

**Correlation between school performance and writing skills in students entering higher education****Correlación entre el desempeño escolar y la escritura en estudiantes de recién ingreso a educación superior**

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**Abstract**

Written language is an organized and voluntary activity, conscious analysis of the sounds that form. As a communication system for which there is structured a context of use and certain formal combinatorial principles. Objective: To identify the writing ability level at new students to higher education using the Brief Neuropsychological Battery NEUROPSI in Spanish. Methodology: The research is quantitative, exploratory, cross-sectional, descriptive, correlational and comparative. It is a non-probabilistic sample by convenience with 38 freshmen in City of Durango, Mexico. Contribution: There is a normal level of writing in 84.21% of college freshmen (32 students), 10.53% with moderate deficit (4 cases) and with severe deficit 5.26% (2 cases). Finally, 15.79% of all cases (6) resulted deficient according to the values of Spanish Brief Neuropsychological Battery.

**Writing, Neuropsychological evaluation, College students**

**Resumen**

El lenguaje escrito es una actividad organizada y voluntaria, de un análisis consciente de los sonidos que lo forman. Siendo un sistema de comunicación estructurado para el que existe un contexto de uso y principios formales. Objetivo: identificar la capacidad para la escritura en alumnos de reciente ingreso a educación superior y su relación con el desempeño escolar. Metodología: La investigación es cuantitativa, exploratoria, transversal, descriptiva, correlacional y comparativa. La capacidad de la escritura se midió con la Batería Neuropsicológica Breve en español NEUROPSI. En una muestra no probabilística por conveniencia con 38 alumnos de recién ingreso a la licenciatura en la Ciudad de Durango. Resultados: De alumnos universitarios de reciente ingreso estudiados, 32 (84.21%) tienen valores normales, 4 (10.53%) con déficit moderado y 2 (5.26%) con déficit severo. Siendo un total de 6 (15.79%) participantes con valores por debajo de lo normal.

**Escritura, Evaluación neuropsicológica, Estudiantes universitarios**

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## Introduction

The act of writing allows us to enter into a subject that reflects personal intimacy but at the same time provokes a social manifesto of the individual who enters into a relationship from his thought with his world and his culture, writing (Andrade Calderón, 2009).

Writing since its birth has boosted the intellect of man, since it has generated great technological advances and innovations, as it allowed the establishment of better communication in society, however, writing is made up of a codified system of visible signs through which a writer can determine the exact words to the reader to generate a context. This is what we call writing in its strictest sense (Scherp, 2013).

Writing involves knowledge of language codes, ability to convert phonemes into graphemes, knowledge of the graphemic system, adequate fine motor skills, and spatial ability to distribute, join, and separate letters. There are three specific modalities of written language: spontaneous writing, writing to dictation and writing to copy. In these modalities different parsers are needed; which is a chain of links which is (Vigotzky, 1978).

Among the skills required in the writing process are auditory recognition of letters and words, searching and visual tracing, once the word is written; auditory figure-ground perception, auditory perception in sequence, auditory-phonetic discrimination, auditory memory, auditory sequencing skills, receptive language, writing fluency, right-left orientation, tactile sensitivity, shape recognition through touch or stereognosia, finger localization, reaction times and lateral preferences.

The process involves different links: in all writing, the first link is the conservation of phonemic hearing, which is indispensable for analyzing the acoustic composition of the word (Rojas, 2005).

The conservation of the order of the sounds conforms the second link, in this, the task consists of analyzing the acoustic complex that constitutes each word. The third link is the inhibition of the components; this process is altered when there is a weakening of the active inhibition. Then the decoding of the phonemes into optical elements (graphemes) is performed, with their motor execution. Each grapheme has its own visuospatial structure and for the realization of a complicated spatial analysis (Cortés, 2006).

## Handwriting or writing

According to Luria, reading and writing are spatial forms of language and run in opposite directions to each other; in writing it is thought that leads to the phonetic analysis of a word, which in turn, allows the construction of graphemes. The reading process starts with the visual perception and analysis of graphemes to later recode them into their corresponding phonetic structures and reach the comprehension of the written word (Sanchez M. d., 2006).

