# A Global Analysis of Universities Performance in the World Higher Education Institution Rankings

## Un Análisis Global del Desempeño de las Universidades en el Ranking Mundial de Instituciones de Educación Superior

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**ABSTRACT:**

This study aims to examine the factors that influence the performance of universities on a global scale. A learning curve method assesses the relationship between research, teaching, faculty, and student recognition and its impact on academic performance in all countries. The information used in the study comes from the three most essential rankings of universities worldwide, such as Times Higher Education, QS World University Rankings, and Academic Ranking of World Universities, from 2011 to 2022. As a central aspect of the study, it is essential to highlight that it is through the comparative analysis that the learning curves allow it to identify associations between the study variables on a global scale. In this way, it is possible to analyze the most significant effects on academic performance compared to other factors. On the other hand, it was also found that the results related to student acknowledgment are established as a distinctive factor, particularly among universities in the highest ranks. However, the general results tend to be more homogeneous as the ranking descends. Finally, academic performance is vital for any university institution that can serve as a platform for its strategic initiatives.

**RESUMEN:**

Este estudio tiene como objetivo examinar los factores que influyen en el desempeño de las universidades a escala global. Un método de curva de aprendizaje evalúa la relación entre la investigación, la enseñanza, el profesorado, el reconocimiento de los estudiantes y su impacto en el rendimiento académico en todos los países. La información utilizada en el estudio proviene de los tres rankings más importantes de universidades a nivel mundial, como Times Higher Education, QS World University Rankings y Academic Ranking of World Universities, entre los años 2011 a 2022. Como aspecto central del estudio, es esencial resaltar que a través del análisis comparativo que las curvas de aprendizaje permiten identificar asociaciones entre las variables de estudio a escala global. De esta forma, es posible analizar los efectos más significativos sobre el rendimiento académico frente a otros factores incluidos en el estudio. Por otro lado, también se encontró que los resultados relacionados con el reconocimiento de los estudiantes se establecen como un factor distintivo, particularmente entre las universidades de los rangos más altos. Sin embargo, los resultados generales tienden a ser más homogéneos a medida que desciende el ranking. Finalmente, el desempeño académico es vital para cualquier institución universitaria que pueda servir como plataforma para sus iniciativas estratégicas.

# 1. Introduction

Since 2017, a large part of the educational institutions in Europe have been working on initiatives to strategically strengthen the education platform, creating networks throughout Europe that directly impact students with degrees that combine studies and contribute to international competitiveness. Among the main challenges was the need to generate an innovative vision, both in the training processes and research area, promoting excellence in higher education, equity, gender, and transnational cooperation between different institutions. The main objective of the European Commission program is to create a group of 60 European universities that can accommodate 500 higher education institutions that will improve the quality of education processes and research, and that is competitive at a global level by 2024.

The aforementioned raises multiple questions about how educational institutions have consolidated themselves as pioneers in educational quality and research products. There is still little literature that considers empirical studies on how academic institutions can use the generation of knowledge and experiences to improve their performance (Dee & Leišytė, 2016). One perspective that allows an analysis of the learning processes conducted by organizations to respond to the demands of the environment is the organizational learning theory.

Higher education institutions' development still needs to be improved (Anand & Brix, 2021; Rashman et al., 2009). The preceding can be explained by the idea that organizations oriented toward public welfare are undervalued. Additionally, learning is not a fundamental aspect of companies to ensure their business success. According to Ortenblad & Koris (2014), many studies in higher education institutions have established limited conceptual models of organizational learning, which have been focused on conceptual rather than empirical elements (Jeris, 1998; Kezar, 2005; Ortenblad & Koris, 2014)

The preceding clarifies the development that organizational learning has had, especially in the different limitations through the various approaches it has had so far. This research aims to overcome these gaps in the literature, especially in the studies of higher education institutions (Dee & Leišytė, 2016; Karatas-Ozkan & Murphy, 2010). On the other hand, they consider different perspectives on the learning process to develop improved performance ways that contribute to organizational learning. The organizational learning theory is a fundamental premise that establishes that organizations learn to improve their performance, but in the process, they naturally accumulate experience (Desai & Madsen, 2021). This behaviour developed experience that includes the strategies and decision-making they conduct, directly affecting the firms' research and development. However, this learning process must be accompanied by a process in which performance can be improved by learning the best practices of other organizations over time (Malik et al., 2020).

This perspective has many variations, going through traditional, functional, competitive, and generic Benchmarking, and a more recent one, rapid Benchmarking (Malik et al., 2020). In the same way, it is possible to appreciate different fields of application, such as Case studies (Afanasiev & Marx, 2008; Al et al., 2019; Boyer & Martin, 2012; Malik et al., 2020; Spiryagin et al., 2017); Health Care (Choi et al., 2020; Galloway & Nadin, 2001); Finance (Fong et al., 2008; Mateus et al., 2019); Software development (Blackburn et al., 2006).

As a field of knowledge, Benchmarking has received increasing attention. Although three decades have passed since its appearance, the number of researchers in the area has grown steadily. For authors such as Castro and Frazzon (2017), this growth has registered almost 50% in recent years. For authors such as (Lafuente et al., 2020a, 2020b), it is necessary to identify how firms can take advantage of the different resources they possess and prioritize their strategies, improving their competitiveness (Fernández-García et al., 2022).

It should be noted that taking into account that both quality and research are essential factors for organizational performance, it is crucial to know the factors that most affect the performance of higher education institutions, which is why the objective of this research is focused on analyzing the influence of factors such as research, teaching, faculty, and student knowledge in the academic performance worldwide. According to the previous idea, this work is structured as follows: In the first part, a tour of the most relevant literature on organizational learning and its relationship with higher education institutions is carried out. In the second part, the methodology used for information processing is presented. Subsequently, the research results obtained are presented. The final part presents the research's main conclusions and the study's main implications.

## 2. Organizational learning theory and higher education institutions

Organizational learning is an organization's dynamic capacity involving different dimensions, including change, social aspects, and psychosocial processes that companies develop (Souza & Takahashi, 2019). Within the change process, flexibility and agility become fundamental qualities to generate change processes that allow innovation and maintain the company's stability. From the exclusively theoretical field, the different investigations in the area establish the need to carry out studies that tend to understand how these capacities are implemented, considering at the same time how the strategies are adapted to the environment and how the actors behave within the contexts processes of change and learning (Fernández-Cruz et al., 2022; Pisano, 2017).

