











Multiple intelligence and learning of Mechanical and Electrical Engineering students at the National University of Engineering-UNI, 2022

[La Inteligencia múltiple y el aprendizaje de los estudiantes de Ingeniería Mecánica y Eléctrica de la Universidad Nacional de Ingeniería-UNI, 2022]

Ronald Juven Reyes Narváez^{a,*} , Máximo Florean Chávez Santos^a , Angel Ramiro Yupanqui Sánchez^a , Roberth Lozano Tacuri Toribio^b , Miriam Esther Campos Llana^b , Antonio Escalante Aburto^c , Raúl Jesús Vergara Moncada^c , Juan Roosevelt González Lucero^d , Álvaro Velásquez Ayma^e , Jesús Efraín Humpire Castillo^e .

^aUniversidad Nacional de Ingeniería -UNI, Perú

^bUniversidad Nacional Daniel Alcides Carrión, Perú

^cUniversidad Nacional Mayor de San Marcos, Perú

^dUniversidad Nacional Santiago Antúnez de Mayolo, Perú

^eUniversidad Nacional Amazónica de Madre de Dios, Perú

* reyesn@uni.edu.pe

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Resumen

El estudio tuvo como objetivo determinar si existe relación significativa entre la inteligencia múltiple y el aprendizaje. Por este motivo, se realizó la investigación en la educación superior. El tipo de investigación es aplicada, siendo el nivel de investigación descriptiva y correlacional. La investigación fue transversal; puesto que se realizó una sola vez la encuesta mediante la técnica del cuestionario y notas. La muestra es aleatoria simple 48 estudiantes. Se demostró que la inteligencia naturalista en el nivel más alto de 3,3750; mientras interpersonal y emocional es 3,3125, musical es 3,2917; y el más bajo es Kinestésico-Corporal es 3,0833 y el promedio general es 3,2176. Por lo tanto, las inteligencias múltiples mejora en el aprendizaje de los estudiantes; sin embargo, es necesario que los docentes tomen en cuenta en sus clases las inteligencias naturalista, interpersonal y emocional son las más representativa. Se determinó que más del 50% de los encuestados se ubican en 3, 0000, ya que el máximo es cinco, entonces es favorable. Asimismo, las veces que más se repite es 3,00 Asimismo, se desvían con respecto al promedio 1,14854 unidades de la escala, debido a que es bajo induce una menor dispersión de datos. Por lo tanto, que es empleado en el aprendizaje las inteligencias múltiples de los estudiantes. Por último, el p valor calculado es de 0.000, que es menor al 0.01 ($0.000 < 0.001$), por lo que se rechaza la hipótesis nula y se acepta la hipótesis alterna. El coeficiente rho es 0,852, lo que indica que la relación entre las variables es directa y su grado es muy alta. En conclusión: Se puede afirmar con un 99% de confianza que existe una relación positiva muy alta entre el grado de inteligencias múltiples y el aprendizaje de los universitarios.

Palabras clave: inteligencia múltiple, aprendizaje, naturalista, emocional, carácter, conocimiento.

Abstract

The study aimed to determine if there is a significant relationship between multiple intelligence and learning. For this reason, the research was carried out in higher education. The type of research is applied, being the level of descriptive and correlational research. The research was cross-sectional; since the survey was carried out only once using the technique of the questionnaire and notes. The sample is simple random 48 students. Naturalistic intelligence was shown to be at the highest level of 3.3750; while interpersonal and emotional is 3.3125, musical is 3.2917; and the lowest is Kinesthetic-Corporal is 3.0833 and the general average is 3.2176. Therefore, multiple intelligences improve student learning; however, it is necessary that teachers take into account in their classes the naturalistic, interpersonal and emotional intelligences are the most representative. It was determined that more than 50% of the respondents are located at 3,0000, since the maximum is five, then it is favorable. Likewise, the most repeated times is 3.00 Likewise, 1.14854 scale units deviate from the average, because it is low it induces less data dispersion. Therefore, it is used in learning the multiple intelligences of the students. Finally, the calculated p value is 0.000, which is less than 0.01 ($0.000 < 0.001$), so the null hypothesis is rejected and the alternative hypothesis is accepted. The rho coefficient is 0.852, which indicates that the relationship between the variables is direct and its degree is very high. In conclusion: It can be stated with 99% confidence that there is a very high positive relationship between the degree of multiple intelligences and the learning of university students.

