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Operation Management in Servuccion Systems in the Educational Sector of Cartagena de Indias (Colombia): A Systematic Review

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Abstract

The education sector is one of the most important sectors of society, as it is responsible for the comprehensive training of future generations, developing the necessary skills for people's personal and professional growth. An educated workforce drives a country's innovation, productivity, and economic and social growth, is essential for human progress, economic development, and the promotion of just and sustainable societies. Due to the fact that new global scenarios have been presented, social organizations have been forced to undertake prompt transformations, education is no stranger to this phenomenon of change, for this and many reasons the educational system has been faced with various challenges to give appropriate and precise responses to the new needs for this 21st century. Under this framework, the present work aims to carry out a systemic review of the literature, supported by the Gavilan model and with the aim of establishing practices that from scientific research have been systematized around the management

of operations in educational service systems of international contexts, in a time horizon of the last 5 (2018 – 2023) years in order to generate proposals that can contribute to the continuous improvement of the educational system of the city of Cartagena de Indias, Colombia.

Keywords
Education Sector, Operations Management, Servuccion Systems, Gavilan Model, Continuous Improvement.

1. Introduction
The quality of education has been the subject of analysis and debate both in government agendas and in the recommendations of international organizations, with the aim of equipping citizens with the necessary skills to face the various local and global challenges. At present, the concern for educational quality is focused on empowering people to meet the demands of the knowledge society. This implies promoting inclusive and widespread economic development in all countries, strengthening digital inclusion through information and communication technologies, ensuring sustainable environmental development and improving the quality of life of all citizens. It is essential that education systems address these needs effectively to prepare future generations for an increasingly complex and changing world. (Jorge Eduardo Martínez-Iñiguez, 2019)

The research problem is framed in the identification of the main challenges and opportunities to improve quality management in educational institutions in Cartagena de Indias. To address this problem, the following research question is posed: How is quality managed in educational institutions in Cartagena de Indias and what are the min challenges and opportunities to improve it?

Through this study, we seek not only to identify the quality criteria and standards applied in the educational institutions of Cartagena de Indias, but also to understand how they are translated into educational practice and how they are perceived by the different actors of the educational system. The findings of this research will aim to provide specific recommendations to strengthen quality assurance mechanisms and ensure quality education for all students in Cartagena de Indias, thus contributing to the comprehensive development of the educational community and the well-being of society as a whole

1.1. Legal Framework
The legal framework that governs educational management in Colombia is comprehensive and covers various aspects, from constitutional provisions to specific regulations for universities.

Act No. 115 of 1994 (General Education Act), in accordance with article 67 of the Constitution, defines and develops the organization and provision of formal education at the pre-school, basic (primary and secondary) and middle, non-formal and informal levels. (MinEducacion, s.f.)

Higher education, on the other hand, is regulated by Law 30 of 1992, which defines the nature and autonomy of Higher Education Institutions (HEIs), the purpose of academic programs and the procedures for promoting, inspecting and monitoring teaching. (MinEducacion, s.f.)

These two laws indicate the constitutional principles on the right to education that every person has, while the quality conditions that education must have are established by Decree 2566 of 2003 and Law 1188 of 2008. (MinEducacion, s.f.)

Decree 2566 of 2003 regulated the quality conditions and other requirements for the offer and development of academic programs of higher education, a rule that was repealed with Law 1188 of 2008 that established the mandatory quality conditions to obtain the qualified registration of an academic program, for which Higher Education Institutions, In addition to demonstrating compliance with the quality conditions of the programmes, they must demonstrate certain quality conditions of an institutional nature. (MinEducacion, s.f.)

1.2. Objective
To establish practices that, from scientific research, have been systematized around the management of operations in educational service systems in international contexts, in a time horizon of the last 5 (2018 – 2023) years, in order to generate proposals that can contribute to the continuous improvement of the educational system of the city of

Cartagena de Indias, Colombia.

2. Literature Review

2.1. Educational management: A key process for the quality of education

The new global scenarios have a direct impact on all social organizations and force them to undertake rapid transformations. Education is no stranger to this phenomenon and, for this reason, the education system faces significant challenges in providing timely and relevant responses to the new training needs of citizens for the twenty-first century. (MinEducacion, 2007).