An important aspect to highlight is that individuals within organizations cannot establish relationships between the market and the available technology (Ramírez-Hurtado et al., 2022). In this way, organizational learning becomes an approach that allows organizations to find the relationships between the market and the company's technology and a space where meanings are negotiated to justify the organization's new processes. This previous condition is how organizational learning is determined as a social and psychological process that can integrate knowledge and learning as a main means of strategic renewal (Souza & Takahashi, 2019).

On the other hand, when individuals collaborate to create knowledge and adapt to business contexts, they establish behaviors that stimulate the development of activities that support future activities (Le & Lee, 2021). In the specific case of higher education institutions, it can be found in the literature that, as knowledge generation institutions, the learning process can be natural to them. Despite this, considerable differences affect their performance and modify their behaviour patterns in their key activities (Ahmad Qadri et al., 2021). Additionally, it is essential to consider that both the value system it possesses and the cultural context in which it operates become critical factors that will affect the results (Kezar & Elrod, 2012).

According to Dee & Leišytė (2016), higher education institutions have been pressured to compete in the market in search of searching funding scholarships, support from

private foundations, and requesting practical efforts for their support. Therefore, the research activities and the quality of the teaching processes are central aspects of the international accreditation processes, an essential aspect of their institutional environment and performance (Garcés-Delgado et al., 2023).

Other studies have shown what factors are associated with performance (Gómez-Hurtado et al., 2020). These factors include the development of metrics, which has become a determining element that allows for identifying behaviour patterns that influence the regional the national level (Garcia-Bernabeu et al., 2020). In this way, Benchmarking has become a technique in an essential field of development that has generated several definitions over time. The essence of benchmarking allows for establishing comparison and measurement processes between organizations, regardless of location, allowing access to crucial company information. This information considers its constitution's philosophical aspects to the existence of practices and measures that allow organizations to improve their performance (Malik et al., 2020).

On the other hand, benchmarking, conceived as a comparison process, considers establishing specific steps to ensure high reliability. These steps start with studying similar processes or activities and describing performance information from established comparisons. Finally, these studies also include adopting and implementing best practices based on the process results (Adebanjo et al., 2010).

This information access identifies best practices and partners in this process (Kleynhans & Roberson, 2017). In the same way, in the comparison processes, some barriers have been identified, such as difficulty in the adaptation processes, management of the partners in the process, trust in sharing information, internal expertise for the adaptation of the methods, difficulty in pursuit of resources (Malik et al., 2020). According to Shukla and Sushil (2022), Benchmarking captures organizational processes and environmental factors that are important to analyze. Likewise, this technique generates relevant information in different processes and performances considering a specific problem domain.

## 3. Learning process from environment dynamics

Within the learning processes that higher education institutions develop, they develop adaptation processes to their specific environments. This adaptation is typical of a decision process in which an attempt is made to take advantage of the opportunities offered by the environment and thus improve the performance of higher education institutions (March 1991). This adaptation process requires benchmarking based on identifying institutions considered leaders in the sector and gathering the best practices. For scholars such as Miner and Haunschild (1995), these experiences achieved by other institutions influence learning processes in the long term. Some research in the field has shown how the activities of taking advantage of the market carried out by higher education institutions tend to present experience curves that produce results in the long term and that have a positive impact on performance at the organizational level (Greve, 1998; Baum, 2000).

The preceding is a sample of how educational institutions make their decisions by building an action model that allows them to focus on counteracting the effects of the environment (Baum & Dahlin, 2007). Finally, for scholars like Wang and Hu (2017), universities' learning processes are part of the analysis they can conduct at the regional level. This process marks the path to follow to achieve better levels of reputation. This study aims to examine the factors that influence the performance of universities on a

global scale. A learning curve method assesses the relationship between research, teaching, faculty, and student recognition and its impact on academic performance in all countries.

Considering this research, the study of factors such as research, teaching, faculty, and student knowledge allows us to investigate the gaps related to the performance of higher education institutions that can influence the practices adopted significantly to improve their position in the international rankings. This previous idea is how the processes related to learning can influence institutional prestige through its results in the research carried out and in the quality of the teaching process. To the extent that this type of institution manages to develop formalization and standardization processes within the institutions, they can count on more significant ways to improve their activities and thus face changes in the market more effectively (Lee, 2011).

It has been found that regardless of the nature of the institution, be it public or private, the quality of teaching and the level of production in research papers remains sustained due to the constant financing of public and private entities (Lee, 2011). Other research has shown substantial differences at the regional and country levels; even the dynamics will depend on the field of knowledge being analyzed (Wang & Hu, 2017). Thus, the literature has shown that universities with a broader knowledge structure will perform better than those that specialist universities characterize.

An essential element to consider is that the literature has primarily focused efforts on the comparative study of different measurement forms, especially in the field of research (Bai et al., 2020). One of the ways of measuring the performance of higher education institutions is also based on the number of citations belonging to academic networks, the quality of teaching, and the management of resources.

Despite the conflicting visions about the use of metrics and the possibility of manipulation, they affect the performance of higher education institutions, especially in the prestige they develop. Additionally, depending on the place of execution of the academic activities, these may take advantage of the competitive base of the regions in which they operate. As well as the successful cases in which it is possible to show performance improvements, some failures in the learning processes can also be observed (Baum & Dahlin, 2007). In this way, being able to observe not only the positive results but also the negative ones will allow us to understand the critical factors of institutional performance that will allow us to identify not only the variables typical of the field but also those that may be outside the field of action of educational institutions. upper (Miner & Haunschild, 1999; Sitkin 1992).

## 4. Research hypothesis

Regarding research activities, authors such as Bondar et al. (2021) state that one of the main characteristics of higher education institutions worldwide is that their performance is evaluated based on standard measurements in which the different actors in the environment are also integrated. Authors such as Choi (2019) and Karnitis and Karnitis (2017) establish a solid relationship between the sustainable growth of economies and the models that higher education institutions adopt. On the other hand, it is also possible to find the need for creating collaboration networks between institutions that allow access to information that allows a more appropriate vision of the environment and to find points for improvement in their mission processes (Dee & Leišytė, 2016; Leiva et al., 2022).