Keywords: Multiple intelligence, learning, naturalistic, emotional, character, knowledge.

I. Introduction

At present, multiple intelligence is considered one of the main problems of university students, regardless of not knowing how to use their intelligence for their learning at the university. It should be noted that they cannot achieve the expected skills and abilities during professional training, due to the fact that they are unaware of multiple intelligence in learning, where often unsatisfactory results occur, presenting cases of disapproval, loss of interest, desertion and disinterest in learning. For this reason, it is of interest to know and identify the main problems that affect students. Thus, it is found that the population of this study, who is in the first cycles of the degree, is in a process of adaptation, within a context characterized by a high level of academic demand, numerous assignments and evaluations, and strict regulations that, coupled with the lack of cognitive resources, it leads students to prioritize the use of affective strategies, even over cognitive strategies. (Kohler, 2013, p.286).

Multiple intelligences intervene in the progress of the development of basic skills in the students of the Faculty of Social Sciences of the National University of the Altiplano, because they make a meritorious contribution in the acquisition of the fundamental capacities of the students and it is adaptable. to any educational field, at all academic levels. It can even be developed gradually, as well as the process of reading comprehension; in the process of action. However, according to the evidence found, we agree that teachers still have the task of continuing to work on the implementation of this theory as an educational model for the benefit of students in the course of their comprehensive education. (Calisaya et al., 2022, p. 1019). The results found in the present study are a starting point to highlight that the reflective and theoretical styles of learning are the most used by the students of the Sports Training university academic program in the initial and intermediate semesters, and the final semesters have a tendency to reflective, theoretical and pragmatic style. (Cardozo et al., 2018, p.13).

Regarding the study, relationships have been found between different variables. Specifically, Pearson's bivariate correlation analysis shows how academic performance maintains statistically

significant positive correlations with linguistic, logical-mathematical, spatial, and interpersonal intelligence; as well as creativity. (Sospedra et al., 2022, p.11). It should be noted that the correlations between the aspects valued in the study and, in this regard, we found different and interesting data that offer novel contributions. On the one hand, performance is related to kinesthetic intelligence, a concrete fact little known up to now. In our work we also found that the different components of emotional intelligence analyzed are related to multiple intelligences. Specifically, the degree to which students consider that they pay attention to their emotions is related to their logical-mathematical intelligence and emotional intelligence, both intra and interpersonal. Regarding the perception of their ability to identify and understand emotions, this is connected with their linguistic, emotional and musical intelligence. Finally, the ability to regulate and repair positive and negative emotions is related to musical and intrapersonal intelligence. (Hidalgo et al., 2018, pp. 278-279).

In addition, in terms of predictive validity, it is understood that the instrument is relevant when it comes to the selection of careers in the industrial area, especially for the dimensions of Logical-Mathematical, Kinesthetic and Emotional Self-efficacy; therefore, its use is recommended as a contribution in the prediction of the selection of university careers, in the administrative and industrial areas. Identifying the values of Self-efficacy for Multiple Intelligences of recently admitted students will be extremely important, due to the possibility of shaping mastery and execution behaviors in specific areas where their performance may be affected. (Durán et al., 2014, p.20). Undoubtedly, it is a challenge to open new paths and alternatives in educational tasks that allow taking into account other ways of presenting content and teaching classes. This typicality of multiple intelligences can be very well used by teachers to devise different ways of learning and evaluating what has been learned, providing that each one, according to their intelligence profile, can learn and obtain the best results. (Mesa, 2018, p.308). On the other hand, verbal linguistic intelligence had the highest number of correlations with metacognitive strategies, which could suggest that certain aspects of language would be related to metacognition (Arias & Linares, 2018, pp. 134 -135).

