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INFORMATION TECHNOLOGIES APPLIED TO ENGINEERING EDUCATION

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Abstract

To develop this article, a documentary review of the elaboration and production of research works related to the study of Information Technologies and their application in Engineering Education was carried out in order to know through a bibliometric study the main characteristics of 2159 publications registered in Scopus database during the period 2018-2022 at the Latin American level. The results of this database were organized in graphs and figures categorizing the information by variables such as Year of Publication, Country of Origin and Area of Knowledge which allowed to identify through a qualitative analysis, the position of different authors against the proposed theme.

The main findings found through this research was that Brazil stood out for having the highest scientific production, leading the list with 621 publications. Likewise, the Area of Knowledge that made the greatest contribution to the construction of bibliographic material related to the study of the variables was engineering with 2159 published documents.

Key Words: Information Technology, Teaching, Teaching-Learning Process, Engineering.

1. Production

It is possible to find technology immersed in various areas as a result of the need for change that over the years has interposed globalization and its interdependence. Hence, the use of specific technologies such as information are essential in Higher Education since they allow the maximization of knowledge by students, that is, they contribute significantly to the achievement of integral and more competitive professionals in the work environment. There are many Information Technologies among which stand out email, virtual education, gamification to mention some of the most used in teaching systems.

On this occasion, we will analyze the role played by these Technologies in Engineering Education. Mariana Pérez defines Engineering as:

A profession in which scientific and empirical knowledge is applied for the optimal conversion of the materials and forces of nature into practical uses for humanity, as well as, the invention, improvement and use of industrial technique, and to the resolution of technical-social problems(Perez, 2022) .

The case of this career is not very different from the others, since being so numerical and precise require various strategies that generate the highest level of motivation in students in order to increase their participation in the classroom. In general, the resources or methodologies implemented in the Teaching-Learning Processes depend on the needs identified by the teacher at the beginning of the courses, however, it is not known for sure if during the execution of the study plan the expected results will be obtained. That is why, this research article seeks to describe the main characteristics of the set of publications attached to the Scopus database and that are directly related to the aforementioned variables, as well as the description of the position of certain authors affiliated with institutions around the world, during the period between 2018 and 2022.

2. General objective

Analyze from a bibliometric and bibliographic perspective, the elaboration of works on the s variables Information Technologies and its application in Engineering Education during the period 2018-2022.

3. Methodology

This article is carried out through a research with 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 Information Technologies and their application in Engineering Education.

On the other hand, it is analyzedfrom a qualitative perspective, examples of some research works published in the area of study indicated above, starting from a bibliographic approach that allows describing the position of different authors against the proposed topic.

It is important to note that all thesearch was carried out through Scopus, managing to establish the parameters referenced in *Figure 1*.

3.1 Methodological design

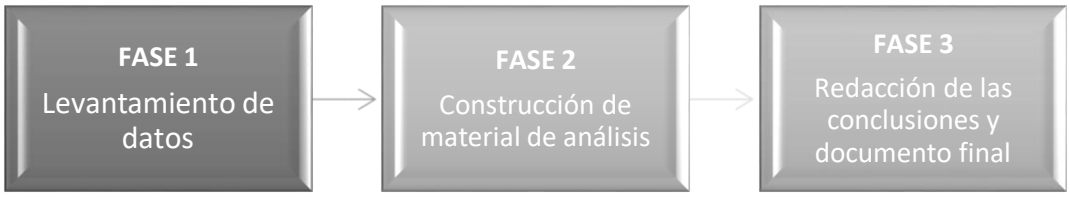

Figure 1. Methodological design

Source: Authors.

