

## **Analysis of the Effectiveness of Statistical Methods in Improving Educational Performance**

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### **Abstract**

*A documentary review was carried out on the production and publication of research papers related to the study of the variables Statistical Methods and Academic Performance. The purpose of the bibliometric analysis proposed in this document was to know the main characteristics of the volume of publications registered in the Scopus database during the period 2017-2022 by Latin American institutions, achieving the identification of 123 publications. The information provided by this platform was organized through graphs and figures, categorizing the information by Year of Publication, Country of Origin, Area of Knowledge and Type of Publication. Once these characteristics have been described, the position of different authors on the proposed topic is referenced through a qualitative analysis. Among the main findings made through this research, it is found that Brazil, with 43 publications, was the Latin American country with the highest scientific production registered in the name of authors affiliated with institutions of that nation. The Area of Knowledge that made the greatest contribution to the construction of bibliographic material related to the study of Academic Performance and Statistical Methods was Medicine with 53 published documents, and the most used Publication Type during the period indicated above were Journal Articles with 91% of the total scientific production.*

**Keywords:** *Academic Performance, Statistical Models, Latin America.*

### **1. Introduction**

In the field of education, where it is in a constant search to improve the academic performance of institutions, it has been a fundamental task for this sector. As educational institutions are constantly challenged to foster an educational environment that has been plagued by constant changes, the aim is to make learning more optimal and also improve performance. Being able to integrate the statistical mathematical model has resulted in a powerful tool capable of deciphering algorithms and trends that allow the education sector to implement strategies based on the evidence provided by this science. Statistical methods serve as invaluable diagnostic tools that would effectively address institutional problems in academic performance and improve outcomes for students in training. This seeks to give importance to being able to integrate these statistical methods in the

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education sector, since it stands out in a diagnosis of academic problems, allowing to guide and promote decision-making processes based on data.

In this context, educators and administrators, when executing statistical models, allow them to analyze and code an extensive field of data which measures students' academic performance, attendance records, and demographic information. At the time of being able to implement econometric and statistical techniques such as regression analysis, whose function is to predict unknown data and study the correlation between variables, this would allow revealing patterns and data relationships that can determine the inefficiency of students and make better decisions about it. By being able to execute this statistical knowledge, a greater understanding of those factors that influence the structural change of academic performance is sought and to be able to take proactive measures that seek to face the specific challenges that each student has individually.

The analysis of the effectiveness of statistical methods contributes to the development of personalized learning interventions by being able to propose new models of learning pedagogies based on student profiles in academic data. These statistical and econometric algorithms of machine learning and personalized studies help to effectively reduce students' academic results and thus be able to identify and mitigate risks in performance, allowing teachers to achieve interventions more quickly and specifically and avoid consequences in low student performance. This new approach not only allows for timely action and addressing individual student needs, but also allows high-achieving students to explore and inquire about new topics of interest and educators on a more accelerated learning path.

Educational institutions operate within resource constraints, making the efficient allocation of resources crucial. Statistical methods help optimize the distribution of resources by identifying areas with the greatest impact on academic performance. Whether it's allocating extra support to struggling students, investing in teacher professional development, or improving technology resources, data-driven decision-making ensures that resources are directed to where they are needed most. The effectiveness of educational interventions can be rigorously evaluated through statistical analysis. By employing experimental design methodologies, institutions can assess the impact of specific interventions on academic outcomes. This evidence-based approach not only informs continuous improvement efforts, but also contributes to the broader body of knowledge about effective educational practices and the tangible benefits of incorporating statistical methods into the educational toolkit. For this reason, this article seeks to describe the main characteristics of the compendium of publications indexed in the Scopus database related to the variables Statistical Methods, Academic Performance, as well. Such as the description of the position of certain authors affiliated with institutions, during the period between 2017 and 2022.

