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A CONTEXT VISION

2013-2019 results in the saber-pro: review for consolidate strategies in technological training

Resultados 2013-2019 en las saber-pro: revisión para consolidar estrategias en la formación tecnológica

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ABSTRACT

The following document analyze the results of the Saber T and T tests in the technological cycle and Saber Pro in the Engineering cycle, with data from the Colombian Institute for the Evaluation of Education (Icfes), of the students of Technology in Electronics, Control Engineering and Telecommunications Engineering of the Universidad Distrital Francisco José de Caldas, during the period 2013-2019. Initially, the information on the results published for each cohort of Students is extracted during the time interval described above. Subsequently, with the help of statistical tools, a balance is made regarding the performance in the different generic and specific competencies, which allows comparing the performances over time with respect to the program, to the related programs that constitute a reference group, to the programs of the Institution and the national population. In the final part, an analysis of the trends obtained is made, with which high performances are highlighted, opportunities for improvement are identified and strategies are proposed that seek to increase the quality of training from the technological level of the Students of these careers.

RESUMEN

En el siguiente documento se realiza un análisis de resultados de las pruebas Saber T y T en el ciclo tecnológico y Saber Pro en el ciclo de Ingeniería, con datos emanados por el Instituto Colombiano Para la Evaluación de la Educación (Icfes), de los estudiantes de Tecnología en Electrónica, Ingeniería en Control e Ingeniería en Telecomunicaciones de la Universidad Distrital Francisco José de Caldas, durante el periodo de 2013-2019. Inicialmente se extrae la información de resultados publicada para cada cohorte de Estudiantes durante el intervalo de tiempo descrito anteriormente. Posteriormente con la ayuda de herramientas estadísticas se realiza un balance en cuanto al desempeño en las

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diferentes competencias genéricas y específicas, que permite comparar los desempeños en el tiempo respecto al programa, a los programas afines que constituyen un grupo de referencia, a los programas de la Institución y a la población nacional. En la parte final se hace un análisis de las tendencias obtenidas, con el cual se resaltan los desempeños altos,
Identifican las oportunidades de mejora y se proponen estrategias que buscan incrementar la calidad de la formación desde el nivel tecnológico de los estudiantes de estas carreras.

1. Introduction

The Saber Pro and Saber T y T. Are the tests applied by the Colombian Institute for the Evaluation of Education (Icfes), an entity created in 1968 and attached to the Ministry of National Education, which offers evaluation services in State exams in all levels, including students close to graduating from a professional, technical or technological training program, once they complete 75% of the pensum credits, as a compulsory degree requirement [1].

The results obtained by the students in these tests are aimed at verifying the development of competencies of the students close to completing the academic programs, comparing the added value of Higher Education according to the level of the competencies evaluated, as well as contrasting against to other programs and Institutions. Analyze their development over time, build indicators for evaluating the quality of programs and institutions so that they allow qualifying institutional processes through management in this regard [2]. The results are useful to the educational institutions that train them to establish whether the academic activities they develop are well oriented, or need some change in order to improve the quality of the education they provide.

The Icfes began the evaluation of higher education in 2003 with the ECAES test (Quality Examination of Higher Education) [3], which was applied to students who voluntarily wanted to present it, therefore not all were evaluated and the assessment obtained could not be applicable to the entire population. In this test, specific, basic knowledge for each academic program was evaluated, which did not allow comparisons between different groups of students who were studying different programs. As of 2009, the test became compulsory [1], which made it possible to assess the entire population, but by continuing to give results from each program separately, it was only possible to contrast results from programs with the same name. That is why as of 2010 the test was called "Know Pro" and it stopped evaluating knowledge, which emphasizes memory, to begin to evaluate "competencies", which reflect the ability of graduates to apply the knowledge acquired in different situations or contexts [4].

In 2011, semester II, the first combinatorial or set of common specific competencies were created according to reference groups, understood as a grouping of programs with similar characteristics, which were defined taking into account the classification of programs of the National System of Information on Higher Education (SNIES) and the International Standard Classification of Education (ISCED) of UNESCO (United Nations Educational, Scientific and Cultural Organization) [5].

In 2012, two types of competencies were defined [6], which in turn determine two different populations; the "generic" competencies, which are those that all students must develop regardless of the academic program in which they are enrolled, determining the "national population", and the "specific" competencies, which are those that students from related programs must develop , thus establishing the population of the "Reference Groups" that determine the set of programs to whom the same combination of specific competencies is offered. Regarding generic competencies, Critical Reading, Written Communication, English and Quantitative Reasoning were evaluated. Starting this year, an additional generic competency called “Citizenship Competencies” is evaluated in the tests. Also, in the combination of specific offerings, the reference groups are given the valid option of not presenting Specific, only generic competencies.

In 2016, the general population was divided into two large groups, one formed by students of professional careers, who presented the Saber Pro test, and another formed by students of technical and technological careers who presented the Saber T&T test. Each of these groups is evaluated in generic and specific competencies for the offer of the reference group in which it is framed. The results reports include regarding different populations such as the Institution, the reference group and the total or National population and the Exams are presented semi-annually for Saber T and T and annually for Saber Pro, delivering and annual balance of results per previous year completed [7].