This challenge was widely recognized during the debates held by the working groups and the deliberations of the assembly of the Ten-Year National Education Plan 2006-2016. This resulted in five lines of action in the field of management:

- Strengthening the management and leadership of the education system.
- Strengthening intra- and inter-sectoral coordination at the national, departmental, municipal and institutional levels.
- Strengthening the effectiveness and transparency of the education system.
- The implementation of adequate mechanisms for the induction, selection, training and evaluation of the performance of those responsible for education.
- The development of a culture of evaluation in order to know, carry out and control the management of the sector and educational institutions. (MinEducacion, 2007)

2.2. How does the education system work in Colombia?

The Colombian education system is organized into four key stages: Early Childhood Education and Comprehensive Care (EIAIPI), which covers from birth to 6 years of age; basic education, which covers nine years (Grades 1 to 9) for children aged 6 to 14; two-year secondary education (Grades 10 and 11) for 15- and 16-year-olds, one year shorter than the OECD average. This system provides a structure for academic development from early childhood through adolescence, preparing students for their academic and professional futures. (UNESCO-UIS, 2015). The higher education system in Colombia is characterized by its complexity, with a wide diversity of providers and an offer of programs of different durations and levels. Compared to their OECD counterparts, Colombian students tend to be younger when entering higher education and are likely to have received fewer years of prior education. (OECD, 2016).

In Colombia, there are approximately 288 institutions of higher education, which offer academic and vocational programs and are divided into 4 main types (Figure 1):

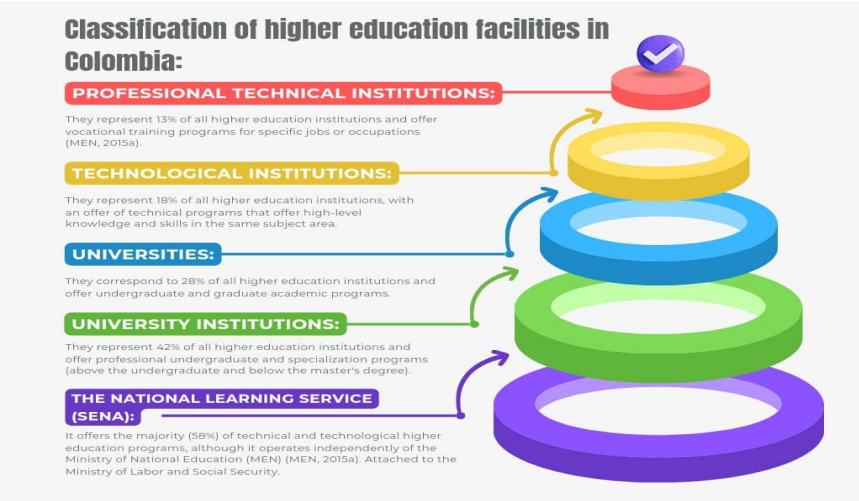

Figure 1: Classification of educational institutions in Colombia

Source: Gobernador.co. Retrieved April 29, 2024, from https://www.mineducacion.gov.co/1759/articles-356787_recurso_1.pdf

2.3. What are the problems in education in Colombia?

According to Diego Mazo, rector of the CEIPA Institution (2023), they point to the need to address the fundamental challenges affecting the national education system. The persistent gap between urban and rural regions highlights structural inequalities in access to quality education. (CEIPA, 2023).

Mazo (2023) highlights that the Colombian education system faces diverse challenges, ranging from equity in access to the quality of teaching. Lack of funding, adapting to emerging technologies, and updating curricula are key concerns. Solving these problems requires a comprehensive approach involving government, educational institutions, and society as a whole, in order to build an inclusive and innovative academic system that adequately prepares young people for the current and future demands of society (CEIPA, 2023)

It also highlights four fundamental challenges facing the academic system:

Coverage: Despite progress, access to education remains unequal, especially in rural areas and marginalized communities. According to figures from Fedesarrollo, the high school graduation rate is low. Mazo emphasizes the need for policies that ensure equitable access, fostering diversity and inclusion.