## **2. General Objective**

To analyze, from a bibliometric and bibliographic perspective, the preparation and publication of research papers in high-impact journals indexed in the Scopus database on the variables Statistical Methods and Academic Performance during the period 2017-2022 by Latin American institutions.

## **3. Methodology**

This article is carried out through a research with a mixed orientation that combines the quantitative and qualitative method.

On the one hand, a quantitative analysis of the information selected in Scopus is carried out under a bibliometric approach of the scientific production corresponding to the study

of Statistical Methods and Academic Performance, Higher Education. On the other hand, examples of some research works published in the area of study mentioned above are analyzed from a qualitative perspective, based on a bibliographic approach that allows describing the position of different authors on the proposed topic. It is important to note that the entire search was carried out through Scopus, managing to establish the parameters referenced in Figure 1.

### 3.1. Methodological design



Figure 1. Methodological design

Source: Authors' own creation

#### 3.1.1 Phase 1: Data collection

Data collection was carried out from the Search tool on the Scopus website, where 123 publications were obtained from the following filters:

TITLE-ABS-KEY ( statistical and methods, and academic and performance ) AND PUBYEAR > 2016 AND PUBYEAR < 2023 AND ( LIMIT-TO ( AFFILCOUNTRY , "Brazil" ) OR LIMIT-TO ( AFFILCOUNTRY , "Mexico" ) OR LIMIT-TO ( AFFILCOUNTRY , "Colombia" ) OR LIMIT-TO ( AFFILCOUNTRY , "Peru" ) OR LIMIT-TO ( AFFILCOUNTRY , "Ecuador" ) OR LIMIT-TO ( AFFILCOUNTRY , "Chile" ) OR LIMIT-TO ( AFFILCOUNTRY , "Cuba" ) OR LIMIT-TO ( AFFILCOUNTRY , "Argentina" ) OR LIMIT-TO ( AFFILCOUNTRY , "Venezuela" ) OR LIMIT-TO ( AFFILCOUNTRY , "Paraguay" ) OR LIMIT-TO ( AFFILCOUNTRY , "Honduras" ) OR LIMIT-TO ( AFFILCOUNTRY , "Costa Rica" )

- Published documents whose study variables are related to the study of Statistical Methods and Academic Performance.
- Limited to the years 2017-2022.
- Limited to Latin American countries.
- Without distinction of area of knowledge.
- No distinction of type of publication.

#### 3.1.2 Phase 2: Construction of analytical material

The information collected in Scopus during the previous phase is organized and then classified by graphs, figures and tables as follows:

- Co-occurrence of words.
- Year of publication.
- Country of origin of the publication.
- Area of knowledge.
- Type of publication.

#### 3.1.3 Phase 3: Drafting of conclusions and outcome document

In this phase, the results of the previous results are analysed, resulting in the determination of conclusions and, consequently, the obtaining of the final document.



#### 4.2 Distribution of scientific production by year of publication

Figure 3 shows how scientific production is distributed according to the year of publication.