From the 2016-1 cohort, the Results have a common line, for SABER PRO with a scale from 0 to 300 and for SABER T and T from 0 to 200. In the results, the average score is applied that corresponds to the most representative result obtained by Students in each

module of generic and Specific competencies [8]. The Specific competencies were updated for the application of exams as of the second semester of 2018, adopting new reference groups for the offer of modules of Specific competencies of the State Exams ICFES SABER Pro and ICFES SABER T&T, reclassifying with information from SNIES code of the programs that frame them in a training level and additional to the Basic Core of Knowledge(BCK), which allowed offering combinations of specific common competencies to the reference groups, so that Higher Education Institutions (HEI) choose among those offered the one that best adapts to the training and profile of its Students [9].

2. Procedure

To perform the analysis of the results published by ICFE, in the Saber Tests from 2013 to 2019 of the Students of the Electronics Technology, Control Engineering and Telecommunications Engineering programs attached to the Technological Faculty of the Universidad Distrital, the average result of the group of Students in each module of Generic and Specific Competencies for each program was taken as a comparative element, that is, in Generic competencies the modules of Citizenship Competencies, Critical Reading, Written Communication, Quantitative Reasoning and English. Regarding the Specific Competencies for Technology in Electronics, the Assembly, Maintenance and Operation of Machinery and Equipment module; in Control Engineering the Control Systems Design Modules, Project Formulation in Engineering and Scientific Thought, physical sciences; in Telecommunications Engineering, the Project Formulation modules in Engineering and Scientific Thinking Mathematics and Statistics. Table 1 summarizes the competencies presented by each program.

According to the 2013-2019 study period, the results analyzed for Electronic Technology are known from 2013 to 2015 every six months and from 2016 to 2019 with annual Icfes balance. For Engineering, the semi-annual results from 2013 to 2015 and from 2016 to 2019 with annual performance data. Currently, the call for Technological and Technological Students who take T and T exams do so every semester and the Icfes results are generated with annual Performance indicators, while the Students of the Saber Pro or Professional level tests present an exam with the call in the second semester of every year from 2016 [7]. And the consolidated results are annual.

Table 1. Competences and Modules presented by the Electronics Curriculum Project Programs.

	Electronic Technology	Control Engineering	Telecommunications Engineering
Generic Competencies Modules	-Written Communication -Critical Reading -Quantitative Reasoning -English -Citizen Competencies	-Written Communication -Critical Reading -Quantitative Reasoning -English -Citizen Competencies	-Written Communication -Critical Reading -Quantitative Reasoning -English -Citizen Competencies
Specific Competencies Modules	Assembly, Maintenance and Operation of Machinery and Equipment	-Design of Control Systems -Formulation of Engineering Projects -Scientific thought, Physical Sciences	- Formulation of Engineering Projects - Scientific thought, Mathematics and Statistics

Source: own.

In the results presentation, in order to carry out the statistical analysis, the ICFES assumes that the results obtained by the students obey a "Normal Distribution" [10-11] therefore, it accounts for the average value and the deviation standard of said results for each module of both generic and specific competencies. The average value for the Generic competencies modules is provided for each population (Program, National, Reference Group, and Institution.) For the specific competencies' modules, the average value is specified for the Program populations and the Reference group [12]. It should be clarified that when referring to the Institutional average, in T and T results for Technology in electronics, the population is all the Students of the Universidad Distrital of the Technological Faculty who presented T and T exams (technical and technological) and when it is done reference to the Institutional average for Saber pro tests, the population is made up of all the Students who took the Saber Pro (Professionals) test of the Universidad Distrital.

The results are presented with a statistical distribution of a normal curve, popularized with this name, by the statistician Karl E Pearson from 1893, previously called the Laplace-Gaussian curve or bell curve [13-18], since it refers to a family of curves with two parameters that represent the density function graph of the distribution f (x) (1), where μ is the mean and σ is the standard deviation.

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \quad (1)$$

The analysis of results in the different periods of time, it was carried out taking into account the averages of the aforementioned Student populations, who presented the exam as Project Students, reference group, Institutional and National Group. These outcome indicators with their respective estimate of dispersion, such as the standard deviation, allow evaluating for some "x", the area under the curve (cumulative probability), multiplied by 100, which represents the percentage of the population that is below of x, in this case, x represents the average of the qualification of the Group of Students of the curricular project, this percentage is given by the integral calculated in (2)

$$100 \int_{-\infty}^{x} f(x)dx \quad (2)$$

The result obtained for x indicates that the average x of the interest group (Projects to be analyzed) is above the average of the percentage of the population resulting from (2). This calculation was made with the mean and standard deviation of each population group to be compared against the curricular project [19-26]. The results of the percentage indicate that the average of the Students of the curricular Project is located above the results of that percentage of the population with each comparative curve.

The percentage results data obtained with the accumulated probability compared with each population and for each module of generic and specific competencies are developed for each year and cohort, taking into account the Icfes guidelines in the saber tests [5-6]. The comparison populations are national, Reference Group and Universidad Distrital for each program. It should be clarified that the results with respect to the population of the Technological Faculty (Fac. Tec.) And that of the Universidad Distrital (UD) appear only as of 2016, because the Icfes did not provide that information in the years prior to this one. The results of Specific competencies are made comparing with the Reference Group population.

3. Results

To analyze the results, the comparisons with each population are plotted, indicating population percentages for which the mean of the Project Students was above the mean of that population group.

