

Influencia de la motivación en el rendimiento académico: un análisis de la evaluación motivacional en el aprendizaje de las matemáticas

Influence of motivation on academic performance: an analysis of motivational assessment in mathematics learning

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Recibido: agosto 12 de 2021

Aceptado: : diciembre 07 de 2021

Abstract

The objective of the study consisted of relating motivation with academic performance in mathematics in schoolchildren in northern Colombia, through the use of Pearson's correlation coefficient, applying the motivational assessment of the learning process (EMPA) questionnaire, to establish the levels of extrinsic and intrinsic motivation of the 65 students belonging to the sample. Academic performance was obtained through second source information provided by the academic coordination of the institution understudy, a quantitative and correlational approach was used. The results show a significant negative correlation in the dimensions of intrinsic and extrinsic motivation with academic performance. Given this, new lines of research are proposed, especially accompaniment by parents and guardians, and socioeconomic characteristics and their relationship to academic motivation.

Resumen

El objetivo del estudio consistió en relacionar la motivación con el rendimiento académico en matemáticas en escolares del norte de Colombia, a través del uso del coeficiente de correlación de Pearson, aplicando el cuestionario de evaluación motivacional del proceso de aprendizaje (EMPA), para establecer los niveles de motivación extrínseca e intrínseca de los 65 estudiantes pertenecientes a la muestra. El rendimiento académico se obtuvo a través de información de segunda fuente, suministrada por la coordinación académica de la institución objeto de estudio, y se utilizó un enfoque cuantitativo y correlacional. Los resultados demuestran que existe una correlación significativa negativa en las dimensiones de la motivación intrínseca y extrínseca, con el rendimiento académico. Ante esto se proponen nuevas líneas de investigación, especialmente, el acompañamiento por parte de los padres y/o acudientes, y las características socioeconómicas y su relación para con la motivación académica.

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Keywords: intrinsic motivation, extrinsic motivation, academic performance, mathematics.

Palabras clave: motivación intrínseca, motivación extrínseca, rendimiento académico, matemáticas.

1. Introduction

Different variables that take place and have a part in the educational process, have been deeply analyzed throughout the growth and technological advance and in all the events in history (Gallo et al., 2021). In one way or another, this has modified important aspects and characteristics in society, so that it is necessary to evaluate the behavior of each implicit variable in education. To this, the need arises to assess their behavior in each context and to be able to optimize the process through plans and strategies that allow meeting the needs encountered.

For this reason, it was essential to carry out an analysis and search for theoretical and conceptual references regarding the variables of motivation and academic performance in mathematics, that were considered in the research.

In this way, it is important to mention the study carried out by Camacho-Miñano & Del Campo-Campos (2015), whose objective was based mainly on empirically demonstrating the influence that voluntary work has on the academic performance of students. Postulating as a working hypothesis that those students who do volunteer work have greater motivation in the school environment and, therefore, their academic results are better. In order to carry out the study, the authors proposed voluntary work in which having to use the competencies acquired in the subjects developed takes precedence. At the end of the essay, its performance is compared with critical and reflective writing capacity. The results show a relationship between the voluntary work carried out and the final grades in the subjects, concluding the existence of an intrinsic motivation, which is key for academic performance.

In the background, mention is made of an investigation aimed at detecting whether or not there

are statistically significant differences with the motivational variables versus the performance of homework, based on academic performance. For the research sample, several 535 students of the fourth, fifth and sixth grades were used, including 9 to 13 years. Results obtained students who achieved higher academic performance, expressed in quantitative grades, are those who performed the greatest amount of homework and who dedicated more time to carry them out, which indicates that they are the same group of students who perceive the execution of these duties positively and have greater intrinsic motivation (Valle et al., 2015). Simultaneously, it is also obtained that as the students advance in the school level, their positive attitude towards the performance of school homework decreases and their intrinsic motivation.

According to the studies that seek to investigate motivation and academic performance, the authors Lagos-Revilla & Valverde-Casana (2015), wanted to determine through their research the degree of relationship that may exist in these two variables, within the area of communication, in sixth-grade students of elementary school. The method used was of a basic correlational type, under a non-experimental and cross-sectional design. A sample of 148 students was used, who through a census provided information on one of the variables (motivation), and organized the record of grades to have information on the variable academic performance in the area of communication. Under a Cronbach's alpha test, to measure the reliability of the survey, indicating a 0.831, which corresponds to strong reliability; later in the results, it is shown that there is a positive correlation of 0.325 and a significant and low correlation level of 0, between the variables analyzed in the study.

