Significant Learning and its Association with Teaching Quality and Previous Knowledge in Engineering Students

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Abstract

The present investigation analyzed the statistical significance among the variables: significant learning, teaching quality and previous knowledge in engineering students of the University of the Guajira. The instruments used to measure significant learning were the scale of strategic and self-regulatory learning of Weinstein and Mayer (1986) while the teaching quality and previous knowledge were evaluated by survey. These instruments yielded Cronbach's alpha values of 0.94, 0.85 and 0.84, which means that they have high internal consistency. The relationship analysis was obtained by crossing the independent variables teaching quality and previous knowledge with the dependent variable significant learning and constructing the bar diagrams and contingency tables 2x2. The degree of statistical significance was obtained by means of the Chi-square test indicating statistical significance (p <0.05) between significant learning and teaching quality (p = 0.008) and prior knowledge (p = 0.005) with a confidence level of 95%. These results allowed us to conclude that the word used by the teacher is the main means that allows students to build and develop significant learning with quality. In the same way, prior knowledge is the pillar on which engineering students build their later knowledge.

Keywords: Significant learning, teaching quality and previous knowledge
Introduction

For Ausubel (1973; 1976), learning is considered significant when it can be built from the students' prior knowledge. That is, the process of significant learning is facilitated when the teacher knows what the students know and builds from there the teaching-learning process [1, 2]. Likewise, for Viera Torres (2003), one of the conditions that drives meaningful learning is the learning material, since the more it is related to the cognitive structure of the student, learning will occur to the same extent. That is, the learning material must have internal coherence and have logical sequence among its elements. This significant learning progressively increases as students interrelate with each other, improve the learning media, teachers and the context, with the word being the main mediator [3].

For Moreira (2005), however, the material is not enough to significantly and substantively promote student learning. On the contrary, it requires a positive disposition on his part to successfully carry out the learning process so that it can nest properly in its cognitive structure [4]. On the other hand, Cano (2005) considers that the person is competent when he knows how to build his knowledge. In this process, the teacher only creates the right conditions for the student to develop their skills [5]. Ramsden (2007) considers that a profound change is necessary in the teaching-learning process and that enable students to understand phenomena in the same way that experts do it in their area of knowledge or discipline [6].

This is why the universities of the 21st century are concerned with improving their teaching processes even though they recognize the scarcity of research work in this area that indicates the best way to do it and also taking into account that research is valued more than undergraduate teaching processes, according to the approaches of Cid et al. (2009) [7]. On the other hand, for McAlpine and Weston (2002), the university professor must possess an experiential competence that allows him to contextualize the teaching process. That is, it will significantly boost the learning process [8]. Another of the qualities of the university professor according to Bandura (1977) and Godard et al. (2000), is related to his self-efficacy, that is, he must be able to organize, plan and execute his academic process in a way that generates motivations and support the students so that they can reach their goals [9, 10].

On the other hand, the previous knowledge plays a fundamental role in the significant learning processes since it constitutes the fundamental base on which the student constructs his knowledge based on elements such as storage, attention, data recovery and execution of the task according to Lindner et. al (1993) [11,12]. Previous knowledge for Ausubel (1983), depends largely on the concepts and ideas that already exist in the cognitive structure of students. This will allow an articulation and interaction between the information that already exists and the new information and that will end up transforming in the new knowledge [13].
In the present investigation, the association between significant learning with the teaching quality and previous knowledge of 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, Industrial, environmental and mechanical of the University of the Guajira. Of the total, 70% were male and 30% female. The ages of the students ranged from 17 to 22 years. The total population studied was 1000 students of the aforementioned engineering programs between the years 2014 and 2016. 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) [14] by equation (1):

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

(1)

n: Number total of population elements; N: Number total of elements of the sample; p: Probability that an element is selected (% estimated); e: Error allowed (5%); σ: Level of confidence chosen; q: Probability that an element is not selected (q = p).

**Variables, phases, instruments and reliability of the test:** The variables used were classified into two (2) categories:

a. Dependent variable: Significant learning
b. Independent variables: Teaching quality and previous knowledge

The research was carried out in three (3) phases: In the first one, the level of previous knowledge of engineering students was identified through a survey. In the second phase, the instrument was applied, to measure significant learning using the instrument constructed from the scale of strategic and self-regulatory learning of Weinstein and Mayer (1986) [15]. The instrument consists of 77 questions weighted from 1 to 5 according to the Likert scale. In phase 3, the independent variables are crossed with the dependent variable significant learning and the bar diagram of the relationship analysis is constructed.

**Instruments**

The instruments used in the research were: The significant learning of Ausubel et al. (1991) [16] was measured from the three types of significant learning: the representational, concepts and propositional using the instrument built from the scale of strategic learning and self-regulation of Weinstein and Mayer (1986) [15]. Teaching quality and previous knowledge were assessed through surveys.
The internal consistency of the test was determined using the Cronbach Alpha [17].
The dependent variable Significant learning was classified into two categories: a) Low Significant Learning (SLL) (SLL <75 points or less) and High Significant Learning (SLH) (SLH ≥ 75 points out of a total of 100 points).
The independent variables were classified into three categories: a) Low teaching quality (LTQ) (score lower than 20, LTQ <20 points) and high teaching quality (HTQ) (score equal to or greater than 20 points out of a total of 30; HTQ ≥ 20) b) Previous knowledge: Low Previous knowledge PKL (0 < PKL ≤ 68) and high previous knowledge (PKH) (68 < PKH ≤ 100 out of a total of 100).

