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*Artículos científicos*

## **Sistema de gestión de calidad del programa educativo de ingeniería Industrial de la UABC**

***Quality Management System of the Industrial Engineering Educational  
Program of the UABC***

***Sistema de gestão da qualidade do programa de Engenharia Industrial da  
UABC***

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### **Resumen**

Esta investigación cualitativa presenta los resultados de una autoevaluación realizada en abril de 2020 para medir el sistema de gestión de calidad del programa educativo de ingeniería Industrial de la Facultad de Ciencias de la Ingeniería y Tecnología de la Universidad Autónoma de Baja California. Se utilizó la metodología de los Comités Interinstitucionales para la Evaluación de la Educación Superior (Ciees) y una escala de Likert. Los resultados muestran que el programa en cuestión cumple con un nivel suficiente, adecuado u óptimo en 95 % de los estándares de los Ciees, reflejo de un buen sistema de gestión de calidad. Las conclusiones confirman que la acreditación de un programa educativo por parte de organismos externos garantiza la calidad educativa.

**Palabras clave:** calidad educativa, educación superior, ingeniería industrial.



## Abstract

This qualitative research presents the results of a self-assessment carried out in April 2020 to measure the quality management system of the Industrial Engineering educational program of the Faculty of Engineering Sciences and Technology of the Universidad Autónoma de Baja California. The methodology of the Comités Interinstitucionales para la Evaluación de la Educación Superior (CIEES) and a Likert scale were used. The results show that the program in question meets a sufficient, adequate or optimal level in 95 % of the CIEES standards, a reflection of a good quality management system. The conclusions confirm that the accreditation of an educational program by external organizations guarantees educational quality.

**Keywords:** educational quality, higher education, industrial engineering.

## Resumo

Esta pesquisa qualitativa apresenta os resultados de uma autoavaliação realizada em abril de 2020 para medir o sistema de gestão da qualidade do programa educacional de Engenharia Industrial da Faculdade de Ciências e Tecnologia de Engenharia da Universidad Autónoma de Baja California. Foi utilizada a metodologia dos Comités Interinstitucionales para la Evaluación de la Educación Superior (Ciees) e escala Likert. Os resultados mostram que o programa em questão atende a um nível suficiente, adequado ou ótimo em 95 % dos padrões do Ciees, reflexo de um bom sistema de gestão da qualidade. As conclusões confirmam que o credenciamento de um programa educacional por organizações externas garante a qualidade educacional.

**Palavras-chave:** qualidade educacional, ensino superior, engenharia industrial.

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## Introduction

Due to advances in the area of information and communication technologies (ICT), as well as organizational, political, economic, social changes and market demands, educational quality in higher education is an issue that has been acquiring great relevance worldwide. According to recent studies by the Organization for Economic Cooperation and Development [OECD] (2019), in Mexico, as in the rest of the OECD member countries, people who manage to obtain a university academic degree are more likely to get a better paying job, which increases their quality of life.

Regarding how to measure quality in the higher education sector, the National Association of Universities and Institutions of Higher Education [Anuies] (2018) mentions three ways to do it. One of them points to the effectiveness of the educational action, that is, to the achievement of the expected learning in a period of time. Another refers to the relevance of the learning contents and how they satisfy the expectations and needs of the interested parties for their professional development and performance. It can also be conceived from the inputs used and the processes of the educational experience, that is, based on the organization, regulations, plans and study programs, the capacities of the teaching staff, infrastructure and equipment (Anuies , 2018).

For Delahoz, Guillen and Fontalvo (2020), it is important that educational programs have quality accreditation, regardless of the criteria used, since it significantly influences the performance of university students. And along the same lines, the European Association for the Quality of Higher Education [EQNA, for its acronym in English] (2015) refers that an internal quality assurance should be sought through mechanisms that allow efficient operation of the processes of teaching-learning, and that one way to sustain continuous quality improvement is through accreditations to educational programs carried out by external organizations.

