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Cognition and Its Relationship with Endogenous and Exogenous Factors in Engineering Students

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Abstract

In this research, a relational study was carried out between student cognition with endogenous factors (student attitude and age) and exogenous (collegiate origin) in engineering students of the University of Cartagena. The project was carried out in three (3) phases where the survey allowed the desired information to be obtained from an estimated nine hundred sixty (960) students between 2014 and 2016. In the second phase, the instrument was used to collect the information, which was constituted the cognitive scale of the Self-Regulation Inventory for Learning (SRLI) and in the third phase, the independent endogenous and exogenous variables were crossed with the dependent one (student cognition), constructing the bar diagram of the relationship analysis; being possible to determine statistical significance with the attitude of the student to a level of confidence of 95% while with the age and collegial origin was not relevant.

Keywords: Attitude, Cognition, Collegial origin, Engineering, University.

INTRODUCTION

Cognition is a complex mental process where the individual voluntarily [1] attends, abstracts, analyzes, processes, stores, retrieves, creates and internalizes meanings [2]. In the same way it involves pre-knowledge, memory, criticality, reasoning, creativity, imagination, that is, the higher components of thought [3]. This allows you to develop competencies related to the execution of a specific intellectual task.

Authors such as Fong et al. (2017) [4] consider thinking as a cognitive process of transforming information into memory. This is done with the aim of analyzing, valuing, transforming concepts and solving problems [5].

In university students, cognition is related to the intellectual capacity that each student possesses and that allows him to reach his academic goals [6]. From this perspective, the cognitive processes are articulated with the self-regulation of learning where students through their own strategies transform information into meaningful knowledge [7].

The cognitive processes related to self-regulation are related to the self-sufficiency that the student can acquire during his formative process and that allows him to achieve results, positive goals and dominate situations that require disciplinary competences [7,8,9]. These cognitive and self-regulatory processes are considered as determinants of academic success and allow students to competently perform in various areas of knowledge [10,11].

Currently the teaching-learning process focuses on the student where the learning process (cognitive) focuses on how the student meets his academic goals which are articulated with the self-regulation that he adopts during his formative process [12,13].

Authors such as Lindner and others [14] developed an instrument known as the Self-Regulation of Learning Inventory (SRLI) which measures the cognitive process of the student through the cognitive scale which takes into account the following elements: attention, automatic process of meaning creation, data storage, information retrieval and execution of the intellectual task [15,16].

Previous investigations have studied students' attitudinal processes in order to develop mediation strategies for students with learning difficulties to achieve greater and better cognitive benefits [9], learning procedures to be effective in regulating their metacognitive processes [16], to be more independent and successful in classrooms [18] thus avoiding academic failure [8,13,19].

Researchers such as Carrión (2002) [20] have studied variables such as the collegial origin of the student and concluded that it is a relevant predictor of academic performance.

According to authors such as Gomez et al. (2017) [17], progressive memory development is associated to some extent with chronological age.

In the present research, the relationship between the student's cognition was evaluated using the instrument "Self-Regulation of Learning" designed by Lindner and others [14] with the endogenous factors, age and student attitude as well as its relation with the exogenous factor of the collegial origin of engineering students.

METHODS

Statistical Method: The statistical method used in the present investigation was "Inferential Statistical" for populations less than 100,000 individuals according to Fong et al. 2017 [22].

Population and Sample Size: The study participants were regular students of the third semester of the programs of Civil Engineering, Systems, Chemistry and Food of the University of Cartagena. Of the total, 75% were male and 25% female. The ages of the students were between 17 and 21 years old. The sample taken was intentional.

To estimate the sample size for a finite population of less than 100,000 individuals, it is calculated according to Fong et al. (2017) [22] by equation (1):

$$N = \frac{\sigma^2 * n * p * q}{e^2 * (n-1) + \sigma^2 p * q} \quad (1)$$

Where:

N: Number of items that the sample must have

σ: Level of confidence or risk chosen.

p: Probability that an element is selected (% Dear).

q: Probability that an item is not selected

(q = p)

e: Error allowed

n: Number of population elements

Variables, phases and reliability of the test: The variables used in the research were classified in the following categories,

a. Endogenous Independent Variables: Student Attitude and Age.

b. Exogenous independent variable: High school

c. Dependent variable: Cognition

Cognition was evaluated using the SRLI (Self-Regulation Inventory of Learning) instrument, which is a questionnaire designed by Lindner et al. (1993) [14] which assesses cognition using 20 questions assessed based on the Likert scale.