3.1.1 Phase 1: Data collection

The data collection was executed from the Search tool on the Scopus website, where 2159 publications were obtained from the choice of the following filters:

information AND technologies AND teaching AND of AND engineering AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018)) AND (LIMIT-TO (SUBJAREA , "ENGI")) AND (

LIMIT-TO (AFFILCOUNTRY , "Brazil") OR LIMIT-TO (AFFILCOUNTRY , "Mexico") OR LIMIT-TO (AFFILCOUNTRY , "Colombia") OR LIMIT-TO (AFFILCOUNTRY , "Ecuador") OR LIMIT-TO (AFFILCOUNTRY , "Peru") OR LIMIT-TO (AFFILCOUNTRY , "Chile") OR LIMIT-TO (AFFILCOUNTRY , "Argentina") OR LIMIT-TO (AFFILCOUNTRY , "Costa Rica") OR LIMIT-TO (AFFILCOUNTRY , "Cuba") OR LIMIT-TO (AFFILCOUNTRY , "Uruguay") OR LIMIT-TO (AFFILCOUNTRY , "Venezuela") OR LIMIT-TO (AFFILCOUNTRY , "Guatemala") OR LIMIT-TO (AFFILCOUNTRY , "Honduras") OR LIMIT-TO (AFFILCOUNTRY , "Panama") OR LIMIT-TO (AFFILCOUNTRY , "Paraguay") OR LIMIT-TO (AFFILCOUNTRY , "Bolivia") OR LIMIT-TO (AFFILCOUNTRY , "Nicaragua"))

- ✓ Published documents whose study variables are related to the study of Information Technologies and their application in Engineering Education.
- ✓ Limited to the years 2018-2022.
- ✓ Limited to Latin America.
- ✓ Limited to Engineering.
- ✓ Without 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 to later be 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, we proceed with the analysis of the results previously yielded resulting in the determination of conclusions and, therefore, the obtaining of the final document.

4. Resultados

4.1 Co-occurrence of words

Figure 2 shows the Co-occurrence of keywords found in the publications identified in the Scopus database.

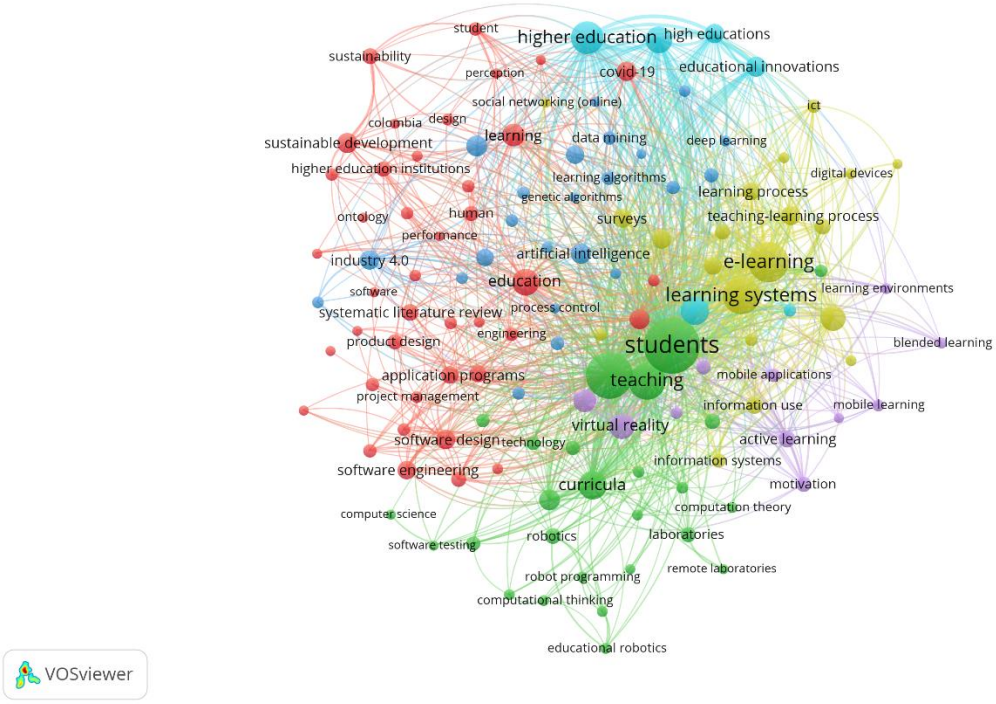

Figure 2. Co-occurrence of words

Source: Authors. (2023); based on data exported from Scopus.