- **Quality and Relevance:** The top-down results in the PISA tests underscore the need to review and update curricula. The incorporation of innovative pedagogical methodologies and relevant academic programs is essential to foster critical thinking and prepare students for the demands of today's and tomorrow's world.
- **Funding and Resources:** Despite the historically high budget, academic performance continues to decline. Mazo advocates for increased funding, ensuring that resources are appropriately allocated to infrastructure, technology, teacher training, and the development of cutting-edge academic programs.
- **Technology and Digital Transformation**: The effective integration of technology into teaching and learning is a critical challenge. This requires the training of teachers, the right infrastructure, and the adaptation of teaching methods to the digital age**.** (CEIPA, 2023)

2.4. The concept of service in the education sector

Servuction refers to highly complex manufacturing systems, generally classified as per-project production systems. These systems seek to meet the particular and non-standardized needs of customers in various market sectors. Examples of this include providing quality dining in restaurants, ensuring a pleasant rest in the hotel sector, providing effective treatment for symptoms in the field of health, or facilitating the development of technical, labor or professional skills in the field of education, among other similar cases. (Hernando Garzon Saenz, 2017)

Education, being considered a public service, is part of second-generation rights, which are both social and economic in nature. This implies that education is not only an individual right, but also has a significant impact on the collective well-being and economic development of a society (Cordero, 2011) In Colombia, education is regulated by the Ministry of National Education. The right to receive quality education is considered a fundamental right, as established in the country's Constitution. This constitution reaffirms the nature of the public education service, which must be managed and supervised by the State. Its objective is to ensure that all citizens have access to an education that ensures coverage, quality, continuity, inclusion and the achievement of their goals of comprehensive training, as well as access to the benefits of education for the entire population.

3. Methodology

In this research we used a systematic review approach, in which we started with a data sample of 63 research papers, among them are research articles, conference abstracts or articles published either in Google Scholar or in the Science direct database, these documents were carefully chosen for their topics and characteristics, in this case we focused on choosing documents that will have topics related to the sector. Education, Operations Management, Servuccion

Systems, Sparrowhawk Model, Continuous Improvement (Figure 2).

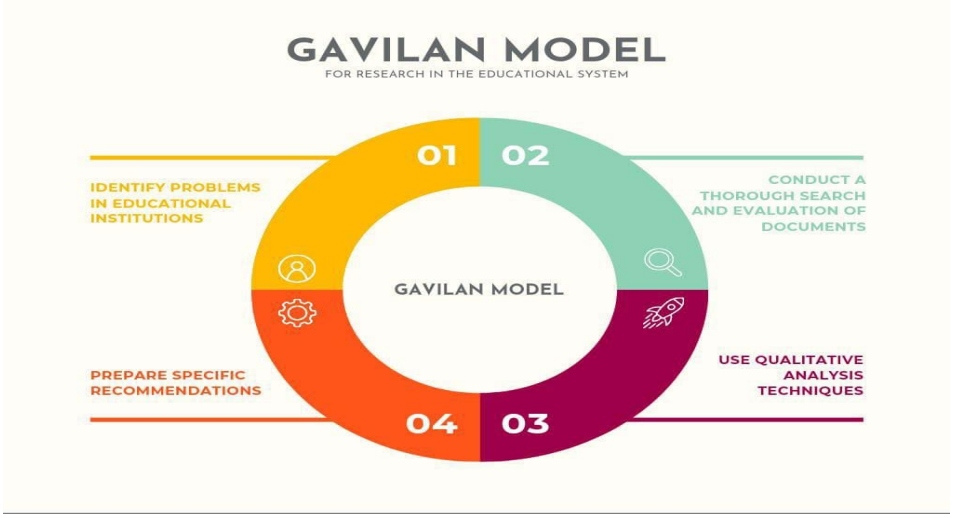

Figure 2. Gavilan model for research in the educational system.
Sources: Own elaboration 2024

3.1 Identification of problems in educational institutions.

The quality of education is a crucial issue in the development of societies. However, many education systems face challenges in terms of efficiency, effectiveness, and student and teacher satisfaction. By applying methodologies such as Lean Service, Six Sigma and Theory of Constraints (TOC), we can identify and address problems in educational quality, and thus ask ourselves how has educational quality been in recent years?