The project was carried out in three (3) phases: In the first one, the endogenous factors (age and student attitude) and exogenous (collegial origin) were identified by means of a survey to evaluate its statistical significance with the student's cognition. In the second phase, the instrument formed by the Self-Regulation Inventory for Learning (SRLI) [14] was applied to the student population that was the subject of this study. In phase 3 the endogenous and exogenous independent variables were crossed with the dependent one (cognition) constructing the bar charts of the relational analysis.

The instrument was validated as reported by Lindner and Bruce (1988) [23]. To determine the reliability of the test the internal consistency was determined by equation (2):

$$\alpha = \left(\frac{k}{k-1}\right)\left(1 - \left[\sum (S_i)^2 / (S_{sum})^2\right]\right) \quad (2)$$

Where, k is the number of test items, $(S_i)^2$ is the variance of the items (from 1 ... i) and $(S_{sum})^2$ is the variance of the total test.

The coefficient measures the reliability according to two terms: the number of items and the proportion of the total variance of the test due to the covariance between its parts (items). This means that reliability depends on the length of the test and the covariance between its items.

The dependent variable Cognition of the student was classified into two categories: CB: Low cognition (scores below 70 points (CB<70)) and CA: High cognition (AC) (scores equal or higher than 70 (CA≥70)).

Endogenous independent variables were classified into two categories: a) Student Attitude Low (AB) (171<AB≤ 213.75 points) and high student attitude (AA) (213.75 <AA ≤ 285). b) Age: Without majority age SM (age<18 years) and with majority (CM) (age≥18). The exogenous variable collegiate origin was classified into two categories as follows: a. P: public school and PR: private school.

Statistic analysis: The Chi-Square test [24] between Cognition and the variables student attitude, collegial origin and age, was used to know which of these factors affect or are related to the Cognition processes in the engineering students of the University of Cartagena.

RESULTS AND DISCUSSION

As the population size was 950 students and taking into account that equation 1, showed a sample size of 201 individuals, when applying the surveys, was made homogeneously about 9 students per academic period and per program (4 programs, 6 academic periods) for a total of 216 respondents.

The reliability of the cognitive scale of the instrument used (SRLI) was made using the Cronbach's Alpha [25] yielding a value of 0.89. The other scales of the instrument allowed evaluating the attitude of the student to his academic processes throwing a Cronbach Alpha of 0.90. These values obtained for Cronbach's Alpha indicate a high degree of internal consistency of the test.

In order to quantify the cognition score of each student, the cognitive scale of the instrument used (SRLI) was assessed and its score corresponds to the sum of each of the weights of the questions on that scale. For the students with low cognition, the measured cognitive parameters showed the following results: attention (15%), storage (35%), data recovery (35%) and task execution (15%), while for high cognition (30%), storage (20%), data recovery (20%) and task execution (30%).

The Chi-Square test was evaluated for the analysis of the relationship between the student's cognition and the independent endogenous variables (age, attitude) and exogenous (collegial origin) variables. Table 2 also shows the values of p (statistical significance) where it is also observed that there is a relation of high statistical significance between Cognition and the student's attitude ($p < 0.05$). This confirms what was proposed by Alter et al. (2007) [11], Bjork et al. (2013) [13], Contreras et al. (2008) [19]. On the other hand, the results show that there is no relation of statistical significance between age and Cognition as well as between cognition and collegial origin, and Carrión (2002) [20] statements cannot be corroborated.

Table 1: Chi-Square Test for Student Cognition

Variable	Chi Square	GL	P value
Age	2.24	1	0.134
Collegial proceeding	1.05	1	0.306
Attitude	48.66	1	0.00**

** Relationship with high statistical significance at a confidence level of 95%

The statistical significance between cognition and the student's attitude could be verified since the metacognitive processes developed by the engineering students of the University of Cartagena are positioned as mediators between the motivation and the strategies used during their academic process as proposed by Dent and Koenka (2016) [15]. It can also be said that self-regulation used by engineering students has been integrated into a paradigm shift of how to approach the teaching-learning process in the new century. The first way in which they do it is to take advantage of the tutor-tutor during classroom work and the second consists of self-learning that crystallizes through work or independent activities that manage to develop outside the classroom in order to achieve meaningful learning [26].

