Learning Strategies and Academic Goals to Strengthen Competencies in Electronics and Digital Circuits in Engineering Students

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SUMMARY

The purpose of this article was to determine the incidence between learning strategies and academic goals in the competences of the curricular experience of electronics and digital circuits in engineering students of a private university in Lima, Peru. The objective was to explain how learning strategies and academic goals explain the behavior of engineering students of competencies in electronics and digital circuits. For this study, a sample of 89 students from the III cycle was used, to whom the ACRA test instruments were applied for the learning strategies of Román and Gallego (2001), the CMA academic goals test of Durán and Arias (2015) and a test to assess skills in electronics and digital circuits. According to the results obtained, it was shown that learning strategies and academic goals explain the behavior of the students of electronics and digital circuits in engineering students. By obtaining x² = 83.782, (p = .000 <0.05 and Wald = 16.326 showing that the proposed model is acceptable

1. Introduction

With globalization and the increasing ease of obtaining information, in Peru in most higher education institutions there is still a large gap in how to carry out an adequate learning strategy despite having the information at hand, regulatory bodies such as the National Superintendency of Higher Education SUNEDU [1] and the accreditation of the System of Evaluation, Accreditation and Certification of Educational Quality SINEACE [2] concerned about this, they try to implement norms so that educational institutions comply with basic quality standards, in this context, university education is in a process of educational reform to a model based on competencies, which they find it difficult to implement while maintaining the traditional teaching [3].

Thus at the national level, although access to university education and the level of skills as indicated is improving, there are still low levels of quality standards also at the international level, reflecting students with weak skills, low performance and insertion problems and job retention [4]. Several universities are still in the process of licensing and accreditation, so they are carrying out their curricular restructuring, to achieve a coherent curriculum to the institutional educational model, in an integrated manner according to the socio-economic, political, cultural context, in the local scope. framework, regional and global [5]. In this sense, a student who does not exercise his skills acquired in the workplace becomes a stranger to his specialty, unable to continue developing his skills [6].

This situation is aggravated, because engineering careers require strong ICT skills, not only for students but also for teachers [7] who, when developing their classes with a curricular program that does not include ICT due to lack of training in the teaching staff and the low implementation of devices and laboratory equipment, it becomes a challenge [8]. In this sense, in a private university of Lima, in the course of electronics and digital circuits of the engineering faculty, passive students were observed in the development of the required competences, presenting deficiencies in the disciplinary knowledge of electronics and digital circuits, having fragmented learning, and not integrated into their professional training, losing interest in the subject, consequently, not being able to solve specialty problems when carrying out their pre-professional and / or work practices, which prevents them from successfully facing the demands of a dynamic real world. In this sense, it shows the need to implement and apply learning strategies and academic goals that address the indicated weaknesses, aimed at seeking the development of effective skills in electronics and digital circuits and in future engineering students that allows them
to exercise in a integrated, the significant learning acquired during their academic training stage at the university.

The need to implement and apply learning strategies and academic goals that address the identified weaknesses is shown, aimed at seeking the development of effective skills in electronics and digital circuits and in future engineering students that allows them to exercise in an integrated manner. The significant learning acquired during their academic training stage at the university.

For example, in Chile, it was found that learning goals and the attribution of academic success to effort have higher statistics, highlighted with respect to academic performance, this allows identifying and considering these dimensions in student support programs to promote academic achievement [9].

Also in Colombia, they obtained the existence of positive and significant correlations in study habits, learning strategies and academic performance, where the importance of using learning strategies as study habits to promote academic performance was highlighted, so both recommended creating intervention and support programs for strengthening in these areas [10].

The students from the Universidad Privada del Norte, Lima, were analyzed with a survey on the use of Arduino technology and a competency learning test. The research resulted in a significant correlation with a Spearman coefficient equal to 0.702 and a p value of 0.01, showing that the use of Arduino technology improves the development of students' skills in their learning [11].

Thus, in another private university of Lima, 96 students from the Faculty of Engineering were applied the instruments of the CMA Academic Goals questionnaire and Form 5 of Self-concept, determining from the results an r (96) = .205, p = .046 of the variables, with which it can be said that there is a relationship weak and significant positive between academic goals and self-concept, which means that high goals will be weakly related to high self-concept [12].

On the other hand, in a study of 290 students from the National University of San Marcos, it allowed to clarify the association between the learning strategies variables, motivation in relation to the explained variable of the study to predict the application of certain learning strategies, cognitive and metacognitive factors in students as indicators and decisive determinants to achieve reading comprehension [13].

The variables that we propose to study are expressed, the first study variable being learning strategies, there are different definitions, stating that it is a metacognitive, planned and conscious process of the subject in a given situation, influenced by the individual's perceptions to achieve optimal learning [14]. Given the above, it is reinforced that the strategies adopted by the students are sequentially concatenated and deliberately planned, in order to achieve the learning of the required task [15]. It can also be said that it is a process of sequence of decisions of the subject in a conscious and intentional state, in which the student deliberately decides and recovers knowledge, which requires the performance of a certain activity [16].

Another variable of study is the variable academic goals that is defined as the purposes proposed by the students, which guide their intentions and actions to obtain their achievements before certain academic activities using the necessary resources. Likewise, it is indicated that they are the objectives that students want to achieve through planning, which will be their action to have a better understanding according to the complexity of the goal, for the solution of the academic activities to be developed [17].

Likewise, they are an integrated and organized pattern of thoughts and reasons that a management produces for a context of achievement, which includes the thoughts of competence, success, competitiveness, effort, errors and evaluation of its objectives to be fulfilled in the classroom [18].