3.1. Generic Competencies

The application of the modules of Generic Competences T and T and saber Pro, evaluate the degree of general knowledge of the Students without distinction of the training area, once they have approved 75% of the credits of the respective program [27-28]. They include the modules of Citizenship Competencies, Written Communication, English, Critical Reading, and Quantitative Reasoning

3.1.1. Citizenship Competencies

According to the guidelines of the Ministry of National Education [29], these competencies are defined as an answer to the following question; What should a citizen who graduated from higher education know and know how to do to be able to fulfill their responsibility to exercise, defend and disseminate the rights established in the Political Constitution of Colombia, as the foundation of peaceful coexistence, to participate in political life and to respect the rights of others and critically understand society, its institutions and norms [30-34]. The Table 2 summarizes the evaluable aspects or conceptual reference areas of the module and the learning evidence.

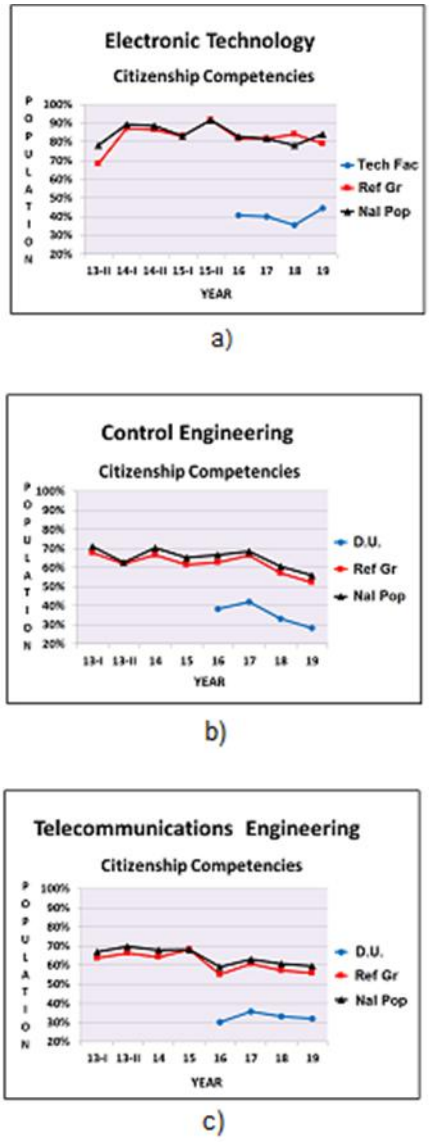
Table 2. Conceptual areas of the Citizenship Competencies Module.

Conceptual Areas	Evidence of Learning
Knowledge	Citizen rights and duties established in the Constitution, organization of the state, functions and scope of the different branches of power and control agencies
Argument Evaluation	Ability to analyze and evaluate the relevance and solidity of statements or speeches regarding a social problem
Multiperspectivism	Ability to analyze a social problem from different perspectives

Source: own.

The results in the Citizenship Competencies module are summarized in Figure 1, by means of the percentage accumulated probability indicator with respect to each population.

Figure 1. Results of the Citizenship Competencies Module 2013-2019 a) Electronics Technology b) Control Engineering c) Telecommunications Engineering.



Source: own.

In Figure 1a, it is observed that Electronic Technology students have obtained in this test a qualification approximately equal to or greater than 70% of the national population and the reference group, in addition it has been above 50% with respect to the obtained by the population of the Technological Faculty.

In Figure 1b, it allows us to observe that for the Engineering in Control program the qualification of the students has been between 50% and 70% of the national population and the reference group, and between 30% and 40% of the population of the Universidad Distrital.

Figure 1c shows the results of the Telecommunications Engineering students and the qualification has been between 50% and 70% of both the national population and that of the reference group and approximately between 30% and 40% of the population of the Universidad Distrital.

3.1.2. Written communication

In accordance with the guidelines in Icfes orientation guides [35-39], this module assesses the competency to communicate ideas in writing related to a given topic. The contents investigated are in the public domain. Table 3 summarizes the aspects to be evaluated.

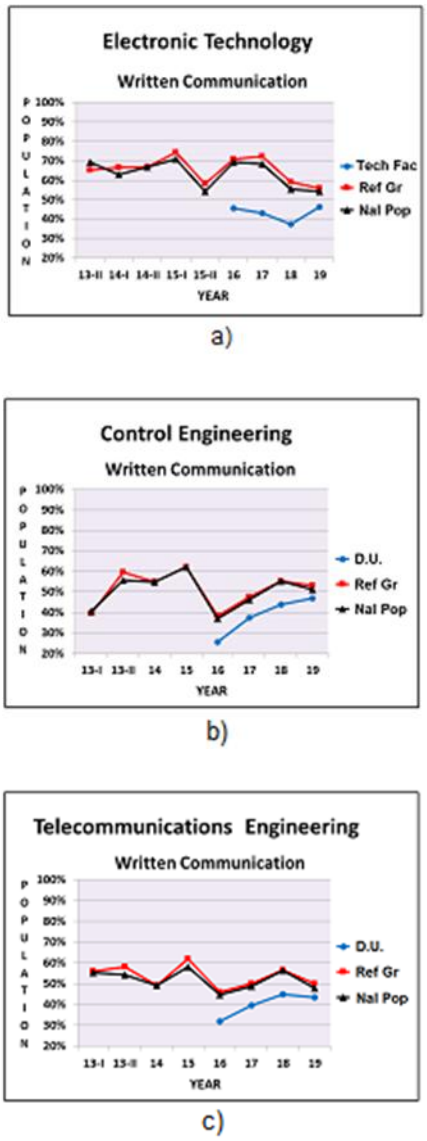
Table 3. Conceptual areas of the Written Communication Module.

