INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) IN EDUCATION: INDICATORS OF IMPROVEMENT IN ECUADOR

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Abstract

A documentary review of the elaboration and production of studies related to Information and Communication Technologies and their Impact on Ecuadorian Education was carried out through a bibliometric study of the main characteristics of 1,576 publications registered in the Scopus database during the period 2018-2022. The results obtained from 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 qualitative analysis, the position of different authors regarding the proposed topic. The main findings of this research were that Ecuador stood out for having the highest scientific production, leading the list with 1,576 publications. Likewise, the area of knowledge that made the greatest contribution to the construction of bibliographic material related to the study of variables was computer science, with 989 published documents.

Keywords: Information and Communication Technologies, ICT, Teaching, Learning, Ecuador.

1. Introduction

Regardless of the area of knowledge, everyone needs to keep up to date with the changes and issues in the environment and the world. Therefore, reading the newspaper, researching, and interacting with foreigners, among others, have become activities that can be carried out from any device that has access to Information and Communication Technologies, which can be defined as follows. "Information and Communication Technologies (ICT) are the set of resources, tools, equipment, software, applications, networks and media; that allow the compilation, processing, storage, and transmission of information such as voice, data, text, video and images" (Ministerio de las Tecnologías de la Información y las Comunicaciones, n.d.).

In the case of educational processes, ICTs are used as mechanisms or tools that seek to improve the teaching and learning processes to obtain better results from the students and therefore achieve their comprehensiveness. Furthermore, as a Latin American country with a large percentage of its population living in rural areas, Ecuador has sought to guarantee access to these technologies to its inhabitants and thus reduce the social gap between urban and rural areas and school dropouts due to a lack of resources.

The teaching team chooses any resource used or implemented in the classroom according to their needs and those of their students. However, this is not a guarantee to achieve the expected results as it depends on multiple factors framing an educational process. This research article describes the main characteristics of the set of publications in the Scopus database that are directly related to the variables mentioned above, as well as the description of the position of certain authors affiliated with institutions around the world during the period between the years 2018 and 2022.

2. General Objective

To analyze from a bibliometric and bibliographic perspective, the elaboration of works on the variables Information and Communication Technologies (ICTs) and their Impact on Ecuadorian education during the period 2018-2022.

3. Methodology

This article is conducted through a mixed research approach combining quantitative and qualitative methods.

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 and Communication Technologies ICTs and their Impact on Ecuadorian education.

On the other hand, from a qualitative perspective, examples of some research works published in the area of the study mentioned above are analyzed from 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, establishing the parameters referenced in *Figure 1*.
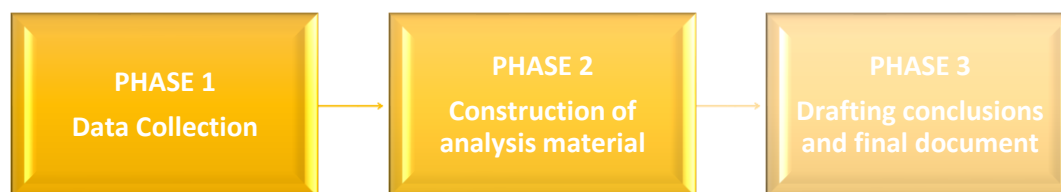
3.1 Methodological design

| PHASE 1 Data Collection | → | PHASE 2 Construction of analysis material | → | PHASE 3 Drafting conclusions and final document |

Figure 1. *Methodological design*
Source: Own elaboration

3.1.1 Phase 1: Data Collection

The data collection was executed from the Search tool on the Scopus web page, where 1576 publications were obtained from the choice of the following filters:

information AND communication AND technologies AND in AND education AND ecuador AND (LIMIT-TO (AFFILCOUNTRY ,"Ecuador")) 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)))

- Published documents whose study variables are related to the study of Information and Communication Technologies (ICTs) and their impact on Ecuadorian education.
- Limited to the years 2018-2022.
- Limited to Ecuador.
- No limit in areas of knowledge.
- Without distinction of type of publication.

3.1.2 Phase 2: Construction of analysis material

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

- Word co-occurrence.
- Year of publication.
- Country of origin of the publication.
- Knowledge area.
- Type of Publication.

3.1.3 Phase 3: Drafting conclusions and final document
In this phase, the study analyzed the results previously obtained, resulting in the determination of conclusions and, consequently, the final document.