The last variable of studies competences of electronic and digital circuits, according to the Electronic Engineering curriculum with a major in Telecommunications of the Private University of Lima [19], mentions that the competences are the set of related knowledge, skills, attitudes and values with each other, in an integral way, that the student develops in the university to perform in academic activities and professional practice, in accordance with the standards of their specialty under the social, political, economic and labor context that governs it.

Posing the problem general research which is: What incidence exists between the learning strategies and the academic goals in the electronic and digital circuits competences in a Private University Lima, 2020? Regarding the specific problems, the following are established:

(a) What impact do the learning strategies and academic goals have on basic electronics and digital circuits in a Private University Lima, 2020? (b) What impact do the learning strategies and academic goals have on the electrical components of electronic and digital circuits in a Private University Lima, 2020? (c) What impact do the learning strategies and academic goals have on the hardware and digital circuits of the arduino electronics at the Universidad Privada Lima, 2020? (d) What impact do learning strategies and academic goals have on arduino electronics and digital circuits software at a Private University Lima, 2020?

For its part, the general objective set for this research is to determine the incidence between learning strategies and academic goals in the competencies of the subject of electronics and circuits in a private university Lima, Peru, and its specific objectives that are considered for the present investigation are: (a) establish the relationship between learning strategies and academic goals in basic electronics and digital circuits in a Private University Lima, 2020 (b) establish the relationship between learning strategies and academic goals in electrical components of electronics and digital circuits in a Private University of Lima, 2020 (c) establish the relationship between learning strategies and academic goals in arduino electronic hardware and digital circuits in a Private University of Lima, 2020 (d) establish the relationship between learning strategies and academic goals in arduino electronics and digital circuit software at a Private University Lima, 2020.

2. Methodology

The present investigation was of a quantitative approach because each stage proceeds to the next and the steps cannot be ignored, it is possible to define and limit them, in addition, it is known exactly where the problem begins, data collection was also carried out, to measure the variables learning strategies and skills.
of electronics and digital circuits in numerical expressions and were analyzed with statistical methods.

2.1. Variables operationalization

For the learning strategies, 119 questions were used (see appendix), on a Likert scale, with 5 dimensions and a total of 9 indicators (Table 1).

Table 1: Operationalization of variable learning strategies

| Dimensions | Indicators | Items | Scale | Levels or ranges |
|------------|------------|-------|-------|------------------|
| 1. Acquisition | 1.1 Attentional strategies | 1 - 10 | A: Never (1) | Low 119 - 277 |
| | 1.2 Repetition strategies | 11 - 20 | B: Sometimes (2) | Moderate 278 - 437 |
| 2. Codification | 2.1 Mnemonization strategies | 21 - 42 | C: Many times (3) | High 438 - 595 |
| | 2.2 Processing strategies | 43 - 63 | D: Always (4) | |
| | 2.3 Organizational strategies | 64 - 66 | | |
| 3. Recovery | 3.1 Search strategies | 67 - 75 | | |
| | 3.2 Response generation strategies | 76 - 84 | | |
| 4. Support | 4.1 Metacognitive strategies | 85-101 | | |
| | 4.2 Socio-affective strategies | 102-119 | | |

Regarding academic goals, 16 questions were used, on a Likert scale, with 3 dimensions and a total of 8 indicators (Table 2). And for the electronic and digital circuits competences, 20 questions were measured, on a dichotomous scale, with 4 dimensions and 12 indicators in total (Table 3).

Table 2: Operationalization of the variable academic goals

| Dimensions | Indicators | Items | Scale |
|------------|------------|-------|-------|
| 1. Learning objectives | 1.1 Problem solving | 1-3 | 1: Strongly disagree |
| | 1.2 Progressive learning | 4 – 7 | 2: disagree |
| 2. Achievement objectives | 2.1 Academic achievement | 8-9 | 3: Neither agree nor disagree |
| | 2.2 Professional achievement | 10 | 4: disagree |
| | 2.3 Personal achievement | 11 | 5: Strongly agree |
| 3. Objectives of social reinforcement | 3.1 Social recognition | 12, 14 | Low 16 - 37 |
| | 3.2 Classroom stimulation | 13, 16 | Moderate 38 - 59 |
| | 3.3 Superior approval | 15 | High 60 - 80 |

2.2. Population

A census population, composed of 89 students, from the third cycle of the engineering faculty of the University of Sciences and Humanities, 2020 I was studied.

Table 3: Operationalization of the variable competencies of electronic and digital circuits

| Dimensions | Indicators | Items | Scale |
|------------|------------|-------|-------|
| 1. Basic electronics | 1.1. Identify the theoretical concepts of electricity | 1-2 | |
| | 1.2. You have an idea of what electrical resistance is | 3 | |
| | 1.3 Define and develop basic exercises of electrical circuits | 4 - 5 | |
| 2. Electrical components | 2.1. Define the diode concept | 7 | |
| | 2.2. Define the concept of transistor | 6 - 8 | |
| | 2.3. Identify and solve circuits with diodes and transistors | 9 - 10 | |
| 3. Arduino hardware | 3.1. Defines the theoretical concept of | 11 | |
| | 3.2. Arduino general concepts details | 12 | |
| | 3.3. Identify the characteristics of the arduino board | 13 - 15 | |
| 4. Arduino software | 4.1. Describe the general structure of a sketch | 16 | |
| | 4.2. Analyze instructions | 17 - 18 | |
| | 4.3. Identify the serial communication with the arduino board | 19 - 20 | |

The instruments of the Roman and Gallegos Acra Test (see appendix) were applied to the students to evaluate the learning strategies, as well as the CMA questionnaire of Durán (2015) to evaluate their academic goals and finally a test was carried out to measure the competencies of electronics and digital circuits. The information collected was then transferred to a database in Excel and to the statistical program SPSS version 23, which will allow us to perform the data analysis.

