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Information and Communication Technologies in Inclusive Education: A Bibliometric Approach in Scopus

María Del Carmen Emilia Ancaya-Martínez[1], Carmen Rosa Rodríguez-Caro[2], Román Jesús Marquina-Luján[3], María Rosario Palomino-Tarazona[4], Roxana Beatriz Gonzales-Huaytahuilca[5], William Eduardo Mory-Chiparra[6]

Abstract

The rise of information and communication technologies has changed lifestyles and academic sectors, facilitating the inclusion of diverse students in the classroom. The present study aimed to analyze the bibliometrics in Scopus on ICT in inclusive education between 2002 and 2023. It was a bibliometric analysis that defined the metrics of scientific production. The indicators were obtained from 94 documents chosen from the Scopus database using keywords in English (information and communication technologies, inclusive education). The results show that the year with the highest scientific production was 2022 (n=22; 23.4%). In addition, Spain (21.6%; n=27) is the country with the most publications, as is the University of Seville (n=5). The journal Sustainability Switzerland published 6 (96 citations) papers, with authors Asongu, S.A. and Fernández-Batanero, J.M. being the most cited (88 and 42 citations respectively). From the studies analyzed, it is concluded that the field of ICT in inclusive education has grown in resources, authorship and thematic variety, due to the potential of ICT to solve massive problems, which improves access, equity and participation in education.

Keywords: *Information and Communication Technologies, Inclusive Education, Students, Scientific Production, Bibliometric.*

INTRODUCTION

Globally, debates on educational inclusion have come to the forefront of policy discussions in education (Cabero-Almenara & Valencia-Ortíz, 2019). In addition, the importance of information and communication technologies (ICTs) in all areas of human endeavor, including education, is increasingly recognized (Vértiz-Osores et al., 2019). For this reason, there are factors that advocate the use of ICTs as tools to enhance inclusion processes among the socially vulnerable and disadvantaged (Anagnostopoulou et al., 2021).

In that order of ideas, the fact that a student with special educational needs learns in a unique way does not prevent teachers from providing the highest quality education possible, nor does it prevent the school from making the necessary adjustments to ensure the success and development of his or her potential (Valenzuela et al., 2020; Navarro, 2023). Thus, the increasing use of ICT by organizations represents more than a challenge, an opportunity in developing countries, since their practical applications can help provide more employment and money, reducing poverty in developing nations (Cruz & Soria, 2022; Crescenzi et al., 2019).

On the other hand, inclusion has been seen as a procedure that requires bets from a differential point of view, from a human rights stance, in order to put ideas into practice, inclusive educational models are needed that adapt to the different circumstances and needs of students of all ages and backgrounds, that eliminate all obstacles (physical, pedagogical and attitudinal) and promote diversity as a resource for learning and growth of human development (Aguirre et al., 2019).

[1] Universidad César Vallejo, Lima, Perú, E-mail: mancayam@ucv.edu.pe

[2] Universidad César Vallejo, Lima, Perú, E-mail: crodriguezca17@ucvvirtual.edu.pe

[3] Universidad César Vallejo, Lima, Perú, E-mail: rmarquinal@ucvvirtual.edu.pe

[4] Universidad César Vallejo, Lima, Perú, E-mail: mpalominot@ucv.edu.pe

[5] Universidad César Vallejo, Lima, Perú, E-mail: rgonzalesh@ucv.edu.pe

[6] Universidad César Vallejo, Lima, Perú, E-mail: wmoryc@ucv.edu.pe

In any case, inclusive education refers to an education system in which students of all backgrounds and abilities come together to learn and grow as a community, including those with special needs, being necessary to make significant adjustments in the structure, pedagogical proposal and operation of the institution to meet the needs of each student, ensuring that all reach their full potential in the classroom and participate equitably (Vera & Yarce, 2022; González et al., 2022).

Because of this, ICT can help in a variety of ways, including: adopting new or improved educational methods and incorporating resulting pedagogical and structural changes, supporting communication processes and breaking the unity of space, time and action, which is typically where traditional training activity originates (Anagnostopoulou et al., 2022; Agudo et al., 2020).