4. Results
4.1 Co-occurrence of words
Figure 2 shows the co-occurrence of keywords found in the publications identified in the Scopus database.
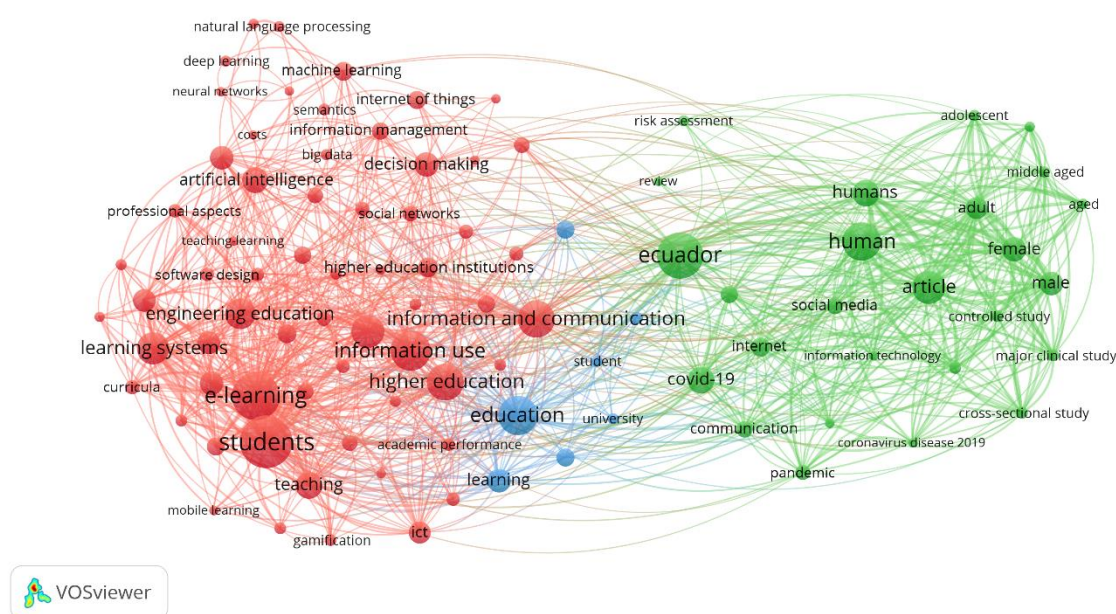

Figure 2. *Co-occurrence of words*
Source: Own elaboration (2023); based on data exported from Scopus.

The data in Figure 2, exported from Scopus, shows the variables and their relationship with other terms, which is explained below.

The implementation of Information and Communication Technologies in Ecuador has undoubtedly modified the teaching doctrine that in the past was maintained in the classroom where the student was limited to listening, writing and repeating what the teacher shared because there was no access to electronic resources to create different points of view from the information found. In general, ICTs have become a necessity that has not only facilitated the expansion of knowledge by teachers and students while keeping them updated but has also allowed the educational sector to adapt diverse methodologies that make teaching times more enjoyable and participatory.

Being such an essential resource, nowadays, it is normal to find the use of mechanisms linked to these technologies in the different grades of schooling, from early childhood to adulthood.

4.2 Distribution of scientific production by year of publication

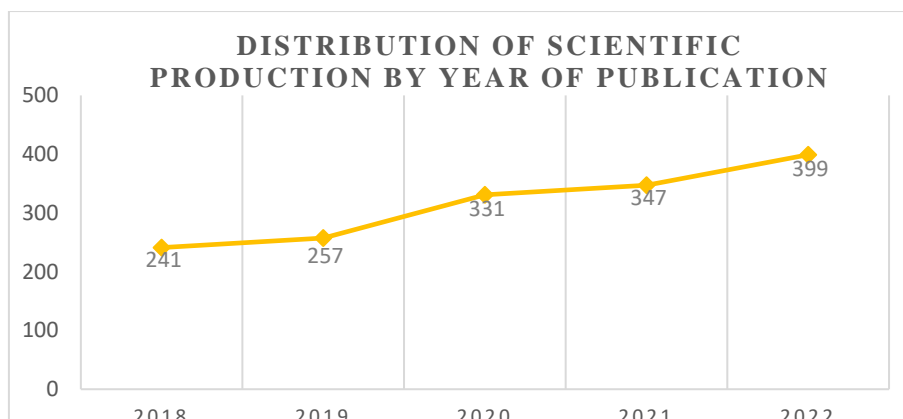*Figure 3* shows the distribution of scientific production according to the year of publication.

Figure 3. *Distribution of scientific production by year of publication.*
Source: Own elaboration (2023); based on data exported from Scopus.

