Mobile Applications for the Implementation of Health Control against Covid-19 in Educational Centers, a Systematic Review of the Literature

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***Abstract*—A health crisis caused by the SARS-CoV-2 virus is still ongoing. That is why an important factor for the resumption of on-site classes is the creation of sanitary measures to help control Covid-19. The present research is a literature review, The PRISMA methodology is used and 265 articles are collected from various databases such as EBSCO Host, IEEE Xplore, SAGE, ScienceDirect, and Scopus. According to the inclusion and exclusion criteria, the most relevant articles aligned to the topic were identified, systematizing 119 articles. Showcasing digital technologies used in mobile applications that allow better control, tracking, and monitoring of the health status of students, teachers, and staff of educational centers, in addition to the parameters and quality attributes that must be taken into account for the effective sanitary control of the disease, finally, a development model is proposed.**

***Keywords*—Mobile application; sanitary control; systematic review; digital technologies**

I. Introduction

Covid-19 is caused by the severe acute respiratory syndrome called SARS-CoV-2. One of its most common symptoms is a lung infection or pneumonia [1]. Covid-19 is an epidemic that has spread rapidly throughout the world. That is why we must be alert to information on how to take care to prevent contagion [2]. The World Health Organization declared the coronavirus (Covid-19) a pandemic on March 11, 2020. Making all countries take preventive measures against the emerging Covid-19 virus [3].

Due to the distancing measures by Covid-19, education went from being face-to-face to virtual, therefore, schools, universities, and institutes closed their doors, and teachers and students had to adapt to the use of technological tools, making way for e-learning [4], [5].

Another very important area in which Covid-19 has had an impact has been in the area of life and mental health [6]. The impact was greater on students, as there were school closures, fear generation due to Covid-19, the interruption and change of modality in education, and the excessive use of digital devices. These factors have caused students to suffer from mental health problems such as stress, anxiety, depression, and sleep disorders during the quarantine period. With the vaccines, it was possible to reduce the mortality rate of the disease, and eventually return to face-to-face teaching in schools, so it is important to know the best digital technologies used for the control and monitoring of the virus.

The objective of this literature review is to analyze articles in order to have a better understanding of the problem, that is, to know which technologies, parameters, and quality attributes were used to have better sanitary control against Covid-19 in educational centers, as well as to identify the countries with more experiences in this field. Section II shows the methodology used in the search and selection of articles, Section III shows the results obtained through graphs and tables, Section IV the discussion in which the research questions posed are answered, and Section V shows the proposed model to be followed in future research, to finally write in Section VI the conclusions of the research.

II. Methodology

The methodology used consisted of three steps. First, the PRISMA methodology was used [7] (Preferred Reporting Items for Systematic Reviews and Meta-Analyses of Preferred reporting elements for systematic reviews and meta-analyses) which helped to find and identify the most appropriate articles for the present literature review. Second, bibliometric analysis was used to find the common terms that influence the disclosure of the implementation of health surveillance against Covid-19 in schools using digital technology. Finally, the most important factors and statistical methods used for the implementation of a sanitary control against Covid-19 in educational centers are extracted and related to the results of the bibliometric analysis.

Following the PRISMA methodology [7], this section is structured as follows: (1) Type of study, (2) Research questions, (3) Search strategy, and (4) Inclusion and exclusion criteria.

A. Type of Study

A systematic review of the literature will be used to prepare the article.

B. Research Questions

The proposed research questions are as follows:

RQ1. Which digital technologies allow better control, follow-up, and monitoring against Covid-19 of the health status of students, teachers, and staff in educational centers?

RQ2. What parameters should be taken into account to make effective sanitary control against Covid-19 in educational centers through the use of a mobile application?

RQ3. What quality attributes must it contain for the viability of the mobile application for the implementation of a health control against Covid-19 in educational centers?

RQ4. Which countries have the most research, in the last three years, related to health monitoring against Covid-19 in schools?

C. Search Strategies

To answer the research questions, a search for published articles was conducted in the main databases EBSCO Host, IEEE Xplore, SAGE, ScienceDirect, and Scopus. A total of 265 scientific articles were collected.

At the time of applying the search for our research, the following keywords were considered: "Covid-19" AND ("health control in schools" OR "in the schools" OR "using mobile application" OR "health control in schools app" OR "in the schools using mobile application" OR "prevention and control in schools"), "mobile application for" AND ("prevent Covid-19" OR "control in schools during Covid-19" OR "Covid-19 health control in schools" OR "prevent Covid-19" OR "the school to prevent Covid-19"), "app mobile for" AND ("health" OR "Covid-19" OR "Covid-19 in the schools"), "app mobile for Covid-19 in schools", "app control of Covid-19 in schools" y "control of Covid-19 in schools". The item collection process is shown in Fig. 1.

