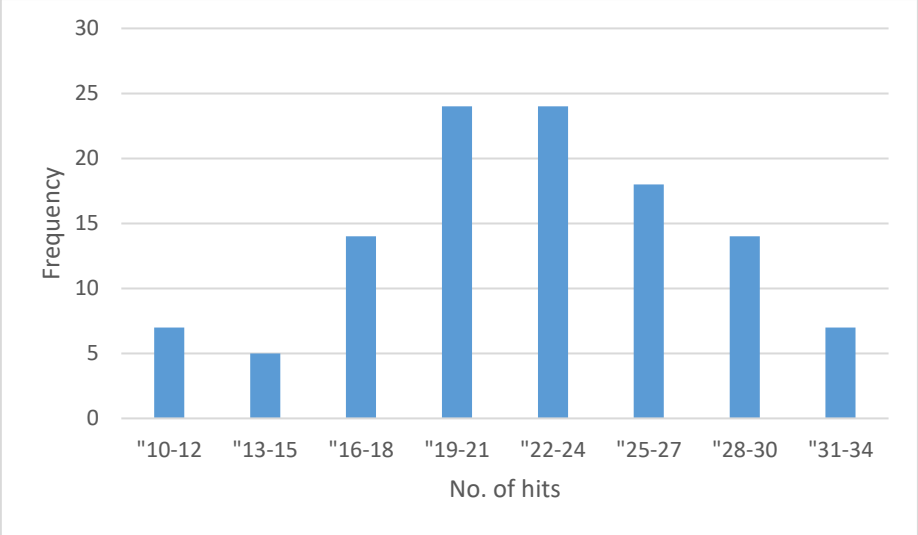
	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistical	Gl	Sig.(p-value)	Statistical	gl	Next.
Reading comprehension	0.053	113	.200*	0.987	113	0.332
Math	0.187	113	0	0.886	113	0

Source: self made

From table 1, it is observed that in the Kolmogorov-Smirnov test , the p-value for the *reading comprehension variable* was 0.200, and for the Shapiro-Wilk test it was 0.332. In both cases, these values are higher than the established level of significance (α = 0.05), that is, 0.200 > 0.05 and 0.332 > 0.05, which indicates that the *reading comprehension variable* follows a normal distribution. However, for the *mathematics variable* , it is observed that the p-value is equal to 0 in both tests, which is less than 0.05, that is, 0 < 0.05. This suggests that the *math variable* does not follow a normal distribution. Given that one of the variables does not meet the normality condition, the most appropriate test to measure the strength of association is Spearman's Rho (r_s).

The distribution of the data, grouped by the number of correct answers, is presented in Figure 1.

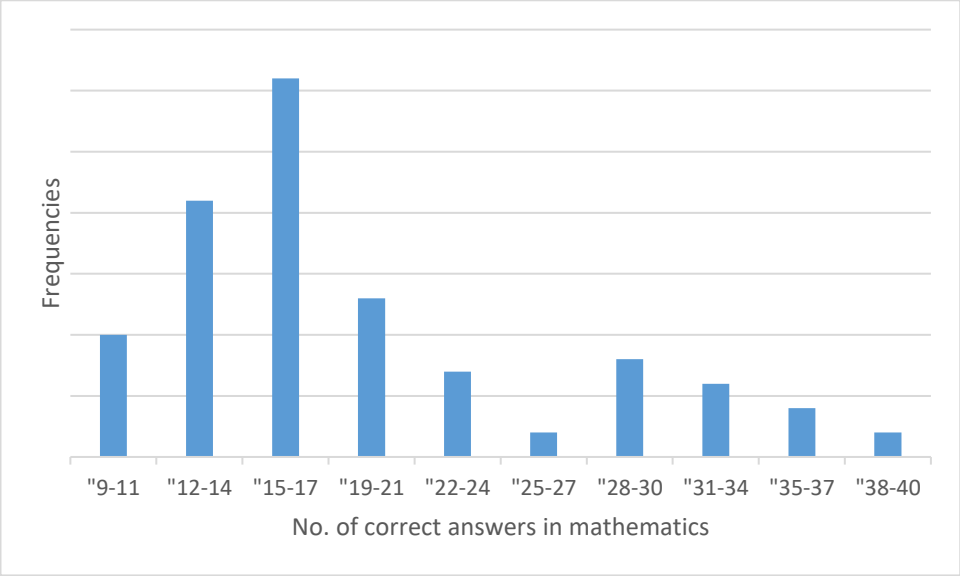
Figure 1. Distribution of the number of Reading Comprehension correct answers.



