REVISTA INVECOM
ISSN en línea: 2739-0063

Motivation and academic performance: a study on the development of mathematical skills in secondary school students

Motivación y rendimiento académico: un estudio sobre el desarrollo de competencias matemáticas en estudiantes de nivel secundario

Received: 22/07/2025 - **Accepted:** 19/10/2025

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Abstract

The purpose of this article is to examine the relationship between motivation and academic performance (AP) in the development of mathematical skills among third-year secondary school students at a Peruvian educational institution. Using a quantitative approach, with a non-experimental design and a descriptive-correlational scope, we sought to identify the extent to which motivation levels influence academic performance in mathematics. The starting point is the idea that adequate motivation not only increases students' interest and persistence in schoolwork, but also contributes significantly to consolidating learning and strengthening skills specific to the discipline. Data was collected using a survey to measure motivation levels and document analysis to obtain subject grades, working with a sample of 85 students selected for convenience. The findings show a positive and statistically significant correlation between the variables, with a Spearman's Rho coefficient of 0.750 and a p-value of 0.000, which shows that higher levels of motivation correspond to better performance in mathematics. This article also highlights the importance of strengthening student motivation as a key strategy for optimizing learning and ensuring solid performance in mathematics. Therefore, it is concluded that it is important for educational institutions to create environments that foster students' interest, autonomy, and active participation.

Keywords: motivation, academic performance, mathematics

Resumen

El presente artículo tiene como objetivo examinar la relación existente entre la motivación y el rendimiento académico (RA) en el desarrollo de competencias matemáticas de los estudiantes de tercer grado de secundaria en una institución educativa peruana. Desde un enfoque cuantitativo, con un diseño no experimental y un alcance descriptivo-correlacional, se buscó identificar en qué medida los niveles de motivación influyen en el desempeño académico en el área de Matemática. Se parte de la idea de que una adecuada motivación no solo incrementa el interés y la persistencia de los estudiantes frente a las tareas escolares, sino que además contribuye de manera significativa a consolidar aprendizajes y fortalecer competencias propias de la disciplina. Para la recolección de datos se aplicó una encuesta que permitió medir los niveles de motivación y se recurrió al análisis documental con el fin de obtener las calificaciones de la asignatura, trabajando con una muestra de 85 estudiantes seleccionados por conveniencia. Los hallazgos muestran una correlación positiva y estadísticamente significativa entre las variables, con un coeficiente Rho de Spearman de 0,750 y valor p de 0,000, lo cual evidencia que a mayores niveles de motivación corresponde un mejor desempeño en Matemática. Asimismo, este artículo resalta la importancia de fortalecer la motivación estudiantil como estrategia clave para optimizar el aprendizaje y garantizar un desempeño sólido en el área de Matemática. Por lo tanto, se concluye que es importante que las instituciones educativas creen ambientes que impulsen el interés, la autonomía y la participación activa de los estudiantes.

Palabras clave: motivación, rendimiento escolar, matemáticas

Introduction

Academic performance (AP) in mathematics remains a persistent challenge for many educational institutions today. This subject serves as a fundamental cornerstone for developing problem-solving skills, as well as logical and cognitive capacities, which are essential not only for academic success but also for the comprehensive formation and future personal and professional endeavors of students (Scanavino, 2024). Despite its significance, a substantial disparity exists between what is expected of students and the results they actually achieve, illustrating a gap in the utilization of mathematical skills (Cevallos et al., 2024).

The challenge of AP in mathematics transcends global boundaries. The findings from the PISA 2022 assessment reveal two distinct realities: Students in countries such as China, Singapore, and South Korea typically demonstrate outstanding performance, whereas students in developing nations like Mexico and Brazil struggle to attain solid learning outcomes in this area. Additionally, a troubling trend has emerged: motivation towards learning mathematics has steadily declined, adversely impacting student performance. According to the same report, nearly 40% of surveyed students perceive mathematics as difficult to understand and inherently boring, highlighting a lack of motivation as a key factor contributing to poor performance (Organización para la Cooperación y el Desarrollo Económicos [OCDE], 2022). This scenario underscores the necessity of re-evaluating not only teaching methodologies but also developing strategies that foster greater enjoyment in learning mathematics to ensure that outcomes improve sustainably on a global scale.