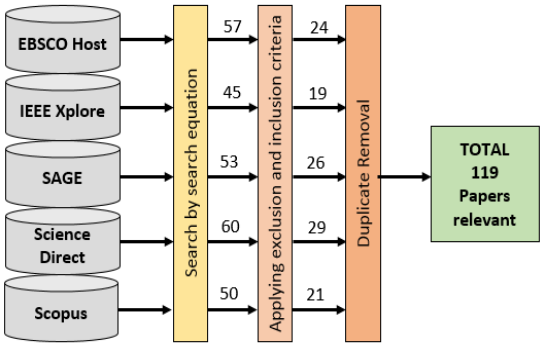

Fig. 1. Item Inclusion Chart.

D. Inclusion and Exclusion Criteria

For the systematic review study, the following inclusion and exclusion criteria were applied, as shown in Table I.

TABLE I. INCLUSION AND EXCLUSION CRITERIA

CRITERIA		
Inclusion	I01	Articles related to digital technologies for Covid-19 preventive control.
	I02	Articles published since the start of Covid-19 2019 – 2022.
	I03	Articles that consider at least one prevention parameter against Covid-19.
Exclusion	E01	Articles not related to digital technologies for preventive control against Covid-19.
	E02	Articles published before 2019.
	E03	Articles related to Covid-19 but do not make use of digital technologies.

III. RESULTS

A total of 265 articles found in the databases related to the research topic were analyzed, of which two duplicate articles were discarded or did not contribute similar topics. After reviewing the articles, 119 were selected, excluding 144 according to the exclusion criteria and which did not contribute to answering the research question. Obtaining 119 articles for the systematic review. Fig. 2 shows the selection process following the Prisma methodology.

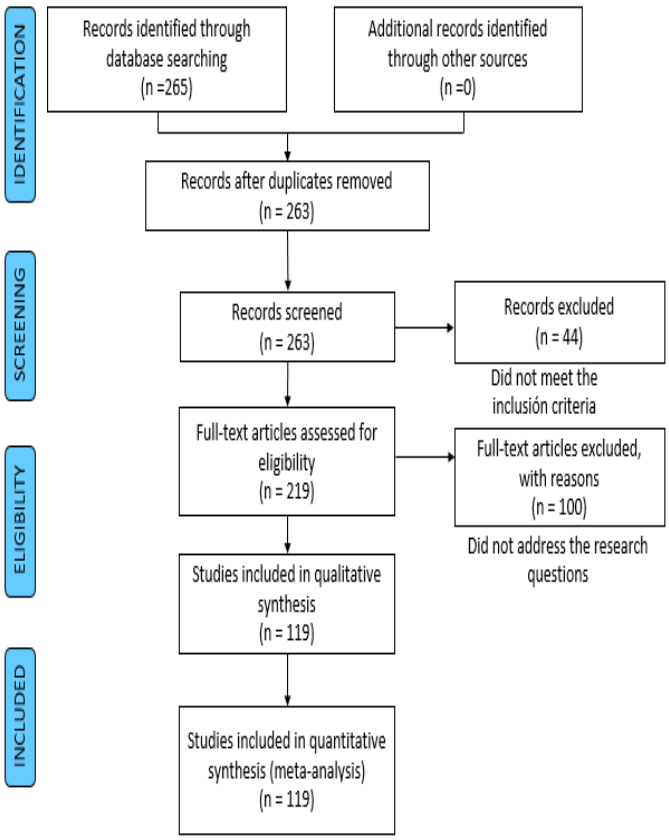

Fig. 2. PRISMA Diagram Methodology.

Fig. 3 shows the number of articles found by the database.

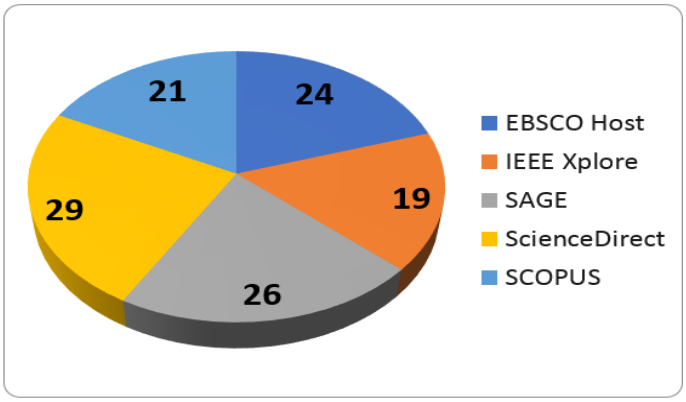

Fig. 3. Articles by Database.