3.2 Exhaustive search and analysis of documents.

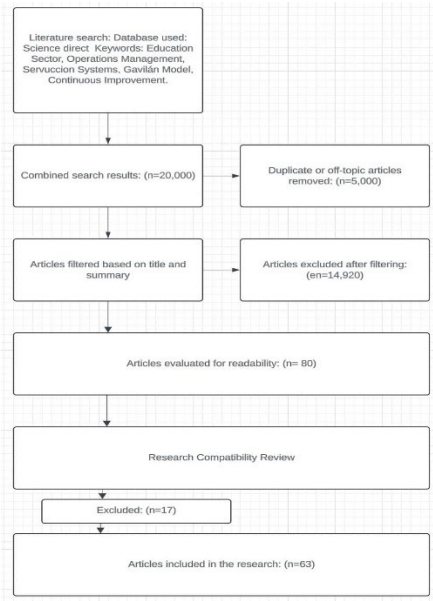

Figure 3. Document selection and analysis process diagram.
Sources: Own elaboration 2024

In Figure 3 and the process of selecting the information we focused on looking for articles related to the Education Sector, Operations Management, Service Systems, Gavilan Model, Continuous Improvement, for this we made use of some databases such as Google Scholar and Science direct since they are sources of truthful and necessary information for the development of this, To carry out this research, we selected 63 papers in which 40 review articles and 25 conference abstracts stand out, which were carefully chosen with the help of the document selection and analysis process diagram. This helped us synthesize the documents in a more efficient and faster way.

3.3 Qualitative analysis of the information collected.

Once the key themes have been identified and categorized, content analysis is carried out to delve deeper into the meaning of these topics. This involves interpreting the data in context, looking for relationships, patterns, and discrepancies between the different perspectives of the participants.

3.4 Specific recommendations.

A report is produced that presents the findings of the qualitative analysis in a clear and coherent manner, using concrete quotes or examples to support the conclusions. This report can serve as a basis for decision-making, policy-making, or the generation of new hypotheses for future research.

4 Results

4.1 Identification of problems in educational institutions.

Through these methodologies, problems related to the efficiency, effectiveness, and satisfaction of students and teachers can be identified and addressed. For example, Lean Service can help streamline educational processes to improve student retention and reduce dropout rates. Six Sigma makes it possible to identify and reduce variability in educational outcomes, which can help create an environment that is more conducive to continuous learning. Theory of Constraints, on the other hand, can help identify the obstacles that cause student dropout and implement strategies to overcome them, thus enabling greater academic success and better educational quality in general (Figure 4).

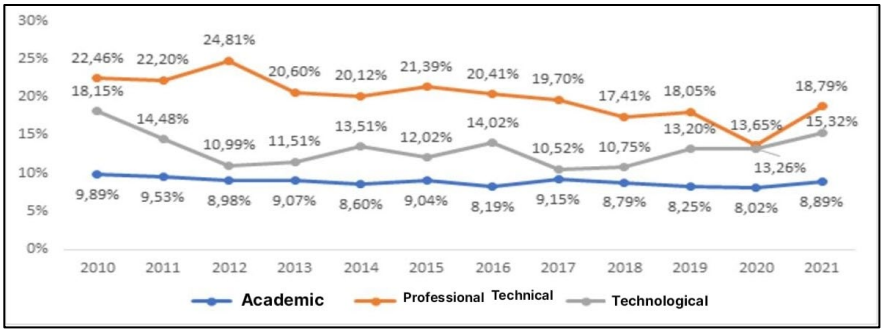

Figure 4. Annual dropout rate by level of education.

