Extrinsic Factors and their Association with the Motivation and Self-Regulation of Learning in Engineering Students

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Abstract

The statistical association between the extrinsic factors was evaluated: social stratum and teaching skills with the motivation and self-regulation of learning in 950 students of the engineering programs of the University of Cartagena between 2014 and 2016. The instruments to collect the information were: the survey and the inventory of self-regulation for learning (SRLI), designed by Lindner, Harris and Gordon (1993) which was modified for the requirements of the research and validated by Cronbach's alpha which yielded a value of 0.81. For the relationship analysis, the variables were crossed and the bar diagrams were constructed and the 2x2 contingency tables applying the Chi-Square independence test, which showed the degree of statistical significance among the variables. The results indicate (p = 0.000) that there is a significant degree of statistical significance between student motivation and professor skills with a confidence level of 95%. This allowed us to conclude that the motivation of the engineering student of the University of Cartagena is associated to a large extent with the innovative teaching strategies used by their professors.

Keywords: Self-regulated learning inventory, motivation, social stratum, professor skills
Introduction

For Winne (1995) [1] self-regulating learning requires the student to become aware of the inconveniences and difficulties that can be encountered during their training process and that may prevent them from achieving their academic achievements. To overcome these barriers, students must employ strategies that allow them to achieve their goals controlling cognitive, emotional and affective variables. For Markus and Wurf (1987) [2] self-regulation consists in observing, organizing, planning, formulating goals, evaluating and reacting to possible difficulties they may encounter during their academic exercise.

For Schunk (1994) [3] the processes of self-regulated learning involve self-generation of strategies on the part of the student that allow him to overcome academic barriers. This self-regulation must be systematic and aimed at achieving the learning goals previously defined or formulated by the students. In the same way Cooke et. al (2004) [4], Koskinen (2007) [5], Furlong and Cartmel (2009) [6] in studies developed in the United Kingdom and North America, determined that the difference of social stratum affects academic integration and coexistence between students. That is to say, students with vulnerable origins and who enter universities where the majority of students belong to the middle and upper class, are affected significantly due to the little relationship they can establish with teachers and peers. In addition, the low self-esteem of this population does not allow them to integrate socially with their classmates in the classroom, making them incompatible in some cases. Lehmann (2007, 2009) [7,8], Thomas and Quinn (2007) [9] consider that vulnerable students from the province, above all, face difficulties in academic performance which is most likely due to their low levels of commitment to the career and with the institution to which they belong.

For Cano (2005) [10] the teacher must generate favorable academic conditions that allow the student to develop the disciplinary and generic competences of their career and at the same time allow them to build new knowledge. According to Cuadrado (2011) [11], teachers must continually renew and adjust their pedagogical skills, which must adapt to the demands and particularities of the students or citizens of the 21st century. For Gallego (2009) [12] the motivation of university students is related to the individual and contemplates aspects that result from processes related to behavior, activation of knowledge, direction and organization of the task. For Trechera (2005) [13] the motivation involves aspects that mobilize the student for the execution of an activity or task. That is, the individual defines goals and objectives supported in the management of resources, positive attitude and proper behavior of the proactive student. Herrera et. al (2004) [14] consider that behavior is a consequence of human behavior when a challenge is faced. That is, the motivation includes three stages that are: the activation (start of the action), the direction (go towards the goal) and maintenance (persist until reaching the goal or objective).
In the present investigation the relationship between the self-regulation of learning in the students of the engineering programs of the University of Cartagena with extrinsic and motivational factors was evaluated, making use of the survey to identify the professor skills and social stratum and of the instrument designed by Lindner et al (1993) [15] called "Inventory of Self-Regulation of Learning" to assess self-regulation and student motivation.

**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) [16] by equation (1):

$$n = \frac{\sigma^2 npq}{e^2(N - 1) + \sigma^2 pq}$$  \hspace{1cm} (1)

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; N: Number of population elements.

**Variables, phases and reliability of the test:** The variables used in the research were classified into two (2) categories (independent and dependent):a. Independent variables: Extrinsic Factors (Social stratum and professor skills); b. Dependent variable: Self-regulation of Learning and Motivation.

Self-regulation of Learning and motivation was assessed using the SRLI (Self-Regulation of Learning Inventory) which is a questionnaire designed by Lindner et al. (1993) [15] consisting of 80 weighted questions from 1 to 5 based on the Likert scale.

The research was carried out in three (3) phases: In the first one, the extrinsic factors (social stratum and professor skills) were identified by means of a survey. In the second phase, the instrument made up of the Self-Regulation Inventory for Learning (SRLI) described above was applied to the student population under study. In phase 3 the independent variables are crossed with the dependent variable Self-regulation of Learning and motivation constructing the bar diagram of the relational analysis.

The instrument was validated as reported by Lindner et al. (1993) [15]. To determine the reliability of the test the internal consistency was determined using the Cronbach Alpha [17]. The dependent variables Motivation and self-regulation of learning were classified into two categories: a) Low motivation (LM) (LM <75
points or less) and high motivation (HM) (HM ≥ 75 points or more than a total of 100 points).  

b) LSR: Low self-regulation (scores below 300 points (LSR <300)) and HSR: High self-regulation (scores equal or greater than 300 (HSR≥300)). The independent variables were classified into two categories:  
c) Low social stratum: LSS (LSS: Social Stratum: levels 0,1,2,3 according to classification of the government of Colombia) and high social stratum (HSS: Social Stratum: levels 4,5,6 according to classification of the government of Colombia).  
d) Professor skills with innovative strategies: TSWIS and professor skills without innovative strategies: TSWOIS.

