Academic Performance and its Relation with Intrinsic Factors in Engineering Students

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Abstract
The association between academic performance, self-regulation, psychological well-being and cognitive processes was studied in 950 students of the engineering programs of the University of Cartagena between 2014 and 2016. The academic performance was evaluated by survey from the dimensions defined by Valle-Santos et. al (2013): conceptual performance, procedural performance and global performance. Self-regulation and cognitive processes were evaluated using the instrument designed by Lindner et al (1993) called "Inventory of Self-Regulation of Learning". Psychological well-being was assessed using the psychological well-being scale, formulated by Ryff & Keyes (1995). For the relationship analysis, the variables were crossed and the bar diagrams and the 2x2 contingency tables were constructed applying the Chi-Square independence test. The values of 0.90, 0.89 and 0.91 for Cronbach's alpha allowed to validate the instruments: Inventory of Self-regulation of Learning, academic performance and psychological well-being, respectively. The results indicate that there is a significant degree of statistical significance (p <0.05) between academic performance with self-regulation of learning (p = 0.032), psychological well-being (p = 0.0000) and cognitive processes (p = 0.0009) at a level of 95% confidence. This means that the engineering student is an emotionally stable student, who is comfortable with the chosen career and has a high degree of abstraction, analysis and competence.

Keywords: Academic Performance, Self-regulation, Psychological well-being, Cognitive processes
Introduction

Latiesa (1992), cited in Rodriguez et. al (2004), considers that academic performance is nothing more than the relationship between what is learned and what must be learned by quantifying with a grade. That is to say, the academic performance is valued in function of the success, delay and academic abandonment where the accumulation of the different academic activities is weighted with a grade and is an indicator of student learning in a given academic period [1, 2]. Edel Navarro (2003) considers that cognitive development has a close relationship with the psychological well-being of the student during his learning process and also with his academic performance in the classroom that is associated with the motivational and self-regulation processes [3]. For Covington (2000) the processes of cognitive organization, achievement of goals and achievements in the student are associated with the presence of processes of self-regulation in it, that is, controlled in the execution by the same student but at a higher level of control [4]. For Schunk (2012), self-regulation is related to the way students appropriately take and participate in their learning process by regulating, controlling and monitoring all the academic processes that allow them to reach their goals. That is, learning is an activity of the individual where his proactivity and effort will allow him to learn and generate specific competences. This is because the students themselves recognize their limitations and strengths [5].

On the other hand, Hurtado (2000) believes that emotional or affective problems could complicate the academic processes of students [6]. In addition, for Veenhoven (1991), psychological well-being is one of the factors that condition academic performance, which is the result of the extent to which a student considers that he is comfortable with the life he leads in positive terms [7]. Also, Bartra and Guerra (2013) consider that if a student is not emotionally stable and with a psychological well-being, they will not be able to achieve success in the classroom [8]. For Kolb (1984) learning as a cognitive process is based on everyday experiences as primary sources of knowledge and at the same time models the ways of learning. In this sense, learning is understood as a cyclical process that involves concrete experience, reflective observation, abstract conceptualization and active experimentation [9]. For De la Torre and Mallart (1991), the cognitive style is specific to each student and is considered as a mental functioning strategy that allows differentiating each individual from the way they process information, think, solve problems, act and learn [10]. In the present investigation, the association between academic performance with self-regulation of learning, psychological well-being and cognitive processes in university students was evaluated.

Materials and Methods

Population and sample size: The study participants were regular students of the fourth 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. To estimate the size of the sample when it comes to a finite population of less than 100,000 individuals is calculated according to Fong et al. (2017) [11] by equation (1):

\[
n = \frac{\sigma^2 Npq}{e^2(N - 1) + \sigma^2 pq}
\]  

(1)

N: Number of population elements; n: Number of elements that the sample must have; \( \sigma \): Level of confidence or risk chosen; \( p \): Probability that an element is selected (% estimated); \( q \): Probability that an element is not selected (\( q = p \)); \( e \): Error allowed.

