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# Impact of learning styles on multiple intelligences in first semester math students

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**Abstract.** The objective of this research was to determine the incidence between learning styles and multiple intelligences in students in the first semester of their degree in Mathematics at the Francisco de Paula Santander University in the second semester of 2019. The study is an exploratory, descriptive correlational design, with a sample of 33 students; Horney Alonso's learning styles and multiple intelligences questionnaires were used. It was determined that 45.5% of students have a high preference for reflective learning styles and 33.33% for mathematical logical intelligence. When the chi-square test was carried out, it showed a significance of 0.223, that is, the variables have a low level of association. On the other hand, this is confirmed by Spearman's correlation test with a significance level of 0.242, which concludes that the variables of this research are not very associated.

## 1. Introduction

Knowing about students' learning styles and how they affect their multiple intelligences is relevant for this research, since it allows both the institution and teachers to have open access to the learning dynamics of each student, as well as providing spaces for analysis where it is possible to determine possible teaching strategies that are not only limited to master classes, but there is also the possibility that learning is more meaningful [1], that is, it is not limited to just learning for the sake of learning.

Intelligence is an innate capacity in the human being, which in a certain way is reinforced during each stage of its life cycle. However, despite the fact that the word is only one, there are several concepts about intelligence mentioned by various authors that according to [2] cited by [3] can be summarized by one: "The capacity to think and to develop abstract thinking, as a learning capacity, as manipulation, processing, representation of symbols, capacity to adapt to new situations, or to solve problems". According to [4] they affirm that intelligence is a mental activity directed with the purpose of adaptation, which is formed by three aspects such as analysis, creativity and application. According to [5], they state that learning styles indicate the way in which the student perceives and processes information, thus building his or her learning, interacting with reality.

The educational context is the most involved in the processes of learning and knowledge, from that, [6] makes the proposal of an education model in which it emphasizes the various ways in which each subject acquires knowledge, mentioned by the author as multiple intelligences, as they are; linguistic, mathematical logic, spatial, kinetic-body, musical, interpersonal, and naturalistic. However, in this learning process not only does the type of intelligence that each person manifests become relevant, it is also taken into account as it does, which is why [7] in his theory of learning styles he mentions 4 types; divergent, assimilating, convergent and accommodating, which he classifies according to the cognitive capacities of each individual.



From what has been mentioned, it is considerable that people learn in different ways and with different ways of thinking and observing the context which in turn, despite the fact that it is usually the same, each individual defines it differently [8,9]. Today, it has been possible to observe over time how education has evolved and how its learning methods must increasingly be modified according to the social context to which the student community is exposed. That is why institutions, as well as teachers, must keep up to date with these changes that often occur in order to adapt to new educational trends [10], that is to say, innovating in the field of education has been a challenge for both educational institutions and teachers themselves [11].

According to [6] it does not deny the genetic component but maintains that these potentialities will be developed in one way or another depending on the environment, the experiences lived, the education received. The same can be said of mathematicians, poets, or emotionally intelligent people. Therefore, according to the model proposed by [6], all human beings are capable of the broad development of their intelligence, supported by their abilities and their motivation.

## 2. Methodology

The research follows a quantitative approach according to the criteria of [12], the study is of an exploratory, descriptive field level. It was carried out in three phases:

- Phase 1. Application of the questionnaires with the purpose of obtaining the necessary information for the identification of multiple learning styles and intelligences.
- Phase 2. The analysis of the results obtained from the questionnaires was carried out using the statistical software SPSS V 23. In which learning styles and multiple intelligences are identified, the chi-square test is also performed to find the level of association of the two variables and the Spearman correlation [13].
- Phase 3. Conclusions are drawn from the comparison of these results. The research hypothesis is whether there is a relationship between Multiple Intelligences and learning styles in first semester mathematics students of the Universidad Francisco de Paula Santander, Colombia, and the alternative hypothesis is that there is no relationship between Multiple Intelligences and learning styles in first-semester students of the Bachelor's degree in mathematics at the Universidad Francisco de Paula Santander, Colombia.

## 3. Results

The population was made up of 214 students between the ages of 17 and 30 who are studying for their bachelor's degree in mathematics at the Universidad Francisco de Paula Santander, Colombia. The sample consisted of 33 students belonging to the first semester, 19 men and 14 women, 51.52% of whom are students of stratum 2 and 48.48% of whom are of stratum 1. Laterality of students 6.06% are ambidextrous, 9.09% left and 84.85% right-handed. The Honey-Alonso questionnaire on learning styles was designed to identify the four specific styles or preferences when addressing the learning process:

- Active style. Active and unbiased involvement in new experiences.
- Reflective style. Observation of experiences from various perspectives. Priority of reflection over action.
- Theoretical style. Logical approach to problems. Integration of experience within complex theories.
- Pragmatic style. Experimentation and application of ideas. This consists of 80 items where the participant answering with a yes is equal to 1 and No is equal to 0. Then each of the items is added up and the style that is most predominant in each of the participants is identified.

The minds scale multiple intelligences questionnaire. The purpose of this questionnaire is to identify the predominant multiple intelligences of each of the students. It is composed of 72 items as follows: verbal-linguistic intelligence; mathematical logical intelligence, musical intelligence, spatial intelligence, kinesthetic intelligence, interpersonal intelligence, intrapersonal intelligence and naturalistic or ecological intelligence.

