RESEARCH ARTICLE

Impact of the EFQM Model on the Academic Performance of Schools in Colombia

Impacto del modelo EFQM en el rendimiento académico de los colegios de Colombia

Impacto do modelo EFQM no desempenho acadêmico das escolas na Colômbia

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ABSTRACT

This research work investigates the incidence of quality accreditation under the EFQM model (European Foundation for Quality Management) on the results of the Saber 11 tests. Studies related to the incidence of quality standards on the management and academic performance of educational institutions are analyzed. The data used correspond to the results of the state tests of a population of 10,696 accredited and non-accredited schools in Colombia, whose students took the Saber tests during 2016, 2017 and 2018. Then, through statistical tests, the differences in the results for each knowledge competency evaluated are contrasted, followed by the implementation of a logistic regression model to validate the classification forecast of a school with EFQM certification using academic variables. The results show that schools accredited under the EFQM model show consistently better results in all the competencies evaluated, in addition the logistic regression model presented a predictive capacity of an accredited school of 76.27 %. The generic component of English is the most important in the tests according to the results obtained, the quality of education of the evaluated institutions, of secondary and high school education, is highly reflected in the performance of the institution in this component.

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Resumen

En el presente trabajo de investigación se indaga sobre la incidencia de la acreditación de calidad bajo el modelo EFQM (European Foundation for Quality Management) en los resultados de las pruebas Saber 11. Se desarrolla una metodología con un enfoque evaluativo. Se analizan estudios relacionados con la incidencia de los estándares de calidad en la gestión y desempeño académico de instituciones educativas. Los datos utilizados corresponden a los resultados de las pruebas de estado de una población de 10.696 colegios acreditados y no acreditados en Colombia, cuyos estudiantes presentaron las pruebas Saber durante los años 2016, 2017 y 2018. Luego a través de pruebas estadísticas se contrastan las diferencias en los resultados por cada competencia de conocimiento evaluada, seguidamente se implementa un modelo de regresión logística para validar el pronóstico de clasificación de un colegio con certificación en EFQM utilizando variables académicas. Los resultados muestran que los colegios acreditados bajo el modelo EFQM, presentan sostenidamente mejores resultados en todas las competencias evaluadas, además el modelo de regresión logística presentó una capacidad de predicción de un colegio acreditado de 76.27 %. El componente genérico de inglés es el más importante en las pruebas de acuerdo con los resultados obtenidos, la calidad en la educación de las instituciones evaluadas, de educación secundaria y media académica, se ve muy reflejada en el desempeño que tenga dicha institución en este componente.

Resumo

Esta pesquisa investiga o impacto da acreditação de qualidade no modelo EFQM (European Foundation for Quality Management) nos resultados dos testes Sabre 11. É desenvolvida uma metodologia com abordagem avaliativa. São analisados estudos relacionados ao impacto dos padrões de qualidade na gestão e no desempenho acadêmico das instituições de ensino. Os dados utilizados correspondem aos resultados dos testes estaduais de uma população de 10.696 escolas credenciadas e não credenciadas na Colômbia, cujos alunos realizaram os testes Saber durante os anos de 2016, 2017 e 2018. Em seguida, as diferenças são contrastadas através de testes estatísticos. nos resultados de cada competência de conhecimento avaliada, é então implementado um modelo de regressão logística para validar a previsão de classificação de uma escola com certificação EFQM utilizando variáveis acadêmicas. Os resultados mostram que as escolas credenciadas no modelo EFQM apresentam consistentemente melhores resultados em todas as competências avaliadas, além disso o modelo de regressão logística apresentou uma capacidade preditiva de uma escola credenciada de 76,27%. A componente genérica do Inglês é a mais importante nos testes de acordo com os resultados obtidos, a qualidade do ensino das instituições avaliadas, ensino secundário e secundário, reflete-se fortemente no desempenho da referida instituição nesta componente

Introduction

Currently, preschool, elementary and middle school educational institutions are under pressure to achieve high performance in the results of external knowledge evaluation tests; these results have become the measure of an institution's success, in addition to being one of the criteria by which infrastructure investment items are decided and, in the eyes of society, they represent a distinctive symbol of excellence. In the above context, schools are placed in a competitive environment, where the management of resources must be framed in the maximization of results, conceiving the results of national tests as an objective factor of quality of educational service. At the same time, more and more organizations have decided to implement international quality standards to improve their processes, train personnel and develop continuous improvement actions that result in the improvement of academic performance indicators.