**Variables, phases, instruments and reliability of the test:** The variables used in the research were classified into two (2) categories (independent and dependent): a. Independent variables: Self-regulation of learning, psychological well-being and cognitive processes in engineering students. b. Dependent variable: Academic performance.

The research was carried out in three (3) phases: In the first phase, the degree of academic achievement of engineering students was identified by means of a survey. In the second phase, self-regulation of learning, psychological well-being and cognitive processes were evaluated. In phase 3 the independent variables are crossed with the dependent variable (academic performance) constructing the bar diagram of the relational analysis. The academic performance was evaluated by survey from the dimensions defined by Valle-Santos et al. (2013): conceptual performance, procedural performance and global performance. The first is related to the conceptual contents. The second with the ability that the student has to execute and solve problems of the context and the third is related to the grade obtained in the subject and that results from collecting the notes (partial assessments) of the conceptual and procedural performance [12]. Self-regulation and cognitive processes were evaluated using the instrument designed by Lindner et al (1993) [13] called "Inventory of Self-Regulation of Learning". Psychological well-being was assessed using the psychological well-being scale, formulated by Carol Ryff (1989; Ryff & Keyes, 1995) [14, 15].

To determine the reliability of the test the internal consistency was determined using the Cronbach Alpha [16]. The dependent variable (academic performance) was classified into two categories: a) Low academic performance LAP (LAP <75 points or less) and high academic performance (HAP) (HAP ≥ 75 points out of 100 points). The independent variables were classified into three categories: a) Self-regulation of learning: LSR: Low self-regulation (scores below 300 points (LSR <300)) and HSR: High self-regulation (scores equal or greater than 300 (HSR ≥300)). b) Psychological well-being: Low psychological well-being LPWB (LPWB <18 points or less) and high psychological well-being (HPWB) (HPWB ≥
18 points out of 36 points). c) Cognitive processes: Low cognitive process (LCP) (LCP < 70 points) and High cognitive process (HCP) (HCP ≥ 70 points out of a total of 100 points).

**Statistical analysis**

The Chi-Square statistical test [17] between academic performance and independent variables: Self-regulation of learning, psychological well-being and cognitive processes, was used to know which of these factors are related to each other in the engineering students of the University of Cartagena.

**Results and Discussion**

According to equation 1, with a confidence level of 95%, a sample size of 274 individuals is obtained. When applying the surveys, a total of 12 students per academic period and per program (4 programs, 6 academic periods) were made homogeneously for a total of 288 respondents. The Cronbach's Alpha [12] for the Self-Regulation Learning Inventory, the academic performance questionnaire and the psychological well-being scale instrument yielded the values of 0.90, 0.89 and 0.91 respectively, which indicates a high degree of internal consistency in each of the tests. The Chi-square test was evaluated for the analysis of the relationship between the dependent academic performance variable and the independent variables: self-regulation of learning, psychological well-being and cognitive processes.

Table 1 additionally indicates the values of p (statistical significance) where it is observed that there is a relationship of high statistical significance between academic performance with self-regulation of learning, psychological well-being and cognitive processes (p < 0.05).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chi-square</th>
<th>GL</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-regulation of learning</td>
<td>4.60</td>
<td>1</td>
<td>0.032</td>
</tr>
<tr>
<td>Psychological well-being</td>
<td>18.59</td>
<td>1</td>
<td>0.0000</td>
</tr>
<tr>
<td>Cognitive processes</td>
<td>10.99</td>
<td>1</td>
<td>0.0009</td>
</tr>
</tbody>
</table>

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

Figure 1 shows the bar graph between academic performance and self-regulation of student learning.
According to Figure 1, 37.1% (80 cases) of the students presented high academic performance due to the high process of self-regulation of learning. This is because in this group of students the academic performance is associated with the processes of self-regulation that they implement during their academic activities as proposed by Edel Navarro (2003) [3]. In the same way it was possible to verify in this student population that the cognitive organization they use to achieve their academic goals and achievements is largely associated with the processes of self-regulation that they have managed to achieve during their academic career, as Covington (2000) puts it [4].