Figure 3 shows the scientific production concerning the variables Information and Communication Technologies ICTs and their influence on Ecuadorian education from 2018 to 2022, which resulted in the publication of 1576 documents in the Scopus database containing the keywords. Likewise, several changes were experienced throughout the period, starting in 2018 with 241 documents, which increased significantly during the following years. In 2019, 257 texts were published; in 2020, they exceeded 300 publications. In 2021, the increase continued achieving the publication of 347 documents, a figure surpassed in 2022 with 399 texts, becoming the highest number of research published.

From the latter year, the article entitled "A hybrid methodology to improve oral skills in English language learning using mobile application" is highlighted (Criollo et al., 2022), which studies a mixed methodology that makes use of traditional methods and mobile devices to facilitate and guarantee the learning of English as a second language, focusing on the ability of students to communicate positively after completing their educational process. English is the language most used in international communications, commercial transactions, finance and science (Criollo et al., 2022), so it undoubtedly represents a great competitive advantage for those who can communicate successfully.

4.3 Distribution of scientific production by country of origin.

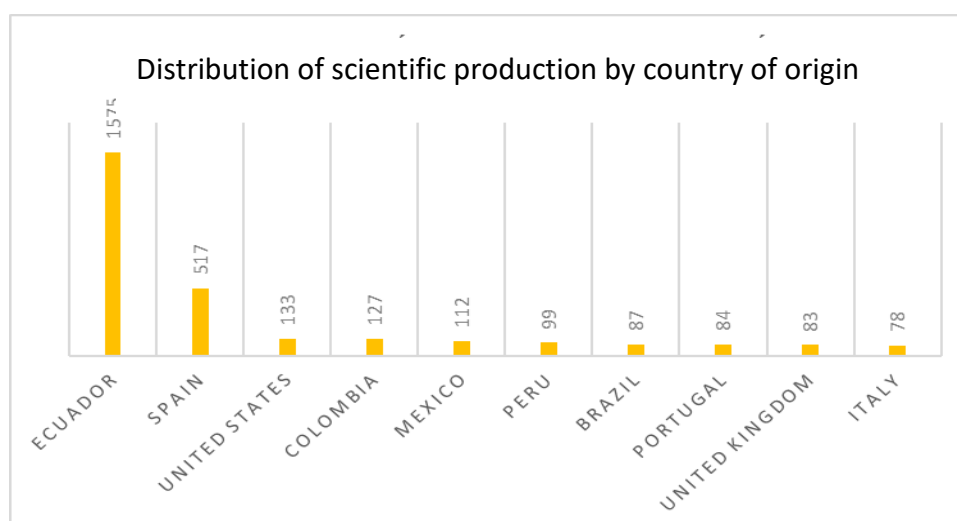*Figure 4* shows the distribution of scientific production according to the nationality of the authors.

Figure 4. *Distribution of scientific production by country of origin.*
Source: Own elaboration (2023); based on data provided by Scopus.

In the study of Information and Communication Technologies (ICTs) and their Impact on Ecuadorian Education, Ecuador leads the list of published documents with a total of 1575 records in the Scopus database during the period of the years 2018-2022, followed by Spain and the United States with 517 and 133 texts each.

The article entitled "Educational Innovation in Adult Learning Considering Digital Transformation for Social Inclusion" (Inga & Ramirez, 2022) sought to determine alternatives that would allow "educational innovation and evolution for Youth and Adult Basic Education and thus achieve social inclusion in a rural development environment that presents technological and internet access limitations in rural areas" (Inga & Ramirez, 2022). In this case, the greatest concern is the little existing knowledge about Language and Literature, which makes it more difficult for students to understand the material provided by their teachers to complement their classes, so 66.67% of teachers agree with implementing ICT as a strategy for better learning in the education of youth and adults despite the limited access to the Internet in rural areas.