Conceptual Areas	Evidence of Learning
Approach	Development of the proposed topic through the appropriate use of mechanisms that give unity and coherence to the text
Organization of the text	Appropriate scheme to communicate an approach to the appropriate use of mechanisms to give cohesion to the presentation of their ideas (sequentiality, use of punctuation marks, use of connectors, etc.)
Form of expression	Language selection associated with the social role of the interlocutor and the communicative purpose of the writings

Source: own.

The results in the Written Communication module are summarized in Figure 2, with the percentage accumulated probability and its evolution in the cohorts of 2013-2019.

Figure 2. Results of the Written Communication Module 2013-2019 a) Electronics Technology b) Control Engineering c) Telecommunications Engineering.



Source: own.

In Figure 2a, it can be seen that the qualification of Electronic Technology students in this module has been approximately between 50% and 70% of the national population and the reference group, it is also inferred that the results regarding these populations has declined in the last three years. Regarding the population of the Technological Faculty, this rating has been approximately between 40% and 50%.

In Figure 2b, it can be indicated that the performance of Control Engineering students in written communication has been between 40% and 60% of the national population and the reference group, and between 20% and 50% of the population of the Universidad Distrital. In addition, the results of this rating with respect to the three populations have tended to improve in the last three years.

For Telecommunications Engineering, according to Figure 2c, the rating has been between 50% and 60% of the national population and the reference group, and between 30% and 50% of the population of the Universidad Distrital. In this case, the performance with respect to the three populations increased between 2016 and 2018, with a slight decrease in 2019.

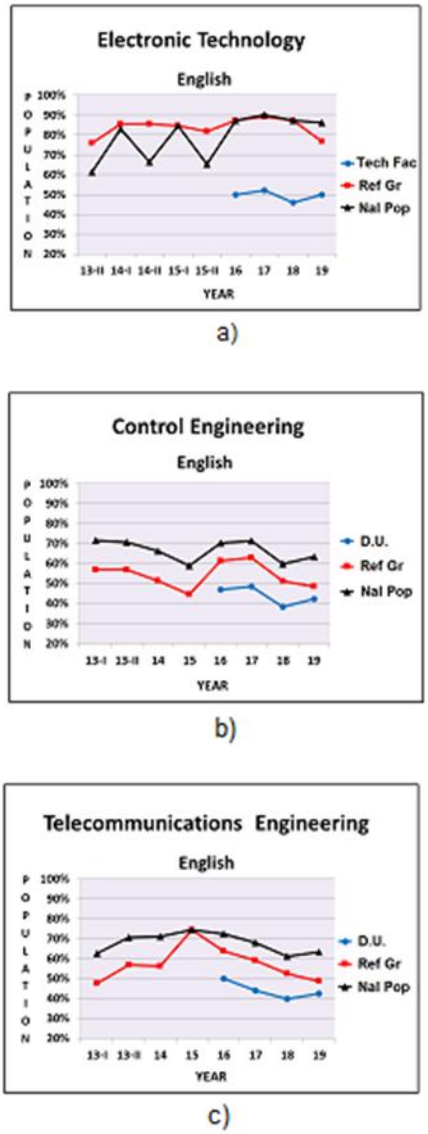
3.1.3. English

This module evaluates the competency to communicate effectively in English. This competency, aligned with the Common European Framework, allows the examinees to be classified into five performance levels –A1, A1, A2, B1, B2 [40-44]. The results obtained in this test are summarized in Figures 3. Figure 3a shows the performance of Electronic Technology students, which has been between 60% and 90% of the national population and the reference group and with respect to the population of the Technological Faculty, the location has been around 50%.

In Figure 3b, it is observed that the average of Control Engineering students in this module has been approximately between 60% and 70% of the national population, between 40% and 60% of the reference group, and between 40% and 50% of the population of the Universidad Distrital. In addition, the performance with respect to the reference group was always lower than that obtained with respect to the national population and the population of the Universidad Distrital.

In Figure 3c, it can be seen that in Telecommunications Engineering the qualification in the English test has been located approximately between 60% and 80% of the national population, between 50% and 80% of the reference group, and between 40% and 50% of the population of the Universidad Distrital. The location of this rating with respect to the reference group decreased in the last four years and with respect to the national population and that of the Universidad Distrital it decreased since 2016 with a rebound in 2019.

Figure 3. English Module Results 2013-2019 a) Electronic Technology b) Control Engineering c) Telecommunications Engineering.