Additionally, the different dynamics of higher education institutions base their teaching activity on results in research aspects (Khytrova et al., 2020). In this way, the educational systems' general performance and teaching activities have been characterized by becoming increasingly stratified services; therefore, the existing inequity tends to widen over time. In the same way, the inequity existing in the resources of the institutions affects the quality of the training processes (Torquemada González & Loredo Enríquez, 2021). Following the above, the literature suggests a need to investigate at a more in-depth level the studies of contribution from innovation and the factors that affect the performance of this type of institution, not only academic but prestigious (Akimova et al., 2020). Another present need is directly related to teaching activities that allow association innovation processes in the business models proposed by this type of institution (Khytrova et al., 2020; Sancho-Álvarez et al., 2021).

Regarding faculty, the resources, and capacities developed by higher education institutions, there is also the challenge of improving the efficiency of their strategic processes (Ibarra-Sáiz & Rodríguez-Gómez, 2020; Molina et al., H022). This previous condition attracts excellent attention in the scenario of institutional development, in the standardization of processes via certifications, and the generation of new sources of income (Bess & Dee, 2014; Kezar, 2014; Rhoads & Szelényi, 2011; Slaughter & Rhoades, 2004). These environmental conditions mean that the interests of higher education institutions are directed toward the generation of entrepreneurship and efficiency strategies that allow them to take advantage of the maximum potential of their staff (Ponce Ceballos et al., 2020). At the same time, the rush to generate alternatives for institutional development, such as academic and administrative development, continues to consolidate as a mandatory mechanism that allows for supporting missionary activities (Escarbajal et al., 2023; Marlina et al., 2021).

Concerning student acknowledgment, the literature suggests that this type of condition not only benefits the personal wellbeing and self-esteem of students but also facilitates the possibility of improving the dynamics of the institution in terms of culture that permeates all internal practices. of the same (Anderson et al., 2022). In addition to having a positive impact on higher education institutions, this type of practice has been found in some investigations that there is a positive relationship between the wellbeing generated by knowledge and the improvement in participation, wellbeing, and the image of the institution vis-à-vis the public community (Lloyd & Emerson, 2017).

As a synthesis of what was explained above, it may be necessary for the higher education sector to have reliable and generalizable information among organizations in the sector. Remember that the information is highly generalizable and valid for analyzing the sector's activities, especially at the regional and country level. Considering the above, the following is the proposed hypothesis:

- H1 (Hypothesis 1). The teaching directly and positively influences per-capita academic performance.

- H2 (Hypothesis 2). The research directly and positively influences per-capita academic performance.

- H3 (Hypothesis 3). Faculty has a direct and positive influence on per-capita academic performance.

- H4 (Hypothesis 4). Student Acknowledgement has a direct and positive influence on per-capita academic performance.

**Figure 1**
*Conceptual Model*
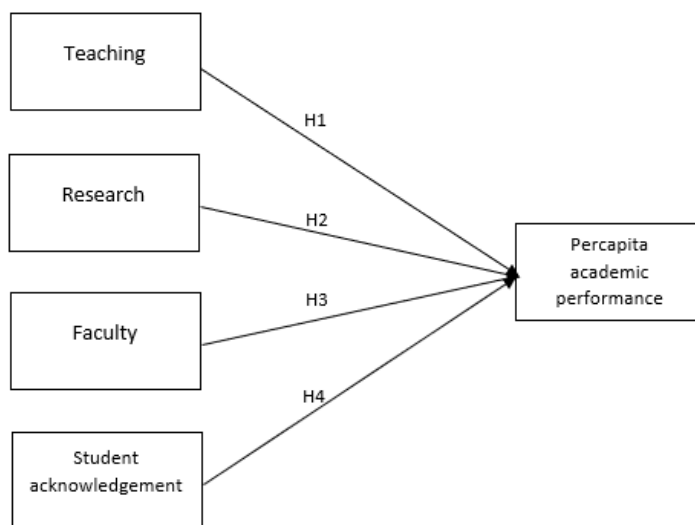


# 5. Method

*Data*

The learning curve is estimated using data between 2011 through 2021 (516 observations in our dataset from The Times Higher Education, QS World University Rankings Latin America, and Academic Ranking of World Universities (ARWU). In the case of The Times Higher Education, it has information on 1,600 universities located in 99 countries. It is established as one of the complete rankings of the existing ones. The indicators that measure the performance of higher education institutions are made up of 4 areas: teaching, research, knowledge transfer, and international outlook. For this study, the first two will be used for performance measurement.

The QS is based on a methodological framework that employs six parameters to represent university performance. These parameters and their weights are Academic Reputation (40%); Employer Reputation (10%); Faculty/Student Ratio (20%); Citations per Faculty (20%); International Faculty Ratio/ International Student Ratio (5%). The data sources are Scopus Database and the University Portfolio Survey. Finally, the Academic Ranking of World Universities (ARWU) was used. This ranking is recognized for containing the 1,000 universities focused on research. This ranking is also characterized by information on 4,000 universities in 93 countries. The variables it contains are research output, research influence, international collaboration, research quality, and international academic awards.

*Methodological approach and information about the rankings*

The methodological approach in this research is quantitative. We used data from three different university rankings to create a factorial variable for each independent variable: research, teaching, faculty, and students' acknowledgment.

Times Higher Education: THE only considers universities with at least 1,000 students enrolled in undergraduate or postgraduate programs. The only considers universities in countries that are members of the Organisation for Economic Cooperation and Development (OECD). It uses a methodology that assesses universities on five pillars:

- Teaching: The learning environment and the quality of teaching.

- Research: The volume, income, and reputation of research.

- Citations: The impact of research.

- International outlook: The diversity of the student body and faculty and the extent of international research collaboration.

- Industry income: The links between universities and industry.

QS World University Rankings Latin America: QS does not have a minimum size requirement for universities that participate in the QS World University Rankings Latin America uses a methodology that assesses universities on six pillars:

- Academic reputation: Based on a survey of academics around the world.

- Employer reputation: Based on a survey of employers around the world.

- Faculty/student ratio: The number of students per faculty member.