The present research proposes the use of the national education tests Saber 11, developed by the Colombian Institute for the Evaluation of the Quality of Education (ICFES) in schools as a factor in the

measurement and evaluation of academic performance and its relation with the European Foundation for Quality Management (EFQM) model. Thus, quality in education is conceptualized from an outcome perspective (intrinsic quality) and the processes and improvement procedures associated with the EFQM model (extrinsic quality). From an intrinsic approach to quality, the different tasks of teaching, knowledge transfer and academic management are evaluated; from an extrinsic approach, the adoption of good administrative practices adjusted to an international standard that have an impact on the performance of the evaluated schools is evaluated.

The impact of quality has been studied by several authors in the business environment. For example, studies by (Siougle et al., 2019; Benner, and Veloso, 2008; Fontalvo and De La Hoz, 2018) suggest that implementing quality management models such as ISO:9000 and the BASC Seal generate positive results in organizational performance. In turn, in the educational field (Anastasiadou and Zirinoglou, 2015) in a research on the perception and concepts of primary education teachers in Greece, have identified the determinants for the adoption of the EFQM improvement philosophy in an educational environment. Rodriguez-Gonzalez, *et al.* (2020a) analyze the simultaneous effect of the perceived impact by teachers and administrators of the implementation of two Quality Management Systems (QMS), the EFQM system and ISO:9001 standards in a sample of 114 schools. In the implementation of the ISO 9000 quality system are the studies of (Espiñeira-Bellón et al., 2016) who performs an exploratory analysis of the implementation quality models in schools in Galicia (Spain), finding positive results in those that have implemented the ISO:9000 standard. Meanwhile (Lasida et al., 2016) in their study on the perception of the implementation of ISO:9000 systems in educational environments, shows limited contributions to performance in the centers studied in addition to a negative perception of those responsible for considering it an administrative burden. Likewise (Basir et al., 2017) investigate the influence of academic culture elements on the maintenance of ISO 9001 quality management system in Malaysian universities. Zwain et al. (2017), investigated the relationship between the results of educational organizations, academic performance and the implementation of quality management processes (Sarrico and Rosa, 2016) indicate that the implementation of quality systems could significantly improve the performance of educational institutions.

Thus, education at the school level is a vitally important part of people's development, and it also generates economic development capable of strengthening equitable social growth. Thus, beyond acquiring theoretical knowledge, students in the course of their education should develop social and personal competencies that allow them to prepare for society, reducing socioeconomic differences (Martínez-Rodríguez and Amador-Muñoz, 2010). In addition to ensuring access to education to all children and young people, it must be guaranteed that such education is of quality, the World Bank (2017) raises the difference between learning and schooling, mentioning that there is currently a "Learning Crisis", and that education without quality learning cannot generate the expected impact on the main objective of the lowest resource countries which is to mitigate poverty.

From the point of view of evaluation, according to Paul Romer, Nobel Prize in Economics 2018, in order to achieve progress it is necessary that governments begin to take actions based on facts, which in this context would mean the need to implement tests to determine the quality of education being offered in schools (Kawamura, 2018). Consequently, it is vital to follow the recommendation that has emerged from the research conducted by the World Bank, as it arises that learning should be assessed in search of improving the quality of schools. This recommendation stems from the fact that only half of the countries considered as developed have a learning assessment system at the end of primary or lower secondary school.

All of the above statements lead us to pose the following questions Does the quality certification process under the EFQM model in schools affect the results of the Saber_11 standardized test taken at the end of secondary education? What data mining tools allow us to analyze the causality of EFQM certification with the Saber_11 standardized test? How can we predict whether a school belongs to an accredited group or not? This leads us to state the general objective of the present research: To evaluate whether certification under the EFQM standard in schools has an impact on learning outcomes in secondary education, using schools in Colombia as the study population.

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EFQM Model

The EFQM Model is normative in nature and is based on 187 evaluative questions divided into nine criteria, five of them *Agents* and four *Outcomes* (Trébucq and Magnaghi, 2017). The model emphasizes self-assessment for the identification of strengths and weaknesses based on the nine criteria and constitutes a valuable tool to help any organization in quality management (Rodríguez-González et al., 2020b). The criteria called Agents refer to what an organization performs or executes, while the criteria Results are related to the achievements attained by the organization (Martínez and Riopérez, 2005).

It is important to mention that different educational institutions (public and private) have adopted the implementation of the EFQM model because its approach allows achieving excellence through self-evaluation processes and the implementation of different improvement plans consistent with the quality needs detected in each of the institutions (Martínez and Rioperez, 2005).