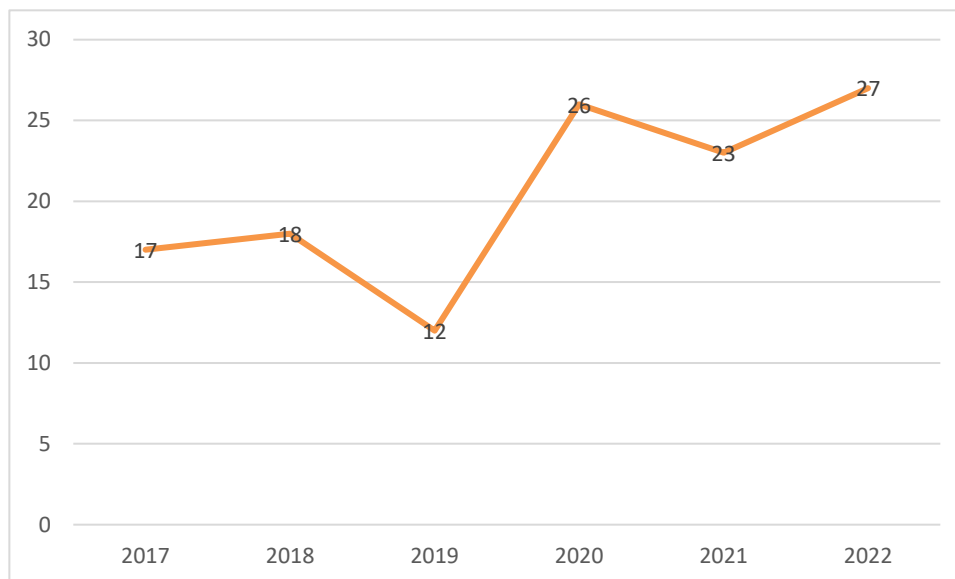


Figure 3. Distribution of scientific production by year of publication.

Source: Authors' own elaboration (2023); based on data exported from Scopus

Among the main characteristics evidenced through the distribution of scientific production by year of publication, the number of publications registered in Scopus was in 2022, reaching a total of 27 documents published in journals indexed on this platform. This can be explained thanks to articles such as the one titled "Excessive Use, Depression, and Anxiety of Smartphones in Medical Students During the COVID-19 Pandemic" This study aimed to evaluate the association between excessive smartphone use and mental disorders in Peruvian medical students during the COVID-19 pandemic. Methods A cross-sectional study was conducted on 370 students aged 16 to 41 years (mean age: 20) at three universities from July to October 2020. A survey was conducted that included the Smartphone Addiction and Dependence Scale, PHQ-9, and GAD-7. applied. Prevalence ratios were estimated using generalized linear models. Results Excessive use of smartphones was a common characteristic among students (n = 291, 79%). Depressive symptoms were present in 290 (78%) students and anxiety symptoms in 255 (69%). Adjusted for confounders, addictive/dependent smartphone use was significantly associated with the presence of depressive symptoms (PR = 1.29, 95% CI 1.20-1.38 for dependent use; PR = 1.30, 95% CI: 1.12-1.50 for addictive use). In addition, addictive/dependent smartphone use was significantly associated with the presence of anxiety symptoms (PR = 1.59, 95% CI: 1.14-2.23 for dependent use; PR = 1.61, 95% CI: 1.07-2.41 for addictive use).(Santander-Hernández, 2022)

#### 4.3 Distribution of scientific output by country of origin

Figure 4 shows how scientific production is distributed according to the country of origin of the institutions to which the authors are affiliated.

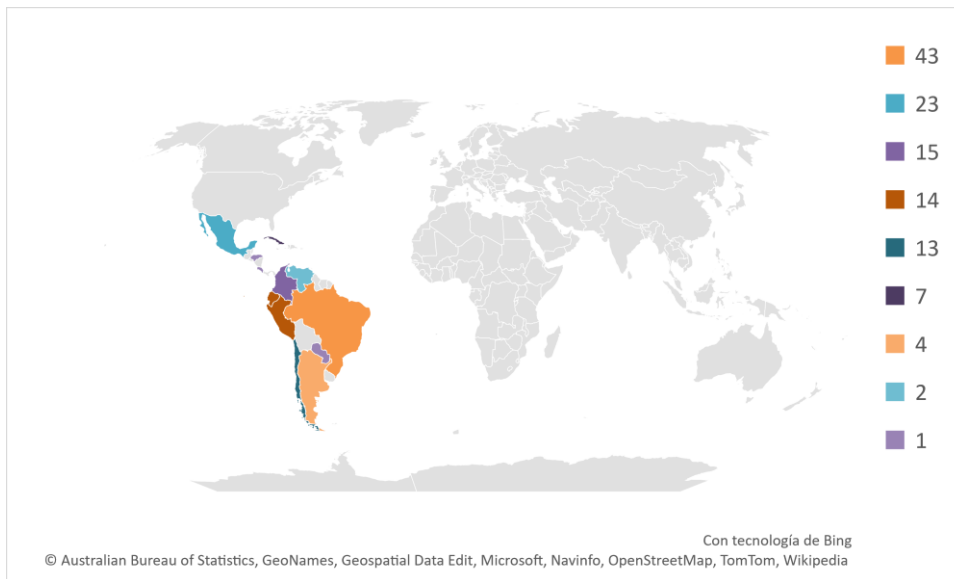


Figure 4. Distribution of scientific production by country of origin.