The educational data mining technique is a tool that also allows data collection and analysis for subsequent decision-making, which is also suitable for evaluating groups of students, with the advantage of being able to cover a large number of data, as is the case of this investigation that has 119 questions for the study, for the case of the present investigation the data will be analyzed using SPSS.
Regarding the validation of the instruments, the content validity of the expert judgment was carried out and for the reliability a pilot test of a sample of 20 students of the electronics and digital circuits subject was used, the statistical values verified the reliability of instruments (Table 4).

Table 4: Reliability of the instrument

| Variables                                | Statistics   | Value  | No. of elements |
|------------------------------------------|--------------|--------|-----------------|
| Learning strategies                      | Cronbach’s alpha | 0.857  | 119             |
| Academic goals                           | Cronbach’s alpha | 0.851  | 16              |
| Competences in electronics and digital circuits | Kuder-Richardson | 0.8179  | 20              |

3. Results

The results obtained from the study are shown below.

3.1. Description of the learning strategies variable

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Do not use abbreviations in the title or headings unless they are unavoidable.

Table 5: Levels of variable learning strategies

| Variables   | Frequency | Percentage |
|-------------|-----------|------------|
| Valid       |           |            |
| Low         | 26        | 29.3       |
| Moderate    | 48        | 53.9       |
| High        | 15        | 16.8       |
| Total       | 89        | 100        |

3.2. Description of the dimensions of the learning strategies

Table 6 and figure 2 show the percentage values of the dimensions of the learning strategies, of a total of 89 students. From these results, it is estimated that the support dimension with more than 24% presents the best results compared to the other dimensions.

Table 6: Levels of dimensions of learning strategies

| Variables   | Frequency | Percentage |
|-------------|-----------|------------|
| Acquisition |           |            |
| Low         | 15        | 20         |
| Moderate    | 54        | 89         |
| High        | 22.5      | 100        |
| Total       | 89        | 100        |

3.3. Description of variable academic goals

Table 7 and Figure 3 show the percentage values of the variable academic goals, of a total of 89 students. With the results obtained, it can be seen that the level of perception of academic goals has a trend of moderate level with more than 60%.

Table 7: Levels of variable academic goals

| Variables   | Frequency | Percentage |
|-------------|-----------|------------|
| Valid       |           |            |
| Low         | 12        | 13.5       |
| Moderate    | 55        | 61.8       |
| High        | 22        | 24.7       |
| Total       | 89        | 100        |
3.4. Description of the dimensions of the academic goals

Table 8 and Figure 4 show the percentage values of the academic goals dimension of a total of 89 students. Based on these results, it is estimated that the achievement goals dimension presents better results with more than 30% compared to the other dimensions.

Table 8: Levels of the dimensions of academic goals

|                        | Low | Moderate | High | Total |
|------------------------|-----|----------|------|-------|
| Learning goals         |     |          |      |       |
| Frequency              | fifteen | 46 | 28 | 89 |
| Percentage             | 16.8 | 51.7 | 31.5 | 100 |
| Achievement goals      |     |          |      |       |
| Frequency              | 10 | 48 | 31 | 89 |
| Percentage             | 11.3 | 53.9 | 34.8 | 100 |
| Objectives of social reinforcement | | | | |
| Frequency              | 15 | 45 | 29 | 89 |
| Percentage             | 16.7 | 50.7 | 32.6 | 100 |

3.5. Description of the electronic and digital circuits skills variable

Table 9 and Figure 5 show the percentage values of the variable dimensions of electronics and digital circuits, of a total of 89 students, which shows a trend of students at the level reached with less than 70%.

Table 9: Levels of electronic and digital circuits variable competencies

|                        | Frequency | Percentage |
|------------------------|-----------|------------|
| Valid                  |           |            |
| In the beginning       | 5         | 5.6        |
| In process             | 11        | 12.4       |
| Accomplished           | 59        | 66.3       |
| Exceptional            | 14        | 15.7       |
| Total                  | 89        | 100        |

3.6. Description of the competencies dimensions of electronics and digital circuits

Table 10 and Figure 6 show the percentage values of the dimensions of competencies in electronics and digital circuits, of a total of 89 students. From these results, it is estimated that the arduino software dimension has low outstanding results with less than 12% compared to the other dimensions.

Table 10: Dimensional Competency Levels for Electronic and Digital Circuits

|                        | Initial | In process | Accomplished | In outgoin | Total |
|------------------------|---------|------------|--------------|------------|-------|
| Basic electronic       | Frequency | 1 | 5 | 67 | 16 | 89 |
|                        | Percentage | 1.1 | 5.6 | 75.3 | 18.0 | 100 |
| Electric components    | Frequency | 3 | 9 | 65 | 12 | 89 |
|                        | Percentage | 3.4 | 10.1 | 73.0 | 13.5 | 100 |
| Arduino Hardware       | Frequency | 5 | 11 | 60 | 13 | 89 |
|                        | Percentage | 5.6 | 12.4 | 67.4 | 14.6 | 100 |
| Arduino software       | Frequency | 8 | 14 | 57 | 10 | 89 |
|                        | Percentage | 9.0 | 15.7 | 64.0 | 11.3 | 100 |

3.7. Contrast of the general hypothesis

Ho: There is no incidence between learning strategies and academic goals in electronic skills and digital circuits in a Private University Lima, 2020.
HG: There is an incidence between learning strategies and academic goals in electronic skills and digital circuits in a Private University Lima, 2020.