Source: self made

Figure 1 shows a minimum negative skewness of -0.148, a dispersion of 5.41 and an interquartile range of 7. These indicators suggest that the distribution tends to behave in accordance with the normal distribution, as demonstrated in table 1. For On the other hand, in contrast to mathematics, as can be seen in Figure 2, the distribution shows a different pattern.

Figure 2. Distribution of number of correct answers in Mathematics



Source: self made

Figure 2 shows a notable positive asymmetry of 1.1, accompanied by a standard deviation of 7.22 and an interquartile range of 8. These data confirm that the variable does not follow a normal distribution, and corroborate what was previously established in table 1. .

Once the use of the test statistic was justified, the Spearman's Rho correlation coefficient was calculated (r_s)given by the following formula taken from Weimer (2009).

$$r_s = 1 - \frac{6 \sum d^2}{n(n^2-1)}$$

Table 2. Spearman's Rho correlation

	Reading comprehension	Math
Correlation coefficient	1	.391**
Sig. (unilateral)	.	0
N	113	113
Correlation coefficient	.391**	1
Sig. (unilateral)	0	.
N	113	113
**The correlation is significant at the 0.01 level (one-sided).		

Source: self made

Table 2 shows a correlation coefficient of Spearman's Rho (r_s) equal to 0.391. To interpret this coefficient, see table 3, where a low positive correlation can be seen. This implies that when one variable increases, the other also tends to increase, although not necessarily in the same proportion. Likewise, it is important to highlight that this coefficient does not establish a causal relationship between the variables.

Now, to determine the effect of the independent variable *reading comprehension* (X) on the dependent variable *mathematics* (Y), a linear regression model will be used, which will be explained later.

Table 3. Spearman's Rho correlation coefficient interpretation

Worth	Meaning
-0.01 – 0-19	very low negative
-0.2 to -0.39	low negative
-0.4 to -0.59	negative low moderate
-0.60 to -0.79	high negative
-0.80 to -0.99	very high negative
-1	perfect negative
0	null relationship
0.01 to 0.19	very low positive
0.2 to 0.39	low positive
0.4 to 0.59	positive low moderate
0.60 to 0.79	high positive
0.80 to 0.99	very high positive
1	perfect positive relationship

Source: Mayorga (2022)

Although the correlation coefficient r_s=0.391 according to Table 3 indicates a positive relationship of low magnitude, the next step will consist of carrying out a formal demonstration to establish that the average of correct answers in reading comprehension is significantly higher than the average obtained in mathematics. To do this, the following hypothesis test is proposed:

- Null hypothesis (Ho): The average score in reading comprehension is less than or equal to the average in mathematics.
- Alternative hypothesis (Hi): The average of correct answers in reading comprehension is higher than the average in mathematics.

Step 1. Statistical approach

$$H_0: \mu_{cl} - \mu_m \leq 0 \quad vs. \quad H_i: \mu_{cl} - \mu_m > 0$$

Step 2. Consider a significance level of $\propto$=5% (0.05) probability of rejecting the null hypothesis being true.

Step 3. The test statistic to use to test the null hypothesis is given by:

$$Z = \frac{\mu_{cl} - \mu_m}{\sqrt{\frac{S_{cl}^2}{n1} + \frac{S_m^2}{n2}}} = \frac{22.16 - 19.06}{\sqrt{\frac{29.30}{113}} + \sqrt{\frac{52.16}{113}}} = \frac{3.1}{0.8489} = 3.651.$$

Step 4. The analysis is unidirectional on the right, and considering a confidence level of 95%, so the critical value is equal $Z_{0.05} = 1.645$.

Step 5. Decision making, comparing the critical value 1.645 with the calculated value 3.651 turns out to be lower, that is, 1.645 < 3.651. Therefore, the decision is made to reject the null hypothesis and accept the research hypothesis at a 95% confidence level.

Step 6. Interpretation. We can affirm with 95% confidence that the average obtained in reading comprehension is significantly higher than the average obtained in mathematics. In other words, if we took 100 samples of the same size, 95 of them would be fulfilled and 5 would not.