- Citations per faculty: The number of research papers faculty members publish yearly.

- International research network: The number of international research collaborations.

- International student ratio: The proportion of students who are not citizens of the country where the university is located.

ARWU: ARWU only considers universities that have published at least 100 papers cited 1,000 times in the last five years. ARWU generally considers universities with at least 100 international students enrolled in undergraduate or postgraduate programs. Finally, it uses a methodology that assesses universities on six indicators:

- Number of alums and staff winning Nobel Prizes and Fields Medals: The number of Nobel Prizes and Fields Medals won by alums and current faculty members.

- Number of highly cited researchers: The number of researchers who have published highly cited papers in the last 10 years.

- Publications in Nature and Science: The number of papers published in Nature and Science journals.

- Total number of papers: The total number of papers published in peer-reviewed journals.

- Citations per paper: The average number of citations per paper.

- International collaboration: The proportion of papers with international co-authors.

*Independent variables*

- Research: Variables from the three rankings are used to build the structure, such as citations per professor, research, and highly qualified researchers' nature and science papers published in the expanded scientific citation index and the social science citation index. To construct a single variable, a factorial is used.

- Teaching: Variables from the three rankings, such as teaching and academic repute, are used in construction. To construct a single variable, a factorial is used.

- Faculty: Variables from the three rankings, such as international faculty ratio, international orientation, and staff of institutions earning Nobel awards and field medals, are used in the construction process. To construct a single variable, a factorial is used.

- Students' Acknowledgment: Variables from the three rankings are used to build the structure, such as the international student ratio and alums of institutions that have won Nobel awards and field medals. To construct a single variable, a factorial is used.

*Dependent variables*

- Per capita academic performance of an institution (PCP): This statistic is measured in the ARWU Ranking, which compares academic achievement, research output, faculty credentials, and infrastructure. Each of the five indicators is assigned a weight to indicate its relative importance in the overall PCP score calculation. The weights reflect the significance assigned to each indicator based on the desired evaluation criteria or research objectives. PCP scores are divided by the number of full-time equivalent academic staff. The preceding indicates that the size of the academic staff is considered in the measurement.

*Model*

Most studies claim that the LC application benefits production challenges, particularly those involving a wide variety and low volume output. A variety of different LC models are available to confirm the process through time:

Wright's model with (2) parameters expresses his algebraic equation by:

$$y_w(x) = \beta x^{-\alpha_w}$$

Crawford's model with (2) parameters expresses his algebraic equation by:

$$y_c(x) = \beta x^{-\alpha_c}$$

Plateau model with (3) parameters expresses his algebraic equation by:

$$y_p(x) = \beta x^{-\alpha_p} + \gamma$$

Stanford-B model with (3) parameters expresses his algebraic equation by:

$$y_B(x) = \beta(x + B)^{-\alpha_B}$$

Dejong's model with (4) parameters expresses his algebraic equation by:

$$y_D(x) = \beta(M + (1 - M)X^{-\alpha_l}$$

S-Curve model with (5) parameters expresses his algebraic equation by:

$$y_S(x) = \beta(M + (1 - M)(X + B)^{-\alpha_S})$$

The dual-phase model expresses his algebraic equation by:

$$y_{CM}(x) = \chi\beta X^{-\alpha_C} + (1 - \chi)(X + B)\beta X^{-\alpha_M})$$

Even though some learning curve models have been presented, only two are widely used: Wright's (cumulative) and Crawford's (unit) models and their modifications. Furthermore, Wright's model is still relevant and is a foundation for recent advances in learning to model. Furthermore, the power model equation is the most basic (just two parameters) and is widely employed for various activities. Compared to the power model, more sophisticated learning models, such as the Dual-phase and Dejong, are preferentially utilized for specific parameters and less successful application instances in the literature.

A brief description of each model is also provided. The mathematical form of the Wright (W) model:

$$y(x) = \beta x - \alpha.$$

In the W model, $y(x)$ represents the average time of Academic reputation to the $x$th university, x represents the university level in each parameter, $\alpha$ is the parameter determining learning speed, and $\beta$ is the level of Academic reputation in the first year.

To compute LC parameters $\alpha$ and $\beta$, enough years (time parameters) must be obtained (production data). K random samples are gathered throughout the time study:

$$x(k), y(k), x(k) < x(k), i = 1, 2, \ldots, N, k = 1, 2, \ldots, K,$$

If K is big enough, all statistical parameters (mean values, standard deviation) and confidence intervals of LC parameters and $\beta$ may be determined with high statistical significance. However, most parameter estimate approaches in LC applications have typically been statistical, with complete data accessible or including additional data with the forecast process.

Let us begin by introducing the LC approximation approach, which is based on a single sample:

$$x_i, y_i, x_i < x_i+1, i = 1, 2, \ldots, N,$$

LC based on function invariants

$$y(x) = \beta x^- a.$$

Invariants are the values that must be constant at all pairs of points on the curve $(x_i, y_i)$, $(x_j, y_j)$, $i < j$. It is clear from that:

$$-a \ln x_i + \ln \beta = \ln y_i$$

$$-a \ln x_j + \ln \beta_j = \ln y_j$$

We obtain two zero-degree invariants after solving the system regarding two unknowns $\alpha$ and $\ln \beta$,

$$I_1\ x, y, x, y\ = a = -\ \frac{\ln(y_j\,) - \ln(y_i\,)}{\ln(x) - \ln(x)},$$

$$I_2\ x, y, x, y\ = \ln \beta = \frac{\ln(y_i\,)\ln(x_j\,) - \ln(y_j\,)\ln(x_i)}{\ln(x) - \ln(x)}$$

For an approximation of the function is:

$$\bar{\alpha} = \frac{1}{M}\sum_{j>i}^{N} I_1(x_i,\ y_i, x_j, y_j)\ and\ \bar{\beta}$$

$$= exp\left\{\frac{1}{M}\sum_{j>i}^{M} I_2(x_i,\ y_i, x_j, y_j)\right\},$$

# 6. Results

Tables 1 and 2 show descriptive data for all variables, such as means, standard deviations, and correlations. Table 2 displays the results of our model. Two models were estimated: Model 1 is the fundamental model, which includes the control variables. Model 2 introduces each variable's direct effects. According to our figures, the means of research and instruction have increased over time, while the number of faculty and students has increased in a very small proportion. The teaching, research, faculty, and student coefficients are significant and positive.