Thedata in Figure 2, exported from Scopus, shows us our variables and their relationship with other terms which we will explain below.

Engineering students, like any other student, have been exposed to changes in the Teaching-Learning Practices, one of them is the implementation of Information Technologies because of the parameters that have been established globally on the characteristics of each curriculum in higher education careers. This need intensified from the Pandemic experienced by the whole world in 2020 where institutions had to resort to virtuality so as not to stop their processes and thus give continuity to the schedule of activities initially defined.

Being such a primordial resource, today it is normal to find the use of mechanisms linked to these Technologies in the different levels of schooling ranging from early childhood to adulthood.

4.2 Distribution of scientific output by yearof publication

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

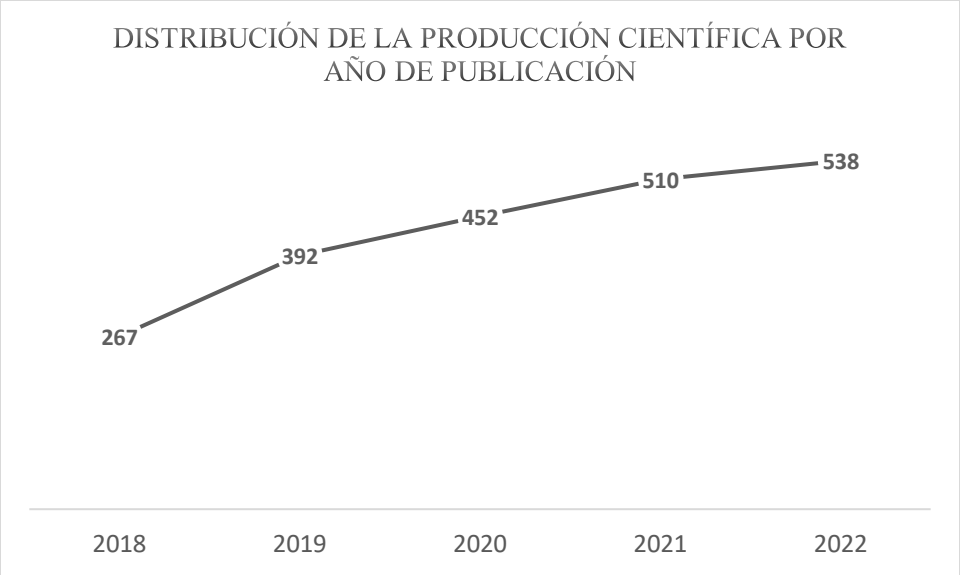

Figure 3. Distribution of scientific production by year of publication.

Source: Authors. (2023); based on data exported from Scopus

In figure 3 we find the scientific production concerning the variables Information Technologies and their application in Engineering Education in the period between 2018 and 2022, which resulted in the publication of 2159 documents, in the Scopus database, containing the keywords. Likewise, it is evident that throughout the period various changes were experienced. We started with 2018 with 267 documents, a number that increases significantly during the following years. During 2019, 392 texts were published, while in 2020 it exceeded 450 publications. In 2021, the increase continued to achieve the publication of 510 documents, a figure exceeded in 2022 with 538 texts, becoming the largest amount of research published during the period.