Table 11: Model fit and likelihood ratio tests for the general hypothesis

| Model fit information | Logarithm of probability - 2 | Chi squared | gl | S.I.G |
|-----------------------|-----------------------------|------------|----|-------|
| Interception only     | 286,034                     |            |    |       |
| Final                 | 202,251                     | 83,782     | 36 | .000  |

Table 11 shows that the value $x^2 = 83.782$, ($p = .000 < 0.05$), indicates that the proposed model is acceptable. In this sense, the null hypothesis is rejected, with a probability of error less than 5%.

Table 12: Pseudo R squared of general hypothesis

| Pseudo R squared | Cox and Snell | .610 |
|------------------|---------------|------|
| Nagelkerke       | .630          |
| McFadden         | .272          |

Table 13: Parameter estimates of the general hypothesis

| $V_3$ Competencies of electronics and digital circuits | Estimate | S.I.G | Wald | Min         | Max         | 95% interval trustworthy |
|-----------------------------------------------------|----------|-------|------|-------------|-------------|--------------------------|
| $V_3$ Competencies of electronics and digital circuits = 1 | -9.224   | .000  | 25.904 | -12.776     | -5.672      |                          |
| $V_3$ Competencies of electronics and digital circuits = 2 | -7.549   | .000  | 24.350 | -10.547     | -4.550      |                          |
| $V_1$ Learning strategies = 1 | -9.918   | .000  | 16.326 | -14.728     | -5.107      |                          |
| $V_1$ Learning strategies = 2 | -4.916   | .001  | 11.346 | -7.808      | -2.064      |                          |
| $V_2$ Academic Goals = 1 | -3.348   | .014  | 6.053  | -6.016      | -.681       |                          |
| $V_2$ Academic Goals = 2 | -2.624   | .038  | 4.311  | -5.101      | -.147       |                          |

Table 12 presents favorable values of pseudo R squared, which ensures a fit adequate of the proposed model to explain competencies in electronics and digital circuits. Similarly, it is stated that learning strategies is the variable that affects the most, since it presents a value of Wald = 16.326 and $p = .000 < 0.05$ (Table 13).

3.8. Specific hypothesis test 1

Ho: There is no incidence between the learning strategies and the academic goals in the basic electronics of electronics and digital circuits in a Private University Lima, 2020.

H1: There is an incidence between the learning strategies and the academic goals in the basic electronics of electronics and digital circuits in a Private University Lima, 2020.

Table 14 shows that the value $x^2 = 61.281$, ($p = .005 < 0.05$), indicates that the proposed model is acceptable. In this sense, the null hypothesis is rejected, with a probability of error less than 5%.

Table 14: Model fit and likelihood ratio tests for specific hypothesis 1

| Model fit information | Logarithm of probability - 2 | Chi squared | gl | S.I.G |
|-----------------------|-----------------------------|------------|----|-------|
| Interception only     | 182.351                     |            |    |       |
| Final                 | 121.070                     | 61.281     | 36 | .005  |

Table 15: Pseudo R squared for specific hypothesis 1

| Pseudo R squared | Cox and Snell | .498 |
|------------------|---------------|------|
| Nagelkerke       | .557          |
| McFadden         | .307          |

Table 15 presents favorable pseudo R squared values, which ensures an adequate fit of the proposed model to explain skills in electronics and digital circuits.

Likewise, learning strategies is the variable that most affects basic electronics of the explained variable with a value of Wald = 21.485 and $p = .000 < 0.05$ (Table 16).

Table 16: Parameter estimates for general hypothesis 1

| $V_3$ Competencies of electronics and digital circuits | Estimate | S.I.G | Wald | Min         | Max         | 95% interval trustworthy |
|-----------------------------------------------------|----------|-------|------|-------------|-------------|--------------------------|
| $V_3$ Competencies of electronics and digital circuits = 1 | -5.632   | .000  | 29.959 | -9.130      | -2.134      |                          |
| $V_3$ Competencies of electronics and digital circuits = 2 | -5.268   | .003  | 23.538 | -10.116     | -.421       |                          |
| $V_1$ Learning strategies = 1 | -2.931    | .000  | 21.485 | -6.007      | .146        |                          |
| $V_1$ Learning strategies = 2 | -2.356    | .014  | 10.547 | -6.069      | 1.356       |                          |
| $V_2$ Academic Goals = 1 | -1.659    | .004  | 18.217 | -4.606      | 1.289       |                          |
| $V_2$ Academic Goals = 2 | 1.415     | .005  | 16.788 | -1.710      | 4.539       |                          |

Table 15 presents favorable pseudo R squared values, which ensures an adequate fit of the proposed model to explain skills in electronics and digital circuits.

Likewise, learning strategies is the variable that most affects basic electronics of the explained variable with a value of Wald = 21.485 and $p = .000 < 0.05$ (Table 16).

3.9. Specific hypothesis test 2

Ho: There is no incidence between the learning strategies and the academic goals in the electrical components of electronics and digital circuits in a Private University Lima, 2020.

H2: There is an incidence between the learning strategies and the academic goals in the electrical components of electronics and digital circuits in a Private University Lima, 2020.
Table 17: Model fit tests and likelihood ratio for specific hypothesis 2

| Model fit information | Logarithm of probability -2 | Chi squared | gl | S.I.G |
|-----------------------|-----------------------------|-------------|----|-------|
| Interception only     | 180,100                     |             |    |       |
| Final                 | 126,963                     | 53,136      | 36 | .003  |

Table 17 shows that the value $x^2 = 53.136$, ($p = .003 <0.05$), indicates that the proposed model serves to explain the dependent behavior of the variable competencies of electronic and digital circuits with respect to electrical circuits. In this sense, the null hypothesis is rejected with a probability of error less than 5%.