**Table 1**

*Mean and standard deviation*

|          | Mean  | SD    |
|----------|-------|-------|
| Research | 63.22 | 18.2  |
| Teaching | 52.43 | 28.14 |
| Faculty  | 40.97 | 22.43 |
| Students | 63.41 | 33.87 |

**Table 2**

*Results of the two models estimated*

| Variables | Model 1 | Model 2 |
|-----------|---------|---------|
| Constant | 36.134*** (2.751) | 38.661*** (3.101) |
| Size | 2.967** (4.826) | 3.401** (5.160) |
| Age | 0.311 (1.510) | 0.554*** (2.540) |
| Research |  | 15.112*** (9.543) |
| Teaching |  | 14.54*** (4.451) |
| Faculty |  | 5.31*** (2.410) |
| Students |  | 3.121*** (2.654) |
| $R^2$ | 0.16 | 0.675 |
| N X T | 4,134 | 4,134 |

*Nota.* *** p<0,01. ** p<0,05. * p<0,10.

Now we will examine the learning curves that resulted from the data analysis to determine how well our models fit the traditional idea of the learning curve and which aspects strengthen it the most. In the four learning curves, the graphs were developed relating the number to the level of academic performance in each of the universities studied and its relationship with research, teaching, faculty, and students.

The model was fitted by minimizing the Chi statistic for goodness-of-fit. The best-fitting (Chi statistic that was discovered was 1,040.0. With 1,768 degrees of freedom, this equates to a chi-square test size of >.99. This signifies that the model fit the data well and was accepted. The size remained large even after excluding the last four or six data points, with recall probabilities close to one. The mean Chi statistic for each curve was 6.89, and the average $R^2$ was .871 (in other words, the model explained a high level of variance in all curves).

First, we want to see that the learning curve is accurate; the curves should start with a high error (low-level of accuracy score) in the intercept and then decrease this error level with time while the accuracy score increases. The relationship between a training score and the cross-validated test score must be shown in a learning curve. This relationship is made on the estimator of the variation related to the numbers of a training sample. This analysis allows finding the benefits of adding more training data, considering that the estimator changes according to the error variance.

Figures 1, 2, 3, and 4 show that the learning curves match our expectations. In all the academic performance curves, regardless of the related variable, it grows over time, being consistent with the theory. The curve related to research and teaching (Figures 1 and 2) is the one that shows more growth alternatives during the first six years, increasing the accuracy rate by 40% and then showing a flattening, reaching a maximum of 93% in the accuracy rate.

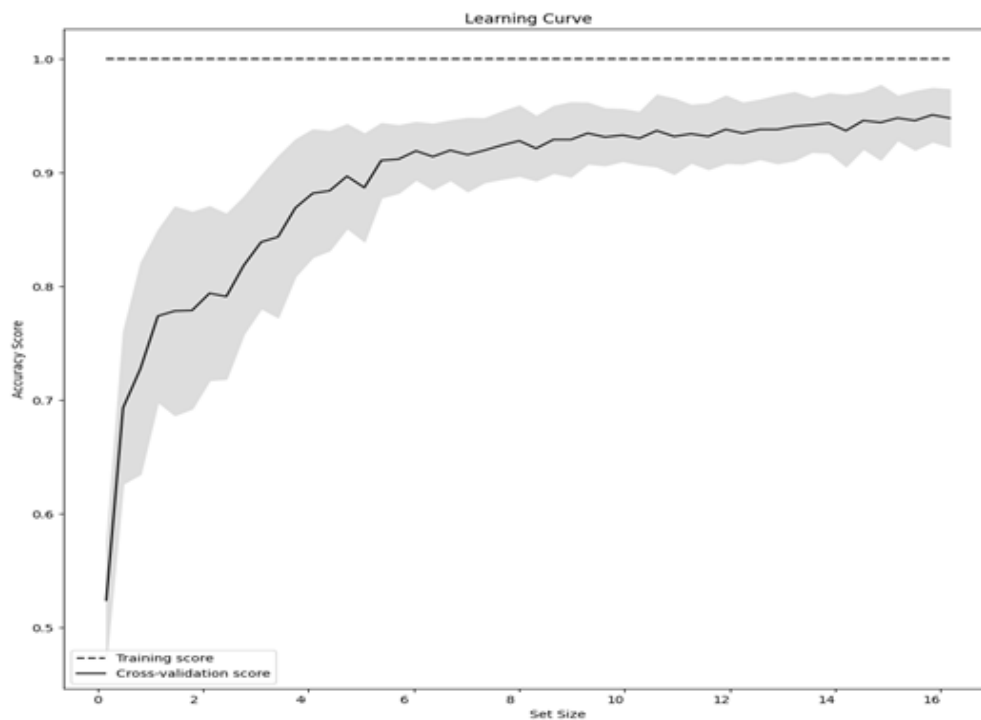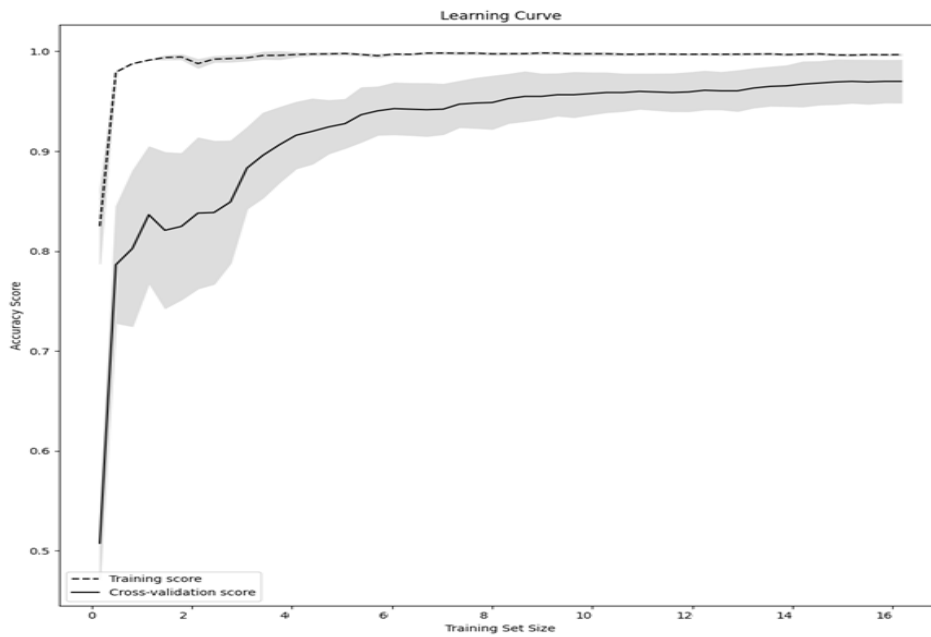**Figure 1**