At this point, it is important to note that the elaboration of scientific publications, in many cases, is based on collaborations that may involve private and public institutions from one or several countries. Therefore, the same publication may be linked to one or more authors with different nationalities and thus to more than one country simultaneously, making part of each of the total number of articles or publications in the final sum. *Figure 5* below shows in greater detail the flow of collaborative work carried out by several countries.
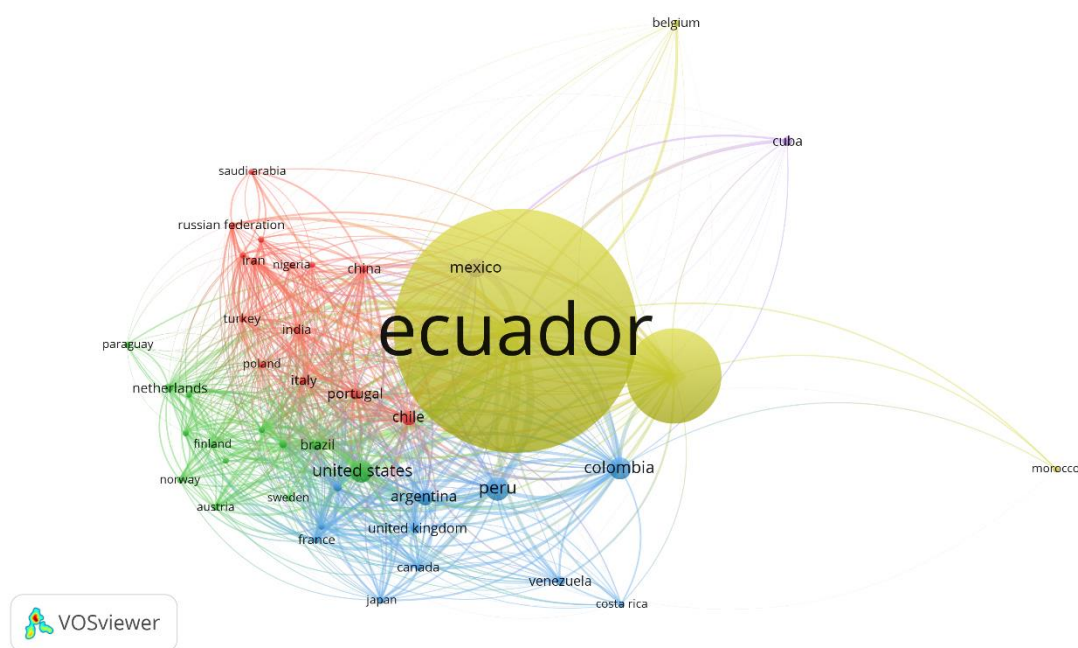

Figure 5. *Co-citations between countries.*
Source: Own elaboration (2023); based on data provided by Scopus.

Figure 5 shows the research grouping according to the collaboration between authors from different international institutions. There is outstanding participation between authors affiliated with institutions from Latin American countries such as Ecuador, Mexico, Venezuela, and Colombia and countries from other regions such as Belgium, Morocco, the United States, and the United Kingdom.

4.4 Distribution of scientific production by area of knowledge

Figure 6 shows the distribution of the production of scientific publications according to the area of knowledge through which the different research methodologies are implemented.
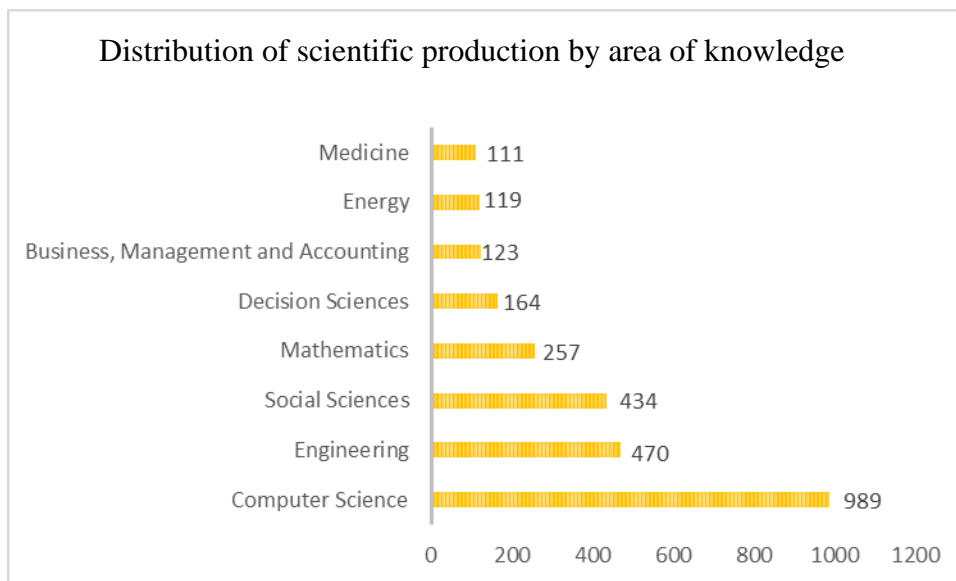
Figure 6*. Distribution of scientific production by area of knowledge.*
Source: Own elaboration (2023); based on data provided by Scopus.

Due to the nature of the variables, it is not surprising that most of the publications found in the Scopus database on these variables are from the field of computer science, which occupies the leading position in the publication of documents. However, other areas, such as engineering and social sciences, have contributed to the study of these variables, publishing 470 and 434 documents each.