For this study, the quality management system implemented within the Industrial Engineering educational program of the Faculty of Engineering Sciences and Technology (FCITEC) of the Autonomous University of Baja California (UABC) is taken as a reference (León et al., 2018; Moreno, 2018). This program was submitted to the 95 quality standards established by the Inter-institutional Committees for the Evaluation of Higher Education (Ciees), the highest body in Mexico that accredits the educational quality of study programs in higher education institutions.

## **Educational quality at the higher level**

One of the most interesting and significant documents for the purposes of this study is the 2019-2023 Institutional Development Plan of the UABC (2019), which describes the educational panorama present in Mexico, as well as the worldwide trends in terms of quality and equity. Following what was stated by the Organization for Economic Cooperation and Development (2019), the UABC (2019) stated that one of the most important issues to improve higher education is the establishment of quality assurance policies.

It should be noted that, like the OECD, the United Nations Educational, Scientific and Cultural Organization (UNESCO), since the 1998 World Conference, has underlined the importance of quality in higher education, as well as It has promoted the establishment of significant changes in favor of equity in the educational offer by higher education institutions. In this regard, the United Nations (UN) (General Assembly, 2015), within the 2030 Agenda for Sustainable Development, has proposed the following: “By 2030, ensure equal access for all men and women to quality technical, professional and higher education, including university education”(p. 19). Likewise, goal four states: “Guarantee inclusive, equitable and quality education and promote lifelong learning opportunities for all” (p. 19).

Returning to the Institutional Development Plan 2019-2023 (UABC, 2019), here the following is mentioned in a textual way:

In the near future, higher education must consider the following trends: a) expansion of higher education systems; b) coverage, quality and equity; c) transformation of the world of work; d) performance indications as a mechanism for accountability, and e) citizenship, social responsibility and human rights (p. 15).

## **Methodology**

This work is a qualitative and descriptive case study (Martínez, 2006). It was undertaken in order to identify educational quality and establish a culture of continuous improvement in the Industrial Engineering educational program of the FCITEC of the UABC. The methodology of the Ciees (2018) is taken as a reference, which includes five axes, 12 categories, 49 indicators and 95 standards that measure educational quality, as shown in Figure 1.

**Figura 1.** Ejes y categorías para la evaluación del PEII

Ejes	Categorías
I. Fundamentos y condiciones de operación	1. Propósitos del programa* 2. Condiciones generales de operación del programa
II. Currículo específico y genérico	3. Modelo educativo plan de estudios* 4. Actividades para la formación integral
III. Tránsito de los estudiantes por el programa	5. Proceso de ingreso 6. Trayectoria escolar 7. Egreso del programa
IV. Resultados	8. Resultados del estudiantes * 9. Resultados del programa*
V. Personal académico y apoyos	10. Personal académico* 11. Infraestructura académica* 12. Servicio de apoyo

Fuente: Ciees (2018)

## Results

The self-evaluation was carried out by a group of seven FCITEC academics (figure 2) and based on the evidence collected from the quality management system of the Industrial Engineering educational program. To work the 95 standards of the 45 indicators, in the 12 categories of the five axes of the Ciees methodology, the following scale was formulated: Not applicable (NA), Insufficient (Ins), Sufficient (Suf), Adequate (Ade) and Optimal (Opt). It should be noted that the data obtained were managed with the support of the Minitab 17 statistical package. These results are presented below.

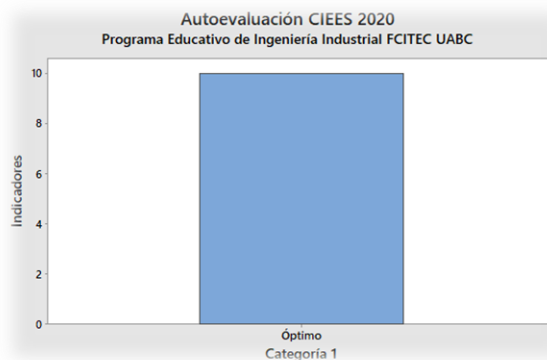
**Figura 2.** FCITEC de la UABC



Fuente: Ingeniería Industrial UABC (s. f.)