It was verified in the hypothesis test that multiple intelligences and the learning of the English language in the first year students of the Enrique Guzmán y Valle National University of Education present a moderate positive correlation. That is, multiple intelligences are directly related to learning the English language; Therefore, the greater the knowledge of the use of multiple intelligences, the higher levels of learning of the English language will exist. (Rojas et al., 2021, p.62). The results obtained seem to show that the use of formative assessment systems has a positive influence on improving the academic performance of students, especially with regard to a high percentage of "passes" and a low percentage of dropouts ("not presented"). On the other hand, comparing the AR based on the learning and evaluation pathway chosen by the students, the data seem to show a notably higher academic performance in the continuous and mixed pathways than in the final exam pathway, as a reflection of a better process. of learning (Fraile et al. 2013, p.32).

For this reason, research on multiple intelligence was carried out to improve learning in higher education. The objective was to determine if there is a correlation between multiple intelligence and learning. It is also necessary to mention the purpose of this research is to promote multiple intelligence in classes to improve the learning of university students.

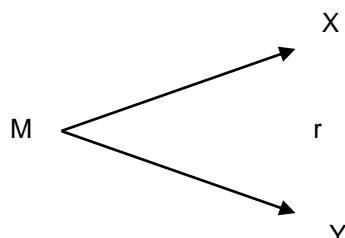
II. Materials and Methods

Type of research

The research is applied (since existing theoretical approaches have been applied), with the level of research being descriptive and correlational (since the behavior of the variables analyzed has

been described in order to later correlate them). The research was cross-sectional; since it was carried out only once and applied the mixed method for interpretation and analysis.

It responds to the following scheme:



Where:

M: sample

X: multiple intelligence

Y: Learning

r: Correlation

Population

According to Hernandez et al. (2014) indicated about this section "that it refers to the group of concordant cases with a row of precisions, and that are accommodated in relation to their contents, place, characteristics and time" (p.174). The population consists of 500 students enrolled in the 2022-2 semester, students of Mechanical and Electrical Engineering from the National University of Engineering-UNI.

Sample

For the determination that reflects a high degree of reliability and low percentage of error, the following statistical formula was used:

Formula

$$n = \frac{\left[\frac{z - \alpha/2}{d} \right]^2 \cdot p(1-p)}{1 + 1/N \cdot \left[\frac{z - \alpha/2}{d} \right]^2 \cdot p(1-p) - 1/N}$$

Where:

n = sample size

N = population size, total number of students = 500 (enrolled, 2022-2)

z = value corresponding to the Gaussian distribution = 1.96 for $\alpha = 0.05$

p = expected prevalence of the parameter to be evaluated. As in this case it is unknown, applying the most unfavorable option ($p = 0.5$), which makes the sample size larger.

q = 1-p ($p = 50\%$, $q = 50\%$)

d = precision error (in this case we want 12.1%)

α = significance level of 0.05

$$n = \frac{\left[\frac{1.96 - 0.05/2}{0.145} \right]^2 \cdot 0.5(1-0.5)}{1 + 1/500 \cdot \left[\frac{1.96 - 0.05/2}{0.145} \right]^2 \cdot 0.5(1-0.5) - 1/500}$$

The number of students is:

$$n = 52.9174204 / 1.10383484 = 47.9396178 = 48$$

Data Collection Techniques

For data collection, survey techniques were applied, a questionnaire by Carla Rosa del Rocío Lastra Bracamonte (2022), for which this instrument was subjected to expert judgment (pp. 135-138) and student notes for multiple intelligence to improve student learning in higher education.

Statistical analysis

For data analysis, descriptive and inferential statistics were used for the Rho Spearman Correlation hypothesis test; then they were processed; Subsequently, the frequencies and percentages were tabulated and found and presented in the corresponding tables and graphs. Statistical analyzes were performed with the SPSS (Statistical Package for Social Sciences) computer program in version 22 in Spanish; which is an instrument developed by the University of Chicago, which is the most widespread and used among researchers in Latin America. For this, the Excel program was used, which allowed the results to be presented in a clear and objective manner.

Procedures

The evaluations were carried out as follows:

- 48 students were taken as a representative sample of the students of Mechanical and Electrical Engineering of the National University of Engineering-UNI.
- A survey of 49 questions with five distractors was prepared (see annex 1).
- The investigation was carried out from 02 to 12-30-2022, where the survey was applied and the notes of the course taught were considered to contrast.
- 13 women and 35 men with an average age of 18 to 22 years corresponding to the first cycles participated.
- Obtained the data through the survey and notes, they were processed through basic and inferential statistics and tables were prepared for their interpretation and analysis.
- Finally, the Rho Spearman Correlation hypothesis test was carried out to measure the relationship of both study variables.