Therefore, according to Ordoñez (2021) the connection between ICTs and inclusive education can be seen from two angles; on the one hand, they can help individuals to obtain quality education and, on the other hand, they can remove the obstacles that have prevented some people from obtaining an education, since the only access to the world of education and culture is through technological means, which encourages the construction of accessible environments (Montenegro et al., 20220).

Likewise, Verdugo et al. (2022) point out that ICT initiatives for vulnerable populations offer a new and promising avenue to educate these people and incorporate them into the mainstream of the knowledge society, as they will enable the creation of enriched learning environments that can help subjects to overcome the social, economic, educational and cultural disadvantages in which they develop, which promotes equal opportunities for all to acquire relevant skills and knowledge.

In addition, in recent decades there has been an increase in the study of the role of ICTs in inclusive education, which has led to the development of measurements and models that seek to explain behaviors and discover causal links between different factors (Gómez et al., 2022). Consequently, bibliometrics, as the study of quantifying information about documents and other types of literature, helps researchers to monitor the growth of scientific publications and to make inferences about the importance of the works under review (Caló, 2022; Leyva et al., 2022).

This option is useful for databases that track scientific background in order to provide reliable details on the resources used and the results of studies (Sanz, 2022). For this purpose, bibliometric indicators are constructed, which serve as numerical representations of the results of metric evaluations of scientific production in this or related areas (Antón, 2022; Astudillo & Marí, 2023).

Therefore, to better explain and analyze the academic community's understanding of ICT in education, it is necessary to classify and capture the information according to various bibliometric indicators, such as year of publication, country, subject area, type of document, source and authorship. Based on this premise, the study aims to analyze the bibliometrics in Scopus on ICT in inclusive education between 2002 and 2023.

METHODOLOGY

Using bibliometric methods, the existing literature on the use of ICTs in inclusive education was analyzed. Likewise, bibliometrics was essential to provide researchers with the necessary data for the study (Salinas and García, 2022). The Scopus database was consulted, due to its wide use and indexing of scientific papers from all over the world, in addition, the search was conducted between the period of 2002 and 2023.

As an additional part of the search strategy, the following Boolean search terms were selected and applied to the keywords, title and abstract: information AND communication AND technologies, including AND education (Gómez et al., 2022; Velarde-Molina et al., 2023). Using this method, a total of 100 files were collected. However, filters were applied to the collected data before generating a final sample. To ensure that the sample was sufficiently representative of the whole, data from 94 documents were taken for the study. In addition, the following exclusion criteria were defined during data filtering: 1) research outside the study period (2002-2023), 2) duplicate publications, and 3) studies not directly related to the topic under study.

Consequently, a set of bibliometric indicators was used to evaluate the quality of the academic production represented by the 94 papers: such as production by year of publication, authorship trends, original source or

journal, place of origin, type of document, subject area, institutional affiliation, etc. (Florez-Fernández & Aguilera-Eguía, 2020).

Finally, descriptive statistics and count data were used to draw conclusions. Descriptive data on the documentary volume of the sample were compiled and analyzed in Excel. Keyword co-occurrence and source density maps were also made using VOSviewer V_1.6.19.

RESULTS

A total of 94 academic papers on the topic of ICT in inclusive education were selected for the bibliometric analysis, which was conducted between 2002 and 2023. Figure 1 shows the total number and distribution of recent international publications indexed by Scopus on this topic. The years 2018-2022, which together account for 63.8% of all global publications with 60 academic papers, show signs of an exponential growth trend in annual publication rates.