Source: Authors' own elaboration (2023); based on data provided by Scopus.

Within the distribution of scientific production by country of origin, the records from institutions were taken into account, establishing Brazil as the country of this community, with the highest number of publications indexed in Scopus during the period 2017-2022, with a total of 43 publications in total. In second place, Mexico with 23 scientific documents, and Colombia occupying the third place presenting to the scientific community, with a total of 15 documents among which is the article entitled "The creation and dissemination of scientific knowledge: an empirical analysis of the scientific performance of the Nobel Laureates in Economics and Open Innovation". collaboration-dissemination of knowledge. To this end, data were collected on the scientific production and collaboration of the 500 authors of the most cited articles on Open Innovation, as well as the 86 Nobel Laureates in Economics available in the Scopus database. The data were treated and analyzed using the simple regression statistical technique, based on the Ordinary Least Squares (OLS) method with the incorporation of nonlinearities, characterized by the use of a Log-Log Model. The results indicate that peer-to-peer collaboration exerts a significant influence on the production and dissemination of knowledge, even among the most prominent individuals in their fields, such as Nobel laureates in economics, confirming what has been found in the literature on the subject. However, despite what the literature points out, especially with regard to the idea that the larger the collaborative network, the higher the productivity, the results found suggest that collaboration networks have the same characteristics of an economic production function, to the extent that after a certain point in time, The addition of one more researcher to the network generates the effect of decreasing marginal productivity. (Walter, 2022)

#### 4.4 Distribution of scientific production by area of knowledge

Figure 5 shows the distribution of the elaboration of scientific publications based on the area of knowledge through which the different research methodologies are implemented.