Writing represents a very late advance in the history of man, because the only way of communication that was used in prehistory approximately 2,500,000 years ago, was through drawings, babbling, representation with objects, etc., We can define Prehistory as the period of time prior to History, that is, what elapsed from the beginning of human evolution until the appearance of the first written testimonies. (Prehistory, The art of history, August 2016).

It is possible to consider as "writing" any semiotic mark, that is, any visible or sensory mark that an individual makes and to which he attributes a meaning (in the times of its acquisition where a simple scratch or drawing contained a meaning or a representation). However, the research that defines writing today does not approve of it because these representations make its meaning more trivial and subjective. Intellectual development and human consciousness were not enhanced by a simple semiotic mark, but by devising a coding system of visible signs by which a writer could determine the exact words to the reader to generate a context.

The alphabet implies another kind of circumstance: that a word is a thing, not an event: that it is present in its full extent and that it is possible to divide it into small graphic elements (graphemes), which can even be written in one way and pronounced the other way around: "p-a-r-t" can be pronounced "trap". If the word "part" is recorded on a tape and played back, one does not hear "trap" but a completely different sound (Scherp, 2013).

### **School performance in university students**

The educational challenge is one of the most important challenges facing Mexican society. Societies whose educational levels stand out in terms of coverage and quality improve their prospects for successful integration into the global economy, while at the same time improving the opportunities of the individuals that comprise them. The returns associated with investment in education have both a social and an individual component (Salazar, 2010).

Academic Achievement (A.R), is understood as the system that measures the achievement and construction of knowledge in students, such knowledge is created by educational didactic interventions that are evaluated through qualitative and quantitative methods in a subject. (Perez Fuentes, 2013)

This performance is understood as the relationship between the learning process and its tangible results in predetermined values, it is a determining issue in the field of higher education due to its implications in the fulfillment of the formative function of educational institutions and the educational project of students. (Montes Gutierrez, 2011).

Probably one of the most important dimensions in the teaching-learning process is the student's academic performance. When it comes to evaluating academic performance, the factors that can influence it are analyzed to a greater or lesser degree, generally considering, among others, socioeconomic factors, the breadth of the curricula, the teaching methodologies used, the difficulty of employing personalized teaching, the previous concepts that students have, and their level of formal thinking (Benitez, Gimenez and Osicka, 2000), however, Jiménez (2000) refers that "one can have a good intellectual capacity and good aptitudes and yet not be obtaining an adequate performance", given the dilemma and the perspective that academic performance is a multifactorial phenomenon.

In academic life, ability and effort are not synonymous; effort does not guarantee success, and ability begins to take on greater importance. This is due to a certain cognitive capacity that allows the student to make a mental elaboration.

That is, in a situation of success, the self-perceptions of ability and effort do not harm or damage the esteem and value that the teacher places on them. However, when the situation is one of failure, things change. To say that great effort was invested implies low ability, which generates a feeling of humiliation. Thus, effort begins to become a double-edged sword and a threat to students, since they must make an effort to avoid the teacher's disapproval. (Navarro, 2003).

### **Writing in college students**

Reading for writing is a common activity in the university environment, both for students and professors. Students may consider this activity as one of the best strategies to organize the information they have read or as a way to convince the professor that they have understood what he/she has tried to teach them (Applebe, 1987, Pressley & McCormick, 1995).

In turn, teachers use it for different purposes such as knowing the students' comprehension levels or assessing their learning, for which they ask them to prepare summaries, outlines, reviews and/or reports of the texts they study in class. In these tasks, they generally cause students to notice and reflect on their critical thinking.

On many occasions, students' performances in the writing processes are not what teachers expect, as they consider that these productions are unstructured, do not rescue the author's communicative intention, are confusing and show little understanding of the topics (Ochoa & Aragón, 2004). (Sollany Ochoa & Aragón Espinosa, 2007).