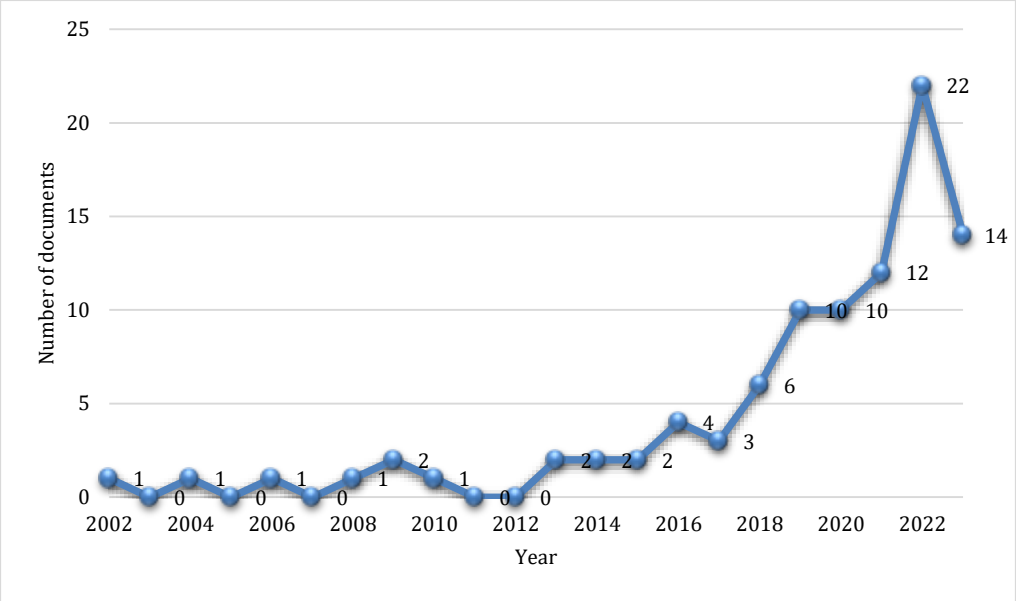

Figure 1. Documents published by year.

Source: Scopus data (2023).

The geographical distribution of the published papers can be seen in Table 2. Due to the large number of nations considered (n=46), those with the highest concentration of academic production in this field are highlighted. The top three countries in terms of scientific production are Spain (21.6%; n=27), South Africa (6.4%; n=8) and the United States (6.4%). In addition, English was the most common language of the approved papers (82%), followed by Spanish (14%) and Portuguese (4%).

Table 1. Publication of documents by country.

N°	Country	Number of documents	%	N°	Country	Number of documents	%
1	Spain	27	21.6%	21	Rwanda	2	1.6%
2	South Africa	8	6.4%	22	Sweden	2	1.6%
3	United States	8	6.4%	23	Argentina	1	0.8%
4	Australia	5	4.0%	24	Bahrain	1	0.8%
5	United Kingdom	5	4.0%	25	Colombia	1	0.8%
6	Brazil	4	3.2%	26	Costa Rica	1	0.8%
7	China	4	3.2%	27	Croatia	1	0.8%
8	Mexico	4	3.2%	28	Denmark	1	0.8%
9	Portugal	4	3.2%	29	Finland	1	0.8%
10	Bangladesh	3	2.4%	30	Hong Kong	1	0.8%

11	Ecuador	3	2.4%	31	Iran	1	0.8%
12	Greece	3	2.4%	32	Iraq	1	0.8%
13	India	3	2.4%	33	Malaysia	1	0.8%
14	Italy	3	2.4%	34	Morocco	1	0.8%
15	Norway	3	2.4%	35	Niger	1	0.8%
16	Canada	2	1.6%	36	Pakistan	1	0.8%
17	Czech Republic	2	1.6%	37	Poland	1	0.8%
18	France	2	1.6%	38	Puerto Rico	1	0.8%
19	Netherlands	2	1.6%	39	Indefinite	8	6.4%
20	Russian Federation	2	1.6%	Total countries		46	

Source: Scopus data (2023).

A total of 74 academic sources contributed to the data used in this study. Table 2 contains a list of the journals considered for this study. As can be seen, Sustainability Switzerland is the journal that published the most papers (n=6), followed by International Journal of Environmental Research and Public Health (n=4). The journals occupy prominent positions (top two quartiles) in terms of their impact factors, placing them among the most influential in their fields.