Fig. 4 shows the number of articles published by year and database, selected in times of pandemic.

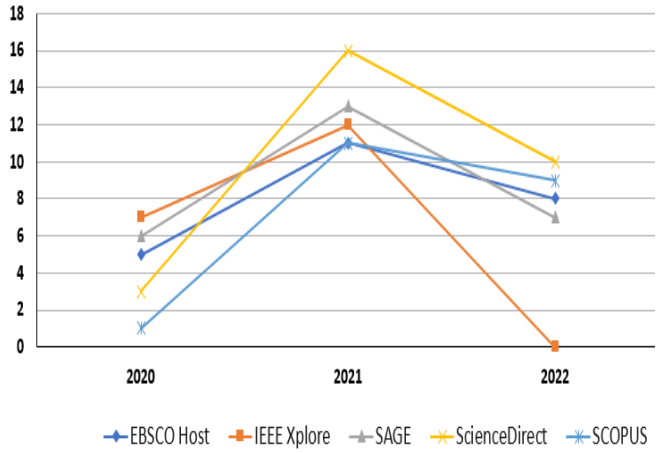

Fig. 4. Articles by Year and Database.

Fig. 5 shows the number of articles published by continent.

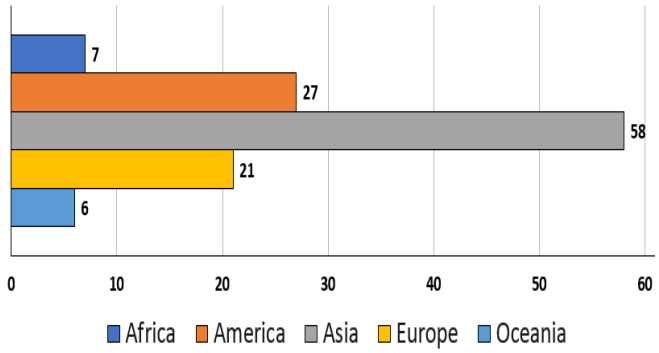

Fig. 5. Articles by Continent.

The number of articles published by country is shown in Fig. 6 on a scale from 1 to 17.

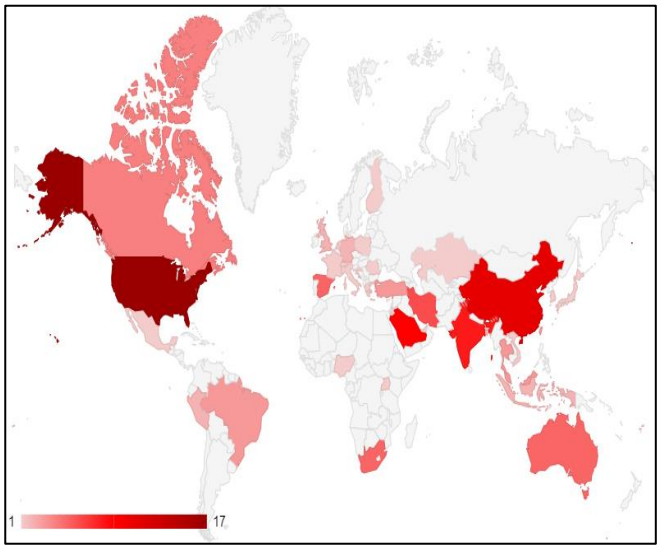

Fig. 6. Articles by Country.

Fig. 7 shows the network visualization based on a bibliometric analysis filtered by keywords, using the VOSviewer software.

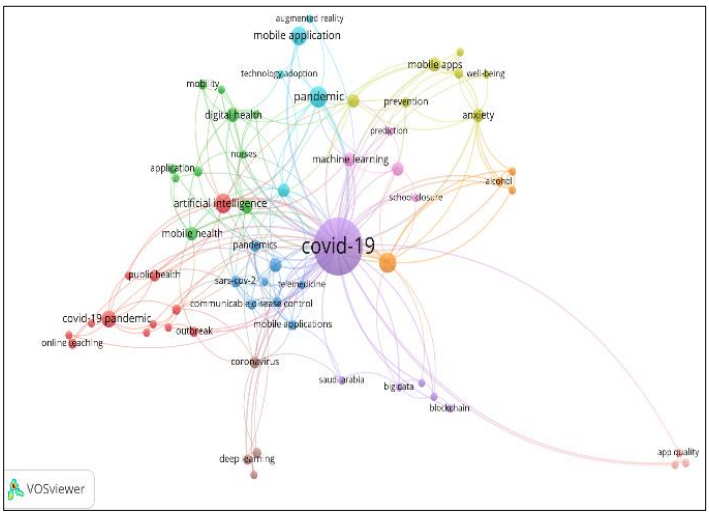

Fig. 7. Network Visualization of Bibliometric Analysis.