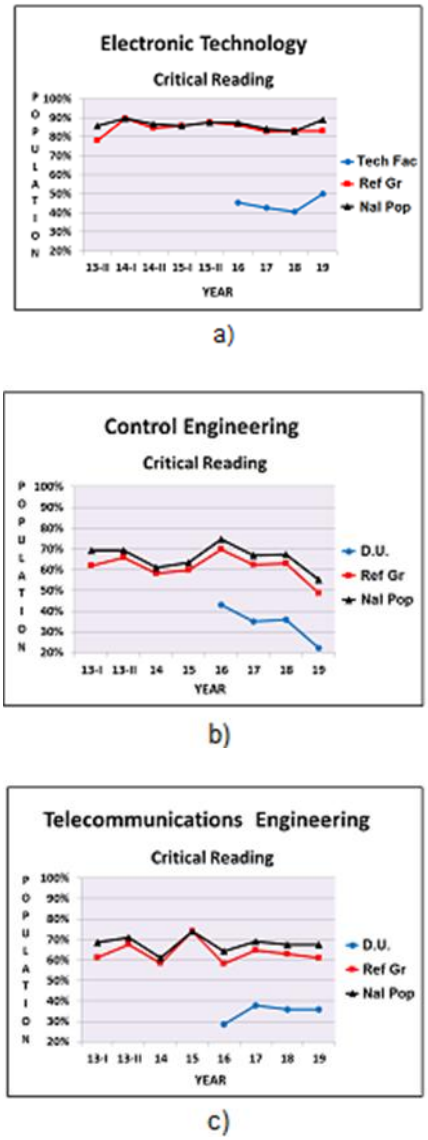
Source: own.

3.1.4. Critical Reading

This test assesses the abilities to understand, interpret and evaluate texts that can be found both in everyday life and in non-specialized academic environments. The purpose is to establish if a student has a reading comprehension that allows her to interpret, learn and take critical positions in front of a text. [45-49].

The results of this test are shown in Figure 4. According to Figure 4a, the critical reading rating of Electronic Technology students has been between 80% to 90% of the national population and the reference group. Regarding the population of the Technological Faculty, this rating has been between 40% and 50%, with a rebound in 2019.

Figure 4. Critical Reading Module Results 2013-2019 a) Electronics Technology b) Control Engineering c) Telecommunications Engineering.



Source: own.

In Figure 4b, it can be seen that the qualification of engineering students in Control in the Critical Reading test with respect to the national population and the

reference group has been between 50% and between 80% and with respect to the population of the Universidad Distrital between 20% and 50%. In addition, it is appreciated that the performance has decreased with respect to the three populations in the last four years.

For Telecommunications Engineering, according to Figure 4c, the rating in the Critical Reading test has been located approximately between 60% and 80% of the national population and the reference group, while for the population of the Universidad Distrital it is located between 30% and 40%.

3.1.5. Quantitative reasoning

This module assesses the set of elements of mathematics, whether these are knowledge or skills that allow a citizen to take an active and informed part in social, cultural, political, administrative, economic, educational and labor contexts [50-54]. Table 4 summarizes the evaluable aspects or conceptual reference areas of the module.

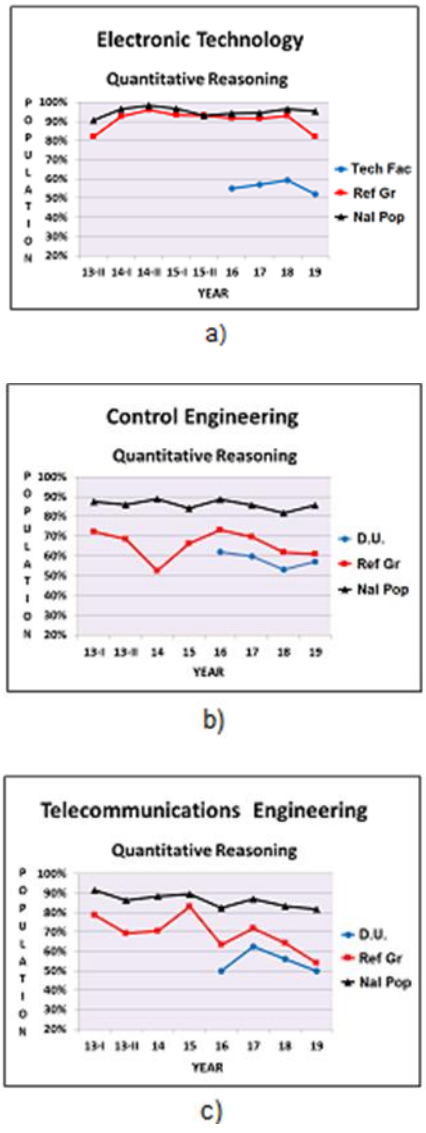
Table 4. Conceptual areas of the Quantitative Reasoning Module.

Conceptual Areas	Evidence of Learning
Interpretation and representation	Understand and manipulate representations of quantitative data or mathematical objects, in different formats (texts, tables, and graphics). Calculations with real numbers
Formulation and execution	Establish, execute and evaluate strategies to analyze problems that involve quantitative information and mathematical objects
Argumentation	Justify or give reasons for statements or judgments about situations of quantitative information or mathematical objects

Source: own.

Figure 5 show the results obtained in this test. In Figure 5a, the qualification of Electronic Technology students has been approximately between 90% and 100% of the national population, between 80% and 100% of the reference group and between 50% and 60% of the population of the Technological Faculty. It is also observed that with respect to the Technological Faculty, this rating was increasing between 2016 and 2018, with a decrease in 2019.

Figure 5. Results Quantitative Reasoning Module 2013-2019 a) Electronic Technology b) Control Engineering c) Telecommunications Engineering.



Source: own.