Gradually, research has been considering how the immediate situational contexts (Flower, 1987), the pedagogical devices that promote or hinder writing and the cultures that tacitly direct writing through their practices, representations and habitual genres (Berkenkotter, Huckin & Ackerman, 1989; Flower, 1990; Lea, 1999) affect the production of a text.

Ro Ivanic (1999) proposes an integrative model of the different levels of analysis of writing, a model that includes the written text, the mental processes of writing, the rhetorical situation of the writing event and the socio-political context of writing. Di Stefano and Pereira (2004) also argue that in teaching it is necessary to consider writing (and reading) as processes, as practices and as social representations (Carlino, 2004).

Through reading and writing, students carry out a process of analysis and synthesis that will lead them to understand contents and to express their own ideas and points of view, arguing correctly. Writing well, in a coherent and orderly manner, denotes clear thinking.

"In other words, learning to write is learning to think and vice versa. One way to learn to write is to accompany the student in the stages of prewriting and rewriting, understanding how students think and create, each one using language and ideas with their own particular voice" (Potter, 2012).

Therefore: The process of writing, even if it is to take notes in class, already implies some information processing, because we write what we understand using our own words.(Guerrero, 2011).

It should be taken into account that academic writing involves higher thought processes and consists of three phases that teachers should supervise:

- 1. Pre-writing or planning phase. Students should be able to pose and answer questions such as: What do I want to write, what is the topic, what type of text, who is it addressed to, is it research, a report or an argumentative text, what is the appropriate bibliography, etc.
- 2. Written production. In this phase it is important to help the students to express their ideas with precision.
- 3. The revision. In this phase the student should be helped to evaluate the work done through questions such as: Is it enough, is it clear, is it orderly, is it coherent, does it correspond to the initial objective, are the right words being used, etc.?

In this way, learning to write means practicing, practicing and practicing with adequate and timely feedback from the teacher during its previously established development (Ulloa Herrero, 2005).

Such writing competence is not acquired naturally or spontaneously but needs to be built and developed through systematic work processes in the classroom, since "learning the written code requires specific teaching" (Vargas Franco, 2015).

### **Anatomical and physiological basis: Neuroeducation and language**

Language is a structured communication system for which there is a context of use and certain formal combinatorial principles. Language indicates a common characteristic of man to express his experiences and communicate them to others through the use of symbols, signs and sounds registered by the sense organs. The human being uses a complex language that expresses sonorous consequences and graphic signs. Among the different brain centers associated with language, we find the following: (Fernandez D. A., 2013)

*Wernicke center:*

Wernicke's area is located in the cerebral cortex in the posterior half of the superior temporal gyrus, and in the adjacent part of the middle temporal gyrus. Its most important function is the decoding and deciphering of the spoken word. For its correct activation, short-term memory, long-term (systematic) memory and knowledge of various grammatical rules are necessary. From a functional point of view, it is a secondary auditory receptor area specialized in the interpretation of sounds related to the human voice. This area could be considered as the most important for language comprehension and its lesion gives rise to Wernicke's aphasia or Wernicke's aphasia (Karl Wernicke).

*Broca Center:*

The language domain is of special interest in this area because of its importance in spoken language, language processing and comprehension. This area is located in the third frontal gyrus, in the opercular and triangular sections of the language dominant hemisphere. Broca's area is divided into two sub-areas; the triangular (which deals with multi-modal interpretation of stimuli - plurimodal association) and the programming of verbal behaviors (which deals with a single stimulus - unimodal association and coordinates the organs of the phonatory apparatus for speech production, due to its position adjacent to the motor cortex). It is connected to Wernicke's area by a bundle of nerve fibers called the arcuate fasciculus. The lesion of this region is called Broca's or expressive, non-fluent motor aphasia (Paul Pierre Broca).

*Exner's center:*

Exner's center occupies the posterior two-thirds of the second frontal gyrus. This center is responsible for creating kinesthetic melodies necessary for writing. The temporal coordination of hand-digital movements is carried out in this center. It is a center that receives continuous information from the hand and fingers, which is used to control writing. A good functioning is essential for writing correctly, since it allows us to optically guide the hand-digital movements while writing.

