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ORIGINAL BRIEF

Scientific production on the use of ICT as a tool for social inclusion for deaf people: a bibliometric analysis

Producción científica sobre el uso de las TIC como herramienta de inclusión social para personas sordas: un análisis bibliométrico

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ABSTRACT

Introduction: this article presents a bibliometric analysis on the scientific production related to the use of Information and Communication Technologies (ICT) as a tool for the social inclusion of deaf people.
Objective: the objective of this study is to identify the trends and patterns of scientific production in this field of research, as well as to determine the most relevant countries, authors and publication sources.
Methods: a systematic search was carried out in Scopus, using the keyword "deaf" combined with "worker" in the area of computing. 140 scientific publications that met the inclusion criteria were selected.
Results: the results of the bibliometric analysis show a significant increase in the number of publications related to the use of ICT as a tool for social inclusion for deaf people from the year 2008. In addition, six countries responsible for 56 % of the production were identified. science: United States, India, United Kingdom, Brazil, Japan and Spain. The most published author is Bigham Jeffrey P., affiliated with Carnegie Mellon University. The universities with the highest affiliation in the publications are Carnegie Mellon and Rochester Institute of Technology.
Conclusions: this bibliometric analysis reveals a growing interest in the use of ICT as a tool for social inclusion for deaf people, and provides valuable information on the most relevant countries, authors and publication sources in the study area. The results suggest the need to continue research in this area and promote international collaboration to advance the social inclusion of deaf people.

Keywords: Information Technologies; Social Inclusion; Deaf People; Scientific Production.

RESUMEN

Introducción: este artículo presenta un análisis bibliométrico sobre la producción científica relacionada con el uso de las Tecnologías de la Información y las Comunicaciones (TIC) como herramienta de inclusión social para personas sordas.
Objetivo: el objetivo de este estudio es identificar las tendencias y patrones de producción científica en este ámbito de investigación, así como determinar los países, autores y fuentes de publicación más relevantes.
Métodos: se llevó a cabo una búsqueda sistemática en Scopus, utilizando la palabra clave "sordo" combinada con "trabajador" en el área de ciencias de la computación. Se seleccionaron 140 publicaciones científicas que cumplían con los criterios de inclusión.
Resultados: los resultados del análisis bibliométrico muestran un aumento significativo en el número de publicaciones relacionadas con el uso de las TIC como herramienta de inclusión social para personas sordas a partir del año 2008. Además, se identificaron seis países responsables del 56 % de la producción científica: Estados Unidos, India, Reino Unido, Brasil, Japón y España. El autor con más publicaciones es Bigham Jeffrey P., con filiación en Carnegie Mellon University. Las universidades con mayor filiación en las publicaciones son

Carnegie Mellon y Rochester Institute of Technology.
Conclusiones: este análisis bibliométrico revela un creciente interés en el uso de las TIC como herramienta de inclusión social para personas sordas, y proporciona información valiosa sobre los países, autores y fuentes de publicación más relevantes en el área de estudio. Los resultados sugieren la necesidad de continuar investigando en este ámbito y fomentar la colaboración internacional para avanzar en la inclusión social de las personas sordas.

Palabras clave: Tecnologías de la Información; Inclusión Social; Personas Sordas; Producción Científica.

INTRODUCTION

The social inclusion of people with disabilities has been a relevant topic in the last decade and Information and Communication Technologies (ICT) have shown to be important tools to achieve this goal. In particular, deaf people face communication barriers that can limit their participation in society, but ICT can provide a viable solution to improve their social inclusion.[1]

Despite advances in ICT, there are still barriers to the social inclusion of deaf people, and this is reflected in the limited scientific production in this research area. Therefore, it is important to analyze the existing scientific production to better understand the current research landscape and determine areas that need more attention.[2]

The term inclusion is constantly revolutionizing the social landscape by challenging established norms and ideals for the community. With the development of smaller communities and migration from underdeveloped countries to an industrial and democratic context, efforts to provide support and participation to people whose abilities differ from the majority become a fundamental axis of development policies. In this sense, the employment of people with disabilities in different labor components is encouraged. But it is not enough to generate opportunity; it is necessary to ensure that it is in line with what is desired and to guarantee that people reach their full potential.[3]