Table 18: Pseudo R squared for specific hypothesis 2

| Pseudo R squared | Cox and Snell | .450 |
|------------------|---------------|------|
|                   | Nagelkerke    | .504 |
|                   | McFadden      | .269 |

Table 18 presents favorable pseudo R squared values, which ensures an adequate fit of the proposed model to explain skills in electronics and digital circuits. Likewise, academic goals is the variable that most affects the competence variable of the electronic and digital components of electronic and digital circuits = 2 for electronic and digital circuits = 2.

Table 19: Parameter estimates for general hypothesis 2

| Estimate | S.I.G | Wald | Min | Max |
|----------|-------|------|-----|-----|
| $V3D2_\text{electrical components of electronic and digital circuits}=1$ | -6.288 | .001 | 11,176 | -9,974 | -2,601 |
| $V3D2_\text{electrical components of electronic and digital circuits}=1$ | -3.936 | .001 | 16,531 | -6,955 | -.917 |
| $V1_\text{Learning strategies}=1$ | -5.317 | .020 | 14,725 | -10,111 | -5,223 |
| $V1_\text{Learning strategies}=2$ | -2.856 | .051 | 8,371 | -7,635 | 1.924 |
| $V2_\text{Academic Goals}=1$ | -2.151 | .042 | 9,985 | -5,143 | .841 |
| $V2_\text{Academic Goals}=2$ | -3.130 | .004 | 16,073 | -5,620 | -.641 |

3.10. Specific hypothesis test 3

H0: There is no incidence between learning strategies and academic goals in arduino electronics hardware and digital circuits in a Private University Lima, 2020.

H3: There is an incidence between learning strategies and academic goals in arduino electronics hardware and digital circuits in a Private University Lima, 2020.

Table 20: Model fit and likelihood ratio tests for specific hypothesis 3

| Model fit information | Logarithm of probability -2 | Chi squared | gl | S.I.G |
|-----------------------|-----------------------------|-------------|----|-------|
| Interception only     | 187,849                     |             |    |       |
| Final                 | 123,641                     | 64,208      | 36 | .003  |

Table 20 shows that the value $x^2 = 64.208$, ($p = .003 <0.05$), indicates that the proposed model serves to explain the behavior

Table 21: Pseudo R squared for specific hypothesis 3

| Pseudo R squared | Cox and Snell | .640 |
|------------------|---------------|------|
|                   | Nagelkerke    | .730 |
|                   | McFadden      | .487 |

Table 21 presents favorable pseudo R squared values, which ensures an adequate fit of the proposed model to explain skills in electronics and digital circuits. Likewise, the learning strategies is the variable that most affects the Arduino hardware of the explained variable with a value of Wald = 6.568 and $p = .010 <0.05$ (Table 22).

Table 22: Parameter estimates of the general hypothesis 4

| Estimate | S.I.G | Wald | Min | Max | 95% interval trustworthy |
|----------|-------|------|-----|-----|--------------------------|
| $V3D3_\text{arduino hardware for electronic and digital circuits}=1$ | -8.390 | .001 | 11,715 | -13,194 | -3,585 |
| $V3D3_\text{arduino hardware for electronic and digital circuits}=2$ | -5.083 | .015 | 5.924 | -9,176 | -5,990 |
| $V1_\text{Learning strategies}=1$ | -4.173 | .010 | 6.568 | -7,365 | -9,990 |
| $V1_\text{Learning strategies}=2$ | -3.431 | .046 | 3.996 | -6,795 | -7,067 |
| $V2_\text{Academic Goals}=1$ | -3.142 | .077 | 3.132 | -6,621 | .337 |
| $V2_\text{Academic Goals}=2$ | -5.295 | .020 | 5.439 | -9,746 | -8,455 |

3.11. Specific hypothesis test 4

H1: There is no incidence between learning strategies and academic goals in arduino electronics hardware and digital circuits in a Private University Lima, 2020.

H2: There is an incidence between learning strategies and academic goals in arduino electronics hardware and digital circuits in a Private University Lima, 2020.

Table 23: Model fit tests and likelihood ratio for specific hypothesis 4

| Model fit information | Logarithm of probability -2 | Chi squared | gl | S.I.G |
|-----------------------|-----------------------------|-------------|----|-------|
| Interception only     | 170,545                     |             |    |       |
| Final                 | 79.648                      | 90,897      | 36 | .000  |

Table 23 shows that the value $x^2 = 64.208$, ($p = .003 <0.05$), indicates that the proposed model serves to explain the behavior
dependent on the variable competencies of electronic and digital circuits referred to Arduino software. In this sense, the null hypothesis is rejected with a probability of error less than 5%.

Table 24: Pseudo R squared for specific hypotheses 4

| Pseudo R squared          | Cox and Snell | Nagelkerke | McFadden |
|---------------------------|---------------|------------|----------|
|                           | .514          | .574       | .319     |

Table 24 presents favorable pseudo R squared values, which ensures an adequate fit of the proposed model to explain skills in electronics and digital circuits. Likewise, learning strategies is the variable that most affects the Arduino software of the explained variable with a value of Wald = 9.624 and p = .023 <0.05 (Table 25).