*Luria center (lower):*

The functions of the inferior Luria center are to coordinate the activities of the laryngeal, pharyngeal, palatal, lingual and labial musculature. It also coordinates the movements and receives information from the parts of the phonoarticulatory system, forms verbo-motor images and intervenes in all types of buco-phonatory, linguo-labial and facial praxias of spoken language.

*Luria center (upper):*

The Luria center for written language is located in the superior part of the inferior parietal lobe, above the Luria center for spoken language. In front it invades the medial part of the ascending parietal gyrus, and behind it is confused with Dejerine's center. Its most important function is related to the hand-digital praxias as well as the nonverbal expressions of the body that accompany all spoken language.

*Types of language**Comprehensive language:*

The study and interpretation of the process of language comprehension has been placed in patients who have deficits in discriminating speech sounds. Also, in those who have lesions in their own language centers, and although they manage to repeat some words, they are unable to understand them or use them spontaneously.

Finally, it is studied in patients who have lesions in the fibers linking the language centers: they are unable to report the words to the comprehension centers through the senses. This leads us to understand that bilateral lesions of the temporal lobes affect acoustic discrimination while unilateral lesions of the left temporal lobe affect word comprehension according to the two levels of acoustic and phonetic processing.

*Spoken language:*

It is one of the most complex functions performed by the human being since it integrates in the same function cortical and subcortical brain processes, linguistic motor and neuromuscular responses.

The cortical structures in charge of planning and programming spoken language are located in the prefrontal cortex, mainly in Broca's area, the hippocampal connections will allow maintaining the necessary memory for such organization and the connections with medial temporal areas, mainly Wernicke's, will allow understanding the extrapyramidal motor process in which the cerebellum and the striate nuclei will be in charge of specifying, adjusting and coordinating the motor process.

#### *Written language:*

The logical process of learning to write in most people must first understand the words, then be able to read them and finally write them, which involves a learning and memory process as well as a series of cognitive skills integrated in the whole process of language acquisition. However, visual and spatial memory are also involved for the writing process.

#### *Writing processes:*

It is important to note that the systemic analysis of writing, Luria is not limited to the description of the components of the structure "horizontally", but points to the complex and flexible organization of the function, the level of its voluntary realization and automation of writing words. Luria discovers not only systemic, but also dynamic organization of the writing function.

Luria indicates that in the first "energetic" functional block in writing are those deep brainstem structures involved in the regulation of cortical tone. Secondly, after the works devoted to the differences between the hemispheric work would point out the contribution of the right hemisphere functions in the process of writing (Kok, 1967 and Simerinitskaya, 1975).

In order for the subject to be able to perform the task, he must be in a state of active wakefulness and preserved until the end of the work, without changes in his ability to work. Thus, in the act of writing is included the maintenance of the active tone of brain functioning (first functional block, Luria) (Akhutina, 2002).

After an accuracy of the sound structure of the word (short and long term memory), the subject can correlate the sounds with the letters, for which the image of the letter is updated. During the task of writing down a well-known word, the subject can remember the visual image of the whole word. In this way, he can use both alphabetic and logographic writing, basically using the analytical (left hemisphere) or holistic (right hemisphere) strategy for operations with visual images (representations) of letters and words (Temple, 1998).

To start writing, the subject must find the line, the place where the pen will be placed, and must orient himself to the elements of the letters and the letters in space. This requires the participation of visuospatial information processing operations. Thus, not only the first functional block, but also different sectors of the second functional block (posterior cortical) participate extensively in writing. (Sanchez L. M., 2012).

The motor act of writing requires information from the kinesthetic and kinesthetic component of movement organization, in particular, the motor programs of letter writing that have to be updated and initiated.

Finally, a necessary condition of writing, which allows to adequately perform the auditory and kinesthetic analysis, to update the visual and visuospatial image of the letter and, to find and realize the motor programs, is the presence of a voluntary program of the whole action of writing in general. Without this, the subject would be easily distracted by external stimuli, would not analyze and memorize the information in a sufficiently active way, and would not regulate and control his own actions. Thus, writing as a voluntary action requires the participation of another component, the aim of which is the programming and control of voluntary actions (Akhutina, 2002).