As shown in *Figure 6,* the variables object of this study are relevant in different areas of knowledge since the Information and Communication Technologies (ICTs) can be used for multiple purposes, among them to facilitate the teaching and learning of different competencies, so the implementation of these can have a positive impact on the understanding and better application of the knowledge acquired at the end of the educational processes.

4.5 Type of publication

Figure 7 shows the distribution of the bibliographic findings according to the type of publication made by each of the authors found in Scopus.
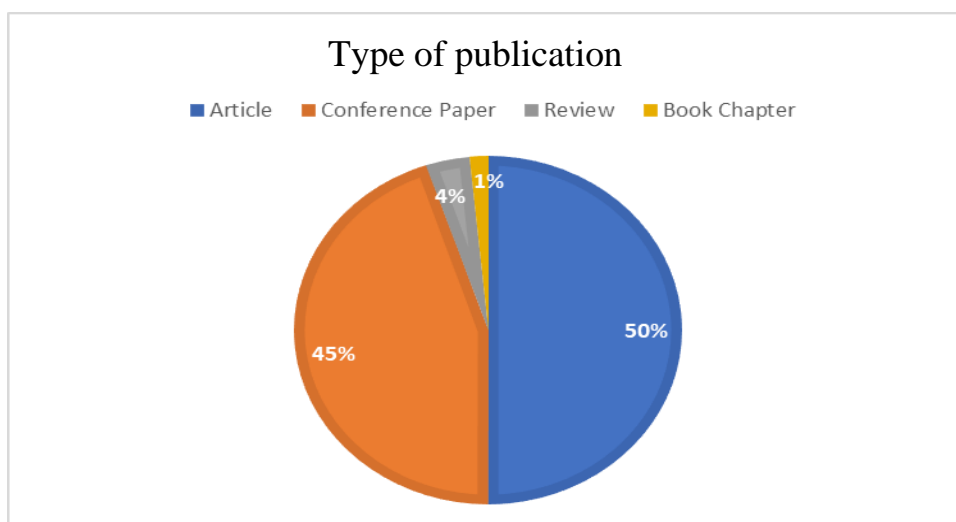

Figure 7*. Type of publication.*
Source: Own elaboration (2023); based on data provided by Scopus.

Figure 7 clearly shows that the predominant type of publication in the study of Information and Communication Technologies (ICTs) and their Impact on Ecuadorian education was the journal article, with a total of 785 documents, corresponding to 50% of the publications. In second place were conference proceedings with 703 documents, followed by reviews with 57 publications, representing 45% and 4%, respectively.

The article entitled "Proposal for the Analysis of the State of Learning in University Students with the Inclusion of ICT in the Classroom" (García-Ortiz et al., 2022) raises the need to know the needs of each educational institution before including ICTs as an educational tool since according to this, the best resources for teaching can be determined. Therefore, it "seeks to create a method that allows establishing the needs and doubts of students about the use of educational technologies in the classroom without affecting their performance" (García-Ortiz et al., 2022). As a result, the study analyzed three different contexts in which students' performance and how technology affected their learning.

5. Conclusions
After the bibliometric analysis carried out in the present research, it was possible to establish that Ecuador was the country with the highest number of published records regarding the variables Information and Communication Technologies ICTs and their Impact on Ecuadorian education with a total of 1576 publications in Scopus database during the period 2018-2023 and that the area of knowledge with the highest contribution was computer science with a total of 989 texts.

On the one hand, it was possible to identify that although the use of ICTs is important as a support in the teaching and learning processes, the best results are not obtained in all cases since it depends on the context and the type of people participating in the classroom. Regarding online classes, a comparison with a one hundred percent face-to-face class does not show many differences in the benefits generated by the implementation of either of the two methodologies. This is why it could be suggested that creating a third educational model that combines the best practices of online and face-to-face learning in a hybrid system could be an alternative that improves student satisfaction (Checa-Morales et al., 2022). On the other hand, the perception of teachers and students regarding the use of ICTs in their educational processes are quite similar. On the other hand, students prefer hybrid models that harmoniously combine face-to-face and virtual learning instead of face-to-face. The students, on the other hand, maintain a preference for hybrid models that harmoniously combine face-to-face and virtual learning rather than the exclusive predominance of only one of these two forms of teaching interaction, while teachers, through the multiple perceptions they have about ICTs, prefer them for making their work easier by promoting the active participation of their students and therefore achieving a greater acceptance of the topics.

Although using ICTs has contributed to improving education, there is still a big gap between the rural and urban sectors, so the improvement indicators are not the highest. For this reason and to continue generating awareness of the importance of ensuring access to ICTs to the entire Ecuadorian population that leads to the reduction of school dropout and improvement of the education system, we hope to encourage 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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