Table 25: Parameter estimates for general hypothesis 4

| [V3D4_arduino software for electronic and digital circuits= 1]   | Estimate | S.I.G  | Wald  | 95% interval trustworthy |
|------------------------------------------------------------------|---------|--------|-------|--------------------------|
|                                                                 | -1.86   | .003   | 13.017| Min -2.951 Max 2.579     |
| [V3D4_arduino software for electronic and digital circuits= 2]   | - .453  | .009   | 11.103| Min -2.225 Max 2.319     |
| [V1_Learning strategies= 1]                                      | -3.556  | .023   | 9.624 | Min -6.797 Max -3.15     |
| [V1_Learning strategies= 2]                                      | -1.163  | .048   | 8.580 | Min 4.156 Max 1.830      |
| [V2_Academic goals= 1]                                           | - .822  | .042   | 9.266 | Min 3.946 Max 2.301      |
| [V2_Academic goals= 2]                                           | .654    | .051   | 7.184 | Min -2.334 Max 3.643     |

4. Discussion

With reference to the general objective set, satisfactory values of x² = 83.782, (p = .000 <0.05), McFadden of 0.272, Nagelkerke of 63%, Cox and Snell of 61% and a Wald value of 16.326 were obtained. Indicating that the estimated model serves to explain the behavior of the dependent variable, being an adequate model, evidencing the rejection of the null hypothesis and admitting the incidence of learning strategies and academic goals in relation to the variable electronic competences and digital circuits. By virtue of this, they reaffirm the results obtained from the electronic and digital circuits competences with a tendency to be achieved with less than 70% of the engineering students of a Private University of Lima, 2020. In addition, the Arduino software was estimated with more than 11% of the analyzed students presented low outstanding results compared to the other dimensions, which shows a profile of the student with deficiency in being able to develop skills in the description of a structure of the Arduino software in the sketch. IDE, analysis of the Arduino software instructions and achieve serial communication by connecting electronic devices to the Arduino board, based on the data collected from the instrument application. On the other hand, the learning strategies show a moderate trend with more than 50% of the students, and it was evidenced that the support learning strategy presented the best results with a high level of more than 24% of the students compared to the rest of your group, according to the Roman y Gallego AC test instrument (see appendix) applied. Likewise, the academic goals presented a moderate trend concentrating more than 60% of the students, being the achievement goal the one that presented the best results with more than 30% in the high level compared to the others in their group, according to the respondents to the the Durán CMA Test.

Similarly, the dependent variable of the research presented an incidence of 63% of variability with respect to the explanatory variables in students, which means that learning strategies and academic goals are important so that higher-level students can optimally develop your skills in electronics and digital circuits for their good academic performance in a comprehensive and professional manner, in that sense they can successfully face the demands of the labor market, it should also be noted that the value of Wald showed that learning strategies have a greater explanatory force of incidence, so that these guide to a better development of the electronic and digital circuit competencies of the students compared to the academic goals, in addition,

With reference to the specific objectives, it was admitted that there is an incidence between learning strategies and academic goals in basic electronics, arduino hardware and software electrical circuits and arduino electronics digital circuits in Engineering students, Universidad Privada de Lima, 2020. No however, for basic electronics, in comparison with the other dimensions, satisfactory inferential values of x² = 61.281, (p = .005 <0.05), Nagelkerke of 55.7% and Wald of 21.485 were obtained. This means that the learning strategies have a greater explanatory force of incidence for the basic electronic dimension compared to the other dimensions.

5. Conclusions

It was evidenced that the strategies of learning and academic goals affect the competences of electronic and digital circuits in engineering students, Universidad Privada Lima 2020. Due to acceptable values it was found of x² = 83.782, (p = .000 <0.05) and Wald = 16.326 showing that the proposed model is plausible.

It was verified that the strategies of learning and academic goals affect basic electronics and digital circuits in Engineering students, Private University, 2020. Due to the favorable values obtained of x² = 61.281, (p = .005 <0.05) and Wald = 21.485, which indicates that the proposed model is acceptable.

It was found that learning strategies and academic goals affect the electrical components of electronics and digital circuits in Engineering students, Private University, 2020. By favorable values of x² = 53.136, (p = .033 <0.05) and Wald = 16.073, indicating that the proposed model is acceptable.

It was shown that the strategies of learning and academic objectives affect the hardware of Arduino electronics and digital circuits in Engineering students, Private University, 2020. Due to the value obtained from x² = 90.897, (p = .000 <0.05) and Wald = 6.568, it which indicates that the proposed model is acceptable.

It is finally concluded that learning strategies and academic goals affect arduino electronics and digital circuits software in Engineering students, Private University, 2020. Due to the
acquired value of $x^2 = 64.208$, (p = .003 <0.05) and Wald = 9.624, indicating that the proposed model is acceptable.

It was considered that there is an option that allows to dynamically cover a large volume of data, as well as flexible for educational environments, known as educational data mining [20].

6. Recommendations

It is recommended that the academic directors of the Private University establish institutional guidelines in their curricular plans for the implementation, incorporation and application of learning strategies and academic goals so that engineering students can effectively develop electronic and digital circuit skills, having significant learning.

The academic coordinator of engineering of the Private University is suggested to carry out activity programs for students of electronics and digital circuits in which topics of learning strategies and academic goals are developed in such a way that they can apply it in the subject and help them to develop, your core competencies in electronics, electrical components, arduino software, and arduino hardware.

It is proposed that the engineering professors of the Private University encourage their students of electronics and digital circuits in their pedagogical practices to use learning strategies, such as the acquisition, coding, retrieval and support of information, in the sense of raising skills and learning from the subject and achieve their academic goals.

New methods are recommended to better cover teaching strategies and thus avoid possible dropouts that may motivate students to drop out of college, such as an educational data mining option [21].

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Appendix

ACRA TEST:

This test is divided into four scales: Acquisition of information: It helps the student to know how to acquire the necessary information for the study. Information coding: It informs about how the main and secondary ideas of a text should be differentiated. Information retrieval: It sets out the mechanisms necessary to retrieve previously stored information. Information support: What means and conditions will help improve the study.