In this context, hearing disabilities and information technologies present an opportunity for insertion into the economic world. However, it is essential to understand the evolution of scientific production on this topic to identify trends and determine areas that require more attention. The main objective of this work is to understand, from a bibliometric analysis perspective, the growth, distribution of scientific documents, as well as to know the structure and dynamics of production and consumption of scientific information published in such documents.[4]

This analysis will provide a general overview of research trends and highlight the most important countries, authors, and universities in this area. Additionally, it is expected that this study will help researchers and professionals better understand the current research landscape and identify areas of opportunity for future research.[5]

METHODS

A bibliometric study was conducted on the use of Information and Communication Technologies (ICT) as a tool for social inclusion for deaf people, with a focus on bibliometric analysis. The research followed a methodology similar to that proposed by Robles,[6] and was carried out using a documentary or bibliographic research technique, applying a research methodology defined in five stages.

In the first stage, the field of study was identified as "information technologies as a tool for social inclusion for deaf people," with no restrictions on the period to be analyzed.

In the second stage, Scopus was selected as the source of information because it is a robust and reliable bibliographic database, considered one of the largest of peer-reviewed literature, which includes scientific journals, books, and conference proceedings.

In the third stage, the search was conducted according to the following equation: TITLE-ABS-KEY (deaf* AND (labor OR worker OR working OR occupational OR job)) AND (LIMIT-TO (SUBJAREA, "COMP")).

In the fourth stage, the management and filtering of the results obtained was carried out using Scopus's search results analysis tool.

Finally, in the fifth stage, the results were analyzed, including the identification of relevant publications, the analysis of their quality, and the extraction of relevant data. The period analyzed was from 2000 to 2021. Additionally, a co-occurrence map was created with Vosviewer using the keywords for further analysis.

RESULTS

The results obtained in this study, which consist of 6 bibliometric indicators. For each indicator, a graph and corresponding description are provided. Firstly, the evolution of the number of publications per year is

presented, followed by the documents published by type of production, production by author, the 10 most productive countries and institutions, and finally, the 10 most cited publications. The evolution of publications related to the keywords "deaf", "work", "occupation", "worker", and "job" in the field of computer science shows a positive trend in research interest starting from 2007. Before this date, from the first article in 1979 until 2007, the scientific production did not exceed 3 publications. However, since 2007, the number of publications has increased progressively, from 0 in that year to 17 in 2020. This result is presented in Figure 1.

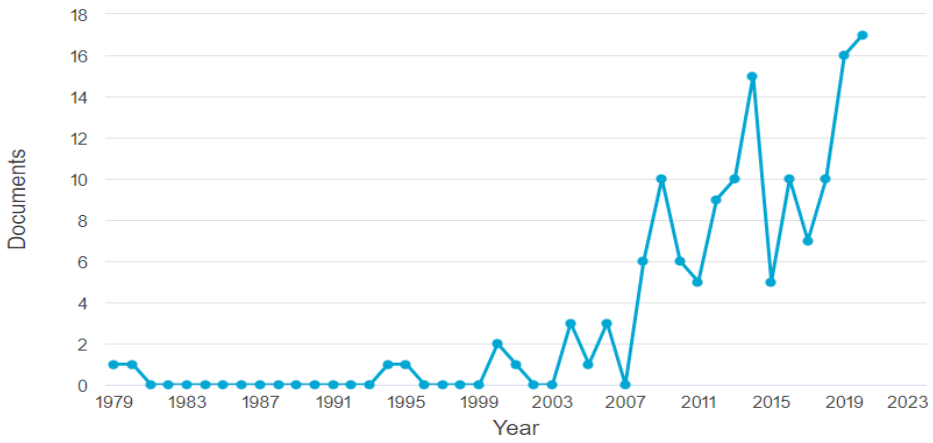

Figure 1. Evolution of the number of publications per year

When analyzing documents published by type of production, conference proceedings represent the largest volume of publications, with 62,9 % equating to 88 documents. In second place are articles published in journals, with 21,4 % corresponding to 30 documents. In third place are conference publications, with 11,4 % corresponding to 16 documents. In fourth place are book chapters, with 3,6 % representing 7 documents. Finally, reviews are identified, with 0.7% equating to 1 scientific document published. This information can be seen in Figure 2.