In Figure 5b, it is observed that the qualification of the Control Engineering students in the test has been approximately between 80% and 90% of the national population, between 50% and 70% of that of the reference group and between 50% and 60% of the population of the Technological Faculty; As for the reference group, this rating has been decreasing during the last four years. Something similar happened with

respect to the population of the Universidad Distrital between 2016 and 2018, with a rebound in 2019.

In Figure 5c for Telecommunications Engineering, it can be seen that the qualification in the Quantitative Reasoning test has been located between 80% and 90% of the national population and between 50% and 80% of that of the reference group, while for the population of the Universidad Distrital it is located between 50% and 70%. For the three populations the location of the rating in this test has a high performance with a slight decrease in the last three years.

3.2. Specific Competencies

The Modules that comprise the Specific Competencies are offered in combinations associated with specific topics and contents according to the professional training area. They can be offered in groups of one to three modules in combinations according to the Basic Core of Knowledge (BCK) and the level of training established according to the SNIES classification of the Ministry of National Education. [55]

Table 5 indicates the reference groups for the Students of the Electronics curricular project. For the curricular project, the results in these specific modules are important and therefore the Students in each cohort have been enrolled to present the combination of Specific competencies, despite the fact that the ICFE does not make the presentation of these Competencies mandatory.

3.2.1. Assembly, Maintenance and Operation of Machinery and Equipment. Specific Module Technology in Electronics.

Table 5. Reference Groups and Specific Competencies Modules.

	Reference Group	Featured Modules
Electronic Technology	Technological in Engineering Industry and Mines. BCK: Telecommunications and Related Electronics Engineering	One: Assembly, Maintenance and Operation of Machinery and Equipment
Control Engineering	Engineering BCK: Telecommunications and Related Electronics Engineering	Three: Design of Control Systems, Formulation of Engineering Projects and Scientific thought- Physical Sciences
Telecommunications Engineering	Engineering BCK: Telecommunications and Related Electronics Engineering	Two: Formulation of Engineering Projects and Scientific thought- Mathematics and Statistics

Source: own.

Table 6. Conceptual areas of the Assembly, Maintenance and Operation of Machinery and Equipment Module. Electronic technology.

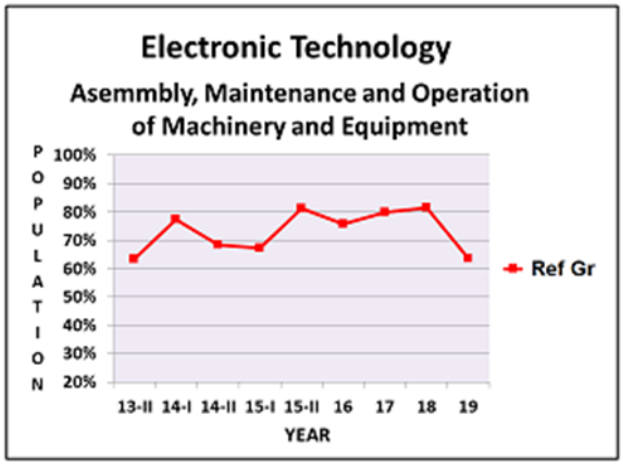
Conceptual Areas	Evidence of Learning
Apply Technical knowledge of Maintenance	Identify and organize activities of the assembly and installation of equipment and machinery, interpret plans and apply technical standards.
Know Maintenance Management Methodologies	Apply Maintenance Management Methodologies and Activities.
Basic Knowledge of Machines and equipment	Analyze proper operation of Machines and Equipment in normal operation.
Know and Apply concepts and standards of Industrial safety, occupational health and environmental impact	Apply standards and concepts of industrial safety in the assembly, installation and operation of Machines and Equipment

Source: own.

This specific competency is the only one offered to Technology in Electronics and has been presented by Students in all analysis cohorts from 2013-2019. This module assesses competencies related to the operation of machines and equipment, identification, evaluation and resolution of problems associated with their operation and maintenance, taking into account aspects of industrial safety and environmental impact. [56]. Table 6 summarizes the evaluable aspects or conceptual areas.

Figure 6 shows the Results of the Technology in Electronics program in the test and it is seen that the qualification in said test has been over 60% and 80% of the population of the Reference Group, made up of students from related programs. Performance improved during 2016, 2017, and 2018 although it was down 15% for 2019.

Figure 6. Results Module Assembly, Maintenance and Operation of Machinery and Equipment 2013-2019 Technology in Electronics.



Source: own.

3.2.2. Design of control systems. Specific Module Control Engineering

This module is in the combinatorial offered and presented by Control Engineering Students in the 2013-2019 range. The module is part of the engineering design modules and refers to the design of artifacts, systems or processes of automatic operation [57]. Table 7 summarizes conceptual reference areas.

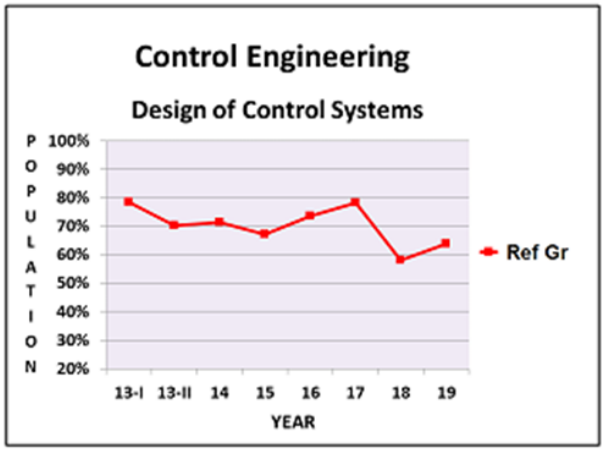
The results of the Engineering in Control program are shown in Figure 7, where it can be seen that the Students' qualification was located over 60% and 80% of the Reference Group population, decreased by 20% in 2018 and 15% in 2019.