Statistic analysis: The Chi-square test [18] between the significant learning and the independent variables: teaching quality and previous knowledge was used to know which of these factors are related to each other in the engineering students of the University of the Guajira.

Results and Discussion

According to equation 1, with a confidence level of 95%, a sample size of 278 individuals is obtained. However, a total of 300 surveys were made (60 per academic program). The Cronbach's Alpha [12] for the instrument constructed from the scale of strategic and self-regulatory learning of Weinstein and Mayer (1986) and for the questionnaires that allowed to measure the teaching quality and previous knowledge yielded values of 0.94, 0.85 and 0.84 respectively, which indicates a high degree of internal consistency of the test. The Chi-Square test was evaluated for the analysis of the relationship between significant learning as dependent variable and the independent variables: teaching quality and previous knowledge. Table 1 also shows the values of p (statistical significance) where it is observed that there is a relationship of high statistical significance between significant learning with teaching quality and prior knowledge (p < 0.05).

Table 1 Chi-Square Test for Significant learning

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chi-square</th>
<th>GL</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher quality</td>
<td>7.14</td>
<td>1</td>
<td>0.008</td>
</tr>
<tr>
<td>Previous knowledge</td>
<td>8.02</td>
<td>1</td>
<td>0.005</td>
</tr>
</tbody>
</table>

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

Figure 1 shows the bar graph between significant learning and teacher quality.
According to Figure 1, 36.6% (79 cases) of the studied population develop significant learning processes in terms of teacher quality, that is, the pedagogical competence of the university teacher directly affects the construction of knowledge carried out by the student from the previous knowledge that he has, as proposed by Ausubel (1973; 1976) [1,2].

In the same way, the learning material is an instrument that has allowed the student to reach their cognitive goals allowing them to enrich themselves even more to the extent that it facilitates interaction with teachers and students where the word of the teacher has become the main mediator in this population studied, according to what was raised by Viera Torres (2003) [3], Moreira (2005) [4]. Likewise, it was possible to verify that this population is competent since it knows how to build its knowledge based on the conditions established by the teacher in the classroom, according to the postulates of Cano (2005) [5].

In 15.3% (33 cases) of the studied population it was possible to verify the statistical significance between significant learning and the quality of the university teacher since at a low quality teaching, there was a low significant learning in the students. That is to say, the word as the main mediator, the learning material and the teacher's knowledge of the group under study, allowed too us to check the postulates of Ausubel (1973, 1976) [1,2], Viera Torres (2003) [3]. In addition, it was possible to verify in this student population that they did not have a complete disposition in their cognitive structure to achieve this type of learning according to the requirements established by Moreira (2005) [4].

4.6% (10 cases) managed to develop high significant learning processes despite facing their academic exercise with low teaching quality. In this population, the precepts of Cano (2005) [5] are fulfilled since the student of this study population constructs his knowledge, independent of the competence of the teacher of the course.
Finally, 43.5% (94 cases) of the studied population developed low significant learning processes despite the fact that the course was developed with high quality teaching. In this sense, it is important that teachers make a profound change in the teaching-learning process and allow students to understand phenomena in the same way as experts in their discipline do, as proposed by Ramsden (2007) [6].

Figure 2 shows the bar graph between previous knowledge and significant learning.

According to Figure 2, the third part of the student population studied (33.3%) developed high significant learning processes by having previous knowledge in the study area. This may be due to the competence of the university faculty teacher of the engineering faculty since it is able to contextualize the teaching process as affirmed by McAlpine and Weston (2002) [8]. Likewise, this teacher organizes, plans and executes his academic process generating continuous motivation in the student who attends according to what was proposed by Bandura (1977) and Godard et al. (2000) [9,10]. Additionally, the previous knowledge that the student has of the faculty of engineering fruit of the academic planning of the curriculum, is allowing this population to build knowledge about those already acquired in previous courses where factors such as storage, attention, data recovery and task execution become fundamental according to the proposal by Lindner et.al (1993) [11,12]. The 17.1% (37 cases) allowed verifying the statistical significance between the student's prior knowledge and the significant learning that develops since in the studied population the student with low previous knowledge developed a low significant learning. This is possibly due to the point raised by Ausubel (1983) where the new knowledge is developed by the student based on what he already knows or possesses in his cognitive structure [13]. 4.2% (9 cases) developed significant high learning despite having low prior knowledge in the area. This may be due to the qualities of the professor of the faculty of engineering that
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contextualizes his teaching process that is, motivates and encourages the student to adopt a positive disposition toward their learning process based on the study of real life cases in the area according to what was proposed by Moreira (2005) [4]. 45.4% (98 cases) developed low significant learning despite having a high previous knowledge in the study area. This may be due to factors specific to the student such as those raised by Moreira (2005) [4]. In addition, these are cases in which should be carried out research work and that allow universities to understand even more the pedagogical exercise of teaching and learning, as proposed by Cid et al. (2009) [7].

**Conclusion**

Based on the analysis as above, it is concluded as follow: The quality of the faculty teaching of the engineering faculty is based on innovative strategies that are built during the teaching-learning process and where the word is the main means that allows students to build and develop significant quality learning. This result was corroborated by the statistical significance that exists at a 95% level of confidence, between significant learning and the quality of the engineering teacher. There is a statistical association at a 95% confidence level between the significant learning and the previous knowledge that the student possesses. This is because the engineering student of the University of the Guajira has a base (initial) knowledge that allows him to build and develop his meaningful knowledge from there.

**References**


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