Table 2. Publication of documents by source or journal.

Source or Magazine	Number of documents	Source or Magazine	Number of documents	Source or Magazine	Number of documents
Sustainability Switzerland	6	Applied Sciences Switzerland	1	Digital Education Review	1
International Journal of Environmental Research and Public Health	4	Archives of Physiotherapy	1	Digital Library Perspectives	1
Education and Information Technologies	2	Australasian Journal of Educational Technology	1	Disability and Rehabilitation Assistive Technology	1
Education Sciences	2	BMC Public Health	1	Education And Society	1
Frontiers in Psychology	2	BMJ Open	1	Edutec	1
Jmir Formative Research	2	Bordon	1	Electronic Journal of E Learning	1
Mediterranean Journal of Social Sciences	2	Bordon Journal of Pedagogy	1	European Review	1
Brazilian Journal of Special Education	2	British Journal of Educational Technology	1	Foundations of Management	1
Societies	2	Ciriec Espana Journal of Social and Cooperative Public Economics	1	IFIP International Federation for Information Processing	1
ACM Journal on Educational Resources in Computing	1	Communicate	1	Information Technology for Development	1
African Journal of Primary Health Care and Family Medicine	1	Croatian Journal of Education	1	Interdisciplinary	1
Aloma	1	Curationis	1	Undefined	37
Electronic Yearbook of Social Communication Studies Dissertations	1	Cypriot Journal of Educational Sciences	1	Total magazines	74

Source: Scopus data (2023).

Based on the information collected from the selected sources, a bibliographic cluster analysis was carried out to categorize the different types of published texts. Figure 2 shows that there are four main clusters: the first corresponds to Sustainability Switzerland (96 citations), the second to Jmir Formative Research (26 citations), the third to International Journal of Environmental Research and Public Health (20 citations) and the fourth to Frontiers in Psychology (15 citations). Bibliographic studies have shown that highly cited articles are frequently published in the same journals or primary sources, as seen in the following data.

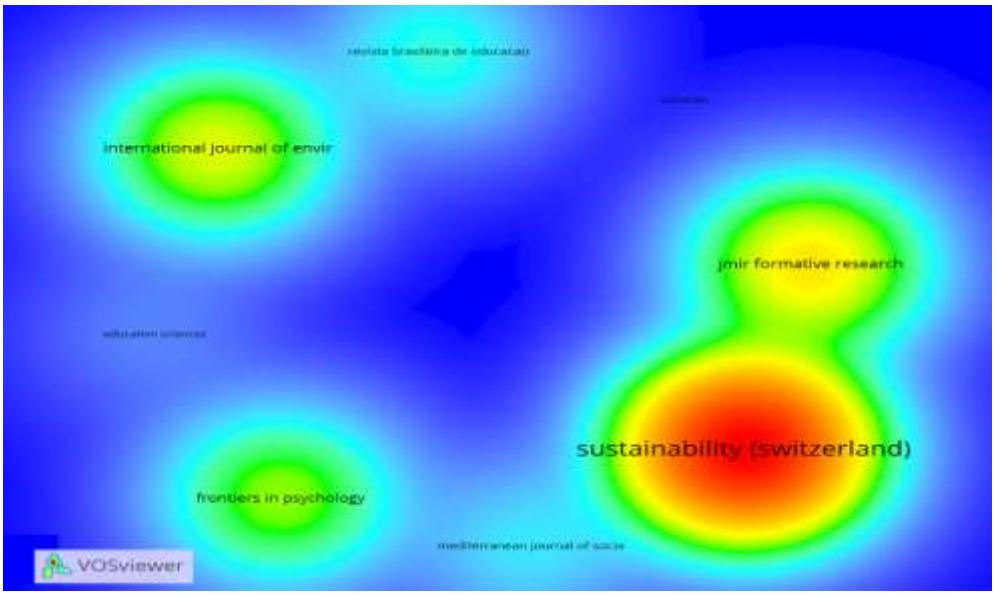

Figure 2. Map of source or journal clustering density.