*Research learning curve*

**Figure 2**

*Teaching Learning curve*



In contrast to Figure 3, unlearning occurs during the first two years, subsequently presenting a recovery, achieving accuracy levels of 85%. While Figure 4, the high accumulation phase is achieved in the first four years, and its flattening phase reaches the maximum level of 83%. According to the previous results, it can be established that the learning curves related to research and teaching achieve a better fit than the models related to Faculty and Students. Many universities are supported by teaching as the primary function, but achieving higher academic performance over time becomes more noticeable with activities related to research.
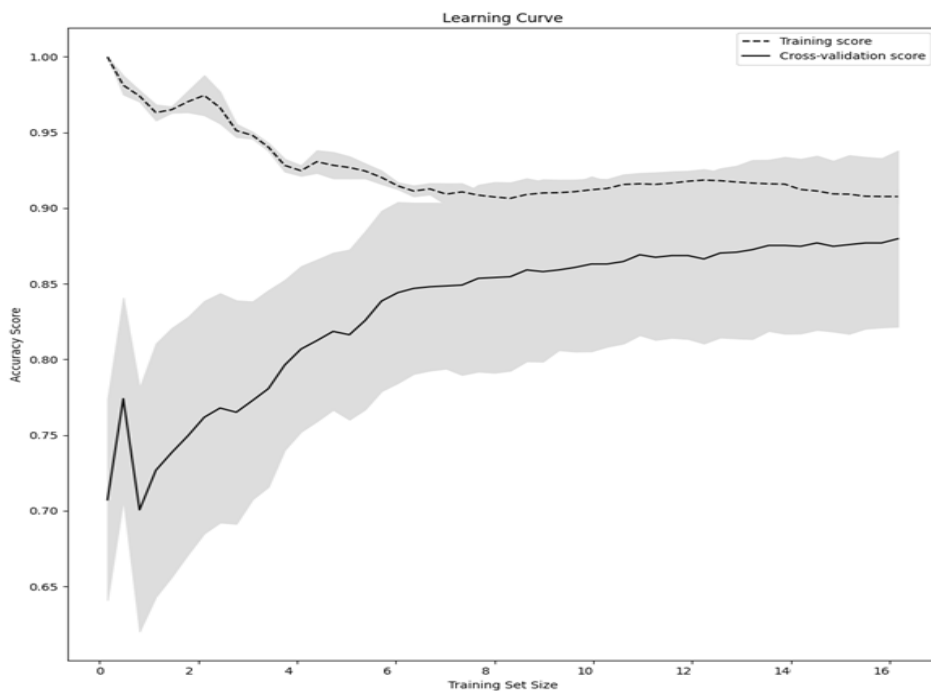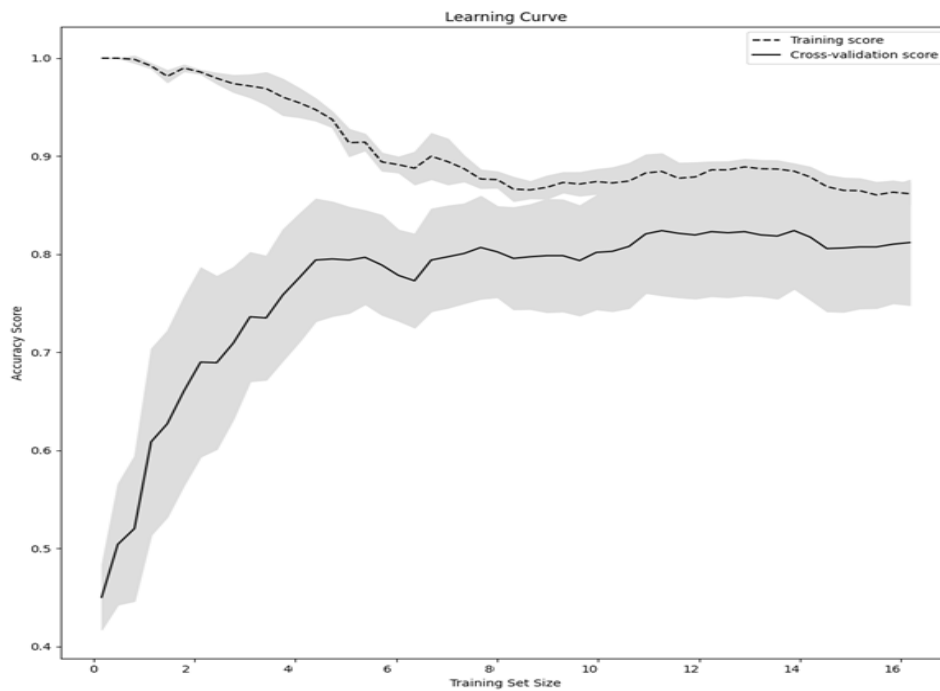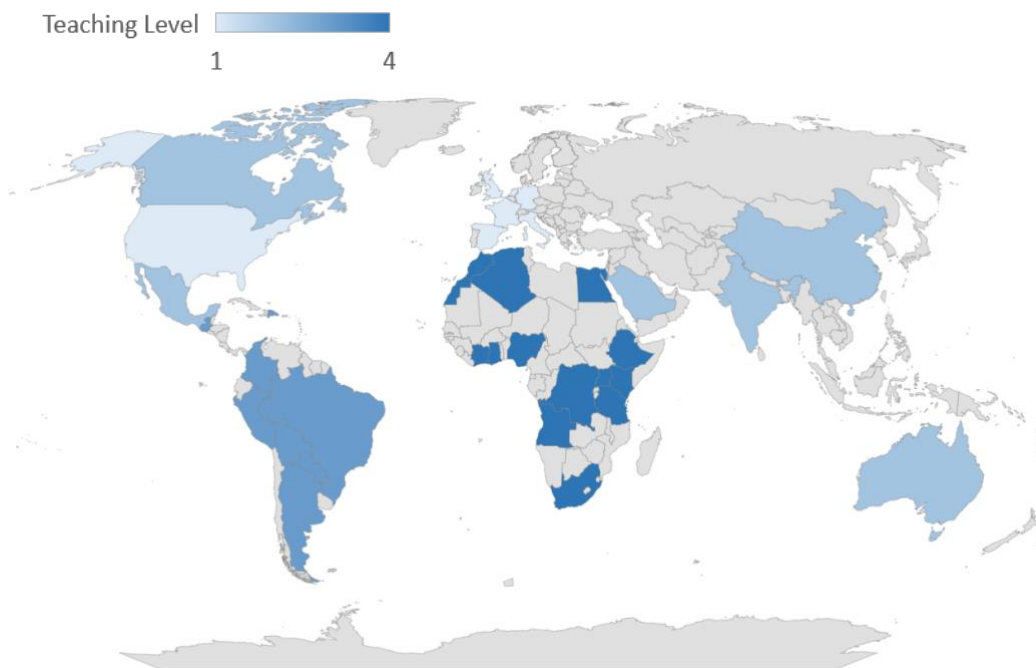
**Figure 3**