In figure 3 it can be seen that the 10 standards in category one, “Program purposes”, obtained a score of Optimal.

**Figura 3.** Autoevaluación de la categoría uno Ciees del programa de ingeniería Industrial de la FCITEC

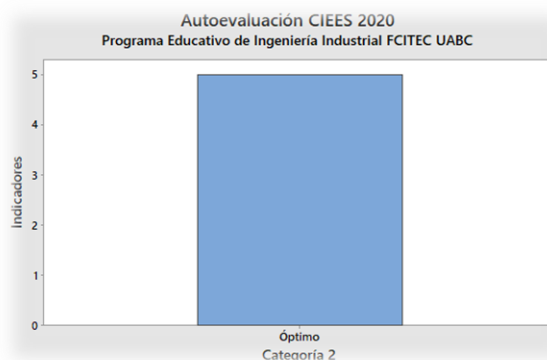


Fuente: Elaboración propia

Among the strengths that were identified are academic tutorials, compliance with the guidelines of the accrediting committees of engineering education, professional social service and the link with the productive sector through learning stays. While the following weaknesses were observed: in the study plan it is recommended to consolidate the economic-financial area and a series of subjects in the 2009-2 study plan.

Within category two, “General operating conditions of the program”, the five standards obtained the maximum score, as can be seen in figure 4.

**Figura 4.** Autoevaluación de la categoría dos Ciees del programa de ingeniería Industrial de la FCITEC



Fuente: Elaboración propia

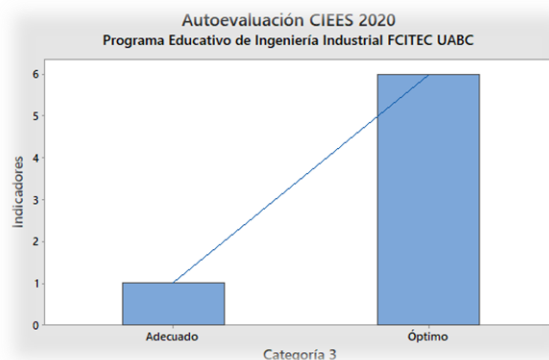
The strengths that were identified within the quality management system of the educational program were that it meets the requirements set by the Ministry of Public Education (SEP), there is an order and regulations of the educational program and a slight



but gradual growth of enrollment . While the weaknesses detected were a possible limited budget that requires a new organizational structure.

In category three, "Educational model and curriculum", the quality management system of the educational program obtained Optimal in six standards and in one Adequate, according to the opinion of the seven FCITEC academics.

**Figura 5.** Autoevaluación de la categoría tres Ciees del programa de ingeniería Industrial de la FCITEC

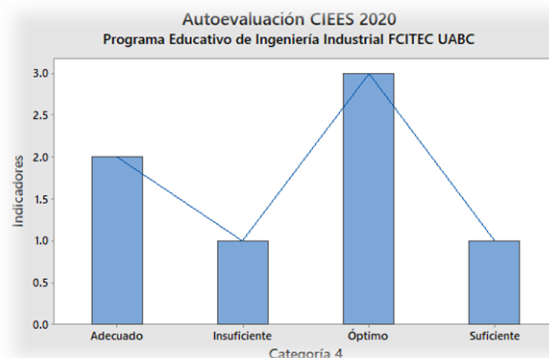


Fuente: Elaboración propia

On the one hand, the strengths found in the quality management system of the educational program were the educational model of the UABC, a permanent teacher training program, a new 2019-2 curriculum, as well as a teacher evaluation instrument available of the students. On the other hand, the weaknesses that were identified were that some subject teachers have not taken the Induction course and the need to implement a mechanism to verify compliance with the competencies and thematic contents.

Regarding category four, "Activities for comprehensive training", as shown in figure 6, the quality management system of the educational program presented a greater variety of marks: a standard with Insufficient, another with Sufficient, two standards were rated Adequate and three standards were rated Excellent.