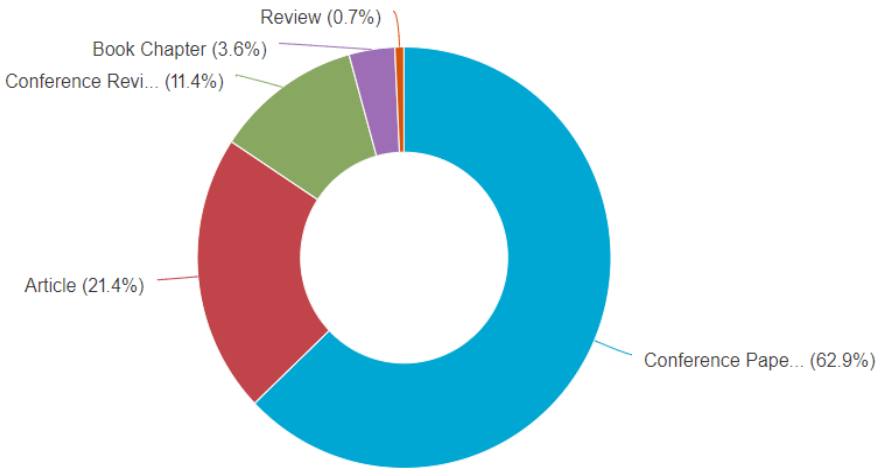

Figure 2. Documents published by type of production

According to the results shown in Figure 3, the top 10 countries with the highest number of publications are: United States in first place with 26 publications, followed by India in second place with 21 publications. United Kingdom is in third place with 9 publications, while Brazil and Japan occupy the fourth and fifth place respectively with 8 publications each. Spain is in sixth place with 7 publications, followed by Italy in seventh place with 6 publications. China, Portugal, and Austria occupy the eighth, ninth, and tenth place with 5, 4, and 3 publications respectively. See Figure 4.

Among the institutions with the highest affiliation to scientific production are: Carnegie Mellon University in the United States with 8 publications, Rochester Institute of Technology in the United States with 7 publications, University of Rochester in the United States with 6 publications, National University Corporation Tsukuba University of Technology in Japan with 5 publications, Universidade Estadual do Ceará in Brazil with

4 publications, Tianjin University of Technology in China with 4 publications, Gallaudet University in the United States and Universidad Politécnica de Madrid in Spain with 3 publications, Broadcom Communication Technologies in India and Univerzita Hradec Králové in the Czech Republic with 2 publications.

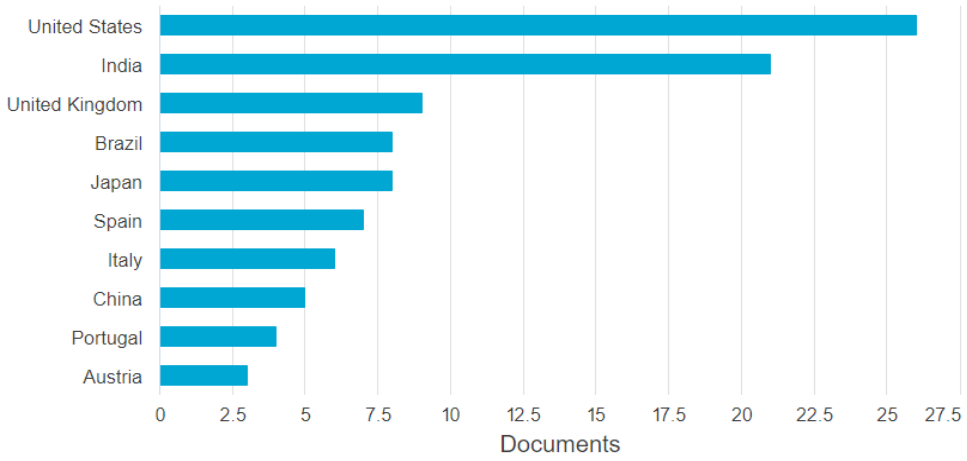

Figure 3. Countries with the highest scientific production

Next, the 20 most cited publications are presented. These publications show that the most studied topics are related to real-time voice recognition for subtitle generation, sign language translators to text or vice versa, non-auditory sound communication, computer vision for sign language recognition, creation of sign language animations from text scripts, and interactive sign language games. This can be seen in Table 1.