Considering now another fundamental aspect such as achievement motivation, the author

García-Ramírez (2016), through an empirical study, seeks to know how achievement motivation can improve academic performance. For this, the author uses the profitability of a teaching innovation program called "ReiDoCrea" to research its academic group. The participants consisted of 63 students, of which two groups were obtained, a control group of 32 students and an experimental group of 30 students. To analyze the results, a group was required to participate in the project while the control group did not participate. For this, two objective tests were used, pre-test and post-test; When reviewing the results, the authors conclude that motivation for competencies or achievements, accompanied by teacher innovation, are essential to stimulate creative thinking and increase academic performance.

In a similar study, Ruiz-Sánchez & Quintana-Peña (2016), wanted to establish the attribution of achievement motivation with academic performance, but this time in the area of mathematics. They used a sample of 993 elementary school students, applying a descriptive-correlational design, using the Attributional Achievement Motivation Scale (EAML) instrument, designed by Manassero-Más & Vázquez-Alonso (1998), also including the registration of academic grades. The authors find through the results that there is a direct and highly significant covariant correlation between achievement motivation and academic performance in mathematics. Thus, concluding that interest in the subject is closely related to its academic performance, attributing these results to the effort made by the student, to the teacher's strategies, to the hope of obtaining a certain result and to the evaluation methodology.

In turn, Mercader et al. (2017), investigated the relationship between motivation and academic performance, specifically in the subject of mathematics, in the early stages of education; For this case, the authors assigned a sample of 180 children, analyzing the difference between three groups with low, medium, and high academic performance in mathematics and analyzing

different motivational variables. The results show a relevant predictive power in terms of academic performance. It is also obtained that persistence and a positive attitude significantly contribute to it. Regarding the results independently for the groups of high and low academic performance, they present significant differences in perceived self-competence and persistence; Differences are also found for the group with average academic performance, especially in terms of persistence.

To the above, this article reports a study whose objective was to relate motivation with academic performance in mathematics. For this, from the field of educational psychology, an analysis of motivational evaluation and its influence on the learning process of mathematics of 65 fifth-grade students of the Institución Educativa Enrique Pupo Martínez of the city of Valledupar is presented.

2. Methodology

A quantitative, correlational study was carried out with a cross-sectional study time. The sample was made up of all the students of the fifth grade of a primary school of the Enrique Pupo Martínez Educational Institution in the city of Valledupar-Colombia, which is equivalent to 62 students (51.6% men and 48.4% women) between 9 and 13 with an average of 10.29 and a standard deviation of 1.06 years, indicating a low variability of this data and therefore greater homogeneity of age. Most of the participants belong to low socioeconomic strata, especially stratum 1, and they come from families with very low incomes. Given that the participants are minors in school, institutional permits and parents were requested who signed the informed consent and assent for the students and the appropriate treatment of the information and its confidentiality.

The instrument used to assess motivation was the Learning Process Motivational Assessment Questionnaire (EMPA), designed by Quevedo-Blasco et al. (2016), which is made up of 33 items,

in From which information regarding intrinsic, extrinsic and global motivation is evaluated, of these, ten items correspond to the evaluation of the extrinsic motivation and another 33 items to the evaluation of intrinsic motivation; It applies to students in elementary school and secondary education, it also allows, within the analysis of results, to differentiate the sex and age of the participants. The questionnaire structure implies that to facilitate the understanding of the scores, they are converted to centiles; the scores cover the range from 0 to 100. A score of 50 refers to the average motivation of the participants belonging to the sample. The authors conclude that the instrument can be applied even through virtual platforms or technological tools that the teacher or researcher wants to use, if they are available to the surveyed students.

The instrument was subjected to factor analysis, in which the Kaiser-Meyer-Olkin test yielded a value of 0.97, likewise when applying it the Bartlett test, which allows measuring sphericity, resulted in an $X^2(820) = 27749$ ($p < .01$); Similarly, Cronbach's alpha scales showed values between 0.83, 0.93 and 0.93, respectively.