**Figura 6.** Autoevaluación de la categoría cuatro Ciees del programa de ingeniería Industrial de la FCITEC

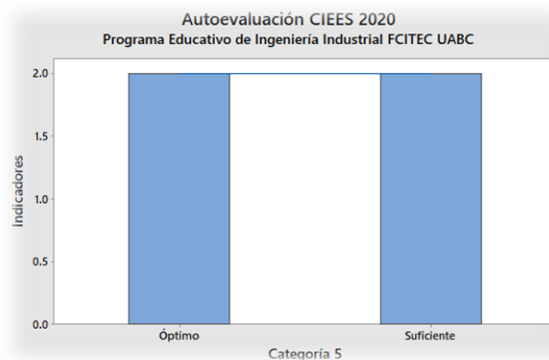


Fuente: Elaboración propia

The strengths found within this category were that the students present a comprehensive training, there is support to develop a second language from the Faculty of Languages and the FCITEC itself, there is a network of institutional values and offers SolidWorks certification. As weaknesses, it was identified that there is little promotion of extracurricular activities and that it is necessary to expand the offer of certifications for the students of the program.

Regarding category five, "Admission process", the academics scored two standards with Sufficient and the other two with Optimal, as can be seen in figure 7.

**Figura 7.** Autoevaluación de la categoría cinco Ciees del programa de ingeniería Industrial de la FCITEC



Fuente: Elaboración propia

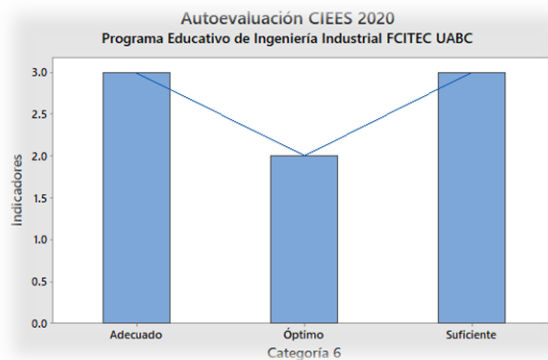
Here it was possible to identify as strengths the welcoming of new students, the induction activities for the new students to integrate in an informed way, the academic leveling course (CNA) in mathematics and the academic advising program. As weaknesses,



the need to establish a follow-up of the CNA and the lack of follow-up of the counseling program were identified.

In the category “School trajectory”, three standards reached Sufficient, three were rated Adequate and two standards scored Excellent.

**Figura 8.** Autoevaluación de la categoría seis Ciees del programa de ingeniería Industrial de la FCITEC

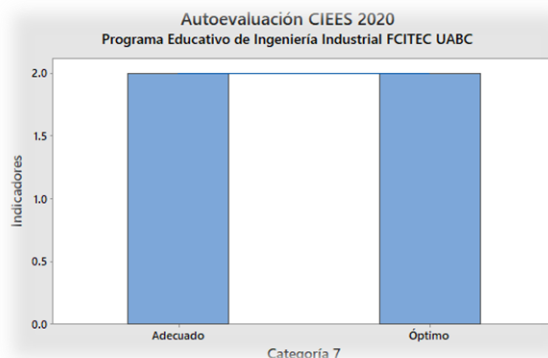


Fuente: Elaboración propia

In this case, the main strengths found were professional practices, professional social service, and credit-worthy bonding projects, the scholarship program for students, and the counseling and tutoring program to reduce the failure, lag, and dropout rates. While the only weakness observed was the need to implement an instrument that quantifies the final impact of students who attend tutorials or counseling on the dropout and lag rate.

Figure 9, on the other hand, shows the scores obtained for the standards of category 7, “Exit from the program”.