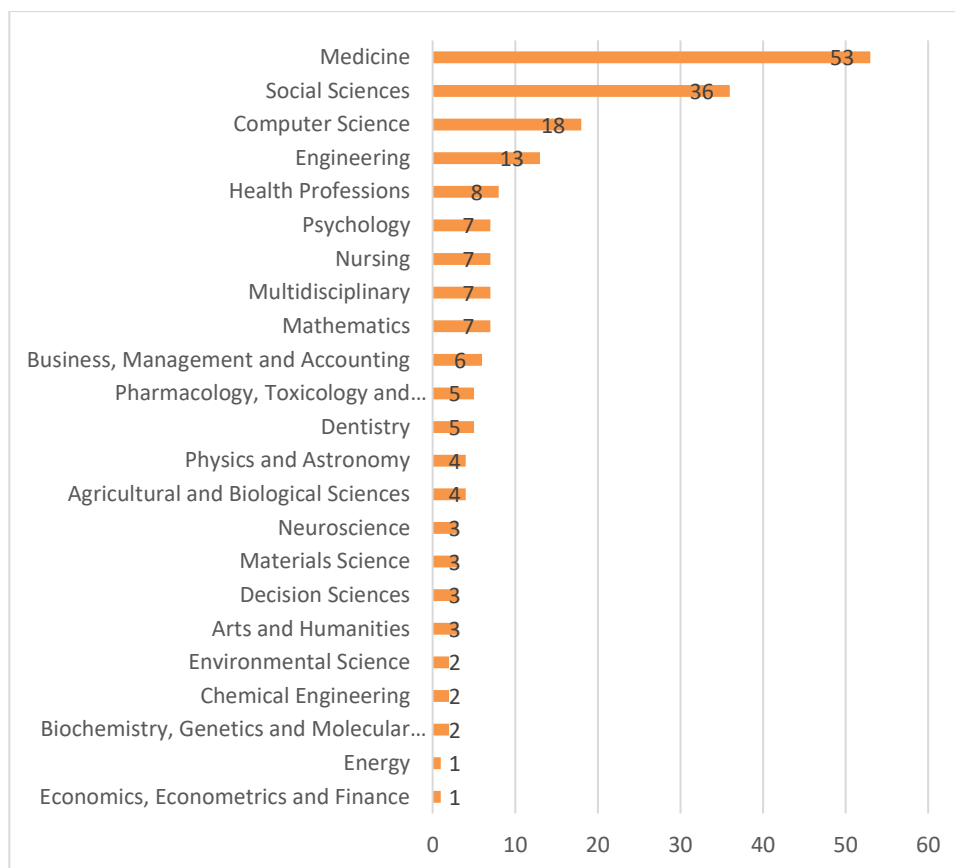


Figure 5. Distribution of scientific production by area of knowledge.

Source: Authors' own elaboration (2023); based on data provided by Scopus

Medicine was the area of knowledge with the highest number of publications registered in Scopus, with a total of 53 documents that have been based on its methodologies: Statistical Methods and Academic Performance. In second place, Social Sciences with 36 articles and Computer Science in third place with 18. The above can be explained thanks to the contribution and study of different branches, the article with the greatest impact was registered by Medicine entitled "Symptoms of insomnia, sleep hygiene, mental health and academic performance in Spanish university students: a cross-sectional study" This study aimed to explore the prevalence of insomnia symptoms and the relationship between insomnia and health habits, mental health and academic performance in a large sample of college students. Methods: Five hundred and eighty-two students from the University of Granada, Spain, were recruited. Data was collected through an online survey with questions about sociodemographic, academic, and health habits, as well as the Pittsburgh Sleep Quality Index, the Insomnia Severity Index, the Sleep Hygiene Index, and the Sleepiness, Depression, Anxiety, and Stress Scales. A multiple regression analysis explored the relationship between academic performance, health habits, mood, and insomnia symptoms. Results: The prevalence of students with insomnia symptoms was high (39.7%). A multiple logistic regression analysis revealed that depression, sleep hygiene, stress, and anxiety were important predictors of insomnia symptoms. Multivariate analyses revealed that subjective symptoms of insomnia, sleep efficiency, and depression were significantly correlated with academic performance dependently. (Carrión-Pantoja, 2022)

#### 4.5 Type of publication

In the following graph, you will see the distribution of the bibliographic finding according to the type of publication made by each of the authors found in Scopus.