**Statistic Analysis:** The Chi-Square test [18] was applied to know the statistical association between the independent variables (social stratum and professor skills) and the dependent variables (Self-regulation of learning and Motivation).

**Results and Discussion**

According to equation 1, with a confidence level of 95%, a sample size of 201 individuals is obtained. When applying the surveys, a total of 9 students per academic period and per program (4 programs, 6 academic periods) were made homogeneously for a total of 216 respondents. The Cronbach's Alpha [17] showed an average value of 0.81, which indicates a high degree of internal consistency of the test. Table 1 also indicates the values of p (statistical significance), which shows that there is a relationship of high statistical significance between motivation and professor skills (p <0.05).

The statistical significance between the motivation and the teaching abilities, allows to infer that the engineering student of the University of Cartagena is a student who takes advantage of the favorable academic conditions generated by the teachers in the classroom to self-regulate their learning. That is to say, the disciplinary competences generated by the students result from the awareness of the students regarding their formative process supported by the efficient teaching practice. This self-regulation of learning allows the student to overcome academic barriers through the construction of new knowledge. This association means that the engineering student at the University of Cartagena can achieve his academic goals and achievements by controlling cognitive and affective variables, as proposed by Cano (2005) [10] and Winne (1995) [1]. In the same way, the postulates of Cuadrado (2011) [11] are fulfilled since the professors of the engineering faculty continually transform and adjust their strategies and pedagogical competences, thus achieving a more comprehensive training for the students. This training is the result of innovative pedagogical strategies that promote, generate autonomy and autonomous learning. Also the affirmations are fulfilled of Cano (2005) [10], Gallego (2009) [12], Trechera (2005) [13] y Herrera et. al (2004) [14]. In the same way, the results show that the teaching strategies used in the engineering programs have allowed the students to self-generate strategies that allow them to overcome
Extrinsic factors and their association with the motivation and academic barriers and reach their learning goals, thus proving the postulates of Schunk (1994) [3]. Likewise, the innovative strategies of engineering teachers have allowed students to react to difficulties, organize and plan their academic exercise to achieve previously established goals, thus verifying the approaches of Markus and Wurf (1987) [2].

On the other hand, the results show that there is no relationship of statistical significance between: self-regulation-professor skills, self-regulation-social stratum, motivation-social stratum (p> 0.05) not being able to verify the claims of Cooke et. al (2004) [4], Koskinen (2007) [5], Furlong y Cartmel (2009) [6], Lehmann (2007, 2009) [7,8], Thomas y Quinn (2007)[9].

### Table 1. Chi-square test for Self-regulation and motivation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chi Square</th>
<th>GL</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social stratum</td>
<td>0.06</td>
<td>1</td>
<td>0.8056</td>
</tr>
<tr>
<td>professor skills</td>
<td>0.03</td>
<td>1</td>
<td>0.8649</td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social stratum</td>
<td>0.62</td>
<td>1</td>
<td>0.4319</td>
</tr>
<tr>
<td>Professor skills</td>
<td>58.77</td>
<td>1</td>
<td>0.000**</td>
</tr>
</tbody>
</table>

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

Figure 1 shows the bar graph between student motivation and professor skills used by professors of the Engineering Faculty of the University of Cartagena.

In Figure 1, it is observed that 7.4% (16 cases) of the students showed high motivation as a result of the teaching exercise with innovative and relevant strategies (TSWIS-HM). That is, a student population is already self-regulating.
However, it is important to note that the number of cases is low for the effort made by the professor. On the other hand, 13.9% (30 cases) which corresponds to one seventh of the students in the sample, achieved low motivation despite the use of innovative strategies by teachers (TWSIS-LM). These results indicate that the teacher must evaluate the reasons why their innovative strategies are not helping some of their students. In addition, it is observed that the student population that shows high motivation when the professor uses innovative strategies, is exactly half of the population that has low motivation when the teacher uses the same strategies. On the other hand, 32.4% (70 cases) of the population that represents the third part, achieved a high motivation despite the non-use of innovative strategies by teachers (TWSOIS-HM). This may be due to the personal commitment that the student has with himself and his family, which obliges him to meet his academic goals even if the teacher does not use the appropriate innovative teaching strategies. Likewise, 46.3% (100 cases) which corresponds to almost half of the population were characterized by low motivation when the professor did not use innovative teaching strategies (TWSOIS-LM). This allows inferring that innovative strategies should be defined that are much more pertinent, applicative and contextualized, which will arouse even more the interest, creativity and disciplinary competence in engineering students. For this reason, teachers of the faculty of engineering are in a permanent training process that allows them to update and complement their pedagogical skills.

**Conclusion**

Based on the analysis as above, it is concluded as follow: There is statistical significance at a 95% confidence level between the professor skills and the motivation (p <0.05) of the engineering student at the University of Cartagena. That is, the teacher is generating academic conditions that contribute to the students' training process in a dynamic, relevant and contextualized way to the business environment of the region and the country. It also uses innovative pedagogical and didactic strategies, which allows students to generate interest in the career and curiosity to discover. This allows to consolidate the disciplinary competences in the students that contribute with the processes of integral formation in the engineering programs of the University of Cartagena. There is no statistical significance between self-regulation of learning and social stratum and teaching skills (p> 0.05) at a 95% level of confidence. There is also no statistically significant relationship at a 95% confidence level between the motivation and the social stratum (p> 0.05). This means that for a student to be self-regulated it is not necessary that he / she comes from a particular social stratum or that the professor has specific didactic skills. In the same way so that a student is motivated towards the formative processes in the engineering programs of the University of Cartagena, it is not necessary that it comes from a particular social stratum.
References


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