**Figura 9.** Autoevaluación de la categoría siete Ciees del programa de ingeniería Industrial de la FCITEC

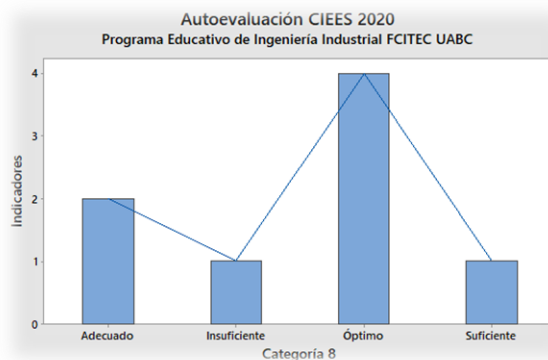


Fuente: Elaboración propia

The strengths found, based on the self-evaluation in this category, were the following: the educational program, through the UABC, offers graduates various options to obtain their Industrial Engineering degree and the career, through the UABC, has a program that guides graduates in their transition from students to professionals. On the other hand, the observed weaknesses had to do with the fact that the graduation rate of the students of the educational program is low and the UABC job bank is institutional, it includes all the educational programs that are offered, and not it is specific to the Industrial Engineering program.

Figure 10 shows the levels achieved by the standards in category eight, “Student Outcomes”, where one standard achieved an Insufficient, one standard the Sufficient level, two standards scored Adequate and four an Excellent level.

**Figura 10.** Autoevaluación de la categoría ocho Ciees del programa de ingeniería Industrial de la FCITEC

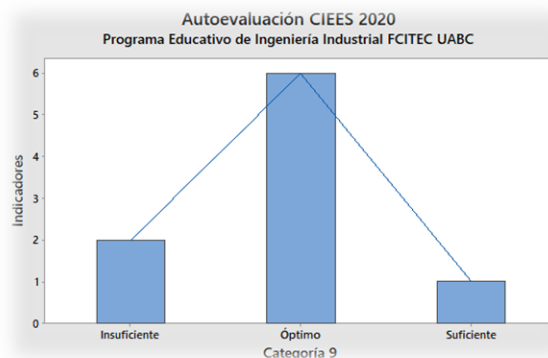


Fuente: Elaboración propia

The strengths identified were that the active participation of students in competitions and forums of national and international importance is encouraged, there is an external graduation exam that allows the knowledge of graduates to be evaluated in a standardized way, employers recognize the ability to solve problems of graduates and there is a student mobility program, through which students can travel abroad and learn or improve a second language. The weaknesses observed were that there are few certifications in the faculty, the results of the General Examination for Bachelor's Degree (EGEL) are unsatisfactory, the indexes of terminal and degree proficiency are low and there is little command of a second language.

Within category nine, "Program results", two standards obtained an Insufficient, one standard obtained a Sufficient mark and six standards obtained an Optimal mark, as can be seen in figure 11.

**Figura 11.** Autoevaluación de la categoría nueve Ciees del programa de ingeniería Industrial de la FCITEC

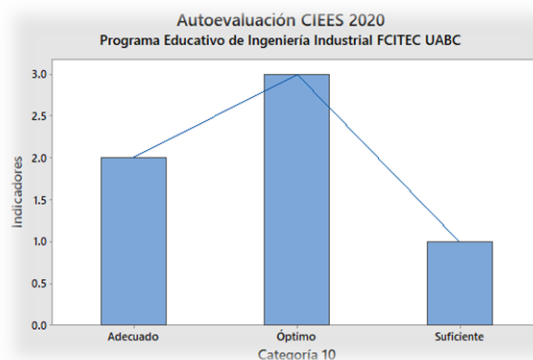


Fuente: Elaboración propia

Here the strengths found in the self-evaluation based on the quality management system of the educational program were that the dropout rate of students is relatively low, there is an academic advising program to support low-performing students, graduates They manage to join the labor sector within the first six months of graduation and the graduates are working in activities directly related to what they studied. On the other hand, the weaknesses of the educational program detected in this category were that the efficiency of the degree is low, there is a need for greater promotion of existing certifications and strategies must be established to monitor graduates who are undertaking postgraduate studies.

Regarding the category referring to academic staff, one standard obtained a Sufficient score, two standards an Adequate and three standards an Optimal, as can be identified in figure 12.