In the context of Peru, AP in mathematics also poses a significant challenge. The Ministry of Education of Peru (MINEDU, 2021), drawing from the results of the 2020 Student Census Evaluation (ECE), indicated that only 17% of secondary students achieved a satisfactory level in this subject. These statistics not only affirm the difficulties surrounding learning but also point to a lack of motivation and interest many students have towards the subject. A pronounced disparity between urban and rural students exacerbates educational inequalities and limits opportunities for academic success. Moreover, it is confirmed that demotivation in relation to mathematics is a recurring issue, as the majority of students find the subject challenging and tedious, which directly influences their low performance (Ponce & Mamani, 2024).

Regarding prior research on the topic, a study conducted by Martínez et al. (2022) in Colombia aimed to determine the influence of motivation on AP in mathematics among secondary students. The research adopted a quantitative approach with a correlational design, employing academic motivation questionnaires and gathering academic grades; the sample consisted of 65 students. Among the most significant findings, it was revealed that students who were more intrinsically motivated outperformed their peers, particularly in tasks requiring problem-solving and logical reasoning. Furthermore, it was noted that extrinsic motivation (such as rewards or grades) was less effective in the long term. The authors established a positive association between the studied variables ($r = 0.881$; $p = 0.000$), asserting that motivation fostered through participatory pedagogical strategies and an interest in applying mathematics to everyday life continuously enhances performance in the subject.

In Puno, Yana (2021) conducted a study examining the relationship between motivation and AP in mathematics. This non-experimental, correlational study included a sample of 270 secondary students. Data were collected through questionnaires and academic record reviews. The findings emphasize that students with higher motivation are more likely to meet expected achievement levels (A), particularly in competencies related to problem-solving. The author identified the strengthening of intrinsic motivation as a critical factor for improving mathematics performance and enabling more students to achieve high levels. A moderate positive association was concluded based on a chi-square value of 15.08, indicating that increased motivation correlates with better mathematics performance.

In terms of the theoretical framework related to motivation, Burgos et al. (2025) note that motivation comprises both internal and external drives that encourage students to engage actively in their learning processes. This not only contributes to the manner in which they approach academic activities but also enhances their interest in achieving goals. Consequently, motivation becomes a pivotal agent influencing performance and the development of essential competencies. Leguizamón and Molina (2021) further contend that motivation is the energy that propels and sustains student participation in their learning experiences, causing them to persevere in the face of challenges and commit to their objectives. It may manifest intrinsically, characterized by an interest in learning and developing new abilities, or extrinsically, associated with external incentives such as grades or social recognition.

To measure motivation, two types are typically considered: intrinsic and extrinsic (Peña et al., 2024). Intrinsic motivation involves the internal drive that compels a student to learn for pleasure, without the need for external stimuli, fueled by an interest in content and the personal satisfaction derived from learning (Rojas, 2023). In contrast, extrinsic motivation arises when students focus on obtaining external rewards, such as good grades

or recognition, often acting more for the sake of rewards or fear of punishment than from a genuine desire to learn (Peña et al., 2024).

Motivation is scientifically grounded in self-determination theory, proposed by Deci and Ryan, which posits that students' motivation is not solely dependent on external rewards or punishments but rather on the fulfillment of three basic psychological needs. Autonomy refers to the students' sense of control over their own learning, encompassing their ability to make choices and actively participate in their educational process. Competence is linked to the desire to experience effectiveness, meaning that students feel capable of overcoming challenges and making progress in their academic achievements. Finally, relatedness pertains to the need for connection with others, feeling accepted and supported by teachers and peers (Albor & Rodríguez, 2022).

Regarding academic performance (AP), Arteaga (2023) describes it as the comprehensive outcome of a student's learning process, reflected not only in the grades attained but also in the level of knowledge appropriation and the application of skills across various educational contexts. Complementarily, Molinas and Mello (2023) note that AP is influenced by various internal and external factors, including motivation, family support, teaching methodologies, and the student's own willingness to confront academic challenges. In this context, AP serves as a key indicator for assessing the achievement of educational objectives and the development of essential competencies necessary for the holistic development of students.

To measure AP in mathematics, the competencies outlined by the Ministry of Education of Peru (MINEDU, 2022) were considered: *Solving quantity problems* involves the student's ability to reason with numbers and operations in contexts requiring quantification and measurement. *Solving problems of regularity, equivalence, and change* pertains to the ability to identify patterns, establish equivalences, and understand transformation procedures in various situations. *Solving problems of shape, movement, and position* relates to geometric concepts and spatial representations used to solve issues regarding figures and bodies. *Solving problems involving data management and uncertainty* entails reading, organizing, and utilizing statistical and probabilistic data in uncertain situations.