Logistic regression

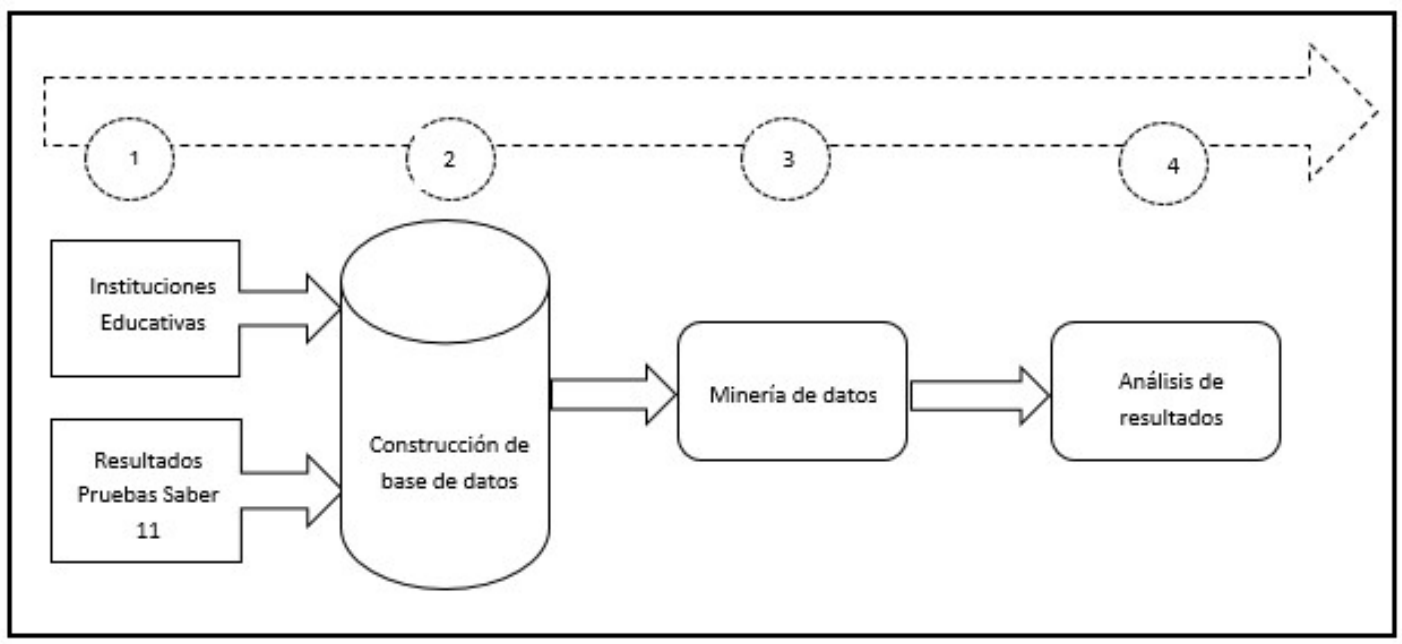
Logistic regression is a statistical technique that seeks to find a relationship between a categorical dependent variable of interest with one or more independent variables to construct a probability function that the variable of interest adopts a previously defined value (Díaz-Rodríguez et al., 2016).

Giraldo and Vargas (2019) point out that the great use that logistic regression has had is due to the fact that in many problems the dependent variable of the regression model takes values from a finite set, the purpose of the developed model is to determine how different factors (independent variables) influence or not the probability that an event occurs (dependent variable), this variable is usually dichotomous, but in some cases it can have more than two categories (polytomous)

Materials and Methods

The focus of this research is evaluative in nature; it is intended to determine with data mining tools and multivariate calculation how certification affects the performance in the Saber 11 tests:

Figure 1. Methodological scheme.



Source: Own elaboration

For the initial development of this research, the results reported by ICFES are the primary source of information. For this purpose, a population of 10,696 accredited and non-accredited educational institutions (schools) at the national level was taken, whose students took the Saber 11 tests during 2016, 2017 and 2018, from the Icfes database (2019) the values of the generic components evaluated are taken, which were subsequently purified and classified, according to their relevance and pertinence with respect to the objectives of the research.

Subsequently, data mining techniques, such as cluster analysis and predictive models were applied to analyze the information and thus obtain the results that would allow us to answer the problem question of this research.