To evaluate the academic performance of the students, second source information was obtained regarding the accumulated academic average of the year 2020 of the fifth-grade students, delivered from the area of the Academic Coordination of the Educational Institution where the study was carried out.

To develop the study was established with directors and teachers of the Institución Educativa Enrique Pupo Martínez, to socialize the project's scope and request institutional permits to develop the study with fifth-grade students, as well as information contact details for parents. Subsequently, contact was established with parents and fifth-grade students through email and WhatsApp; a virtual meeting was scheduled to socialize the project, its scope and request permission from parents so that their children could participate in the study. The parents signed the informed consent through

a Google Form, and the students through this same modality.

In another virtual session under the supervision of the researchers, the Motivational Assessment of the Learning Process (EMPA), questionnaire was sent, virtualized by the researchers to the students who filled it out, and if they had doubts, they were clarified directly by the study leaders. Once the participants filled out the questionnaire, the information was exported into Excel and organized nominally. The data on the academic performance of mathematics were entered and statistically processed through SPSS v.24 software. To establish the correlation of the variables, the Pearson correlation coefficient statistician was used, which, through values that indicate significance or not between the dependence of the data, allows us to assume the type of relationship between the variables analyzed.

3. Results and discussion

3.1 Data analysis

The evaluation of the scores obtained by the participants, showed that intrinsic motivation obtained a minimum score of 83 and a maximum score of 110 points, with a standard deviation of 6.6, from which high scores of the students are observed. Regarding extrinsic motivation, the minimum score obtained by those evaluated was 29 and the maximum score of 50, with a mean of 41.5 and a standard deviation of 5.4, which shows a trend towards high scores. Regarding the academic average, the data show minimum scores of 3.5 and a maximum of 4.8 (table 1).

Table 1. Descriptive statistics of motivation and academic average.

	Minimum	Maximum	Half	Dev. Standard	Variance
Grade point average	3.5	4.8	4.22	4.05	1.642
Extrinsic Motivation	83	110	102.11	6.611	43.708
Intrinsic motivation	29	50	41.55	5.410	29.268
Academic motivation	110	154	137.89	10.229	104.626

The global motivation analysis showed high levels present in the students evaluated for this study. In this sense, the percentages of the scores were concentrated in high and medium-high. These results show a great capacity of young

people to focus on the proposed tasks and the established goals regardless of the source of motivation, which can be internal or external (Table 2).

Table 2. Frequency of global motivation levels.

	Frequency	Percentage
Half	6	9.7
Medium high	17	27.4
High	39	62.9

In addition to the analysis of the descriptive statistics, the frequencies of the academic average levels obtained by the students were analyzed to identify their performance, based on the rating scale of educational institutions in Colombia

since the scale, in general terms, does not have equal ranges between levels. In this regard, it was possible to identify that most of the study participants are at high and very high levels of mathematical academic performance (Table 3).

Table 3. Average academic level in mathematics.

	Frequency	Percentage
Half	10	16.1
High	24	38.7
Very high	28	45.2

In order to respond to the main objective of the study, the correlation analysis between the variables was carried out by using the bilateral Pearson correlation coefficient $p \leq 0.01$, as identified in Table 4. No statistically significant correlations were found between the motivation and the

academic average of the students, but between the different dimensions of motivation, that is, between intrinsic and extrinsic motivation, as well as between these variables and global motivation.

Table 4. Correlations between motivation and academic performance.

		Grade point average	Extrinsic Motivation	Intrinsic motivation	Academic motivation
Grade point average	Pearson's correlation	1			
	Sig. (bilateral)				
Extrinsic Motivation	Pearson's correlation	-0.069	1		
	Sig. (bilateral)	0.594			
Intrinsic motivation	Pearson's correlation	-0.019	,477**	1	
	Sig. (bilateral)	0.882	0.000		
Academic motivation	Pearson's correlation	-0.057	,881**	,834**	1
	Sig. (bilateral)	0.662	0.000	0.000	

** The correlation is significant at the 0.01 level (bilateral).

In order to complement the analysis of the data presented, a T-test was carried out to identify possible statistical differences between the variables. For this purpose, the variable socioeconomic stratum and the variable sex were included: in this regard, the results showed significant

significance. Bilateral less than 0.005 in all values, indicating a statistically significant difference in the values obtained by men and women of different socioeconomic stratum in motivation and academic average, and according to the data being higher in women than in men (Table 5).

