Robots in nursing education: a bibliometric analysis

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Abstract. Laboratory experimentation using robotics plays an essential role in nursing education. This research to answer the question, How do the use of robots by the nursing students influence the effectiveness, the usefulness, and user friendliness of, their satisfaction with, this kind of education technology for a clinical experience. Furthermore, this technology provide additional benefits such as supporting distance learning, improving lab accessibility to handicapped people, and increasing safety for dangerous experimentation. This paper analyzes the literature on robotics labs in nursing education from its beginnings to 2019, identifying the most influential publications, the most researched topics, and how the interest in those topics has evolved along the way. To do so, bibliographical data gathered from ISI Web of Science, Scopus and MedLine have been examined using two prominent bibliometric approaches: science mapping and performance analysis prominent bibliometric approaches: science mapping and performance analysis.

1. Introduction
One of the most relevant means of communication and dissemination of results in most fields of knowledge is the publication of scientific articles in specialized journals, which concludes the effort of the research work of a process that demands a high level of solidly established knowledge. Due to the increasing number of articles it has been necessary to apply mathematical methods to all scientific literature, which include statistical foundations to assess the status of current research, as well as the contributions of researchers and countries in the various fields of knowledge towards the creation of new lines of research in specific fields. This analysis includes indicators such as parameters of scientific activity, identifying research groups and authors, their citations of published articles, consumption of this information, impact factor, h index, among others. Lewison and Devey defined: "Bibliometry is to scientific articles what epidemiology is to patients". Given the above, using this resource is essential for those who administer scientific tasks in a specific work group or institution [1, 2, 3].

From the field of health knowledge, robotic technologies have helped patient care, including from medication administration, physiological parameters monitoring to mobility assistance. Which has had a positive impact on nursing activities, due to the use of robotic smart technologies, in daily processes and activities, either through the use of virtual or mechanical robots. Therefore, universities have focused efforts on the development of innovations in educational robotics and their use for the promotion of research using robotics in the area of nursing, generating a large number of scientific articles that contribute to databases of health literature [4, 5].

This research focused on determining the types and extent of research in nursing robotics, study origins and citation information, searching the databases for specific literature on robotics
research reports used to help or increase the care of nurses. In this sense, the objective of this study is: To analyze the articles published in nursing robotics using the Scopus and Web of Science databases in the period of 2009-2019.

1.1. Nursing and Technology

The incursion of technology in this new millennium in all areas of the Society from industrial to homes is changing the way humans act in their work environment and health sciences is not back to this reality, since the diagnosis from a simple flu, even the diagnosis of the general state of health can be done with a computer or a mobile device, facilitating patient care, but at the same time challenging health professionals on how to involve technology in more aspects complexes in the care of critically ill patients. Thus, advances in bioengineering and biomedical technologies have allowed the development of more advanced technologies in the care of patients of their health status, artificial and robotic intelligence, this has positively influenced the way of acting in modern healthcare and its methods of providing services to nursing professionals [6].

The practice of nurses requires established protocols that involve: diagnosis, planning and results, implementation and evaluation, a process that guides nursing professionals to the care and care of patients, allowing them to plan their intervention actions in case of emergency and to be able to provide human, timely and effective care to patients. The practice of nursing can change a lot in the future, this is because we live in a technologically advanced world and every time the human being is looking for new aspects that improve their work in the clinics and in the places where the care of people is required It is difficult to imagine in the last century that a machine would be in charge of your care, of diagnosing you medication for a severe headache, or simply giving you a back massage, which we have to reflect with the following questioning: what would they be? The tasks of human nurses in the future when these predictable tasks are performed with such skill by a programmed robot? What would the nurse-robot relationship be like? Does the incursion of robot in the form of humans humanize the nursing profession? Is it possible that these types of technologies help develop skills in future health professionals?

It is known that institutions of higher education worldwide are incorporating these types of technologies year after year, replacing the usual dolls in the form of humans with robot-humanoids so that their students before entering the difficult world of work can perform practices closer to the reality with simulators very similar to autonomous machines, with human characteristics, creating an environment similar to that of a clinic. This simulator will allow you to know how the human body reacts to certain procedures (wound cleaning, medication dose delivery, bone breakage, etc.) carried out by the future health professional.

With this type of technology students can teach and learn a multitude of first-hand procedures before performing them with human patients. As it has been shown, robotics has been taking very significant steps, reaching the world of nursing in different ways, as in Japan, as the robots are taking care of the elderly, to highlight an example. Because this is a novel field, literary production is very limited in the growing field of robotics as a tool in the training of students in higher education nursing programs. A bibliometric search was carried out with the purpose of learning that literature exists on nursing care robotics. This bibliographic search mechanism allows us to map, identify information on sources of important information, new research developments, impact and acceptance from a geo-referential perspective.