From the year 2022, the conference proceedings called "Virtual tutors and their relationship with the learning of students of the National University of Callao" stand out, in which it was determined that there is a positive relationship between the use of Technologies through Virtual Tutors and Virtual Learning, revealing that it generates an improvement in their Learning Process thanks to "the(Garcia-Talledo, Gutierrez-Tirado, Grados-Espinoza, & Nieves-Barreto, 2022) flexibility, didactics and motivation provided by the virtual tutors, as well as the conceptual, attitudinal and procedural learning of the course". (Garcia-Talledo, Gutierrez-Tirado, Grados-Espinoza, & Nieves-Barreto, 2022)

4.3 Distribution of scientific production by country of origin.

Figure 4 shows how scientific production is distributed according to the nationality of the authors.

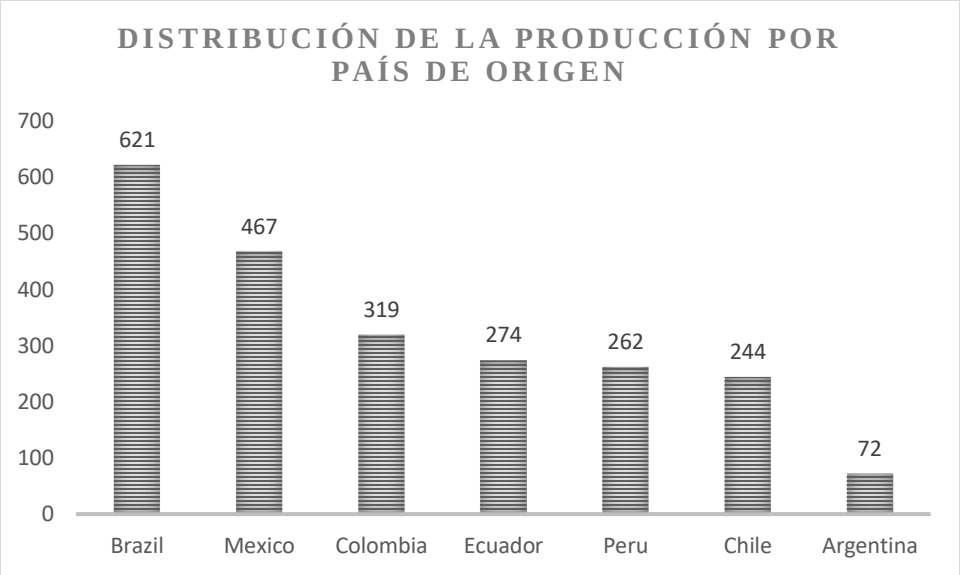

Figure 4. Distribution of scientific production by country of origin.

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

In the study of Information Technologies and their application in Engineering Education, Brazil leads the list of documents published with a total of 625 records in the Scopus database during the period of the years 2018-2022, followed by Mexico and Colombia with 467 and 319 texts each.

"Adapting engineering education to BIM and Industry 4.0: A vision from Kolb's experiential theory in the laboratory" is one of the articles published during 2022 in which a proposal is presented to teachers in Engineering in which the implementation of new technologies such as "(Garcés & Peña, 2022)Building Information Modeling (BIM)" and "Industry 4.0" is suggested. (Garcés & Peña, 2022) in order to achieve an improvement in the Teaching-Learning Process and with this better results in the training of its students.

At this point, it is important to note that the preparation of scientific publications in many cases is carried out from collaborations that may involve private and / or public institutions from one or several countries. Therefore, the same publication can be linked to one or more authors with different nationality and thus to more than one country simultaneously, being part of the total number of articles or publications of each of them in the final sum. They will then see, in *Figure 5*, in greater detail the flow of collaborative work by several countries.