III. Results

The frequency analysis of the scores achieved after applying the instruments in students was tabulated and then a scale was obtained to be able to interpret the charts and graphs as shown in Table 1.

Table 1. Arithmetic means of the dimensions of the multiple intelligences variable.

Dimensions	Arithmetic means
Linguistics	3.1250
Logic and mathematics	3.1667
Space	3.1667
Musical	3.2917
Kinesthetic-Corporal	3.0833
Interpersonal	3.3125
Intrapersonal	3.1250
Naturalist	3.3750
Emotional	3.3125
General average of the variable	3.2176

Interpretation

The results obtained from the average values of multiple intelligence in the students according to the applied instrument are shown in Table 1, where it is seen that of the intelligences analyzed, four are above the general average, which means that the students have more developed intelligences: naturalistic, interpersonal, emotional and musical. Of the four most developed intelligences, the first two is highly developed according to the established scale; In this sense, the remaining intelligences are in the medium range accompanied by another five that reached averages above 3. The Kinesthetic-Body, linguistic and intrapersonal intelligences are present at a low level. Regarding the general average of the variable, it resulted in 3.2176, which indicates that the multiple intelligences of the students have a medium level of development.

The naturalistic intelligence and the learning of the English language in the students of the sample present a moderate positive correlation. That is, naturalistic intelligence is directly related to learning the English language; therefore, if the student develops this type of intelligence, he will achieve a higher level of learning. Interpersonal intelligence and English language learning in the students in the sample show a moderate positive correlation. That is, interpersonal intelligence is directly related to learning the English language; therefore, the better the interpersonal intelligence, the higher levels of learning will exist. The musical intelligence and the learning of the English language in the students of the sample represent a moderate positive correlation. That is, musical intelligence is directly related to learning the English language; therefore, the better the musical intelligence, the higher levels of learning will exist. (Rojas et al., 2021, p. 63).