1.2. Nursing Bibliometry

Great efforts have been made to explore the literature focused on describing research studies using robotics in the area of patient care, which vary in their bibliometric analysis in the types of reviews that generally include systematic reviews about both experimental and experimental studies. non-experimental, sometimes achieving satisfactory results or only in some cases, due to the complexity of this type of analysis and the large volume of information contained in the
databases. This is because the metrics available to help measure the impact of research and the relative importance of publications are limited [5, 7, 8]. Traditionally, scientific communities have used measures such as the impact factor of the journal and primary calculations based on citations to indicate the performance of scientific journals, but this is not necessarily a reflection of the impact of published content and the reputation of the journal. The bibliometric analysis in nursing must be more rigorous in these aspects to be able to exhibit really practical research in the use of robotics in nursing, especially in education and reveal its true impact [9, 10]. To do this, it is necessary to map the development of robotics by identifying new developments in research and assessing research products in terms of productivity, financing, impact and acceptance from a geographical perspective. Bibliometric analyzes in nursing should also include a description of productivity such as the count of collaborative publications using indexes, analysis of appointments and coappointments.

2. Robotics in nursing: Research

We obtained academic article data from the robotics and nursing. Here the following filters were applied: scientific journals, articles and English language publications, limiting the search between the years 2009–2019, throwing 318 documents, and with the descriptors nursing and robotic. Fig.1 (left) shows the percentages of publication of articles in relation to our research by subject, where we can see that in Computer Science with 38.4 % it has generated the greatest contribution in the development of nursing robotics together with the subject of Engineering with 31.4%, showing that nursing robotics is still under development. While the subject the application as Medicine 4.5 % and its related Health Professional (2.3 %), Neuroscience (1.8 %) etc. show that the application of robotics in nursing is still very low or at least the dissemination of the effects of the use of robots in nursing. Robotics is a large field that aggregates multiple types of technology and research, in which nursing robotics seems like a small and specific subfield. However, a closer inspection also reveals the accelerating pace of publishing in nursing robotics [See Fig. 1 (right)].

The search criteria in Scopus were performed using the following filters: (TITLE-ABS-KEY (“artificial intelligence” OR “education nursing” OR “nursing care” OR “robotics”) AND DOCTYPE (ar OR re) AND PUBYEAR ≤ 2008 AND PUBYEAR ≥2020) AND ((“nursing care” OR “robotics”) AND (“nursing” OR “robotics”) AND (LIMIT-TO (DOCTYPE, “ar”) OR LIMIT-TO (DOCTYPE, “re” )) AND (LIMIT-TO (SUBJAREA, “MEDI”) OR LIMIT-TO...
As a result, there are 15 countries publish nursing robotics (NR) literature selected in this bibilometric analysis. As expected the USA is the predominant country that publishes literature in NR, the rapid growth of robotics products for many field of applications in the USA and its impact on national economic policy clearly justify predominance of American contributions in NR literature. The Japan and Italy contributes the second and third followed by Germany, United Kingdom and China each contributing with a important number of publications of the total literature. Being Mexico in the first Latin American country in the ranking [see Fig.2 (left)]. The involvement of scientists of so many countries in NR research clearly suggests that use of NR has been able to draw the attention of the whole world. Fig.2 (right) illustrates the distribution of document type in nursing robotics literature. We can see that is the journal article, which contributes with the 86.2% of the total literature, as in common in many fields, the single most prevalent form of publication. It is interesting to note that 53.4% of total literature are covered in conference/symposia documents. Proceedings of conferences are seemed to becoming more and more important specially for a newly growing subject. Restricted only to participating scientists.
of the conferences the proceedings is the most effective and speedier communication channel than publications of ideas in primary journals. On the other hand, Books chapter, Books and Review make up only the 11.7%, and Patents are not covered by this research. It is also of interest to explore the documents published by funding sponsor, the Fig. 3 (left) exhibits the statistics, where the National Science Foundation and European Commission are the most relevant. The subject field of a journal is also related to the productivity. Although the core nursing robotics literature is concentrated in a small number of journals, they are quite diversified in their subject coverage. As indicated in the Fig.3 (right), most of the core journals deal with Communications in Computer and Information Science, Proceedings IEEE International Conference on Robotics and Automation, Lecture Notes of the Institute for Computer Science Social Informatics and Telecommunications Engineering Lncst., IEEE Journal of Biomedical and Health Informatics, etc. and each published the most of the papers in nursing robotics until nowadays. Fig.4 shows documents published by Institutions and Authors highly related to the countries in which the largest number of documents have been published.

3. Conclusions
In this article, we studied nursing robotics from a bibliometric perspective. By applying filters in Scopus which is the largest abstract and citation database of peer-reviewed literature, we extracted highly connected communities of articles that represent clusters of knowledge. Academic publications were used to create an academic landscape based on the citation information. Our research reveals the accelerating pace of publishing in nursing robotics, nevertheless, show that the application of robotics in nursing is still very low or at least the dissemination of the effects of the use of robots in nursing, if we compare the number of documents published by subjects such as Computer Science and Engineering showing that nursing robotics is still under development.

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