Table 7. Conceptual areas of the Control Systems Design Module. Specific Control Engineering Competency.

Conceptual Areas	Evidence of Learning
Analog Control	Understand Information, pose restrictions, and requirements, and formulate design specifications
Discrete Systems	Structure a problem according to specifications and formulate solutions
Logic Control	Performs calculations and procedures, raises specifications, reviews and verifies a solution
Instrumentation	Structure a problem, give design alternatives, and review detailed design

Source: own.

Figure 7. Results of the Control Systems Design Module 2013-2019. Control Engineering.



Source: own.

3.2.3. Formulation of Engineering Projects. Specific Module Control Engineering and Telecommunications Engineering

This module is in the combinatorial offered and presented by the Students of both Control Engineering and Telecommunications. It is the module with the most population in the Reference Group, since it is offered to all Engineering schools in the country. The module assesses learning related to the ability to contextualize, identify and formulate engineering projects considering environmental conditions and the analysis of alternatives within a methodological framework [58]. Table 8 summarizes the conceptual areas.

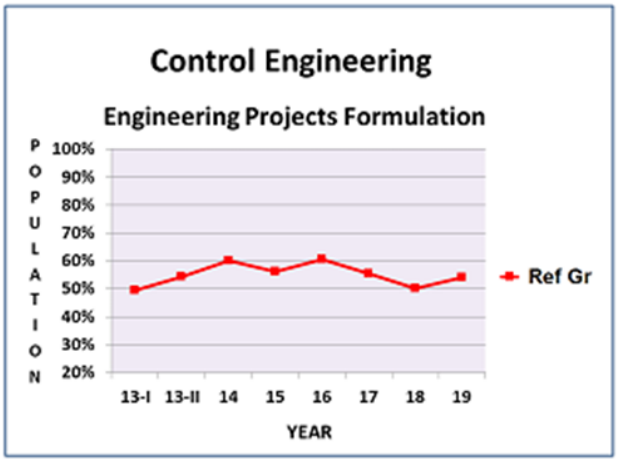
Table 8. Conceptual areas of the Engineering Project Formulation Module. Specific Competencies for Control Engineering and Telecommunications Engineering.

Conceptual Areas	Evidence of Learning
Identify and characterize projects in a specific context	Characterize the project according to its Nature social and economic, applying appropriate methodologies in the formulation of the same
Formulate Engineering Projects	Formulate the project within an adequate methodological framework, establishing the financial viability of the Project and reach planning times and costs
Recognize social and ethical responsibility of the Engineer in an Engineering Project	Identify social and technical responsibilities vis a vis codes and norms and assume an ethical position vis a vis their profession

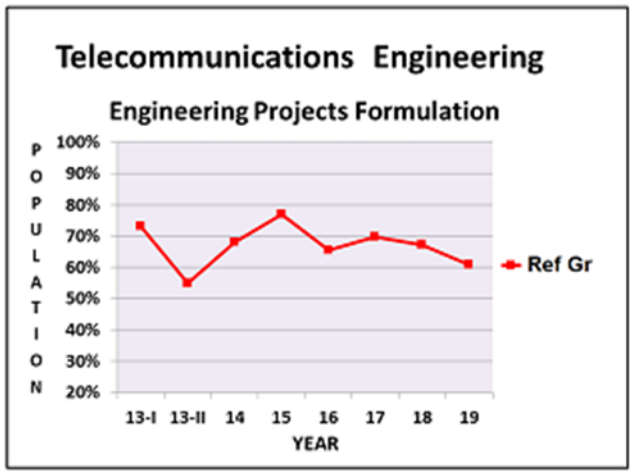
Source: own.

The performance results in this competency for Control Engineering are shown in Figure 8a, where it can be inferred that the students' score in this test was located approximately above the average of 50% and 60% of the Reference Group population, decreasing between 2016 and 2018 and improving in 2019. According to Figure 8b, the qualification of the Telecommunications Engineering students was located above the average of 50% and 80% of the Reference Group population although it has decreased between 2017 and 2019.

Figure 8. Results Module Formulation of Engineering Projects 2013-2019. a) Control Engineering. b) Telecommunications Engineering.



a)



b)

Source: own.