To perform the analysis of results of the present research, the structure of the Saber 11 exam was taken into account, which consists of five generic tests that are evaluated on a scale from 0 to 100, with average equal to fifty (50) and standard deviation equal to ten (10) (ICFES, 2018). Table 2 details the five generic components evaluated in the Saber 11 test. The components evaluated are Mathematics, Critical Reading, Natural Sciences, Social Sciences and English. Since the focus of this research is on private and public secondary and high school institutions, and in addition, what we want to develop is a statistical analysis of the test results for each of the schools, it was necessary to group the data by educational establishment. For this purpose, these results were taken by generic test of all the students of the schools and an average was calculated, and this value was rounded since the values of the Saber 11 test are expressed in whole numbers, thus determining the results obtained for each of the educational institutions in each of the subjects of the test. At the end of this process, 10696 schools were obtained as shown in Table 1, which had at least one student enrolled in the Saber 11 test in the period between 2016-1 and 2018-2.

The data of accredited institutions were obtained from the website of the Ministry of National Education (2018). In Table 1 are classified the schools in the Saber 11 test database according to their status of having or not having EFQM certification.

Table 1. Schools enrolled in the Saber 11 test between 2016-1 and 2018-2.

EFQM Model	n
Certified schools	721
School no certificates	9975

Source: Own elaboration. Information taken from the Ministry of National Education (2019).

According to the table above, the proportion of accredited institutions with respect to the total number of schools evaluated in the period from 2016-1 to 2018-2 is approximately 6%, which once again evidences that the objectives of middle and secondary education institutions are not primarily aligned to a quality model.

Results and discussion

Since the main variable in our model is whether a school is accredited or not, it is important to offer an analysis comparing the mean scores of accredited and non-accredited institutions in each of the exam tests. Therefore, it was decided to perform a *t-student* test in order to compare the mean total score of accredited versus non-accredited schools, and thus be able to answer the hypothesis that institutions that have quality certificates obtain better results in the Saber 11° tests with respect to those that do not have this distinction.

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The results of the statistical tests show a marked statistical difference between having EFQM certification and not being certified. This empirical evidence answers the problem question, so that having an EFQM quality certification results in better performance in terms of the quality of academic processes, reflected in the consistent superiority of the results for each of the competencies evaluated, as can be seen in Table 2.

Table 2. Saber 11 test results for accredited and non-accredited schools

Results	Accredited with EFQM average (n=9975)	Not Accredited with EFQM average (n= 721)	P-value
Overall result	298	250	2×10^{-16}
Mathematics	59	49	2×10^{-16}
Critical reading	60	52	2×10^{-16}
Natural sciences	59	50	2×10^{-16}
Citizenship competencies	58	49	2×10^{-16}
English	63	50	2×10^{-16}

Source: Own elaboration. Information taken from Icfes (2019).

Table 3. Confusion matrix resulting from the logistic regression model

		Actual ranking	
		Non-accredited schools	Accredited schools
Logistic regression	Non-accredited schools	7785	184
	Accredited schools	2190	537

Source: Own elaboration

As shown in Table 3, the model correctly predicts 8322 schools, of which 7785 were categorized as NOT accredited and 537 as accredited. Taking into account the actual number of accredited and NON-accredited institutions, which is 721 and 9975 respectively (see Table 1), we see that the model correctly classifies 78% of the NON-accredited schools and 74.5% of the accredited institutions. In order to perform a more in-depth analysis of the model, it was decided to calculate performance measures, these values are presented below in Table 4.