Next, the student must take this test, which must be answered in the following way: The questions that are asked must be answered as follows:

If you NEVER or NEVER do what is asked, you must put A.
If the question is EVER done, put B.
If ENOUGH TIMES what is asked is done, put C.
If you ALWAYS do what you ask, you have to put D.

| Scale I: Information Acquisition Strategy: | A | B | C | D |
|------------------------------------------|---|---|---|---|
| 1. Before starting to study I read the index, or the summary, or the sections of the material to be learned. |   |   |   |   |
| 2. When I am going to study a material, I write down the important points that I have seen in a first cursory reading to more easily get an overview. |   |   |   |   |
| 3. When I begin to study a lesson, I read it all over the top first. |   |   |   |   |
| 4. As I study, I look for the meaning of unknown words, or of which I have doubts about their meaning. |   |   |   |   |
| 5. In books, notes or other material to learn, I underline in each paragraph the words, data or phrases that seem most important to me. |   |   |   |   |
| 6. I use signs (admirements, asterisks, drawings…), some of them only intelligible by me, to highlight those information in the texts that I consider especially important. |   |   |   |   |
| 7. I use pencils or pens of different colors to promote learning. |   |   |   |   |
| 8. I use the underlining to facilitate memorization. |   |   |   |   |
| 9. To discover and highlight the different parts of what is composed a long text, subdivided into several small by means of annotations, titles and epigraphs. |   |   |   |   |
| 10. I write down words or phrases by the author, which seem significant to me, in the margins of books, articles, notes, or on a separate page. |   |   |   |   |
| 11. During the study, I write or repeat the important or most difficult data to remember several times. |   |   |   |   |
| 12. When the content of a topic is dense and difficult I reread it slowly. |   |   |   |   |
| 13. I read aloud, more than once, the underlines, diagrams, etc…, made during the study. |   |   |   |   |
| 14. I repeat the lesson as if I were explaining it to a classmate who does not understand it. |   |   |   |   |
| 15. When I study I try to mentally summarize the most important things. |   |   |   |   |
| 16. To check what I am learning about a topic, I ask myself section by section. |   |   |   |   |

| Scale II: Information Coding Strategy: | A | B | C | D |
|---------------------------------------|---|---|---|---|
| 1. When I study, I make drawings, figures, graphs or vignettes to represent the relationships between fundamental ideas. |   |   |   |   |
| 2. To solve a problem, I begin by carefully recording the data and then try to represent it graphically. |   |   |   |   |
| 3. When I read, I differentiate important or main aspects and contents from accessories or secondary ones. |   |   |   |   |
| 4. I look for the “structure of the text”, that is, the relationships already established between its contents. |   |   |   |   |
| 5. I rearrange or carry out, from a personal point of view, new relationships between the ideas contained in a topic. |   |   |   |   |
| 6. I relate or link the topic I am studying with others that I have studied or with the data or knowledge previously learned. |   |   |   |   |
| 7. I apply what I learn in some subjects to better understand the contents of others. |   |   |   |   |
| 8. I discuss, relate or compare with my colleagues the works, diagrams, summaries or topics that we have studied. |   |   |   |   |
| 9. I go to friends, teachers or family when I have doubts about the study topics or to exchange information. |   |   |   |   |
| 10. I complete the information in the textbook or class notes by going to other books, encyclopedias, articles, etc. |   |   |   |   |
| 11. I establish relationships between the knowledge that the study provides me and the experiences, events or anecdotes of my private and social life. |   |   |   |   |
| 12. I associate the information and data that I am learning with fantasies of my past or present life. |   |   |   |   |
| 13. When studying, I put my imagination into play, trying to see, like in a movie, what the subject suggests to me. |   |   |   |   |
| 14. I make comparisons by making metaphors with the issues I am learning (eg, the kidneys function as a filter). |   |   |   |   |
| 15. When the topics are very abstract, I try to look for something familiar (animal, plant, object or event) that resembles what I am learning. |   |   |   |   |
| 16. I carry out exercises, tests or small experiments, etc., as an application of what I have learned. |   |   |   |   |
| 17. I use what I learn, as much as possible, in my daily life. |   |   |   |   |
| 18. I try to find possible social applications in the content I study. |   |   |   |   |
| 19. I am interested in the application that the subjects I study may have to the labor fields that I know. |   |   |   |   |