Additionally, the National Basic Education Curriculum (MINEDU, 2016) defines a scale of achievement levels to measure student performance in the development of their competencies. These levels include: *Outstanding Achievement (AD)*: achieved by students who surpass the proposed objectives, demonstrating excellent mastery in applying concepts. *Expected Achievement (A)*: indicates that the student has attained the expected learning outcomes, meeting the curricular goals of their grade. *In Progress (B)*: includes students who show progress, grasp elementary content, but have not yet consolidated all necessary competencies. *Beginning (C)*: represents students who struggle to understand and apply content, requiring pedagogical support to enhance their learning.

Moreover, AP is associated with Pintrich's theory of self-regulated learning, which asserts that students must be capable of acquiring new knowledge while intentionally and systematically controlling their learning. A self-regulated student recognizes how they learn, applies strategies according to the context, and critically reflects on their outcomes to adjust their efforts for improvement (Sáez et al., 2022).

Overall, this article contributes to understanding the challenges faced by secondary school students in mathematics, emphasizing that motivation is a vital factor influencing student performance. The primary objective is to study the association between motivation and AP in mathematics within a Peruvian educational institution, analyzing how different types of motivation impact the achievement of significant outcomes in this subject.

Methodology

The study adopted a basic research design with the aim of examining the relationship between motivation and AP without providing immediate solutions to a defined problem. The purpose was to delve into how levels of motivation influence skills in solving mathematical problems. A quantitative approach was employed, with numerical data collected using structured instruments and statistical methods to test the hypotheses.

This research was characterized by a non-experimental and cross-sectional design, as the information was gathered at a single point in time without manipulating the variables; rather, the variables were observed as they existed in the reality of the students. Furthermore, the study achieved a descriptive and correlational level, as it aimed not only to characterize the presentation of motivation and AP in mathematics but also to analyze the relationship between these two variables.

The research included a sample of 85 third-year secondary students from a Peruvian educational institution. Participants were selected for convenience using non-probabilistic sampling. Inclusion criteria considered students who were enrolled in their grade and consented to participate voluntarily in the research. Students who did not attend classes regularly or showed disinterest in collaborating with data collection were excluded.

The data collection technique employed was a survey, supplemented by a questionnaire measuring the levels of student motivation. To assess AP, the academic records of each student were analyzed. These tools were chosen to provide systematic and clear data, facilitating analysis of both motivational perceptions and performance in mathematics. The applied questionnaire demonstrated an adequate reliability level, with a Cronbach's alpha value exceeding 0.8, indicating good internal consistency among its items.

Finally, the information was processed using SPSS software version 27. Descriptive statistics were first applied to organize and clearly present the levels of motivation and AP in mathematics. Inferential statistics allowed for comparisons of the defined hypotheses and established the existence of a relationship between the variables.

Results

Descriptive results

Table 1

Results of the motivation variable

Level	Frequency	Percentage
Low	7	8,2%
Regular	73	85,9%
High	5	5,9%
Total	85	100.00%

Table 1 indicates that the majority of students (85.9%) exhibit a regular level of motivation. In comparison, only 5.9% have a high level of motivation, while 8.2% fall into the low motivation category.

Table 2

Results of the academic performance in mathematics variable

Level	Frequency	Percentage
Beginning	4	4,7%
In progress	33	38,8%
Expected achievement	35	41,2%
Outstanding achievement	13	15,3%
Total	85	100,0%

Table 2 demonstrates that 41.2% of students achieved the expected level (A) in mathematics, while 38.8% are still in progress (B). Additionally, 15.3% of students obtained an outstanding achievement (AD), whereas only 4.7% are at the beginning level (C).

Table 3

Normality test

	Kolmogorov Smirnov		
	Statistic	df	Sig.
AP in Mathematics	0.105	85	0.021
Motivation	0.184	85	0.001

The results of the Kolmogorov-Smirnov test reveal that the AP variable returned a significance value of 0.021, and the motivation variable a value of 0.001. In both cases, the significance levels are below the threshold of 0.05, indicating that the data do not follow a normal distribution. This justifies the use of a non-parametric statistical test for inferential analysis (Spearman’s Rho).

Inferential results

Table 4

Correlation between motivation and AP in Mathematics

	AP in Mathematics

Motivation	Spearman's Rho	0.750
	Sig. (Two-tailed)	0.000
	N	85

Correlation analysis yielded a coefficient of 0.750, with a two-tailed significance level of 0.000. This value reflects a high and statistically significant positive association between the analyzed variables. Thus, higher motivation levels in students correspond to better performance in developing mathematical skills.