**Figura 12.** Autoevaluación de la categoría 10 Ciees del programa de ingeniería Industrial de la FCITEC

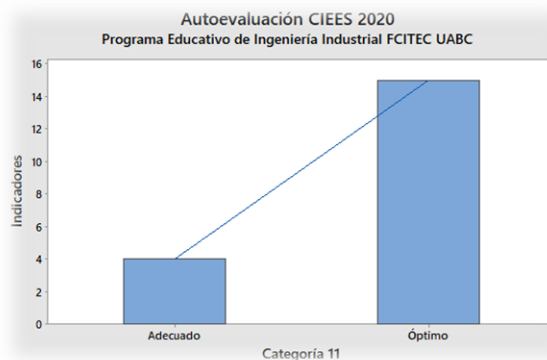


Fuente: Elaboración propia

The strengths identified were the profile of the teaching body that attends the educational program, the educational program supports academic empowerment to improve the teaching of the discipline, and the educational program supports disciplinary improvement for teachers to carry out postgraduate studies or continuing education activities. . The weaknesses were related to the fact that the educational program only has three full-time professors assigned and that, despite the fact that the three full-time professors belong to an academic body of research, none acts as a leader.

Category 11, “Academic infrastructure”, has 19 standards, of which four were Adequate and the rest were Optimal, as shown in figure 13.

**Figura 13.** Autoevaluación de la categoría 11 Ciees del programa de ingeniería Industrial de la FCITEC

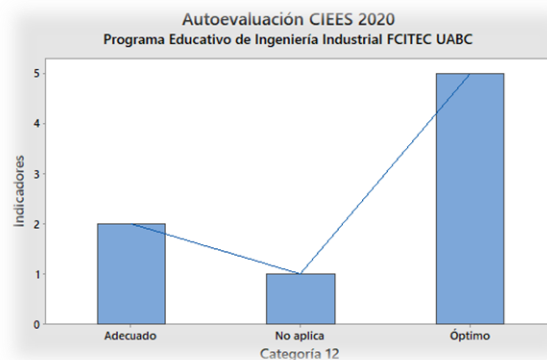


Fuente: Elaboración propia

Among the strengths identified in this category, is the quantity and quality of classrooms, laboratories and workshops, that the furniture has the necessary quality to carry out the different activities, the agreements established with companies and government agencies, the wide and pertinent bibliographic collection for career and technological ability. While the weaknesses found are oriented to the fact that it is advisable to have a plan to update the computer infrastructure, both for equipment and computer programs.

In relation to the standards of category 12, “Support services”, one of them obtained Not applicable, two standards were Adequate and five were rated as Optimal (figure 14)

**Figura 14.** Autoevaluación de la categoría 12 Ciees del programa de ingeniería Industrial de la FCITEC



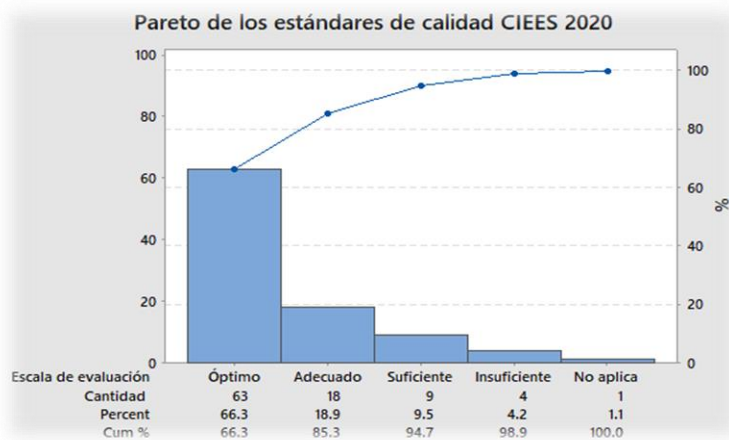
Fuente: Elaboración propia

The student can carry out some procedures completely online, there is a broad scholarship program adapted to the needs of the students and there is a Psychopedagogical Department that provides support to students in a timely and comprehensive manner, those

were the strengths detected. While the weaknesses were that it has not been possible to guarantee efficient transportation for the community of the Valle de las Palmas unit and that the Psychopedagogical Department has no evidence of the impact on the improvement of the school trajectory of the students who have been attended.