*Brief Neuropsychological Battery NEUROPSI in English*

The NEUROPSI test is characterized as an instrument to assess and evaluate cognitive processes. It should be noted that it has been developed and standardized in Mexico. It was specifically designed to evaluate cognitive functions in normal and pathological conditions including the areas of orientation, attention and concentration, memory, language, reading and writing, calculation and executive functions.

In general, oral language disorders (aphasia) are accompanied by defects in the ability to read (alexia), write (agraphia), and perform numerical calculations (acalculia). However, alexias and agraphias can be aphasic or non-aphasic.

The performance of these tasks involves the interaction of linguistic and non-linguistic areas, and the participation of areas of the left and right hemispheres, each contributing specific aspects. It is frequent that even in mild damage or during early degenerative processes these processes are altered.

- **Material and administration:**

The scheme consists of simple and short items. Tests of high neuropsychological validity are included. The administration is individual and requires a set of cards (attached sheets) and the recording protocol. A protocol is included for the schooled population (5 years and older) and another protocol for the evaluation of individuals with low and no schooling (1 to 4 years).

- **Scoring:**

The scoring system allows obtaining a total score and an individual profile of cognitive functions, which indicates the subject's abilities and disabilities in each of the evaluated areas.

Taking into account the level of schooling and age of the subject, the performance can be classified into: normal, mild or borderline, moderate and severe alterations (Ostrosky, Ardila and Rosselli, 1999).

**Methodology**

A quantitative, exploratory, non-experimental, cross-sectional, cross-sectional, observational research was conducted by survey and by evaluation of neurocognitive functions (Batería Neuropsicológica Breve en Español-NEUROPSI. (Hernandez Sampieri, 2014).

Seven variables were analyzed; 3 correspond to the Batería Neuropsicológica Breve en Español NEUROPSI; writing and calculation variables (simple variables) and the total of executive functions as a complex variable.

The following variables were also considered: age, sex, school status (regular and non-regular) and school average.

The results were analyzed using descriptive (measures of central tendency and variability), correlational and comparative statistics. The sample was obtained in a non-probabilistic way by convenience; where NEUROPSI was applied to new students entering higher education, belonging to two local universities, one public and one private.

Each student was given an informed consent form and the procedure was explained to them before starting the NEUROPSI test, with a total of 38 participants. All of them voluntarily signed the consent form agreeing to participate in the research.

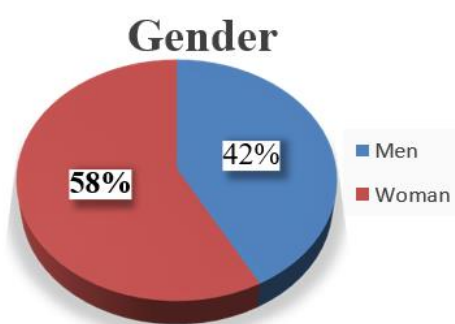
The data obtained were captured in an EXCEL data sheet and the information was analyzed using descriptive statistics, measures of central tendency (mean, mode and median) and of variability (frequencies, proportions and standard deviation); Pearson correlation and comparison using Student's t-test to find differences between groups of regular and non-regular students; students with a school average below and above the mean of the school average of the sample and between male and female students. Data collection was carried out during the period from March 2, 2022 to March 29, 2022.

### Evaluation

For the study of writing, the brief neuropsychological battery in Spanish NEUROPSI was used, using the variable corresponding to writing: without a time limit for the subject to perform it, in the first evaluation a blank sheet of paper is provided, a draft and the sentence to be written is dictated, then, when copying, sheet 12 of the appendix material is provided, which contains the sentence to be copied. At the end of the test, the student is evaluated with a maximum possible score of 2 points.

