Educational Robot for the Care of Infectious Diseases in Children: A Review of the Scientific Literature 2010 - 2020

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Abstract: Due to the pandemic caused by the COVID-19, we are forced to maintain a social distance, relying on technology such as the use of robots for both commercial and educational activities. This document is a systematic review of scientific literature using Prism methodology and aims to determine the best characteristics for the development of educational robots in children on infectious disease care. We obtained 50 articles associated to the research topic collected from databases such as IEEE Xplore, Scielo, Scopus and WoS. The results were synthesized in different tables and graphs separated in approaches of: robotics in education, robotics in relation to humans, education in diseases, robotics in health and digital applications in education, where the first one is the most treated in the articles found.

1 INTRODUCTION

As it is of global knowledge at the end of the year 2019 it was reported the finding of a type of infectious disease by a new coronavirus in Wuhan, city of China, that generated a new disease called COVID-19. This disease affects humans and acts quickly both for its development in the carrier and for transmission from person to person, which caused a difficult situation to manage; by March of this year 2020 the World Health Organization (WHO) finally declared officially this disease as a pandemic given the high numbers of infected in 110 countries and territories at that time (WHO, 2020). One of these countries is Peru, which had its first case of coronavirus on March 6.

Consequently, activities within each sector, following a decision by many governments, were completely or partially halted so that each person could stay at home and avoid an increase in the number of people infected; this led to technology and networks being the main means of communicating and learning about this new disease (R. Pierre, 2020).

On the other hand, it has been classified as people at risk to both the elderly and children, the latter being where it is more common for there to be ignorance of the subject and therefore fear is generated, which is why it seeks to relate the need to learn about infectious diseases with something that captures the interest of children. Due to the importance of the use of technological advances for the benefit of protecting the health of the child population, it is necessary to implement educational means that optimize children's understanding so that they internalize the different modes of health care, emphasizing infectious diseases (P. Buss, 2020).

Based on the above, it was thought that the solution would be a robot given that it is an option with advantages in the educational area (J. Ramirez, 2017); in addition, it can allow the development of more than just learning but also the development of alternate skills in children with autism spectrum disorders where I stimulate their social skills (C. Valadão, 2016).

Therefore, the following research question was asked: What are the best characteristics for the development of an educational robot for children on infectious disease care? With this, it was decided to guide this documentation with the objective of determining the best characteristics for the development of an educational robot in children for care of infectious diseases.

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2   METHODOLOGY

The present document is a systematic review of the scientific literature, in which the Prism methodology has been used. According to (B. Moreno, 2018), a systematic review is a concise summary of the information provided by other research on a topic of social interest.

The selection of the articles had as sources of information a: IEE, Scopus, WoS and SciELO. These databases were searched between March and May 2020. For the search related to the topic, the following key words were used in each database: "application" AND "robot OR robotics" AND "education" AND "infants OR children" AND "pandemic OR disease".

Articles were selected in English, Portuguese and Spanish, between 2010 and September 2020. These articles should have as a central theme the key words or establish a relationship between them.

Articles referring to corporate and business contexts, chemical research on infectious diseases, industrial robotics studies, as well as research that did not contribute to answer the research question were excluded.

3   RESULTS

A total of 58 articles associated with the research topic were obtained. These references are distributed as follows: 37 articles from IEEE Explorer, 8 articles from SciELO, 11 articles from Scopus and 2 articles from WoS, all of them were obtained applying for search criteria, 8 articles were excluded since they were repeated or included topics of business aspect, education focused on the school environment, articles on chemical issues and industrial fields. Thus, having applied the selection filters, the number of 50 articles was finally obtained.
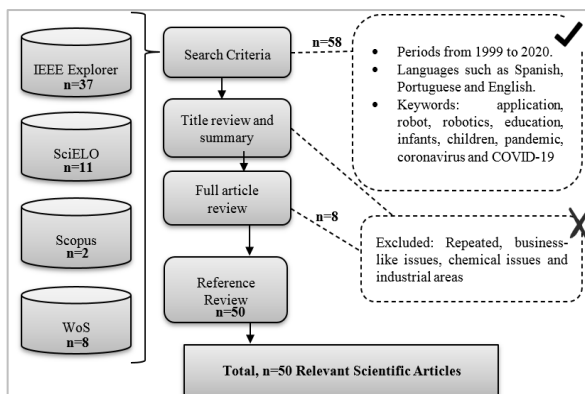

Fig. 1 Scientific Article Search Summary

The countries in which these articles were published provide quantitative evidence of the issues related to the research. Thus, it is shown that the United States has more articles referred.
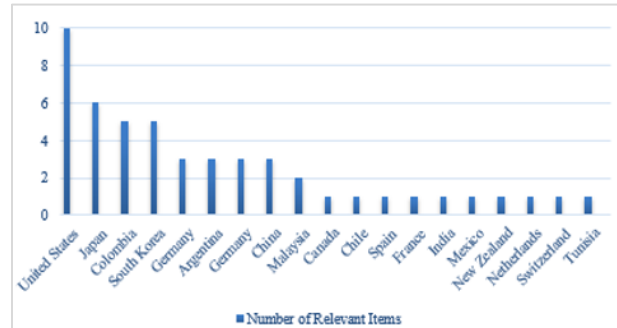

Fig. 2 Articles by country

In order to clearly answer the research question with the help of the 50 selected articles; it was possible to identify the significant characteristics for the contribution of this research. For this reason, 5 perspectives were selected and classified, which are presented in the following pie chart.
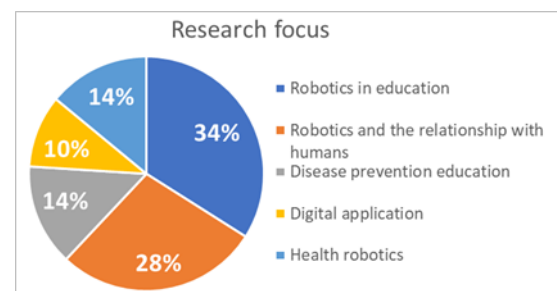

Fig. 3 Number of articles regarding Research approaches

Each approach is shown below with the relevant characteristics of each approach in the following tables.