Table 5

Correlation between dimensions of motivation and AP in Mathematics

		Intrinsic motivation	**Extrinsic motivation**
AP in Mathematics	Spearman's Rho	0.638	0.657
	Sig. (Two-tailed)	0.000	0.000
	N	85	85

The results indicate a positive and significant relationship between both intrinsic motivation ($r = 0.638$; $p = 0.000$) and extrinsic motivation ($r = 0.657$; $p = 0.000$) with academic performance in mathematics. This suggests that students who possess a genuine interest in learning, along with receiving external stimuli such as good grades or recognition, will consistently enhance their performance in mathematics.

Discussion

The statistical results reveal a direct and significant relationship between motivation and academic performance in mathematics, as evidenced by a coefficient of 0.750 with a two-tailed significance of 0.000. This finding demonstrates that both internal and external motivation levels substantially affect students' performance in learning mathematical skills. Increased motivation fosters greater commitment, perseverance, and a positive attitude towards the challenges of learning mathematics, ultimately leading to improved academic outcomes.

This conclusion aligns with the findings of Trías et al. (2024), who indicated that motivation significantly impacts academic performance, particularly in subjects requiring sustained mental effort, like mathematics. The authors assert that students exhibiting high intrinsic motivation tend to be more persistent, enjoy learning, and approach challenges with a positive mindset. Similarly, Martínez et al. (2022) noted that extrinsic motivation, associated with factors such as recognition or rewards, can also enhance performance if paired with a genuine interest in learning. Thus, the results of this research support the notion that motivation in its various forms serves as a catalyst for improving the acquisition of mathematical skills and achieving favorable outcomes.

Additionally, the majority of students (85.9%) displayed a regular level of motivation for learning mathematics. This finding indicates that their interest rests somewhere between indifference and enthusiasm for the subject. Although students are somewhat engaged in their learning, they lack the robust motivation necessary to attain excellent academic performance. Similar findings were reported by Esquivel (2023), who found that 43.4% of moderately motivated students engage in academic activities only when external support or stimulation is present, which limits the development of their internal motivation.

Concerning academic performance, it was found that 41.2% of students reached the expected achievement level (A) in mathematics, while 38.8% are in the process of attaining this level. These results illustrate that, while many students have acquired the necessary skills for their grade, a significant number still require improvement in their learning to enhance their performance. This finding corroborates reports from Maquera et al. (2024), which indicated that 34% of assessed students achieved expected performance in mathematics. This suggests that they are making progress but face challenges in applying their knowledge in practice.

Therefore, the study's findings are grounded in Deci and Ryan's self-determination theory, which posits that motivation increases and strengthens when the needs for autonomy, competence, and relatedness are fulfilled. In this context, students who experience strong motivation are better equipped to exert control over their own learning, which enhances their engagement with mathematics. Therefore, an educational environment that fosters active participation, recognition, and trust transforms motivation into a fundamental element for academic success and the development of essential skills (Albor & Rodríguez, 2022).

Conclusions

The results reveal a strong, positive, and significant relationship between motivation and academic performance in mathematics, indicating that student motivation is directly linked to the development of their mathematical skills, enabling more effective and meaningful learning. Therefore, enhancing both intrinsic and extrinsic motivation is essential for strengthening academic performance. Furthermore, it is crucial for educational institutions to create environments that promote student interest, autonomy, and active participation to ensure a more comprehensive education that facilitates lasting and quality learning.

Based on these findings, schools should focus on teaching methods that contribute to increasing student motivation, as this is vital for enhancing their performance in mathematics. Promoting active teaching methodologies, valuing effort, fostering autonomy in learning, and providing consistent support from educators would create a more motivating environment that encourages genuine interest in the subject. Additionally, the results may serve as a reference for the Ministry of Education (MINEDU) to initiate policies and programs aimed at strengthening student motivation. These policies should incorporate innovative approaches that cultivate enthusiasm for mathematics and ensure an education grounded in meaningful learning.

The study offers valuable evidence to the educational field in Peru regarding the significance of both internal and external motivation on students' academic performance in mathematics. It highlights that both self-initiatives to learn and external incentives play a role in the development of mathematical skills. Moreover, the findings facilitate comparisons with other studies conducted across Latin America, where student motivation continues to be a challenge in achieving high standards in mathematical competencies.

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