Table 5. Comparison of means T between the variables.

	Test value = 0			Difference of means	95% Confidence interval of the difference	
	T	gl	Sig. (bilateral)		Lower	Higher
Socioeconomic	20.116	61	0.000	1.516	1.37	1.67
Gender	23.191	61	0.000	1.484	1.36	1.61
Extrinsic motivation level	23.946	61	0.000	3.081	2.82	3.34
Intrinsic motivation level	28.372	61	0.000	3.258	3.03	3.49
Overall motivation level	22.982	61	0.000	2.823	2.58	3.07
Academic average level	24.603	61	0.000	2.290	2.10	2.48

3.2 Discussion

In context with the analysis of the results achieved, the working hypothesis was accepted through the statistical process. There is a slight positive significant correlation between motivation and academic performance in the mathematics subject of the students of the degree fifth, of the Institución Educativa Enrique Pupo Martínez. These findings are closely related with the contribution made by Cifuentes-Garzón (2021), Pitre-Redondo et al. (2021), and Niño-Vega & Fernández-Morales (2019), who concluded by conducting their research on the motivation of students in school, that the motivation immersed in the emotion is closely related to the success of learning and the educational process. It stimulates within the emotional framework the aspects that intervene in motivation such as intrinsic and extrinsic motivation, alluding to the importance of a conducive physical school environment in the latter.

The findings allowed finding relationships between the research variables and the sub-variables involved in them, such as intrinsic motivation, in which there is a moderate negative correlation with academic performance. Also, extrinsic motivation and academic motivation for the academic performance show a moderate and slight negative correlation, respectively, as shown in Table 4. Said findings are supported by the results presented by the authors' Sixte et al. (2020), Presentación-Herrero et al. (2016), Yory-Sanabria et al. (2021), and Niño-Vega et al. (2020). They indicate that the motivation variable is conditioned and exposed to modifications due to its sub-variables, specifically those implicit in practice education, which is subject to variations around time, space, social, pedagogical, emotional, and intrapersonal conceptions. Therefore, it is considered pertinent in this type of research to assume and assess all the aspects involved to achieve accurate and significant results.

It is also important to mention the finding obtained in the T-test, which was carried out to identify the statistical differences between

the variables, taking into account the variable socioeconomic stratum and gender. In whose results a bilateral significance of less than 0.005 was obtained in all values, a question that indicates that there is a statistically significant difference in the values obtained by men and women of different socioeconomic strata in motivation and academic average and according to the data, being higher in women than in men, as shown in table 5. The result agrees with the conclusions expressed by Castrillón-Gómez et al. (2020). It research sought to contrast the results of the academic motivation versus the socioeconomic stratum in different schools and social contexts, obtaining that it is very important to assess the socio-pedagogical approach in studies of motivation in the academic field since it intervenes directly and specifically in each context, as well as Significant differences were stated in the results regarding the sex of the participants; as observed in the current investigation.

Another important aspect are the levels of global motivation concerning academic performance in the subject of mathematics, having obtained a total frequency of 56 of the 62 students, between medium-high and high motivation according to table 2. A frequency of 52 of the 62 students, between high and very high academic performance, respectively, according to table 3. Being able to observe from this a large percentage in the positive levels for these two aspects, global motivation and academic performance. Corresponds to the theory of Deck (1986, cited by Nieto-Márquez et al., 2021), in which the author conceives under the approach of cognition and motivation, the importance of achieving personal goals for the increase and high levels in academic performance, these aspects being directly related to the behavior of the individual which is determined by intrinsic and extrinsic motivation, which corresponds to global motivation in the process. In a similar position, Bandura's theory (1986, cited by Cardoso-Espinosa et al., 2020), affirms that successful academic results are closely linked to self-efficacy and, therefore, to intrinsic motivation.