Table 1. Characteristics of the robotic approach in Education

Features	Quantity	References
Basic education for children	7	(J. Álvarez, 2011), (J. Han, 2009), (E. Karna-Lin, 2006), (W. Ko, J. Han, 2009), (S. Pinto, 2015), (N. Torres, 2018), (B. Zha, 2019)
Improvement in learning skills	2	(J. Ramírez, 2017), (Q. Zia-ul-Haque, 2007)
Education for autistic children	3	(T. S. Barger, 2020), (M. A. Miskam, 2014), (M. A. Miskam. 2015)

Engineering and Robotics Education	5	(J. Buitrago, 2014), (J. Kim, 2012), (M. Marinelli, 2012), (H. Quintián, 2012), (J. Zheng, 2018)

Table 2. Characteristics of the robotic approach and the relationship with humans

Features	Quantity	References
Effective social and communicative interaction	7	(J. Álvarez, 2011), (J. Han, 2009), (E. Karna-Lin, 2006), (W. Ko, 2009), (S. Pinto, 2015), (N. Torres, 2018), (B. Zha, 2019)
Effective care of needs	2	(J. Ramírez, 2017), (Q. Zia-ul-Haque, 2007)
Inference capacity through gestures and/or moods	3	(T. S. Barger, 2020), (M. A. Miskam, 2014), (M. A. Miskam, 2015)
Social relationship with autistic children	5	(J. Buitrago, 2014), (J. Kim, 2012), (M. Marinelli, 2012), (H. Quintián, 2012), (J. Zheng, 2018)

Table 3. Characteristics of the education approach to disease prevention

Features	Quantity	References
Information in Multimedia format	1	(Y. Ishibashi, 2004)
Simulations for prevention	3	(O. M. Araz, 2009), (T. Wibisono, 2008), (J. Zhou, 2006)
Pandemic Prevention and Studies	3	(R. Pierre, 2020), (P. Buss, 2020), (M. Greene, 2014)

Table 4. Characteristics of the robotic approach to health

Features	Quantity	References
Child care	2	(S. Dagdanpurev, 2019), (S. Kang, 2007)
Child therapy and rehabilitation assistance	3	(B. Maalej, 2018), (D. H. García, 2019), (H. Javed, 2020)
Treatment of autistic children	2	(V. Kostrubie, 2020), (A. Ramírez, 2020)

Table 5. Characteristics of the digital application approach

Features	Quantity	References
Contribution to remote education	1	(G. Anaguano, 2010)
Contribution to medical research	3	(F. Fernandes, 2016), Lopez R. 2020), (C. Sousa, 2019)
Good privacy and security practices	1	(M. Hatamian, 2020)

4 DISCUSSION

The review of scientific literature carried out in the present context focuses on determining the significant characteristics for developing a robot for children and to support whether these can be adapted to each other for the smooth pedagogical process of knowledge, and in turn support this technique as an opportunity for prevention and care issues in health.

First approach: Robotics in education (Table 1); the characteristics of "Improvement in learning skills" and "Education for autistic children" were found to be more effective because they are adapted to the required learning needs.

Second approach: Robotics and the relationship with humans (Table 2); it was found that the characteristics "Effective attention to needs" and "Inference capacity through gestures and/or mood states" obtained a higher percentage of effectiveness, due to the fact that the robot can be adapted, the capacity to help in different tasks that support basic needs and also the perception of the mood state for a better understanding of the human being.

Third approach: Education in disease prevention (Table 3); with respect to this approach, the three characteristics analyzed obtained very acceptable results in order to strengthen the teachings on the prevention of infectious diseases.

Fourth approach: Robotics in health (Table 4); in the analysis of this approach it was found that "Child Care" and "Assistance in child therapy and rehabilitation" had relevant percentages of effectiveness since it was optimal in the support of the care of hospitalized children; and in turn the therapies and rehabilitation of the same, as well as support in the communicative and social skills of the different treatments as for example of autistic children.

Fifth approach: Digital application in education (Table 5); in this respect it was found that the features "Contribution to remote education" and "Contribution to medical research" both had a significant effectiveness result, since the applications are a user-friendly medium that helps in the learning of different subjects.

5 CONCLUSION

This systematic review of literature generated the finding of those characteristics important for the development of an educational robot with information on infectious disease care directed to children, such as generating improvements in the area of learning, being able to provide attention to needs that allow the capacity of inference through gestures and/or states of mind; providing child care, therapy assistance and child rehabilitation; and contributing to remote education and research in medicine. Likewise, it is important to indicate that the information presented is multimedia, since it allows prevention simulations to be carried out and is based on studies on pandemics.

Finally, as a recommendation we leave first that, as it is a handled robot, it must be under the control of a proxy capable of making the study of prevention advice by the child constant, finally, we also recommend that the economic factor be more taken into account in future research, since an adequate cost will allow more people to access the technology

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