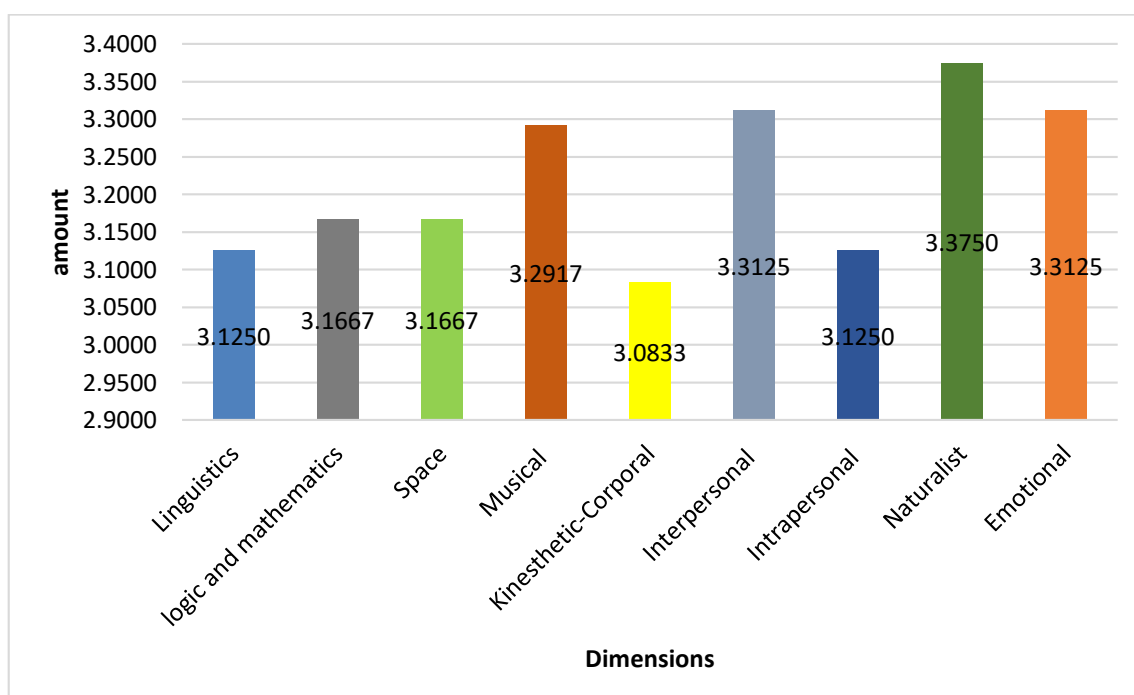


Figure 1. Arithmetic means of the dimensions of the variable multiple intelligences

Table 2. Dimensions of Learning

Dimensions	Arithmetic means
Aptitudes	3,0000
Knowledge	3,0208
Character	3,3333
Goal learning	2,8542
General average of the variable	3.052075

Interpretation

The results obtained from the average values of Learning in the students according to the applied instrument are shown in Table 2, where it can be seen that the three dimensions of learning analyzed are above the general average, which means that the students have more developed in learning: aptitudes, knowledge and character.

Of the three most developed dimensions of learning, one is character highly developed, according to the established scale; In this sense, the remaining dimension is in the medium range accompanied by others that reached means above 3. The learning goal is present at a low level of 2.8542. As for the general average of the variable, this resulted in 3.052075, which indicates in the learning of the students they have a medium level of development. Learning has been a concern for teachers, if it transforms students, the teacher will wonder how and in what circumstances it occurred, it is there where the act of training university student's expresses learning and the teacher's performance emerges a significant role because it determines conceptual relationships, experiences and reflections that lead to a learning environment that recognizes the other and their differences (Cardozo et al., 2018, p.10).

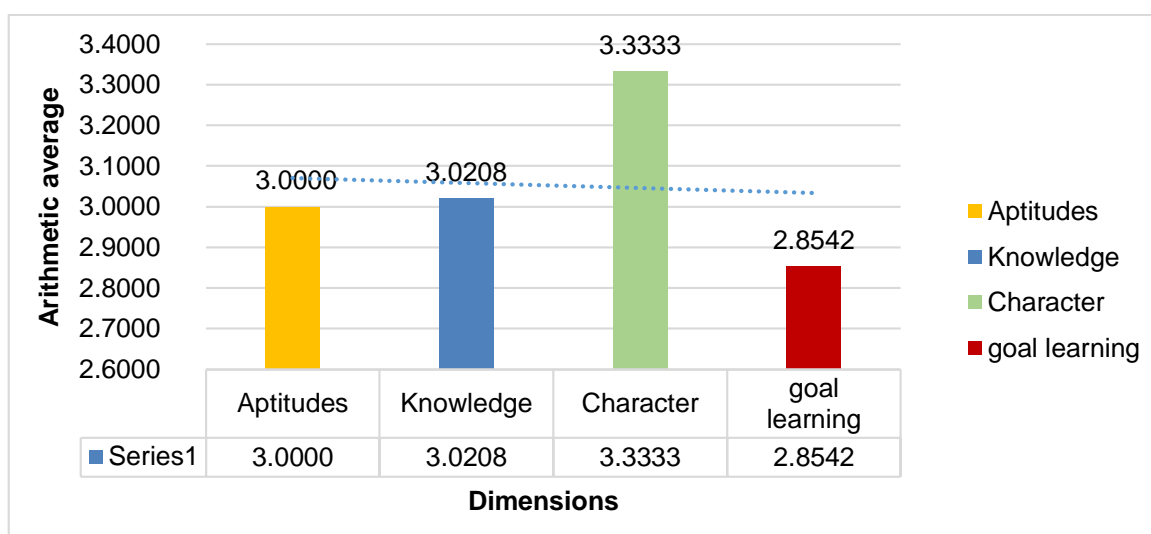


Figure 2. Learning Dimensions

Measures of central tendency of the application of multiple intelligences

Table 3. Levels of the application of multiple intelligences

N°	Valids	48
Mean		3,0000
Median		3,0000
Mode		3,00
Std deviation		1,14854
Minimum		1,00
Maximum		5,00