**Sum**

| Multiply | X1 | X2 | X3 | X4 |
|---------|----|----|----|----|
| Outcome |     |    |    |    |
| Direct Score |     |    |    |    |
| Percentile |     |    |    |    |
|   |   |   |   |
|---|---|---|---|
| 20. I usually write down in the margins that what I am studying (or on a separate sheet) suggestions or doubts about what I am studying. | Direct Score |   |   |
| 21. During the teachers' explanations, I usually ask myself questions on the subject. | Percentile |   |   |
| 22. Before the first reading, I ask myself questions whose answers I hope to find in the material I am going to study. | Scale II: Information Recovery Strategy | A | B | C | D |
|   |   |   |   |
| 23. When I study, I ask myself questions suggested by the topic, to which I try to answer. | 1. Before speaking or writing, I remember words and drawings that are related to the "main ideas" of the material studied. |
| 24. I usually take notes of the tutor's ideas, in the margins of the text I am studying or on the separate sheet, but in my own words. | 2. Before speaking or writing, I use keywords or phrases that help me differentiate the main and secondary ideas of what I study. |
| 25. I try to learn the topics in my own words instead of memorizing them verbatim. | 3. When I have to present something orally or in writing, I remember drawings, images, etc. through which I elaborated the information during learning. |
| 26. I make critical annotations to the books and articles I read, either in the margins or on separate sheets. | 4. Before responding to an exam, I remember those groupings of concepts (summaries, diagrams, etc.) made at the time of studying. |
| 27. I arrive at new ideas or concepts starting from the data, facts or particular chaos that the text contains. | 5. For important questions, which are difficult for me to remember, I look for secondary data in order to be able to remember what is important. |
| 28. I draw conclusions from the information contained in the topic I am studying. | 6. It helps me to remember what I have learned by evoking events, episodes or clues that occurred during class or at other learning moments. |
| 29. When studying, I group and classify the data according to my own criteria. | 7. It helps me to remember other topics that are related to what I really want to remember. |
| 30. I summarize the most important of each of the sections of a topic, the lesson or the notes. | 8. Putting myself in a mental and affective situation similar to that experienced during the teacher's explanation or at the time of study, makes it easier for me to remember important information. |
| 31. I make summaries of what was studied at the end of each topic. | 9. In order to better recover what I have learned, I take into account the corrections and observations that teachers make in exams, exercises or assignments. |
| 32. I prepare the summaries using the previously underlined words or phrases. | 10. To remember information, I first look for it in my memory and then decide if it fits what I have been asked or want to answer. |
| 33. I make diagrams of what I study. | 11. Before I start to speak or write, I think and mentally prepare what I am going to say or write. |
| 34. I build the diagrams using the underlined words or phrases from the summaries made. | 12. I try to express what I have learned in my own words instead of repeating literally or verbatim what the book or the teacher says. |
| 35. I order the information to be learned according to some logical criterion: cause-effect, problemsolution, etc. | 13. When answering an exam, before writing, first I remember, in any order, everything I can, then I order it and make an outline or script and finally develop it point by point. |
| 36. When the subject under study presents the information organized temporally (historical aspects), I learn it taking into account that temporal sequence. | 14. When I have to do a free writing on any subject, I write down the ideas that occur to me, then I order them and finally I write them. |
| 37. If I have to learn different steps to solve a problem, I use diagrams to help capture the information. | 15. When carrying out an exercise or exam, I am concerned about its presentation, order, cleanliness, margins. |
| 38. During the study, or at the end, I design concept maps to relate the concepts of a topic. | 16. Before doing a written assignment, I make an outline, script or program of the points to be discussed. |
| 39. To develop concept maps, I rely on the underlined keywords. | Sum | A | B | C | D |
| 40. When I have to make comparisons or classifications, I use tables. | 17. When faced with a problem or difficulty, I first consider the data that I know before venturing to provide an intuitive solution. |
| 41. When studying any subject, I use V-diagrams to solve the above. | 18. When I have to answer a topic for which I have no data, I generate an "approximate" answer relating what I already know about other topics. |
| 42. I spend some study time memorizing, above all, summaries, diagrams, concept maps, etc. that is, to memorize the importance of each subject. | Sum | Multiply | X1 | X2 | X3 | X4 |
| 43. To fix data when studying, I usually use "tricks" to make that idea stick in my memory. | Outcome | Direct Score | Percentile |
| 44. I construct "rhymes" or "fillers" to memorize lists of concepts. | Scale IV: Processing Support Strategy | A | B | C | D |
| 45. To memorize, I mentally place the data in places in a well-known space. | 1. Before speaking or writing, I remember words and pictures that are related to the "main ideas" of the material studied. |
| 46. I learn unfamiliar names or terms by developing a "keyword" that bridges the gap between the familiar name and the new one to remember. | 2. Before speaking or writing, I use keywords or catch phrases that help me differentiate the main and secondary ideas of what I study. |
| Sum | Multiply | X1 | X2 | X3 | X4 |
| Outcome |   |   |   |   |

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3. When I have to present something orally or in writing, I remember drawings, images, etc. through which I elaborated the information during learning.

4. Before responding to an exam, I remember those groupings of concepts (summaries, diagrams, etc.) made at the time of studying.

5. For important questions, which are difficult for me to remember, I look for secondary data in order to be able to remember what is important.

6. It helps me to remember what I have learned by evoking events, episodes or clues that occurred during class or at other learning moments.

7. It helps me to remember other topics that are related to what I really want to remember.

8. Putting myself in a mental and affective situation similar to that experienced during the teacher’s explanation or at the time of study, makes it easier for me to remember important information.

9. In order to better recover what I have learned, I take into account the corrections and observations that teachers make in exams, exercises or assignments.

10. To remember information, I first look for it in my memory and then decide if it fits what I have been asked or want to answer.

11. Before I start to speak or write, I think and mentally prepare what I am going to say or write.

12. I try to express what I have learned in my own words instead of repeating literally or verbatim what the book or the teacher says.

13. When answering an exam, before writing, first I remember, in any order, everything I can, then I order it and make an outline or script and finally develop it point by point.

14. When I have to do a free writing on any subject, I write down the ideas that occur to me, then I order them and finally I write them.

15. When carrying out an exercise or exam, I am concerned about its presentation, order, cleanliness, margins.

16. Before doing a written assignment, I make an outline, script or program of the points to be discussed.

17. When faced with a problem or difficulty, I first consider the data that I know before venturing to provide an intuitive solution.

18. When I have to answer a topic for which I have no data, I generate an “approximate” answer relating what I already know about other topics.

| A | B | C | D |
|---|---|---|---|
| 19 | I imagine places, scenes or events in my life to calm me down and to focus on work. |
| 20 | I know how to self-relax, self-talk, self-apply positive thoughts to be calm on exams. |
| 21 | I tell myself that I can exceed my current performance level (expectations) in the various subjects. |
| 22 | I try that in the place I study there is nothing that can distract me, such as people, noise, disorder, lack of light and ventilation, etc. |
| 23 | When I have family conflicts, I try to resolve them sooner, if I can, to better concentrate on studying. |
| 24 | If I am studying and am distracted by thoughts or fantasies, I fight them by imagining the negative effects of not having studied. |
| 25 | At work, I am encouraged to exchange opinions with my colleagues, friends or family about the subjects I am studying. |