Table 1. The 20 most cited publications

Tittle	Year	Cites
Recognition of gestures in Arabic sign language using neuro-fuzzy systems.[7]	2001	139
Real-time captioning by groups of non-experts.[8]	2012	120
Sign language recognition, generation, and translation: An interdisciplinary perspective.[9]	2019	60
Evaluating non-speech sound visualizations for the deaf.[10]	2006	26
Development of an American Sign Language game for deaf children.[11]	2005	25
Vision-based portuguese sign language recognition system.[12]	2014	17
Spoken Spanish generation from sign language.[13]	2010	17
New methodologies in teaching e-structural mechanics using WWW.[14]	2008	17
Manual labour: Tackling machine translation for sign languages.[15]	2013	15
Online quality control for real-time crowd captioning.[16]	2012	15
Regression analysis of demographic and technology-experience factors influencing acceptance of sign language animation.[17]	2017	14
Building a Swiss German Sign Language avatar with JASigning and evaluating it among the Deaf community.[18]	2016	14
Sign language phoneme transcription with rule-based hand trajectory segmentation.[19]	2010	11
Real-time live broadcast news subtitling system for Spanish.[20]	2009	11
Scribe: Deep integration of human and machine intelligence to caption speech in real time.[21]	2017	10
E-learning accessibility for the deaf and hard of hearing - Practical examples and experiences.[22]	2010	10
A Learning game for deaf learners.[23]	2015	9
Legion scribe: Real-time captioning by non-experts.[24]	2014	9
Teaching mathematics vocabulary with an interactive signing math dictionary.[25]	2013	9
How to design games for deaf children: Evidence-based guidelines.[26]	2013	8

Finally, in Figure 4, through the co-occurrence analysis of keywords related to the use of technology as a tool for social inclusion of deaf people, mainly four clusters are identified that represent the most relevant research fronts or lines.

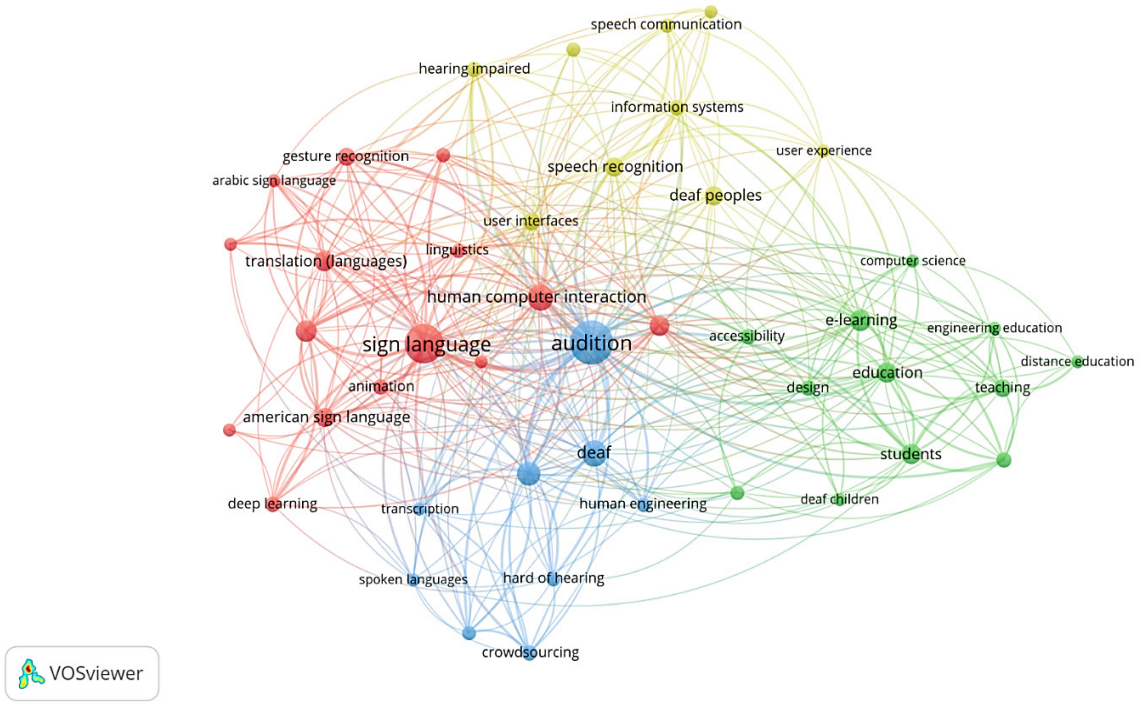

Figure 4. Analysis of co-occurrence of keywords

These clusters presented in Figure 4 and ordered by importance, along with their associated keywords, are:

Sign language (in blue): this line of research focuses on aspects such as person-computer interaction, sign language recognition, language translation, linguistics, artificial intelligence, learning systems, animation, among others.

e-Learning (in green): this line of research focuses on aspects such as education, accessibility, students, deaf children, technology, teaching, distance education, computer science, among others.

Hearing (in blue): this line of research focuses on aspects such as deafness, hearing problems, transcription, spoken language, among others.

Deaf people (in yellow): this line of research focuses on aspects such as user interfaces, deaf people, user experience, voice recognition, people with disabilities, hearing disabilities, information systems, among others.

DISCUSSION

In this discussion of results, we will address the information provided in the previous data, identifying interesting patterns and trends that shed light on the relationship between education and technology use.[1,2,4,5]

Firstly, it is observed that there is a positive correlation between the level of education and technology use. This is consistent with what Majorana et al.[14] pointed out, stating that the use of ICTs proves to be a challenge for constant qualification and translation into sign language, exploring artificial intelligence and other emerging technologies.

This trend is consistent with the idea that education is an important factor in a person's ability to adapt to technological changes and take advantage of opportunities with technology.[14]

Secondly, it is evident that technology use varies according to the type of device, reflecting users' preference for devices that allow them to access the internet quickly and easily, as well as the need for flexibility and mobility in accessing information.[22]

Thirdly, it is observed that technology use varies according to gender, age, and educational level. This trend may be related to sociocultural factors such as the digital divide, competencies that facilitate the use and appropriation of technologies, which refers to inequality in access, and the greater familiarity of young people in adapting to technological changes.[27]

Additionally, a relationship between technology use and employment status is observed. This trend may be related to the fact that technology use is increasingly necessary in the workplace, and companies demand workers with digital skills and competencies.

It is important to mention that in the 20 most cited publications, the most worked-on topics are related to real-time voice recognition for subtitle generation, sign language translators to text or vice versa, non-auditory sound communication, and computer vision for sign language recognition. These results suggest that these topics have been the most relevant and have generated greater interest in the scientific community.[1,7,9,10,16]

Regarding this, Repiso et al.[27] state that another element that influences the frequency with which an article is cited is the relevant scientific authority in the area, either from the authors or from the journal where it is published.

Finally, authors such as Warschauer, Van Dijk, García, Bolaño[28,29,3,31,32] emphasize the importance of technology use in the workplace and the need for workers to develop digital skills and competencies to adapt to the demands of the current job market, avoiding being left behind by not being able to access technology and failing to create the digital competencies required today.

CONCLUSIONS

Based on the bibliometric indicators analyzed, we can understand the behavior of scientific production through publications in the period 1979-2020. The most cited publications reveal that the areas of research that stand out are related to technologies for sign language recognition or translation, real-time subtitle generation, non-auditory sound communication, computer vision for sign language recognition, and the creation of sign language animations from text scripts.

Regarding the 10 most productive authors, institutions, and countries, we found only one author, one higher education institution, and one Latin American country, all from Brazil. This represents an opportunity for other countries in the region to increase their research production in this area.

Through the co-occurrence analysis of keywords, four relevant research lines were identified for the use of technology as a tool for social inclusion for deaf people: Sign Language, e-Learning, Hearing, and Deaf People.

This reflects the importance of addressing multiple aspects to achieve effective inclusion. In conclusion, this study highlights the importance of ongoing research on technologies for the deaf and hard-of-hearing population in the workplace.

There is a clear need for more diverse and global research efforts in this area, as well as more collaborations between researchers and institutions worldwide. It is recommended that more resources be allocated to increase research production in this field, particularly in underrepresented regions.

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CONFLICTS OF INTEREST

None.

AUTHOR CONTRIBUTION

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