Interpretation

The attitude of the respondents towards the multiple intelligence application is favorable. It was determined that more than 50% of the respondents are located at 3,0000, since the maximum is five, then it is favorable. Likewise, the most repeated times is 3.00 and 1.14854 scale units deviate from the average, because it is low it induces less data dispersion. Therefore, it is used in learning the multiple intelligences of the students. A minimum score of 1 and a maximum of 5 was observed. According to the data obtained in the measures of central tendency, there is a favorable attitude regarding the application of multiple intelligence according to the students surveyed. This typicality of multiple intelligences can be very well used by teachers to devise different ways of learning and evaluating what has been learned, providing that each one, according to their intelligence profile, can learn and obtain the best results. (Mesa, 2018, p.11). In summary, it is concluded from what has been discussed that it is relevant to analyze the socio-emotional variables that have been studied in the present investigation with a double purpose, on the one hand, to clarify which ones, in what way and at what moment each one of them intervenes and, on the other, to be able to design intervention programs focused on optimizing the overall performance of university students. (Hidalgo et al., 2018, p. 279).

Analysis of the independent and dependent variables

Before carrying out the respective hypothesis test, we will first determine if there is a normal distribution of the data (parametric statistics) or not, that is, a free distribution (non-parametric statistics). For this purpose, we will use the Kolmogorov Smirnov normality test ($n > 50$).

Table 4. Test of Normality

	Test of Normality					
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Linguistics	,229	48	,000	,803	48	,000
Logic and mathematics	,276	48	,000	,783	48	,000
Space	,306	48	,000	,741	48	,000
Musical	,300	48	,000	,767	48	,000
Kinesthetic-Corporal	,232	48	,000	,808	48	,000
Interpersonal	,312	48	,000	,757	48	,000
Intrapersonal	,241	48	,000	,798	48	,000
Naturalist	,375	48	,000	,684	48	,000
Emotional	,325	48	,000	,744	48	,000

a. Lilliefors Significance Correction

Interpretation

The normality test shows that both variables are not distributed according to a normal law, since the sig. asymptot for both variables it is 0.000, that is, for the self-esteem group, it is below the predetermined alpha significance level (0.05); therefore, for the academic performance variable it is 0.000, it is below the predetermined alpha level of significance (0.05). Which means that, for the analysis of the relationship between these two variables, non-parametric tests were chosen. Therefore, the data does not come from normal populations, since they present a percentage of less than 5%.

Table 5. Rho Spearman correlation between multiple intelligences and Learning

Correlations			
		multiple intelligences	Learning
Spearman's Rho	multiple intelligences	Correlation Coefficient	1,000
		Sig. (2-tailed)	,852
		N	,000
	Learning		48
		Correlation Coefficient	,852
		Sig. (2-tailed)	1,000
		N	,000
			48

*Correlation is significant at the 0.01 level (2-tailed)

Interpretation

In Table 5, the calculated p value is 0.000, which is less than 0.01 ($0.000 < 0.001$), so the null hypothesis is rejected and the alternative hypothesis is accepted. The rho coefficient is 0.852, which indicates that the relationship between the variables is direct and its degree is very high. In conclusion: It can be stated with 99% confidence that there is a very high positive relationship between the degree of multiple intelligences and the learning of university students. According to (Hopkins, 2014). Likewise, the value of significance $p < 0.05$ indicates that said correlation is statistically significant with a confidence level of 95%. The foregoing demonstrates that multiple intelligences are involved in the development of the primary abilities of students. Finally, the multiple intelligence profiles obtained in our population are of great value for rethinking educational teaching and learning practices at the university level, in order to address the strengths of students from various disciplines. In this sense, it is a challenge to open new paths and alternatives in university tasks that allow us to respect and take into account other ways of presenting content and teaching classes. (Rigo and Donolo, 2010, p.10).