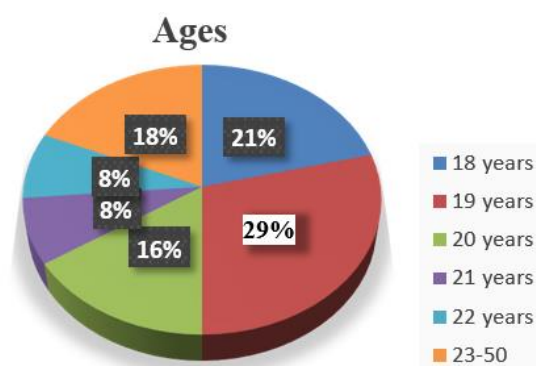
### Results

The sample studied consisted of 38 higher education students from two local universities, one public and one private. In terms of gender, of the 38 participants, 16 (42.11%) were male and 22 (57.89%) were female, as shown in the following graphic.



Graphic 1

The age of the participants was within a range of 18 to 50 years of age, with 8 participants aged 18 years (21.05%), 11 aged 19 years (28.94%), 6 aged 20 years (15.79%), 3 aged 21 years (7.89%), 3 aged 22 years (7.89%) and 7 distributed between 23 and 50 years of age (18.26%).

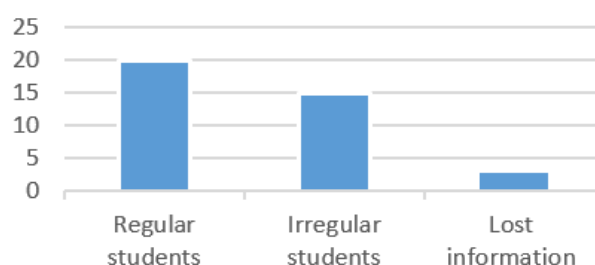


Graphic 2

The mean age was 21.31 years, with a mode of 19 years and a median of 19.5 years, while the standard deviation was 5.63 years (see Table 1).

The school status of the sample consisted of 15 non-regular participants (42.86%) and 20 regular participants (57.14%). It is important to note that in this variable information was lost for 3 participants who did not provide the corresponding data.

### School status



Graphic 3

The participants reported a school average in a minimum range of 6.6 and up to a maximum range of 9.3, with a mean of 8.23, a mode of 8, a median of 8.3, standard deviation of 0.57 in the sample of 35 participants due to what is stated in the previous paragraph. (See Table 1 in annexes).

Statistics	Sex	Age	Mean
Mean	1.57	21.31	8.23
Median	2	19	8.3
Mode	0.50	19.5	8
Standard Deviation	0.50	5.63	0.57

Table 1 Descriptive statistics

The total NEUROPSI score obtained in the sample studied showed values with a minimum range of 79 points and a maximum value of 122, with a mean of 108.39, mode of 114, median of 110 and standard deviation of 8.88 (See table 2 for normative values).

Total neuropsi

Maximum score 130

Cut-off scores

Schooling

10-24 years old

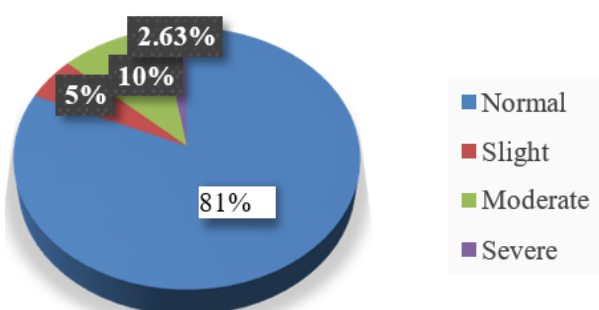


Age	Normal	Mild	Moderate	Severe
16-30	114-103	102-98	97-87	86-77
31-50	112-102	101-97	96-88	87-78
51-65	101-93	92-88	97-80	79-72
66-85	91-78	77-72	71-59	58-46