3.2.4. Scientific thought. Specific Module Control Engineering and Telecommunications Engineering

This module is in the combination offered and presented by the Students of both Control Engineering and Telecommunications. In Control Engineering

offered by Icfes with emphasis on Physical Sciences and for Telecommunications in Mathematics and Statistics. The module assesses the ability to understand, analyze and face real or abstract situations with scientific rigor. Scientific thought is established as a transversal trait to careers in engineering, natural sciences, mathematics and statistics. [59]

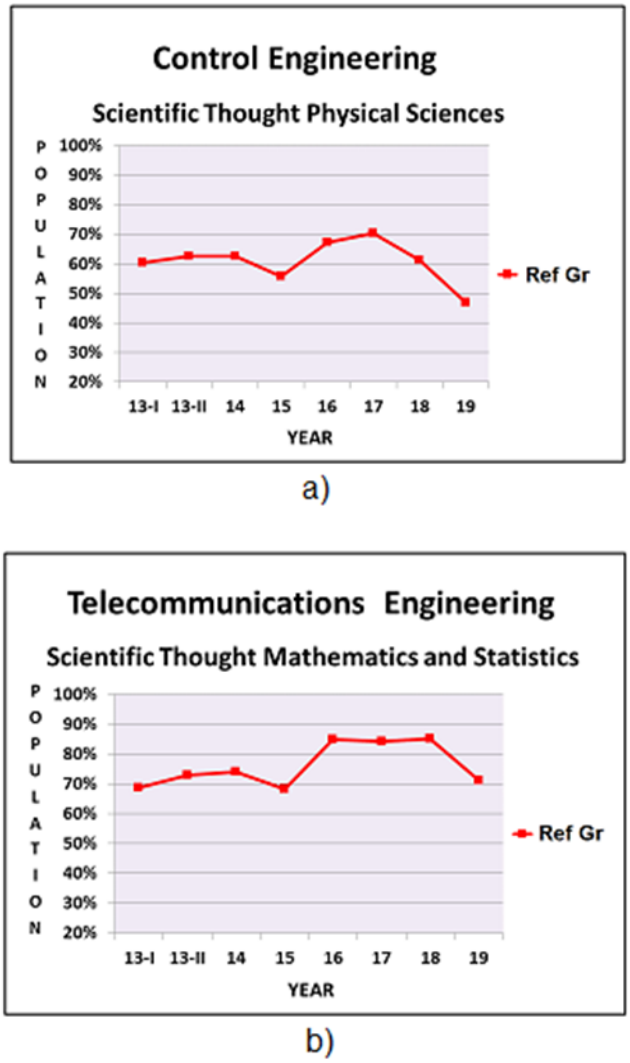
Table 9. Conceptual areas of the Scientific Thinking Module. Specific Competencies for Control Engineering and Telecommunications Engineering.

Conceptual Areas	Evidence of Learning
Acquire and interpret information about a problem situation	Understand, determine and propose models to a given system or phenomenon
Analyze results and conclude	Obtains conclusions supported by information about a situation, Evaluates hypotheses and conjectures from results
Understand and apply models that describe phenomena or systems	Understand, determine and propose models to a given system or phenomenon to study it, make inferences and extrapolations
Establish strategies to address and solve problems	Proposes, recognizes and selects appropriate strategies to solve a research problem
Propose explanations that are approached with scientific rigor	Ask questions and propose explanations for a phenomenon in accordance with scientific models and theories

Source: own.

As can be observed in Figure 9a, in the Scientific Thinking test in Physical Sciences for Control Engineering, the performance of the students was located above 40% and 70% of the reference group, decreasing in 2018 and 2019 to a fifty%. Regarding the Telecommunications Engineering program, as shown in Figure 9b, the qualification was between 70% and 90% of the reference group population.

Figure 9. 2013-2019 Scientific Thinking Module Results. a) Control Engineering-Physical Sciences. b) Telecommunications Engineering - Mathematics and Statistics.



Source: own.

4. Conclusions

It was evidenced that in the modules of citizenship competencies, English and critical reading, the average of the students of the curricular project is equal to or higher than that of the reference and National population groups with an average in these modules above 50% in the cycle Engineering and 90% in the technological cycle with respect to these groups, which represents a good performance compared to these populations.

The analyzed data show that in the quantitative reasoning module there is a high performance of the Students, since the average of the Curricular Project is above the average of the results of the reference group, National and Universidad Distrital population from 50% to a 95% of these populations, identifying that this area is a strength from the technological cycle to the Engineering cycle.

The results clearly identify an opportunity to search for improvement strategies in the written communication module, given that the average number of Students, especially in the last two years of the study, has decreased. In technology, the average of the test for Students has been above the average of 50 to 75% of the reference group and national populations, already in the Engineering cycle the average of Students has been above the average of 35% to 60 % of these populations.

The analyzed data also show that for the period 2013-2019 in comparison with the Universidad Distrital population, the average of the Students of the curricular Project is located within the range of 25% to 60% of the average of this population, standing out as high the performance of the Universidad Distrital population and evidencing an opportunity for action to improve against this population group.

It can be inferred from the results in Specific Competencies, that with respect to the Reference Group, the average of the Project Students is above the average of this population in a percentage of 45% to 85% of this population that has a similar education. In addition, in the tests common to the two Engineering Programs of the curricular Project, such as the formulation of Engineering Projects and Scientific Thinking, better performance was evidenced in Telecommunications Engineering Students than in Control Engineering, thus identifying areas of action to improve, with additional training strategies for these competencies.

In general, it can be concluded that the performance results for the Electronics Curriculum Project tests "saber", with respect to the national population and the reference group are good, exceeding approximately 80% of the average of these populations, while with respect to the population from the Universidad Distrital are acceptable, exceeding approximately 50% of the average of this population, which allows to feed back the learning processes, evidencing the need for progress with respect to this group. On the other hand, in Specific competencies the performances are also good but with improvement opportunities for Control Engineering in the Project formulation module and in the Scientific Thinking module.

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