IV. Conclusions

- Naturalistic intelligence was shown to be at the highest level of 3.3750; while interpersonal and emotional is 3.3125, musical is 3.2917; and the lowest is Kinesthetic-Corporal is 3.0833 and the general average is 3.2176. Therefore, multiple intelligences improve student learning; however, it is necessary that teachers take into account in their classes intelligences such as: naturalistic, interpersonal and emotional are the most representative.
- It was determined that more than 50% of the respondents are located at 3,0000, since the maximum is five, then it is favorable. Likewise, the most repeated times is 3.00 Likewise, 1.14854 scale units deviate from the average, because it is low it induces less data dispersion. Therefore, it is used in learning the multiple intelligences of the students.
- Finally, the calculated p value is 0.000, which is less than 0.01 ($0.000 < 0.001$), so the null hypothesis is rejected and the alternative hypothesis is accepted. The rho coefficient is

0.852, which indicates that the relationship between the variables is direct and its degree is very high. In conclusion: It can be stated with 99% confidence that there is a very high positive relationship between the degree of multiple intelligences and the learning of university students.

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Annex 1. Questionnaire**INSTRUMENT TO MEASURE MULTIPLE INTELLIGENCES
GENERAL DATA:**

Gender: M/F	Age:	Date:	/	/
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INSTRUCTIONS:
Select the option and mark the information requested with an "X" in the corresponding box. This survey is ANONYMOUS, and its processing will be reserved, so we ask you to be honest in your responses, according to the following rating scales.

Never	1
Hardly ever	2
Sometimes	3
Almost always	4
Always	5

N°	Items	1	2	3	4	5
	LINGUISTIC INTELLIGENCE					
1	I find it easy and pleasant to write					
2	I enjoy word games (crossword puzzles, riddles)					
3	I enjoy reading books					
4	Correctly write words, sentences and texts					
5	He likes to listen to stories, comments on the radio, etc.					
6	Communicates with others in a markedly verbal manner					
	LOGICAL AND MATHEMATICAL INTELLIGENCE					
7	I find it easy to do a mental calculation					
8	I like math classes.					
9	I like to work or play on the computer					
10	I like puzzles, chess, checkers or other games					
11	I like working with numbers and figures					
12	Has a good sense of cause and effect					
	SPACE INTELLIGENCE					
13	Various instruments or household appliances are used					
14	I like to watch movies, slides, and other visual presentations					
15	I like to solve mazes, dominoes or other similar visual activities.					
16	I like to look at the shape of buildings and constructions					
17	I prefer reading material with lots of illustrations					
18.	Engraves your workbooks, work templates, and other materials					
	PHYSICAL AND KINESTHETIC INTELLIGENCE					

19	I excel in one or more sports						
20	I easily learn the steps of a new dance						
21	I can imitate characteristic gestures and movements of other people very well						
22	I enjoy working with my hands in concrete activities (sewing, crafts, weaving, carpentry, assembling models, etc.)						
23	I like to run, jump, move quickly, hop, or do physical activities						
24	I enjoy working with clay and other tactile experiences						

	MUSICAL INTELLIGENCE						
25	I like to hum, whistle						
26	I remember the melodies of the songs and I sing outside the classroom.						
27	I like to dance or move rhythmically						
28	I can play a musical instrument or sing in a choir or some other group						
29	It is sensitive to environmental noises (eg rain on the roof)						
30	I like to sing in the shower or when I'm alone						
	INTERPERSONAL INTELLIGENCE						
31	I enjoy conversing or interacting with my peers						
32	I am sensitive to other people's moods						
33	I like to lead my group of classmates						
34	I enjoy playing with my classmates, with other people or in a team						
35	I have two or more very close friends						
36	I have a good sense of empathy or concern for others						
37	Others seek your company						
	INTRAPERSONAL INTELLIGENCE						
38	I feel good when I'm alone because that way I can think about my own things						
39	When I am alone playing or studying I present a good performance						
40	I feel happy with myself						
41	I prefer working alone to working with others						
42	I am able to learn from my mistakes and achievements						
43	I show great self-love and adequately express my feelings						
	NATURALISTIC INTELLIGENCE						
44	I use spray or some other aerosol to scent my room						
45	I like to participate in activities that take place outdoors						
46	I am indifferent to seeing an animal suffer in the street						
47	I prefer a pet (robot) than a real one						
48	I worry about the danger of the destruction of the earth (earthquake, tidal wave)						
49	I like to draw outdoors						

¡Thank you for your collaboration!