Source: System for the Prevention and Analysis of Dropouts in Higher Education Institutions (SPADIES, 2022)

In figure 4 and according to data provided by the Ministry of Education, there is evidence of a worrying phenomenon: the increase in the annual dropout rate at all levels of education. This increase is especially notable at the professional technical level, with a significant increase of 5.14 percentage points, from 13.65% in 2020 to 18.79% in 2021. However, when carefully analyzing the historical trajectory of this rate at this level, it is highlighted that the value recorded in 2020 could be considered an outlier, as the 2021 result is more in line with the trend observed in previous years.

On the other hand, the university level shows the smallest increase in the annual dropout rate, with an increase of 0.87 percentage points, from 8.02% in 2020 to 8.89% in 2021. It is important to note that this level exhibits less historical variability compared to the other educational levels.

In terms of technology, there has been an upward trend in the dropout rate since 2017. Regarding the inter-semester absence rate, there is an increase only in the professional technical level, which increased by 1.24 percentage points, from 25.00% in 2020 to 26.25% in 2021. On the other hand, at the technological level there was a slight decrease of 0.29 percentage points, while for the university level it was more pronounced, with a decrease of 2.08 percentage points.

These data reflect the urgent need to address challenges related to student retention and engagement at all levels of education, implementing effective strategies to improve student retention and academic success

4.2 Exhaustive search and analysis of documents

Figure 5 shows the various approaches addressed by each of the selected articles. In this context, we have highlighted three key points: quality, efficiency and operations management, in order to discern the relevant publications for our research. This graphic representation reveals that the most frequently discussed topic in relation to quality is "Higher Education", which implies a clear emphasis on evaluating this aspect in academic studies. On the other hand, efficiency research tends to focus on "Data Envelopment Analysis" (DEA), while in the realm of operations management, there is a predominant interest in "Education".

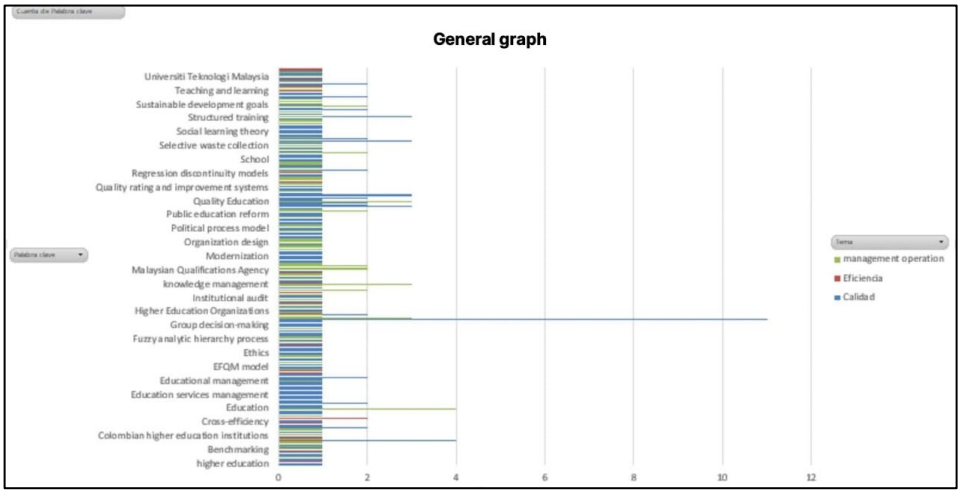

Figure 5: Overview chart of the selected items.
Source: Authors' own creation 2024

4.3 Qualitative analysis of the information collected

In Figure 6 in a more detailed analysis of each of the topics investigated, we found that of the 63 articles selected, 37 were related to the topic of student quality, in which 20% of them concluded that quality in Colombia should be improved with more innovative methods and a little more complex and more up-to-date than the current ones. some of these are the "Global network systems" which would translate into "Global network systems" (Arif Sari, 2016), others such as the philosophy of continuous improvement, where 25% of the articles use the contributions that educational institutions should make common decisions in search of quality, and increase the level of knowledge about new techniques. (Cevallos A., 2004).