In the same way the students have been able to consolidate the essential competences of their training and professional profile as well as the instrumental and specific competences for the knowledge society as proposed by Gargallo et al. (2011) [27] thanks to the attitude with which they empower all their processes academic [28,29] which are articulated with complex processes of cognitive analysis and processing.

Statistical significance between the exogenous factor of collegial origin and cognition did not result in a significant association ($p > 0.05$), which means that collegial origin (public or private school) does not affect cognitive processes and is therefore not determinant for the academic performance of the students not being able to verify the approaches of Carrión (2002) [20].

The statistical significance between the endogenous factor of age and cognition did not result in a significant association ($p > 0.05$), which means that age does not affect the cognitive processes of engineering students at the University of Cartagena. The progressive development of memory is associated to a certain extent with chronological age as posed by Bach and Underwood (1970) [21], Reese (1962) [26], Keeney et al. (1967) [28]. Figure 1 shows the bar chart between Cognition and student attitude.

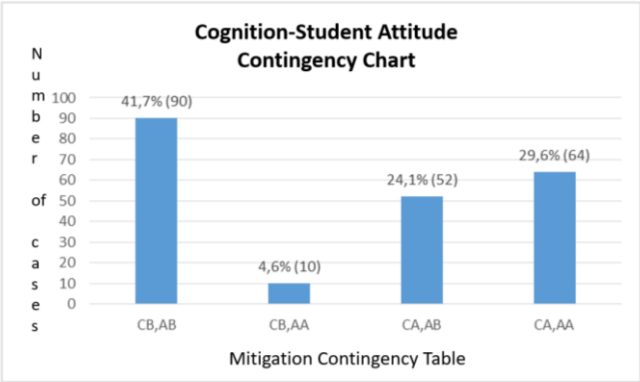

Figure 1: Bar chart between Cognition - student attitude

According to Figure 1, students with low cognition have a low student attitude (90 cases). In this category, the largest number of cases are grouped and represent a very close to half (41.7%). It is very rare to find cases of students who despite having a low cognition have a high student attitude (4.6%, 10

cases) this means that there is a student population that despite knowing their intellectual limitations face their academic activities with a very high predisposition to learning. 24.1% (52 cases) of the sample have a high cognition and low student attitude which is probably due to the student's lack of motivation due to some type of intrinsic or extrinsic drawback [29]. The cases of high cognition and high attitude correspond to 29.6% (64 cases), which means that almost a third of the sample, despite having high cognition, face their academic exercise with the best disposition. In this way the student will be able to integrate knowledge, cognitive, communicative and collaborative work skills that will strengthen his / her disciplinary competences in his area of professional performance [30].

CONCLUSION

According to the results obtained, we have the following conclusions: 1) The cognition measured from the SRLI can be considered as a reliable tool that allows students to organize, plan, identify and strengthen their weaknesses in academic engineering processes. In the same way, it allows them to reach their goals and objectives of integral formation. 2) There is a statistically significant relationship between cognition and Student Attitude at a 95% confidence level. This means that the engineering student attends, abstracts, analyzes, processes, stores, retrieves, creates, internalizes meanings, reasons, is creative, employs imagination, values, transforms concepts and solves problems. These factors allow you to achieve academic success by making you an academic self-regulated student and achieving your goals and objectives with ease. 3) There is no statistically significant relationship between the cognitive processes and the student's collegial course at a 95% confidence level. This means that, although it is true that in each secondary school (public or private) they lay the foundations for constructing a learning model that allows the process of transition between middle and high school to be generated and made more dynamic and fluid in the student. Higher education, it is the student himself who is responsible for his academic success at the University, regardless of the school from which he came. 4) There is no statistically significant relationship between cognition and age at a 95% confidence level in engineering students. This means that qualities such as reflexivity and abstraction that are characteristic of older people and the more active learning styles of young people are not differential factors to advance academic processes related to engineering.

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