Table 4. Logistic regression model performance measures

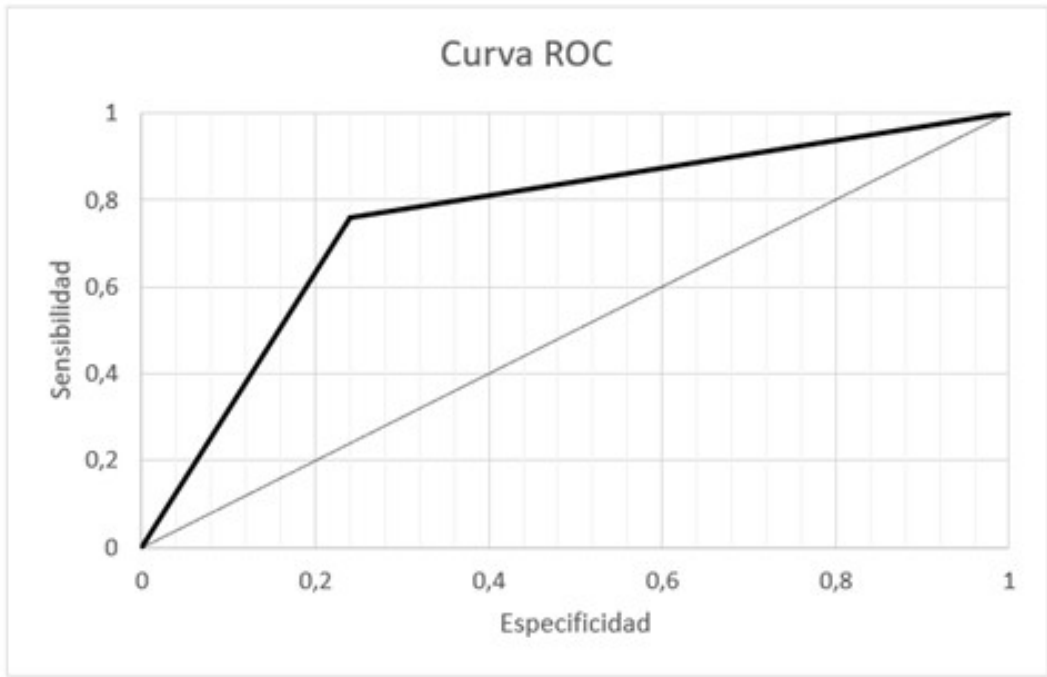
Performance measure	Accuracy	Sensitivity	Specificity	AUC
Value	77.8 %	78.04 %	74.47 %	76.26 %

Source: Own elaboration

In the indicators that can be observed in Table 4, it is evident that the model has an accuracy of 77.8 %. This indicates that the predictions made are very close to reality, i.e., that the classification made for the schools coincides 77.8 % of the time with the data that the Ministry of Education has on certified schools. The sensitivity indicator tells us the model's ability to predict that a given school will be certified and that in reality this will be the case. In this sense, the logistic regression model has a great capacity to predict the institutions that are actually certified, since its value is close to 80%. On the other hand, we have the Specificity indicator, which, unlike the sensitivity indicator, determines the model's ability to predict the schools that are not certified and that in reality these schools are not certified. Therefore, we see that the model has a great capacity to predict the institutions that do not have quality certification.

Finally, Figure 2 shows the ROC (*Receiver Operating Characteristic*) curve for the logistic regression data, indicating an AUC (*Area Under Curve*) of 0.7627, which shows that the model has a good classification capacity.

Figure 2. Logistic regression ROC curve.



Source: Own elaboration in R software

It is important to note that although it is true that the implementation of the high quality certification standard has an impact on the good results that students of the institutions achieve in the saber 11 tests, it is important to highlight that it is necessary that these institutions possess methodological strengths associated with the design, implementation and sustainability of quality systems and other management metrics, structurally support these high quality standards (Fontalvo and De La Hoz, 2018), within these strengths we can highlight the virtual environments that positively affect student performance (Cavadía et al., 2019).

Conclusions

From the results analyzed, it can be understood that the generic English component is the most important in the test. According to the results obtained, the quality of the education of the secondary and high school institutions would be highly reflected in the performance of the institution in this component, since, in most cases, those institutions that obtain high scores in this subject also obtain high scores in the other subjects. This goes hand in hand with the results of the statistical analysis, since the English subject was the one in which the best average score was obtained among all the subjects evaluated for the accredited institutions, and, in addition, they were able to obtain a better average score than the non-accredited schools in this subject. This leads us to the conclusion that the institutions that obtain high scores in the English component, and consequently in the other subjects, are due to the application of the quality management model, which gives great importance to the teaching of a second language.

Accredited institutions obtain better scores on average than non-accredited ones, although the assumption was that, if a school followed a structured teaching model, it was expected that its results in the Saber 11° tests would be very good and/or better than those of institutions that do not have the standard. The test results were conclusive, and showed that in each of the subjects, accredited schools obtained better scores on average than non-accredited schools.

The results of the classification techniques, both supervised and unsupervised, allow concluding and evidencing that the quality models do have an impact on the results of the Saber 11° tests, since the actual classification of accredited and non-accredited institutions based on the test scores had an accuracy of 77.8%. In addition, institutions classified as accredited had better scores on average than those that were not certified.

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Finally, from the logistic regression model and from the results of the institutions, it is possible to statistically deduce whether the institution is accredited or not, given that according to the results the model showed a good accuracy with respect to reality. But a significant contribution of this research is that the proposed method is replicable in any other educational context at the international level.

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