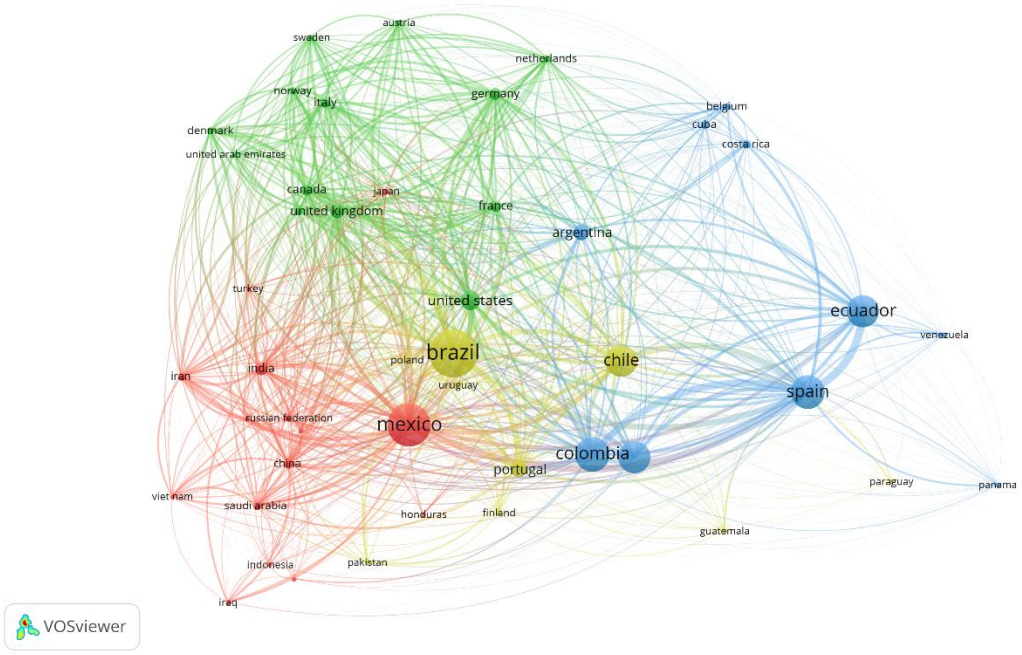

Figure 5. Co-citations between countries.

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

Figure 5 shows the grouping of research according to the collaboration between authors belonging to various international institutions. There is evidence of outstanding participation among authors affiliated with institutions from Latin American countries such as Brazil, Mexico, Chile, Colombia with countries from other regions such as Spain, United Kingdom, Indonesia, Canada among others.

4.4 Distribution of scientific production by area of knowledge

Figure 6 shows the distribution of the elaboration of scientific publications from the area of knowledge through which the different research methodologies are implemented.

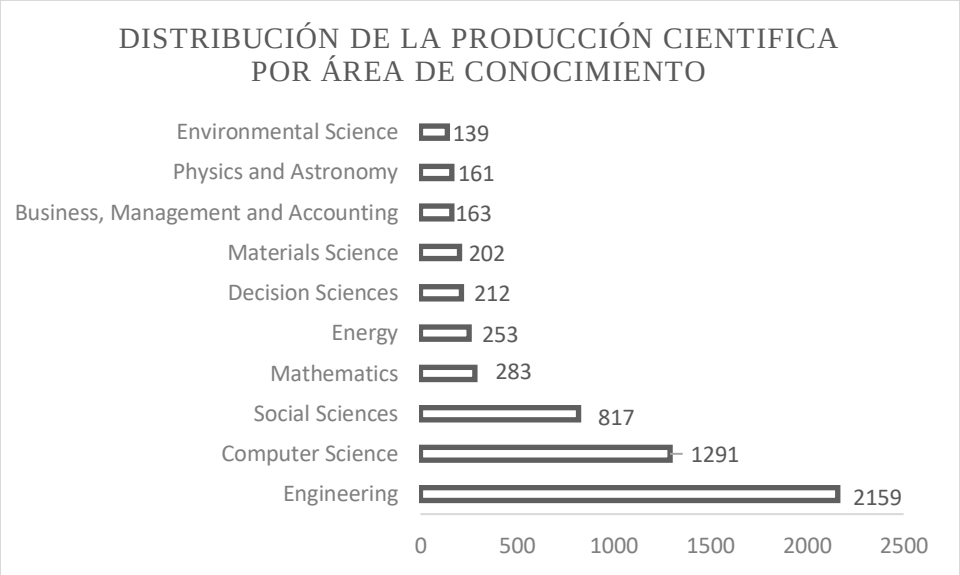

Figure 6. Distribution of scientific production by area of knowledge.