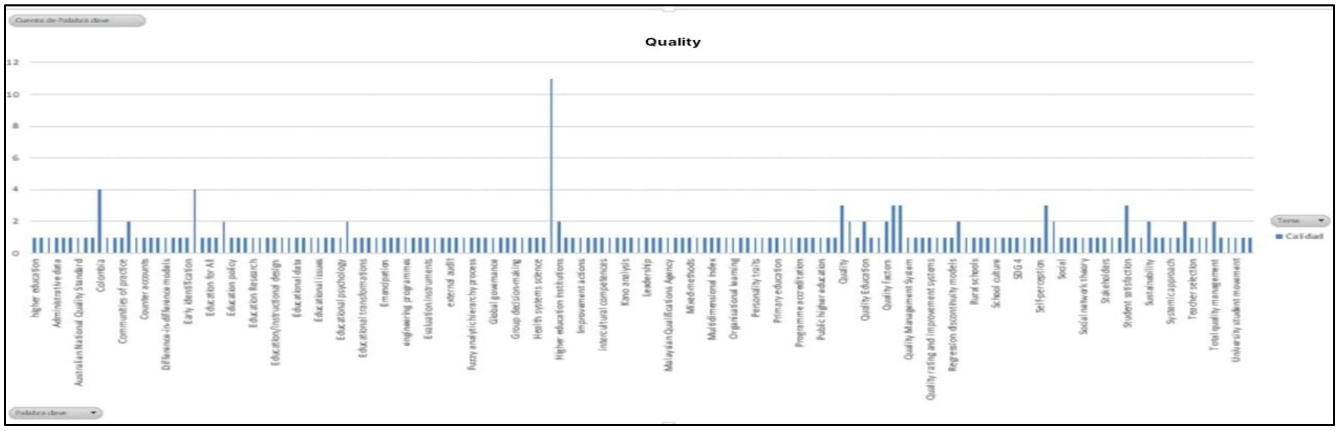

Figure 6: Graph of quality-related articles.
Source: Authors' own creation 2024

It also found that university enrollments increased from 31.6% (1.3 million students) in 2007 to 51.2% (2.3 million students) in 2016 (Lina P. Navas, 2020), The government has responded to this rapid growth by offering funding opportunities to facilitate access and encouraging development plans to strengthen quality assurance processes. Consequently, Higher Education Institutions (HEIs) have been able to improve their capacity and invest in their quality assurance processes, as well as increase their interaction with business, government and communities through the extension of their teaching and research services for sustainable development at both regional and national levels. However, there is still a low proportion of accredited HEIs: 17.4% in 2016. (Lina P. Navas, 2020).

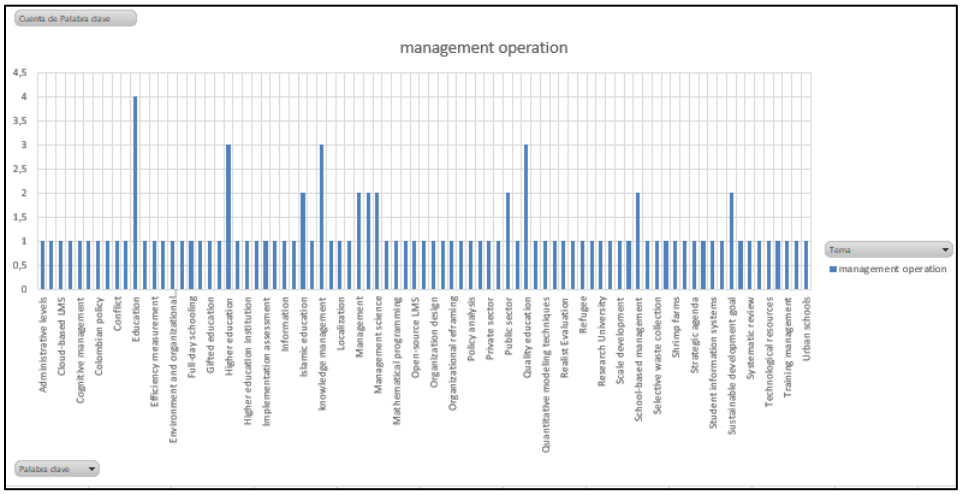

Figure 7: Chart of items related to operations management.
Source: Authors' own creation 2024

Figure 7 Regarding the management of operations, we found that of the 63 articles selected, 22 were related to the topic to be investigated, in this we found that 100% of the articles focused on operations management more focused on higher education systems, In Colombia, higher education institutions (HEIs) play a key role in the development and economic growth of the country through the production of capital Human & Knowledge (Lina P. Navas, 2020), These investigations also related to quality and the Sustainable Development Goals, where they mentioned the importance of ensuring inclusive and equitable education with quality and the promotion of new educational opportunities.