Finally, the 95 quality standards of the Ciees methodology adapted to the educational program of the FCITEC of the UABC by academic peers were concentrated in a Pareto diagram with the support of Minitab 17, and the score of Sufficient was obtained in 94.7% of the quality standards, that is, 90 of the 95 standards comply with the guidelines established by the accrediting body, so, based on these results, it can aspire to be part of the National Register of Quality of Educational Programs, such as mirrors figure 15.

**Figura 15.** Diagrama de Pareto de la autoevaluación del programa de ingeniería Industrial de la FCITEC



Fuente: Elaboración propia

Currently, the Industrial Engineering educational program is awaiting the opinion that will be issued by the Ciees; if it is favorable, it will be an important endorsement that the quality management system implemented guarantees a quality educational quality.

## Discussion

Some of the limitations encountered in this study lie in the fact that it did not have the final opinion of the Ciees, which allowed comparing the self-evaluation carried out by academic peers within the educational program of Industrial engineering of the management system of quality with the official process of the accrediting body.



Regarding the strengths of this study, it is mainly the availability and access to information to carry out the research, as well as a quality management system to some extent validated within the educational program of Industrial engineering of the FCITEC, which coincides with the approach of UABC (2019) that educational quality prevails.

On the other hand, the results of this study reinforce what other studies point out (EQNA, 2015): the way to guarantee the educational quality of students in universities is precisely by evaluating and accrediting study programs by external organizations, such as in This study was carried out under the methodology of the Ciees.

Finally, having the resources to carry out a comparative research with other study programs of the university itself, or even foreign universities, would have produced more results that would allow a new proposal for a quality management system, aligned not only with the methodology of the Ciees, but with methodologies of other accrediting bodies, as well as making a comparative table on the issue of educational quality.

## Conclusions

Having a quality management system based on the 95 standards of the Ciees methodology helped, oriented and prepared the FCITEC Industrial Engineering educational program.

Within the self-evaluation carried out by the academic peers of the educational program, the quality standards of category one, "Purposes of the program", category two, "General operating conditions of the program", category three, "Educational model and plan of studies", category six, "School trajectory", category seven, "Program graduation", category 10, "Academic staff", category 11, "Academic infrastructure" and category 12, "Support services", they met the quality established by the Ciees.

On the other hand, within the quality standards of category four, "Activities for comprehensive training", an area of improvement was found in terms of the number of certifications related to quality, production or manufacturing, since there are few students that have this type of certification. Within the standards of category eight, "Student results", results below the national average were identified in the graduates who presented the EGEL, an instrument designed by the National Center for Evaluation of Higher Education (Ceneval) that measures the level of knowledge in industrial engineering. In category nine, "Program

results”, it was found as an area of opportunity to improve the follow-up of graduates within the educational program.

Currently, the industrial engineering educational program of the FCITEC of the UABC is awaiting the opinion of the remote evaluation carried out by the Ciees. Once the opinion is issued, said results of the external body can be compared with those of the self-evaluation carried out in this study, which leaves open the invitation to other researchers interested in carrying out a comparative study.

### **Future lines of research**

From the results and findings of the research project, possible aspects emerged that are worth exploring at another time, an open invitation for other researchers to join the design of a quality management model oriented to the educational part, considering the new virtual reality, which include qualitative and quantitative indicators that make it possible to measure the educational quality of Mexico's public universities and establish a true culture of continuous improvement, perhaps considering the Sustainable Development Goals of the 2030 Agenda.

Finally, consider exploring ICT and other tools such as big data, artificial intelligence and industry 4.0 to improve educational quality in higher education institutions, not only in Mexico, but in any region of the world, taking advantage of the increase in technologies. as support for the teaching of classes in the educational system, and thereby positively influence the learning of university students.

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