**Table 2** NEUROPSI total, in annexes of the manual  
Source: (Ostrosky-Solis F, 1999)

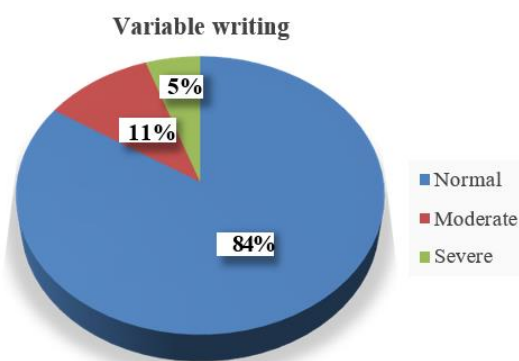
Taking into consideration the normative values of the NEUROPSI, the evaluation of the sample studied (38 participants) allowed identifying 31 participants with normal values (81.58%), 2 with mild deficit (5.26%), 4 with moderate deficit (10.53%) and 1 with severe deficit (2.63%). Seven students were identified with values below normal (18.42%).

#### Neuropsi Evaluation



**Graphic 4**

In the sample studied, it was observed that in the writing ability of new university students, 32 (84.21%) have normal values, 4 (11%) with moderate deficit and 2 (5.26%) with severe deficit. A total of 6 (15.79%) participants had values below normal.



**Graphic 5**

#### Correlation

The variable alertness has a weak to medium positive correlation with the variable writing with a value of 0.379 with a  $p < 0.019$ .

The complex variable "executive functions" has a positive correlation between weak and medium with the variable writing with a value of 0.368 with a  $p < 0.023$ .

In the simple variable "calculation", it was found to have a positive correlation between weak and medium with the variable writing with a value of 0.324 with a  $p < 0.048$ .

The other signalistic variables (age, sex, school status and GPA) did not show any significant correlation with the writing variable.

#### Comparison

The comparative analysis by Student's t with 34 gl, was performed considering the critical values of 2.032 with a  $p < 0.05$  and 2.728 with a  $p < 0.01$ . Regarding the writing performance according to school status, the mean of regular students (1.8) was compared with the mean of non-regular students (1.73) obtaining a Student's t of 0.327, which is not significant.

When comparing the writing variable of students with a higher average (1.9) to the general average against the writing variable with a lower average (1.64) to the general average, a Student's t of 1.2965 was observed, which allows identifying that there is no significant difference in writing ability between students with higher and lower school averages.

When comparing the writing variable of female students with male students, a Student's t of 0.9621 was observed, which indicates that there is no significant difference in writing ability between males and females.

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We would also like to thank the participating institutions for providing the opportunity to carry out this research. It should be clarified that the participating institutions are not mentioned, since for ethical purposes it was considered necessary to do so in order to maintain the secrecy of the information of the participants in the study.

## Conclusion

Taking into account what was seen in previous paragraphs, it was considered pertinent to carry out a study on the ability of writing and its correct execution for the learning processes and the correlation among new students, each of the variables analyzed being relevant.

Writing, together with reading, have become factors that encourage the processes of analysis and synthesis that lead the reader or writer to the understanding of contents and expression of ideas and points of view.

In other words, orderly and coherent writing speaks of clear and structured thinking. In the sample studied, it was observed that in the writing ability of new university students, 32 (84.21%) have normal values, 4 (10.53%) with moderate deficit and 2 (5.26%) with severe deficit. A total of 6 (15.79%) participants had values below normal.

Regarding writing performance according to school status, the mean of regular students was compared with the mean of non-regular students, obtaining a non-significant Student's t-test. The same occurred when comparing the gender variable between males and females.

Finally, the positive correlation between the weak and mean of the writing variable with the alertness variable allows us to identify that greater writing ability is linked to greater alertness.

In other words, writing ability, in this analysis, was found to be directly related to the participants' state of alertness, being more relevant, in this case, than their age, sex, school status, average, etc., etc.

Reiterating in this way, what Luria said in previous paragraphs, in relation to the first "energetic" functional block, he mentions that deep structures of the brain stem that are related to the regulation of cortical tone participate in writing. That is to say, for the subject to be able to perform the task, he must be in a state of active wakefulness and this must be preserved until the end of the work, without changes. Thus, the act of scirutation includes the maintenance of the active tone of brain functioning (Akhutina, 2002).

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