It also highlights existing research on the use of quantitative OR/MS modelling techniques in the context of higher education and highlights the potential of quantitative modelling techniques to help higher education policy and

decision-makers improve performance, improve quality and reduce costs in higher education to address challenges due to funding cuts and societal expectations to improve performance, quality and accountability. (Aghdas Badiee, 2024). It also explored the use of artificial intelligence, concluding that in the future, researchers could explore the effectiveness of simulation techniques to model and analyze different scenarios related to teaching, student performance, and curriculum design. Leveraging simulation methods in higher education could help educators make data-driven decisions to improve the quality of education. (Aghdas Badiee, 2024).

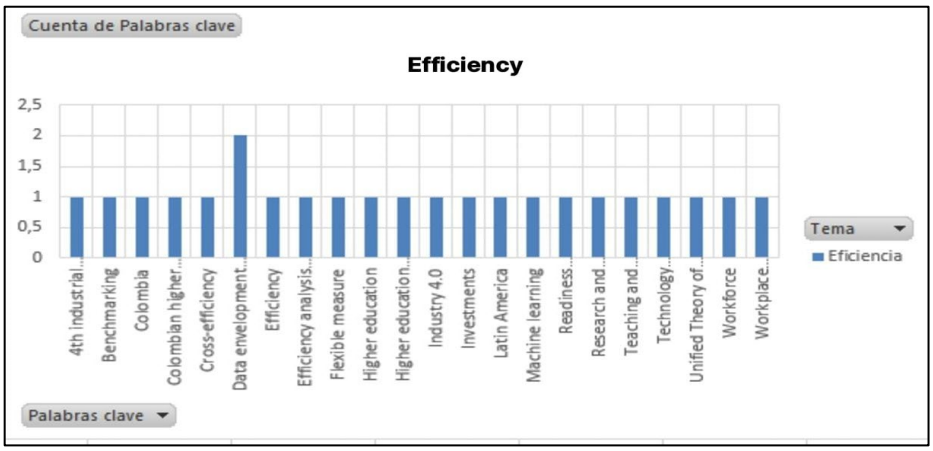

Figure 8: Graph of efficiency-related items.
Source: Authors' own creation 2024

In the Figure 8 And finally, of the 63 selected articles, 4 were related to efficiency in the education sector, it was found that the rapid growth of enrollments has posed the challenge of maintaining and improving the teaching, research and extension missions of HEIs. (Lina P. Navas, 2020), This showed that new techniques were needed to improve efficiency in this sector, for these techniques such as "Machine learning techniques" were used, this brought new evidence on how to carry out systemic evaluations of the performance of HEIs. With their application to the Colombian higher education system, it is evident how these methods have the potential to provide knowledge to managers and policymakers in charge of decision-making in HEIs, thus supporting the design of strategies aimed at improving efficiency. In particular, the created tree and its nodes segment the observations according to their input-output structural characteristics, to which we associate specific management models, and the different HEIs are grouped. (Zofio, Aparicio, Barbero, & Zabala-Iturriagagoitia, 2024).

4.4 Specific recommendations.

Since education is a fundamental pillar for the integral development of societies and the well-being of their citizens. Effective quality management in the education sector is a crucial challenge that directly influences the future of generations to come. In this sense, we cannot ignore the problems it already has, since it can directly affect our society as a whole. Being aware of these issues, we used operations management tools to adopt a roadmap in order to address and improve the situation of student practice in Colombia (Figure 9).

Implementing solutions to solve these issues can take time and ongoing efforts. The speed of implementation will depend on factors such as political commitment, the availability of financial and human resources, and coordination between different government entities and organizations.