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

Due to the nature of our variables it is not surprising that most of the publications found in the Scopus database, on these are made from Engineering occupying the main position in the publication of documents. Other areas such as computer science and social sciences have contributed to the study of these variables, publishing 1291 and 817 documents each.

As we can see in *figure 6*, the variables object of this study are relevant in various areas of knowledge, since Information Technologies can be used for multiple purposes, including facilitating the teaching and learning of different skills, so the implementation of these can positively impact the understanding and better application of the knowledge acquired at the end of the educational processes.

4.5 Type of publication

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

Figure 7. Type of publication.

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

Figure 7 clearly shows that the predominant type of publication in the study of Information Technologies and their application in Engineering Education was the journal article with a total of 1058 documents, corresponding to 49% of the publications. In second place, the conference proceedings are located with 970 documents followed by the revisions with 91 publications, representing 45% and 4% respectively.

Among the articles published is "A methodology to incorporate construction information modeling (BIM) in an undergraduate program of civil engineering" in which (Del Savio, Díaz-Garay, Galantini Velarde, & Valcárcel Pollard, 2022) the need for university programs to transform according to the processes of "globalization and internationalization" is exposed, in this case it is raised from Civil Engineering which must respond to other areas such as " Architecture, Engineering, Construction and Exploitation (AECO)". (Del Savio, Díaz-Garay, Galantini Velarde, & Valcárcel Pollard, 2022) This is why the implementation of the methodology "Building Information Modeling (BIM) is suggested, which constitutes a process that involves shared digital representations of built assets to facilitate design, construction and operations processes within the industry to form a reliable basis for decision making(Del Savio, Díaz-Garay, Galantini Velarde, & Valcárcel Pollard, 2022)".

5. Conclusions

After the bibliometric analysis carried out in this research work, it was established that Brazil was the country with the highest number of records published for the Information Technologies variable and its application in Engineering Education with a total of 621 publications in the datos Scopus during the period 2018-2023 and that the area of knowledge with the greatest contribution was Engineering with a total of 2159 texts.

On the one hand, it was found that the application of Information Technologies has brought the following benefits to Engineering Education: "Easy access to information, Global broadband networks, Virtual reality technologies, Fusion of telecommunications and computing (televoting, teleshopping, going to work will be history for many people: telecommuting...), Barrier-free services. " (Hoyos Castellanos, Jaime Parra, Sifuentes Ocegueda, & Treviño Montemayor, 2018). Likewise, it has allowed students and / or graduates to be more competitive and efficient

thanks to the use of different software or programs that facilitate the development of their functions in any company. In other words, it can be said that students perceive these technological aids as "significant and useful according to the context to which they belong, becoming transcendental tools to improve the profile and performance at a personal and professional level". (Benjumea-Arias, Mosquera-González, Palacios-Moya, & Valencia-Arias, 2021)

On the other hand, the group of teachers has also found benefits from the use of this type of technology since "It also implies that teachers stay updated in each of the fields in which they operate, since they must be continuously trained to remain relevant to the current market".(Hoyos Castellanos, Jaime Parra, Sifuentes Ocegueda, & Treviño Montemayor, 2018)

Although the use of Information Technologies has contributed to the improvement of education, it is still possible to find institutions where there is a lack of the necessary resources for the use of these technologies. For this reason and in order to continue generating awareness of the importance of guaranteeing access to these by all students. We hope to promote with this article the participation of scientific communities in the study of these variables from any scientific profile and area of knowledge, always seeking to provide more alternatives that contribute to the formation of better students.

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