Source: Results in VOSviewer (2023).

Researchers from 103 different academic institutions collaborated in the development of these 94 research papers. As can be seen in Figure 3, the University of Seville (n=5) published the most articles on the topic of ICT in inclusive education during the designated study period, followed by the Universities of South Africa, Cordoba, Jaen and Pretoria (all with three articles each). Finally, during the study period, researchers from the University of Castilla-La Mancha published two academic articles.

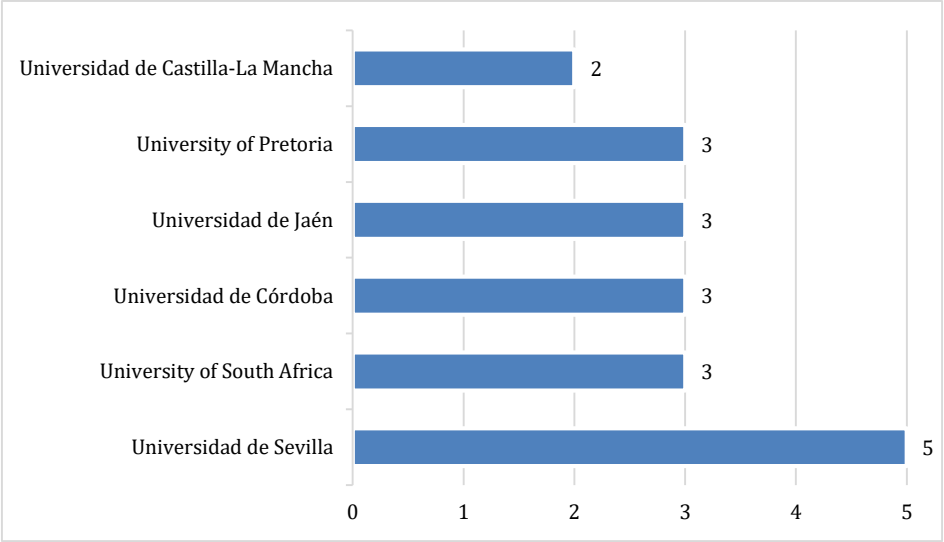

Figure 3. Documents published by institution.

Source: Scopus data (2023).

A total of 119 authors representing various academic institutions contributed to the selected academic papers. Table 3 reveals more information, noting that Fernández-Batanero J.M. was the author who published the most papers (n=3). However, Asongu, S.A. ranked first with a total of 88 citations.

Table 3. Published papers by author.

By author	Quantity	Total citations	By author	Quantity	Total citations
Fernández-Batanero, J.M.	3	42	Soron, T.R.	2	11
Asongu, S.A.	2	88	Acosta-Vargas, P.	1	5
Fernández-Cerero, J.	2	5	Aguirre, B.O.A.	1	7
Karangwa, E.	2	11	Al Mansouri, M.	1	2
Montenegro-Rueda, M.	2	5	Al Mutawaa, A.	1	2
Nduwingoma, M.	2	11	Al Tamimi, A.	1	2
Ntalindwa, T.	2	11	Alam, K.	1	2
Palomares-Ruiz, A.	2	5	Almashhadani, A.N.	1	1

Source: Scopus data (2023).

Table 4 organizes all the papers that were published during the study period (2002-2023) that dealt with the use of ICTs in inclusive education and classifies them according to the subject area in which they were published, as well as the type of publication they were. Data from 20 different scientific disciplines reveal that, social sciences account for 32% of all scientific output worldwide, while computer science contributes 14% and medicine 10%. There are a total of 20 different subject areas. On the other hand, when examining the production according to the different categories of documents, it is observed that scientific articles constitute the largest part of the production (95.7%), followed by book chapters (2.1%) and books (2.1%) respectively.

Table 4. Publication of documents by subject area and type.