- **Optimization of resources.** We can analyze and optimize educational processes to make more efficient use of available resources, such as time, staff, infrastructure, and educational materials. This could include implementing more effective school schedules, managing inventories of teaching materials, and improving the distribution of resources among educational institutions.

- **Design of educational facilities**. Develop a redesign of educational facilities that maximizes the capacity and efficiency of the space. This could involve planning multifunctional classrooms, optimizing student flow, and incorporating advanced educational technology to facilitate teaching and learning.

- **Implementation of educational technology.** Implementation of innovative educational technologies that expand the reach of education and improve accessibility for remote or marginalized communities. This could include developing online platforms for distance education, designing customized learning management systems, and installing connectivity infrastructure in rural areas.

- **Educational data analysis.** Apply data analysis techniques to collect and analyze information on educational coverage in Colombia. This could involve assessing enrollment trends, dropout rates, geographic distribution of educational institutions, and other key indicators to identify areas for improvement and guide strategic decision-making.

- **Interdisciplinary collaboration**. Resources for the improvement of educational coverage in Colombia, this requires an interdisciplinary approach that involves experts in education, engineering, economics, public policy and other areas.

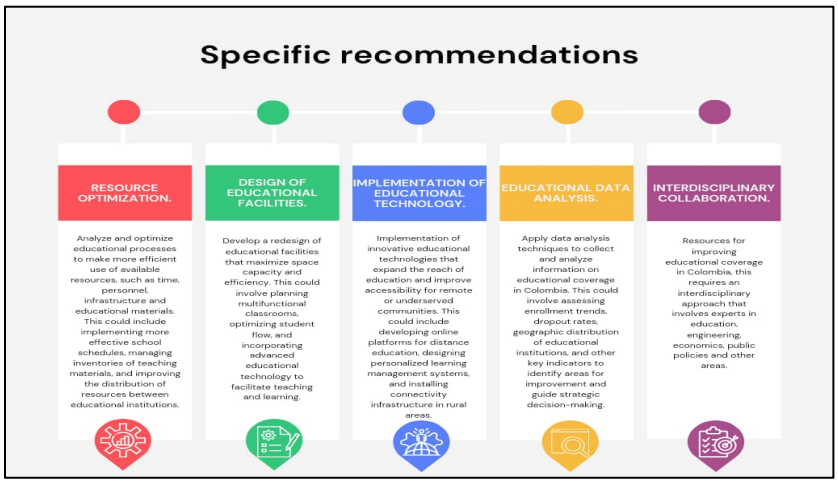

Figure 9: Specific recommendations.
Source: Authors' own creation 2024

5. Conclusions

The low quality of education, evidenced by poor results in standardized tests, the increase in school dropouts and persistent absenteeism, is attributed to inefficiency in educational processes. This inefficiency arises from the lack of optimization of resources, inadequate infrastructure, and the poor implementation of educational technology, highlighting the urgent need to improve these aspects to ensure a more effective and equitable education system.

Lean Service, Six Sigma and Theory of Constraints offer effective tools and methodologies to identify and solve problems of efficiency, effectiveness and satisfaction in the educational field. Through the application of these methodologies, it is possible to optimize processes, reduce waste and improve the quality of the educational service. In addition, educational data analysis plays a critical role in providing detailed insights into student achievement, allowing for the identification of areas for improvement and make informed strategic decisions for the development and continuous improvement of the education system.

Addressing educational issues requires an interdisciplinary approach that involves the collaboration of experts in various areas such as education, engineering, economics, public policy, and other relevant disciplines. This synergy of knowledge and perspectives makes it possible to develop comprehensive solutions that effectively address the complex challenges faced by the education system, thus promoting a holistic approach to the continuous and sustainable improvement of education.

Investment in quality education is critical for Colombia's development, as improving the quality of education is crucial for the well-being of citizens and the country's progress. Public policies that promote equity in access to quality education are required, as investing in education is an investment in Colombia's future, thus ensuring sustainable

development and a more prosperous and equitable society.

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Biographies

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