Finally, the linear equation of Y on X was found, which allows us to approximate the dependency relationship between the dependent variable Y (mathematics) and the independent variable mathematics Y = $a_0 + a_1 X$. In this sense, using the least squares method to find the values of the coefficients and SPSS, the following is obtained:

Table 4. Linear regression model

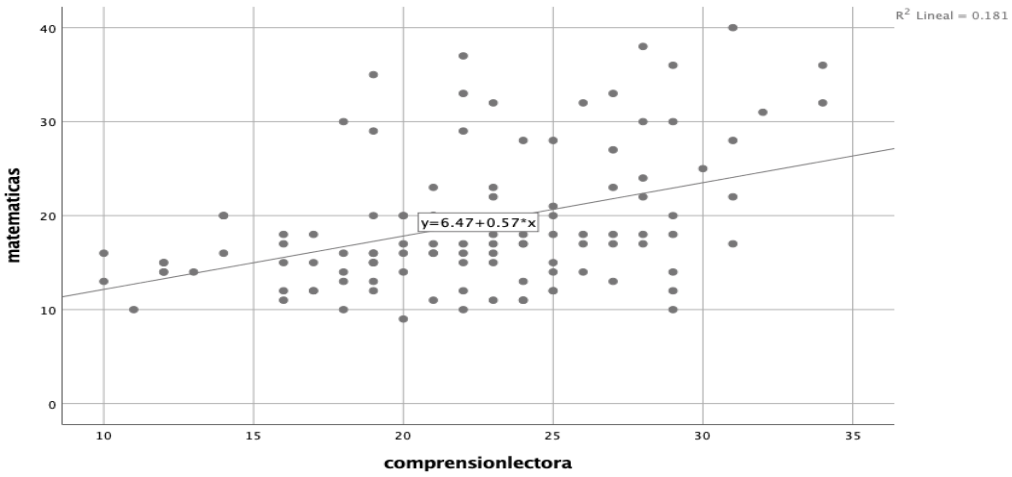
Model		Unstandardized coefficients		Standardized coefficients	t	Next.
		b	Dev. Mistake	Beta		
1	(Constant)	6,472	2,614		2,476	.015
	Reading comprehension	.568	.115	.426	4,956	,000
to. Dependent variable: mathematics						

Source: self made

From table 4, the linear regression model obtained is the following: $Y = 6.472 + 0.568\ X$, where the parameters found are equal to $a_0 = 6.472,\ a_1 = 0.568$.

Now, the interpretation of the model is the following: according to the equation provided, for each additional success in reading comprehension (X), an increase of 0.568 successes in mathematics (Y) is expected. This means that for every 10 correct answers in reading comprehension, approximately 5.6 correct answers are expected in mathematics. This result illustrates the degree of dependence between both variables, which demonstrates how better performance in reading comprehension is associated with an increase in performance in mathematics (figure 4).

Figure 4. Linear regression model Y= 6.47 + 0.57



Source: self made

Discussion

Bastiand (2012) examined the relationship between reading comprehension and the ability to solve mathematical problems, and found that significant learning in the first variable improves students' ability to more effectively address mathematical problems.

On the other hand, Cubas (2007) explored students' attitudes toward reading comprehension and its possible relationship with interest in solving mathematical problems. Their study revealed a low level of interest in reading among young people, which sometimes translates into a lack of motivation to understand and solve mathematical problems.

Likewise, although through an experimental program, Canales (2005) investigated the improvement of reading comprehension in young people and adolescents. The results indicated that this type of interventions offers significant benefits, since several students achieved an improvement in their reading comprehension ability.

Similarly, Romero (2012) focused on the relationship between reading comprehension and mathematical problem solving at the basic level. Their study evaluated students' ability to solve mathematical problems and their level of reading comprehension, and found a significant correlation between both skills, results that coincide with those of our own research.

These results support our own findings on the correlation between reading comprehension and mathematical problem solving. However, it is important to highlight that our study not only demonstrates the presence of this positive correlation, but also quantifies and measures this relationship, as well as the dependence between both variables.

Conclusions

Spearman's Rho correlation coefficient r_s= 0.391 indicates a low positive relationship between reading comprehension (Y) and mathematics (X), suggesting that, in general, an increase in one variable is associated with an increase in the other, although not necessarily in the same proportion. Furthermore, it has been significantly demonstrated that the average number of correct answers obtained in reading comprehension is higher than that obtained in mathematics. Finally, the proportion of change between the number of correct answers in reading comprehension and its impact

on correct answers in mathematics has been evaluated using a linear regression model, where the slope found indicates the magnitude of the change.

Future lines of research

It is important to keep in mind that these results apply specifically to the school under study and cannot be generalized, although they do provide a relevant insight into the behavior of these variables. For future research, therefore, it is recommended to consider a representative sample of all schools of the same level and grade in the aforementioned state or municipality.

Furthermore, although our research focuses on basic education, specifically secondary education, with an emphasis on the training fields of reading comprehension and mathematics, a possible direction for future research would be to explore other academic fields, such as physics, chemistry, biology, among others. Likewise, it would be relevant to expand the spectrum of the population studied to include upper secondary level (high school) and university education (bachelor's degree).

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