By area	Quantity	%
Social Sciences	60	33%
Computing	25	14%
Medicine	19	10%
Psychology	14	8%
Neuroscience	13	7%
Arts and Humanities	10	5%
Health professions	9	5%
Energy	7	4%
Engineering	6	3%
Decision Sciences	4	2%
Other areas	16	9%
Total	183	100%
By type	Quantity	%
Article	90	95.7%
Book chapter	2	2.1%
Book	2	2.1%
Total	94	100%

Source: Scopus data (2023).

The information shown in Figure 4 was obtained by filtering the terms that appeared (more than three times) in the titles, keyword lists and abstracts of the publications that were analyzed. Each color denotes a different set of keywords, which can be distinguished from each other based on the degree to which VOSviewer considers that there is a connection between the keywords in question.

Green cluster. "ICT" (n=64 occurrences), groups the following words: student, accessibility, higher education, teacher training, inclusion, technology, sustainable development.

Blue cluster. "inclusive education" (n=53 occurrences), groups the following words: e-learning, teaching, information and communication, engineering education.

Red cluster. "human" (n=28 occurrences), groups the following words: learning, school, communication, woman, man, information and communication technologies, adult.

The grouping shows that the most frequently used terms have a clear relationship with the research topic.

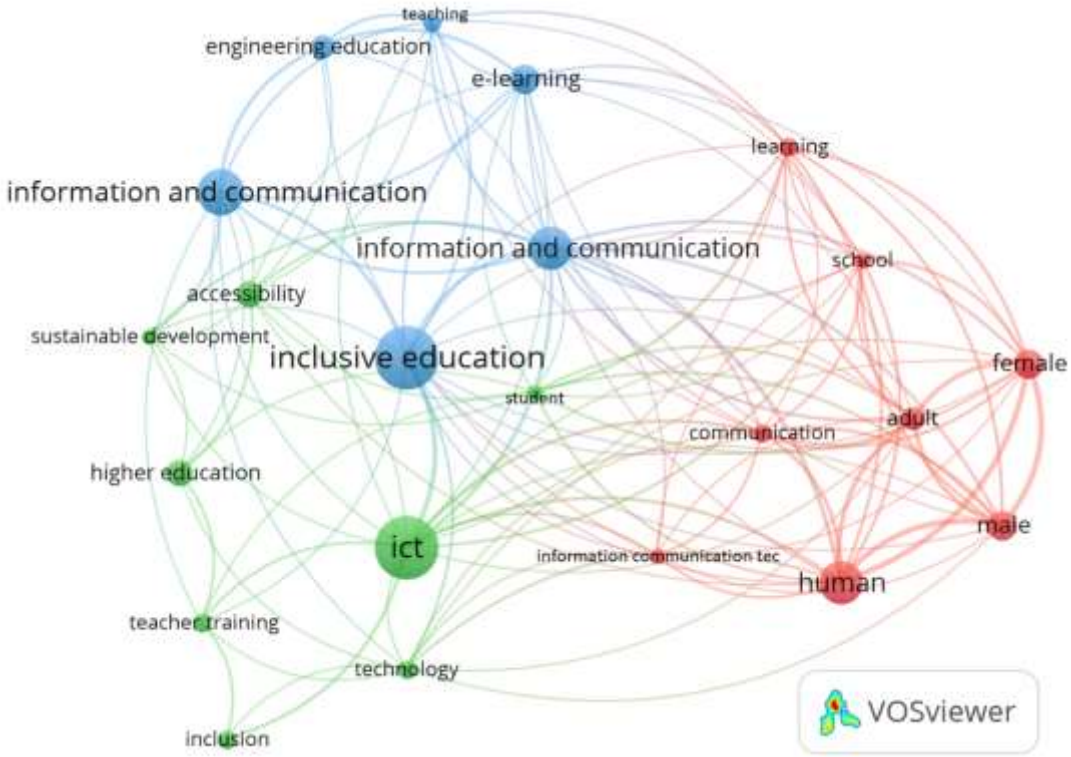

Figure 4. Map of keyword co-occurrence.

Source: Results in VOSviewer (2023).