Figure 1 shows the learning styles of the students participating in the test. 21.21% of the students, equivalent to seven (7) people, are active. The 9.09% equivalent to (3) people, are of pragmatic style. The 45.45% equivalent to (15) people, are of reflexive style and finally, the 24.24% equivalent to (8) people, are of theoretical style. From the results evidenced in the graph, it can be stated that the learning style with the highest dominance in students is the reflective one, as well as it can be observed that the style with the lowest dominance is the pragmatic one.

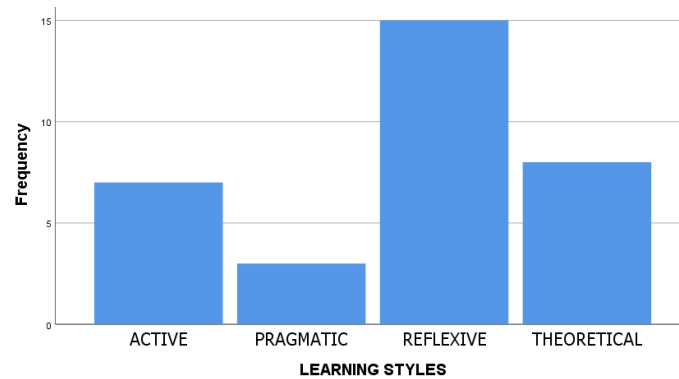


Figure 1. Learning styles.

Figure 2 relates the types of intelligences of the participating students, 6.06% equivalent to (2) people, are of spatial intelligence. The 27.27% equivalent to (9) persons, are of interpersonal intelligence. 12.12% equivalent to (4) persons are of intrapersonal intelligence. 33.33%, equivalent to 11 persons, are of mathematical logical intelligence. The 6.06% equivalent to (2) people, are of musical intelligence and finally, the 15.15% equivalent to (5) people, are of natural intelligence. Based on the results shown in the graph, it can be stated that the intelligence with the greatest dominance in students is mathematical logic, according to [14] subjects who have this intelligence play with ideas, need to understand the causes and why of things and phenomena. It can also be seen that the least dominant intelligence is spatial intelligence.

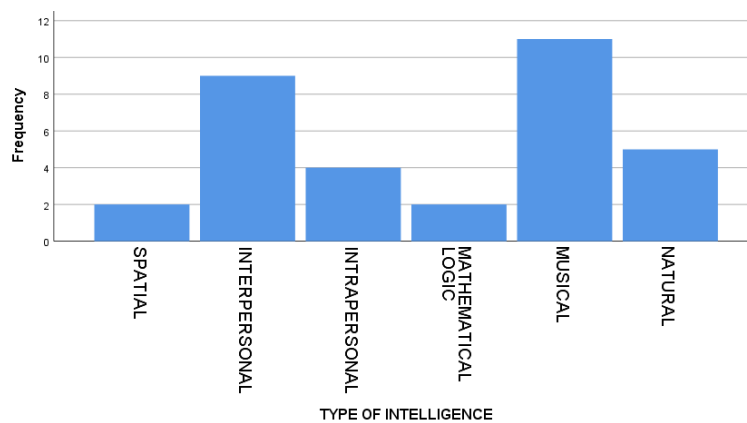


Figure 2. Types of student intelligence.

Learning styles and multiple intelligences were related to show the level of association and correlation of the two variables. Table 1 shows the chi-square test where it is observed that the level of association of the variables is too low of 0.223, it can be said that the variables in this research are not associated in turn they are independent variables.

Table 2 shows the results corresponding to the correlation between learning styles and multiple intelligences. The Rho is 0.210, which reveals a very weak level of correlation. With respect to significance the value of p is 0.242 is greater than 0.05 indicates that the null hypothesis is accepted,

and the alternative is rejected; concluding that learning styles are not significantly related or associated with the development of multiple intelligences in students in the mathematics degree program.

**Table 1.** Chi Square test.

	Value	Df	Asymptotic significance (bilateral)
Pearson's Chi-square	18.799 <sup>a</sup>	15	0.223
Likelihood ratio	23.815	15	0.068
No. of valid cases	33	-	-

<sup>a</sup> 23 cells (95.8%) have expected a count lower than 5. The minimum expected count is 0.18

**Table 2.** Spearman correlation.

			Learning styles	Multiple intelligences
Rho by spearman	Learning styles	Correlation coefficient	1.000	0.210
		Sig. (bilateral)	-	0.242
		N	33	33
	Multiple intelligences	Correlation coefficient	0.210	1.000
		Sig. (bilateral)	0.242	-
		N	33	33

The results obtained in the present investigation are similar to the results of the investigations carried out by [15] in the city of Lima entitled: learning styles and multiple intelligences in university students and the one carried out in the city of San José de Cúcuta, Colombia by [16] entitled multiple intelligences and learning styles, their relationship with the academic performance of students in statistics, which showed that learning styles have no level of association, nor correlation with multiple intelligences.

#### 4. Conclusions

It is evident that when identifying the type of intelligence used by the students during their formation process, the most usual for the great majority is the mathematical logical intelligence; considering that the students belong to the program of degree in mathematics and that generally it manages to be a positive aspect, since it is according to the processes of formation that they will receive during the course of their professional career. Likewise, in reference to the description of the students' learning styles with the application of the learning styles questionnaire, it is observed that the most used style according to the results of the test is the reflexive one, framed in a significant percentage compared to the other styles.

Finally, by establishing the relationship between learning styles and the multiple intelligences of the students, it is evident that there is no relationship between both, based on the statistical analysis of Spearman's correlation coefficient and the association coefficient of the chi-square test with which it is determined that they are independent variables.

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