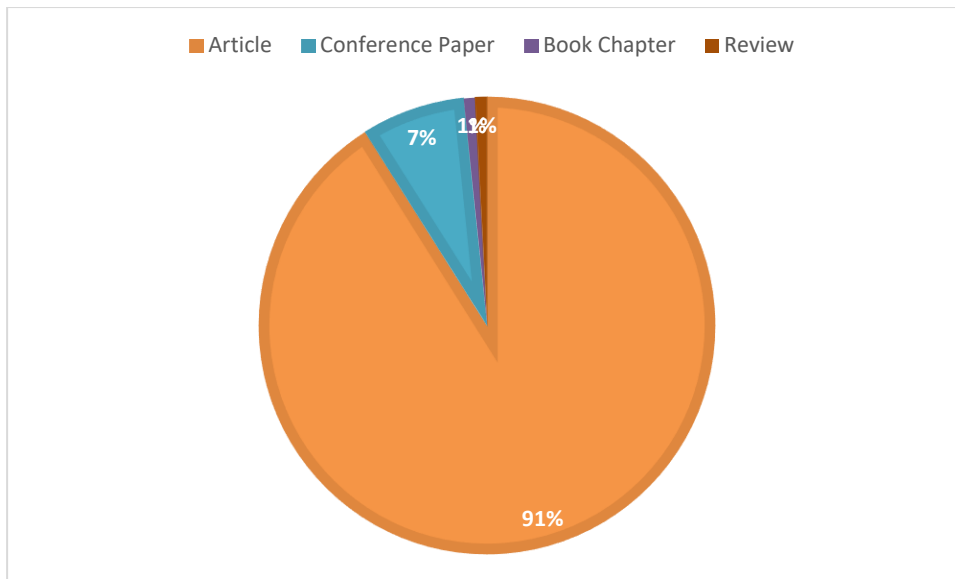


Figure 6. Type of publication.

Source: Authors' own elaboration (2023); based on data provided by Scopus.

The type of publication most frequently used by the researchers referenced in the body of this document was the one entitled Journal Articles with 91% of the total production identified for analysis, followed by Session Paper with 7%. Chapter of the Book are part of this classification, representing 1% of the research papers published during the period 2017-2022, in journals indexed in Scopus. In this last category, the one entitled "Symptoms of insomnia, sleep hygiene, mental health and academic performance in Spanish university students: a cross-sectional study" stands out. The objective was to compare published studies on traditional laboratory practices with new technologies for the study of the human body in medical students. A systematic review and meta-analysis were conducted. Four review authors conducted a systematic and comprehensive literature search, based on the location and selection of 54 primary studies published in ten databases, three review authors assessed the methodological quality of 33 studies, with checklists for critical assessment of internal validity, by type of study. The fourth blinded review author calculated the degree of agreement among reviewers with Fleiss Kappa and assessed risk of bias, sensitivity, heterogeneity and pooled analysis using RevMan 5.4. A qualitative systematic review and combination by statistical methods of the results was obtained with meta-analyses of seven primary studies, with a sample of 465 participants, 260 exposed to traditional laboratories and 205 to new technologies. Satisfaction with the process and positive results of learning, comprehension and application were found, with the initial favorability to traditional practices not being significant when evaluating confidence intervals. Thus, the contrast between methods for these practices revealed results related to physical-emotional reactions, focused on the construct of academic performance and learning processes. (Martha, 2022 )

## 5. Conclusions

Through the bibliometric analysis carried out in this research work, it was possible to establish that Brazil was the country with the highest number of published records regarding the variables Statistical Methods and Academic Performance, with a total of 43 publications in the Scopus database. In the same way, it was established that the application of theories framed in the area of Medicine, were used more frequently in the integration of statistical methods in educational practices since being able to execute this practice as valuable as data analysis would allow institutions and the educational sector to be able to find their shortcomings and thus be able to improve academic performance. By



exploiting the power offered by these methods of data analysis and coding, they allow institutions to obtain valuable knowledge, with this information to be able to develop strategies that allow them to adapt their teaching and learning methods and create a more proactive and dynamic educational environment that is responsive to students in general. However, it is vitally important to know the limitations and challenges that can be obtained when executing these statistical practices in the broad context that encompasses the education sector. To be able to apply these regression and data analyses must be carried out with care, since the omission of some variables and the size of the samples are important factors for the design of these investigations and which seeks to have no margin of error, this so that the statistical analyses are completely holistic to the learning environment. In addition, the success of statistical approaches to improving academic achievement depends on effective communication and collaboration among educators, administrators, and researchers. Integrating statistical knowledge into practical and feasible strategies requires a commitment to continuous evaluation and adaptation and a willingness to adopt innovative pedagogical approaches.

To conclude, while it is important to recognize that this practice plays an undeniable role in shaping the improvement of educational practices and improving learning methods and addressing academic deficiencies, its effectiveness is reflected in the implementation of these practices and the implementation of these practices in a much broader educational framework. As this sector undergoes constant changes due to the different methods of learning and approach to education, it is considered that the sensible use of statistical methods can provide a data-driven and student-centered approach to learning, where ultimately it seeks to increase their academic performance and ensure success in their academic and student trajectory.

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