DISCUSSION

The results suggest that between 2018 and 2022 (n=60; 63.8%), the highest number of published papers is represented, suggesting an exponential growth of scholarly publications related to ICT in inclusive education over the study period from 2002 to 2023.

According to Reyes and Prado (2020), there has been an increase in the number of academic works dealing with this topic. This is due to the fact that ICTs, in their multiple forms and functions, play a crucial role in the evolution of inclusive education by helping to give practical expression to its guiding principles-among them, the pursuit of access, equality, democracy, quality, social justice, participation, and a healthy balance between diversity and community (Rosado et al., 2022). Therefore, it is crucial for teachers to have knowledge of ICTs so that they can use them effectively to improve students' access to and engagement with formal education, because they help disseminate information and promote equality through the use of technology in education (Rodriguez et al., 2020; Silva & Oliveira, 2022).

On the other hand, compared to other universities, the University of Seville has contributed five academic papers. Likewise, approximately eight out of ten (82%) of the papers published on this topic are of English authorship, while Spain represents 21.6% (n=27) of the world production in this field, Asongu, S.A. was the most frequently referenced author (n=88 citations). It was also found that the largest number of scientific papers (n=6) were published in Sustainability Switzerland, which received 96 citations.

According to Planta-Ulloa et al. (2023), he argues that international collaboration is crucial for the advancement of knowledge. Consequently, inclusive education is a pressing concern that must be incorporated into all existing educational models to foster communication, education and the full development of the potential of all students, thus, contributing greatly to the development of a more just and egalitarian society (Bolaño, 2019; García & Fabra, 2023). In this sense, it is important to raise awareness of how ICTs are changing education,

and to insist on training new teachers to use ICTs effectively with diverse student populations, including those with disabilities and at risk of social exclusion (Concha et al., 2023).

Likewise, the documents on ICT in inclusive education selected for this analysis included similar terms indicating interdisciplinarity in the fields of neuroscience, engineering, psychology, arts and humanities, among others. However, 57% of all papers belong to the fields of medicine, computer science, and social sciences. In addition, scientific articles represent 95.7% of the total production. Although "ICT" is the keyword that appears most frequently in the papers, other terms such as "inclusive education" and "human", are found throughout the analysis and are closely related to the topics investigated by the authors. That is, the clusters created by the co-occurrence network serve as a visual representation of the fundamental ideas shared by the various fields of study contributing to the topic under investigation.

Therefore, according to Alnasser (2020) this means that teachers and students are free to adapt and freely adapt the content of digital learning objects produced with ICTs. In general, Rodriguez et al. (2023) argue that ICTs are an essential technological tool to achieve educational inclusion, which helps people in vulnerable situations to acquire knowledge and advance in their learning. In this sense, according to Bernate & Fonseca (2023), this makes ICTs crucial and vital tools to bring education closer to all vulnerable people and incorporate them into the 21st century society.

CONCLUSION

According to the study objective, the bibliometric analysis of all the documents indexed in Scopus from 2002 to 2023 revealed that studies that include ICT in inclusive education grew exponentially during this period of time, with 2022 being the year with the highest growth rate (23.4%; n=22). Likewise, out of a sample of 46 countries, Spain is responsible for 21.6% (27 papers) of the scientific production.

In addition, Sustainability Switzerland is the journal with the most papers published (n=6). For its part, the University of Seville has produced five academic papers related to this topic. Most of the papers were scientific articles (95.7%), and were classified in one of the three main areas of study: social sciences (33.3%), computer science (14%) or medicine (10%). The VOSviewer keyword analysis revealed that "ICT" was the most frequently used term, with 64 occurrences.

The analysis of the study's sample of 94 documents reveals that ICT in education is conceived as a tool for promoting social and human development that takes into account various avenues for improvement as vital components of the shift towards information societies. Finally, it is concluded that the field of ICT in inclusive education has led to an expansion, both in terms of number of resources available and in terms of authorship and thematic variety, due to the potential of ICT used to address massive problems, which translates into improved access, equity and participation in education.

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