6.9% (15 cases) of students developed high academic performance despite having low levels of self-regulation. This is due to the fact that learning is an activity of the individual where his proactivity and effort will allow him to generate and develop good academic performance regardless of whether or not he has self-regulation processes, according to what was proposed by Schunk (2012) [5].

The 40.3% (87 cases) of the students developed poor academic performance despite having high levels of self-regulation. This is due to emotional or affective problems as proposed by Hurtado (2000) [6]. Additionally, this could be due to stress problems when performing academic activities such as exams, oral work or involving a qualification in the classroom. 15.7% (34 cases) of the students developed low academic performance due to the low levels of self-regulation they develop. This allows us to corroborate the statistical significance between the variables where, by decreasing self-regulation, academic performance is directly affected, decreasing to the same extent. In addition, the effort the student makes to achieve their academic goals is reflected in the grade obtained by him, as stated by Schunk (2012) [5].
Figure 2 shows that 42.6% (92 cases) of students developed high academic performance due to the high levels of psychological well-being they had. This is due to the fact that the students in the study did not present emotional or affective problems as Hurtado (2000) suggests [6]. In addition, the approaches of Veenhoven (1991) and Bartra and Guerra (2013) are met, which consider psychological well-being as a condition for success and academic achievement [7,8].

3.7% (8 cases) of students developed high academic performance despite having low levels of psychological well-being. In this group of students it was possible to show that they are comfortable with the academic life they lead in positive terms where psychological aspects do not affect them significantly, that is, they are students with solid personality and defined as Veenhoven (1991) suggests [7].

36.6% (79 cases) of the students developed poor academic performance despite having high levels of psychological well-being. According to Latiesa (1992) cited in Rodriguez et. al (2004) [1, 2], this is due to the fact that this group of students is dedicated to learning aspects that, although important, do not relate significantly to the learning objectives, that is, these students are careless and the majority, even, have fallen in the removal of some subject to consider it complicated.

17.1% (37 cases) of students developed poor academic performance due to the low levels of psychological well-being they had. In this group of students, the premise is fulfilled that by reducing psychological well-being, academic performance is significantly affected, which agrees with that proposed by Hurtado (2000), Veenhoven (1991), Bartra and Guerra (2013) [6, 7, 8].
According to Figure 3, 40.3% (87 cases) of the students developed high academic performance due to the high cognitive processes they use. This allows to verify the postulates of Edel Navarro (2003) which considers that cognitive development is related to academic performance [3]. In the same way, the cognitive processes used by the students have allowed them to achieve goals and achievements, due to the high academic performance they demonstrate in the classroom as Covington (2000) puts it [4]. 4.6% (10 cases) of students developed high academic performance despite the low cognitive processes they use. In this group, it is likely that there are students who have daily experiences as primary sources of knowledge, concrete experience and active experimentation as proposed by Kolb (1984) [9]. The 39.4% (85 cases) of the students developed low academic performance despite using high levels of cognitive processing. This is because the cognitive styles are specific to each student where the processing of information, solving problems are related to the authenticity of each individual as proposed by De la Torre and Mallart (1991) [10]. 15.7% (34 cases) of the students developed poor academic performance due to the low levels of cognitive processing they develop. This is because these types of students are immature during the processing of information, that is, they need to reach the cognitive maturity that allows them to achieve success, goals and positive academic performance as proposed by Kolb (1984) [9].

Conclusions

The research allowed to verify statistical significance at a 95% level of confidence between the self-regulation of learning and the academic performance of the engineering student at the University of Cartagena. This is because the engineering student assimilates the programmatic contents by self-regulating their academic process in an active way, reflective, controlling, regulating and monitoring their academic practice which has allowed them to efficiently achieve their goals and objectives. There is statistical significance at a 95% level of confidence between
the academic performance and the psychological well-being of the engineering student at the University of Cartagena. This is because the engineering student is an emotionally stable student, has control over his emotions, affects and is comfortable with the student life he leads, which has allowed him to achieve recognition and good grades. Statistical significance was verified at a 95% confidence level between the academic performance and the cognitive processes of the engineering students of the University of Cartagena. This is because students base their formative process on observation and reflexive analysis where they use abstract conceptualization to develop competences and achieve academic success.

References


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