*Faculty learning curve*

**Figure 4**

**Students learning curve**



In addition, Figure 5 depicts the geographic distribution of the influence of academic achievement per capita and its relationship to each of our variables. The intensity levels are assigned from 1 to 4, with 1 being the best ranking and 4 representing the lowest levels. In the case of variable Teaching (Figure 5), countries like the United States, China, Spain, and others achieve higher levels in this area.

**Figure 5**

**Teaching level map**



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The variable associated with Faculty (Figure 6) achieves the most homogeneous results at the global level. However, the best results are in developed countries such as Europe, Asia, and North America. Finally, there are African countries and several Latin American countries. Regarding the student factor (Figure 7), the United States and China dominate as indicators of student quality.
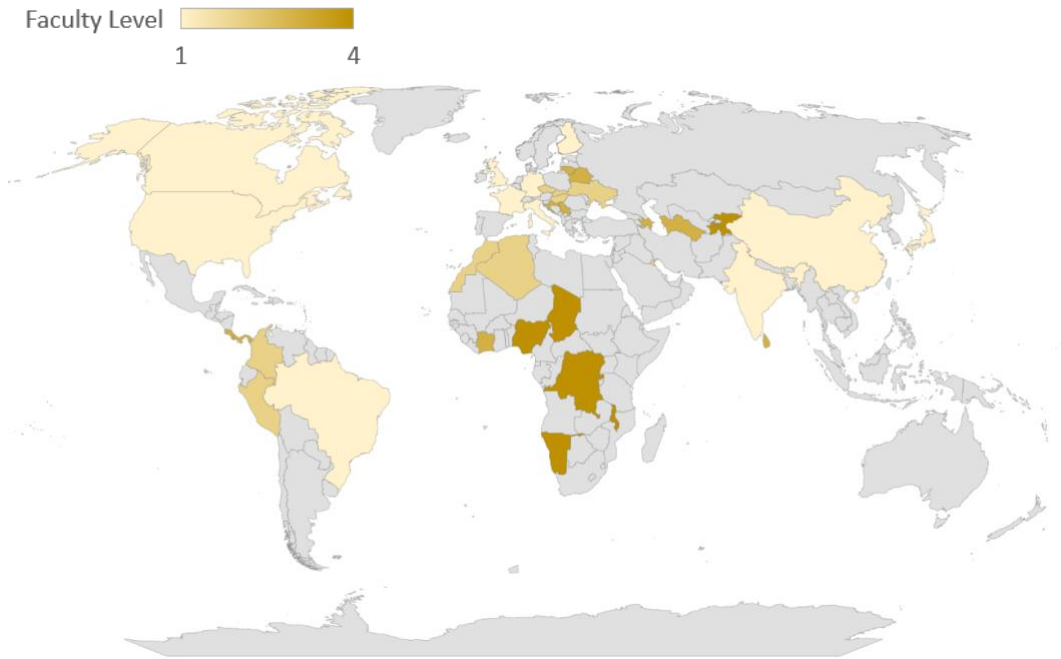
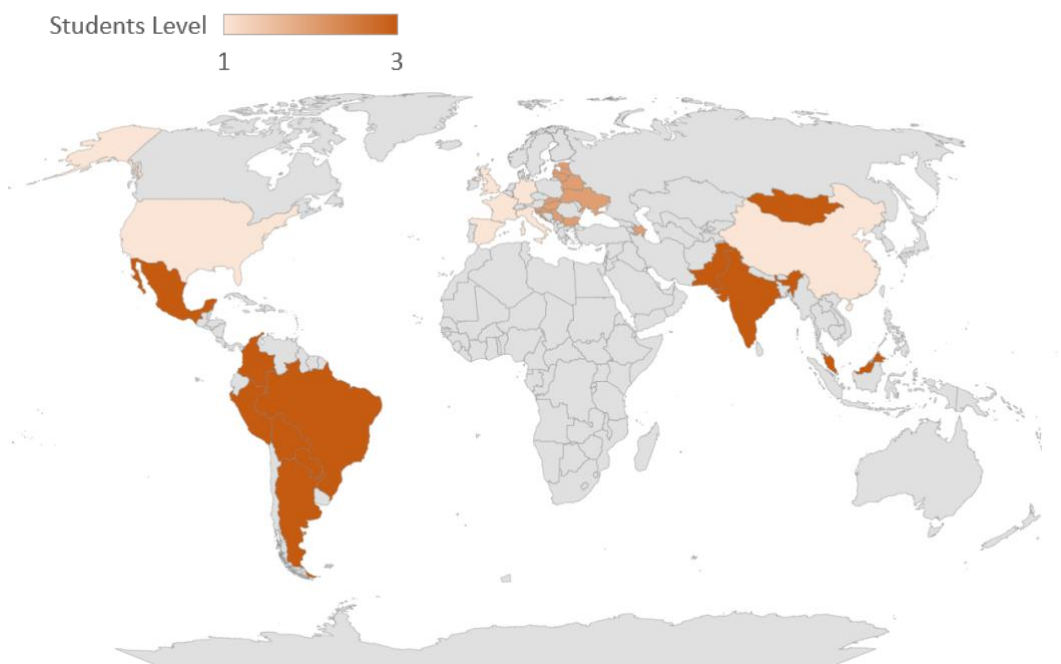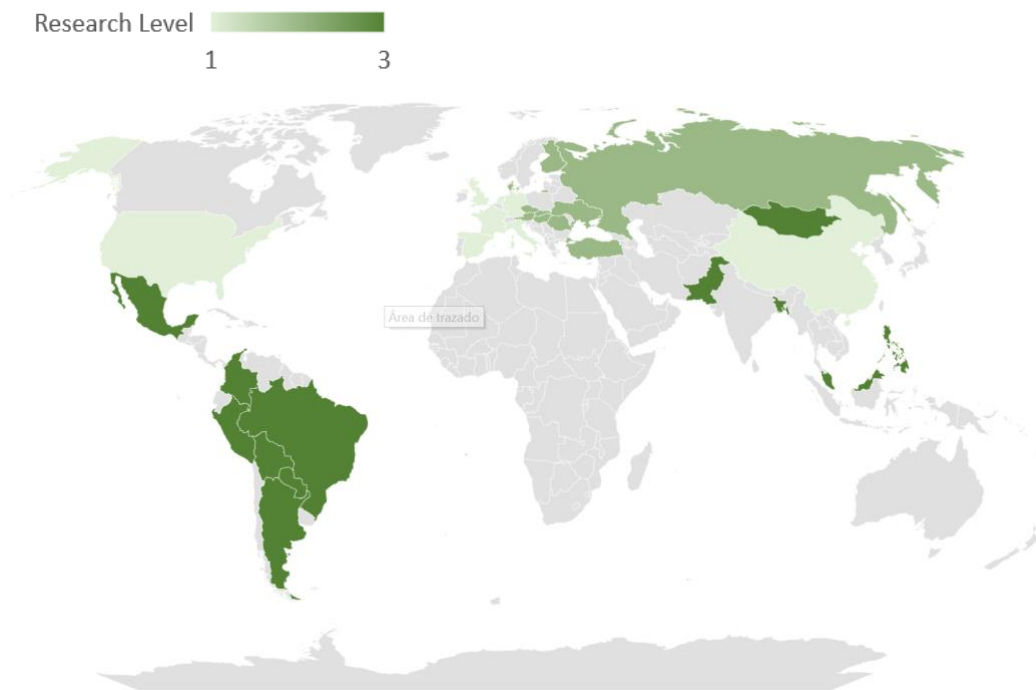**Figure 6**