Likewise, a great similarity was found with the study carried out by the authors Hernández-Jiménez et al. (2020), in which the results obtained allow the detection of statistically significant differences for the motivational variables in academic performance. Concluding, the students who positively perceive the performance of homework; have a direct intrinsic motivation in which the authors consider that the latter is more relevant versus extrinsic motivation within global motivation.

Among the results of other studies that allow generating discussions with those obtained in the present study is Ruiz-Sánchez & Quintana-Peña (2016), who also specifically studied the motivation of mathematical learning and academic performance in this area. They likewise applied a correlational design but based their comparison clearly on the intrinsic achievement motivation, and under the Attributional Achievement Motivation Scale (EAML) instrument. The authors report that the performance in the area of mathematics has a direct and highly significant correlation between achievement motivation, which is immersed in intrinsic motivation, in which the authors explain that interest is a fundamental part of the achievement of mathematical competencies.

Consequently, the comparison of the means in the T-test in the present study and taking into account what was stated. We find extrinsic motivation with 23,946 and motivation intrinsic with 28,982. Likewise, the confidence interval in its lower and upper ranges will be 2.84 and 2.34 for the level of extrinsic motivation, and from 3.03 to 3.49 for the level of intrinsic motivation. Considering that the academic average object study was specifically part of the mathematics subject, it is possible to support the results with those already obtained by the authors Ruiz-Sánchez & Quintana-Peña (2016), confirming the relevance of intrinsic motivation in the satisfactory academic results in the mathematics subject.

In this sense, after the development of this research it was possible to demonstrate that the motivation of the fifth-grade students of the

Institución Educativa Enrique Pupo Martínez, is related to academic performance specifically in mathematics; demonstrating a correlation between these two variables. By obtaining a significant percentage of students with medium-high and high averages, a significant percentage in high and very high levels of motivation, whose data was evidenced in the collection of information after applying the EMPA instrument. It was possible to specifically determine the extrinsic and intrinsic motivation of the students who participated in the study. It proves that motivation and academic performance are closely associated since motivation is conceived as a powerful tool to originate learning, especially at an early age. It is because it influences the development of each student's academic motivation, especially achievement motivation, in which both intrinsic and extrinsic motivation intervene.

Regarding new lines of research and future works it is necessary based on what was obtained in the study, questions are opened about the central theme of analysis. Taking into account, although two specific variables were evaluated. There are sub-variables, the which were immersed in the study and which can become very important to obtain specific information in the educational field and the motivational aspects of it, which also show their justification in the scientific contribution that they can provide to the research community of the context evaluated.

Thus, the results obtained allow the study of socioeconomic factors to be considered, in which it is possible to determine how these factors can intervene in academic motivation and academic performance in different areas of knowledge or specifically in mathematics. To identify if there is a correlation between the purchasing power of parents and the academic results of students; where this characteristic can contrast differentiating contexts. Also, it is important to evaluate motivation using educational technologies, autonomous learning, and academic performance, which would allow comparing information on academic performance during confinement for COVID-19 and the return to face-to-face with the mentioned variables (Vergara-Pareja et al., 2021).

4. Conclusions

The results and data obtained allow us to denote that the motivation of the 65 students belonging to the Institución Educativa Enrique Pupo Martínez, is related to academic performance in mathematics. It was verified after applying Pearson's correlation coefficient, which allows observing the values and significance of the said correlation, in which a significant negative correlation was obtained in extrinsic motivation.

Similarly, a significant negative correlation was obtained with motivation (Intrinsic and academic motivation). On the other hand, the T-test allowed comparing the differences in the confidence interval, lower and higher, contrasting the extrinsic, intrinsic and global motivation with the academic performance, the socioeconomic stratum and sex. To this end, significant differences were found in the sub-variables socioeconomic stratum and sex, assessing their impact on motivation and academic performance within the context.

The sociodemographic characteristics of the participants, who presented the highest frequency for strata 1 and 2, likewise the highest frequency in the ages of 9, 10 and 11, of which 51.6 % were men and 48.4% were women. It is allowed to infer from the results that such characteristics such as stratum 1 and 2 and the percentage obtained for the sex of the participants have an impact on the results. As they are fundamental characteristics of the sample, they provide relevant information on the characteristics of the context and the study population, which can be considered relevant information for administrators and teaching directors, since the results correspond to the general characteristics of the institution where the study was developed.

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