*Faculty level map*



**Figure 7**

*Student level map*

Finally, the research (Figure 8) demonstrates that European countries such as Germany, Spain, and Switzerland lead this category. These are added to the United States and other Asian countries where the world's highest levels of research are concentrated.

**Figure 8**
*Research level map*



## 7. Conclusions

This study examined the learning curves linked with research, teaching, faculty, and students and their impact on university academic achievement. This study intended to offer theoretical insights into the elements that determine academic accomplishment globally by thoroughly examining data from prominent rankings such as Times Higher Education, QS World University Rankings, and Academic Ranking of World Universities.

The analysis of the learning curves revealed important information about the relationship between the variables analyzed and academic success. The analysis of the learning curves revealed that academic performance tended to improve over time, corroborating the classic idea of the learning curve. The curves displayed distinct patterns and rates of growth, offering vital information on the dynamics of learning achievement in many areas (Fernández-Cruz & Rodríguez-Legendre, 2022).

The learning curve for teaching and research displayed the most significant rise over the first years, resulting in a considerable improvement in accuracy rates (Malik et al., 2020). This data implies that research-related activities have a significant impact on improving academic performance over time. It emphasizes the significance of research in achieving higher academic success in universities (Fernández-García et al., 2022).

In comparison, the learning curves linked with teachers and students indicated slower rates of increase. While teaching is still essential in colleges, the data shows that research-related activities promote academic performance more than teaching. These

findings highlight the need to cultivate a research-oriented culture within colleges to improve overall academic performance (Leiva et al., 2022).

This study contributes to understanding the factors influencing academic achievement in colleges worldwide. The findings emphasize the significance of research and teaching activities in promoting academic excellence and raising university rankings (Le & Lee, 2021). The findings highlight the need for ongoing investment in research and faculty development.

Universities must acknowledge the importance of research-driven programs and establish an environment encouraging research and innovation. Universities can improve their academic reputation, attract bright staff, and provide a high-quality educational experience for students by promoting research. The outcomes of this study can help academic institutions, policymakers, and stakeholders develop methods to stimulate research and improve overall academic performance.

From a theoretical approach, this research aims to determine the elements that influence the academic performance of colleges listed in three important global rankings. According to the literature, given these institutions' unique conditions and dynamics, this particular component demands extra attention, primarily focusing on research. As a result, this empirical study covers a critical vacuum in the sector, addressing the requirement identified by Dee and Leiyt (2016). It makes an essential contribution to understanding the dynamics of the education industry. It is worth noting that organizational learning in education has been thoroughly researched and is now recognized as a unique area of study (Anand & Brix, 2021; Rashman et al., 2009).

Furthermore, organizational learning theory argues that companies can acquire information, adapt to their environment, and enhance performance through continual learning. It acknowledges the importance of both individual and collective learning in organizational development. This condition could include collecting information through research, sharing best practices in teaching, and implementing effective organizational tactics in universities (Choi, 2019).

Future studies in this area will be able to delve deeper into the exact mechanisms through which teaching and research contribute to academic success. Investigating the connections between various research components, such as funding, cooperation, and publication output, could provide more insights into improving academic success. Investigating the effect of other variables, such as infrastructure, institutional support, and external collaborations, helps us better understand the elements that influence academic performance in institutions (Khytrova et al., 2020).

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