Fig. 8 shows the analysis of bibliometric data considering the year of publication of each article.

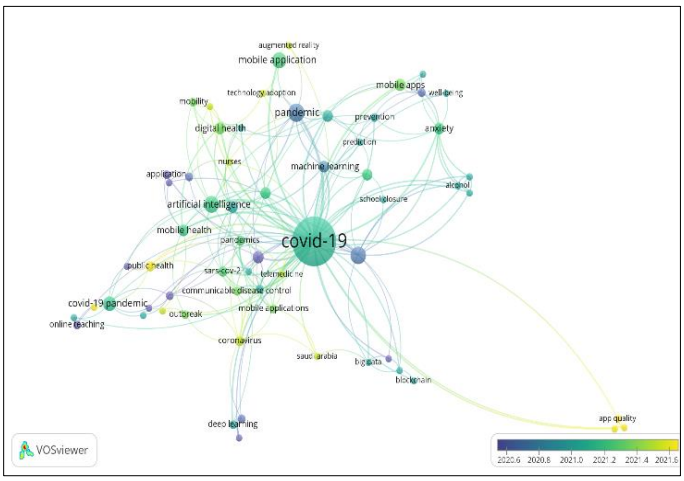

Fig. 8. Overlay Visualization of Bibliometric Analysis

It was in 1926 when Alfred Lotka introduced the term "bibliometrics" by analyzing the production patterns of different authors, concluding with the presentation of the first criteria for bibliometrics [8]. Bibliometrics is part of scientific research, as time goes by scientists become interested in this field and even academic institutions use it in their research work. It is a very effective technique to retrieve, evaluate and analyze, in a statistical way, quantifiable data in the academic literature, merits of a particular thematic area, or a particular publication containing indicators to obtain a better evolution of the research direction. Bibliometric analysis is expected to contribute to filling gaps in the research field, provide new perspectives for future research and promote collaboration [9].

VOSviewer is a software tool that allows us to construct and visualize bibliometric networks (including individual publications, authors, and scientific journals); it is constructed from co-authorship relationships, co-citation, bibliographic coupling, citation networks, and co-occurrence of important terms extracted from a body of scientific literature [10].

VOSViewer was used to obtain networks based on co-occurrences of important terms, from which visualization maps were created as shown in Fig. 7, Fig. 8, and Fig. 9.

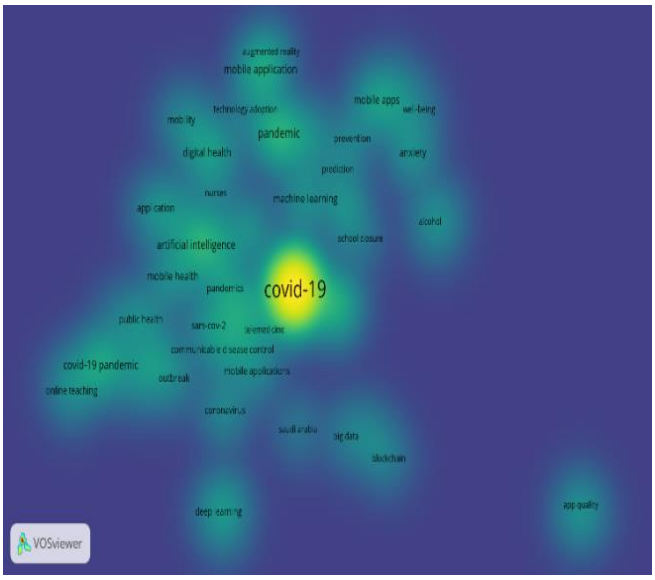

Fig. 9. Visualization of Density of Bibliometric Analysis.

In Fig. 9 it can be observed that Covid-19 is the most important term co-occurrence of all cited articles, such term co-occurrence is aligned to the present literature review. It is also observed that artificial intelligence and mobile application are the digital technologies with the highest term co-occurrence in relation to all cited articles.

After performing the bibliometric analysis, sixty-three (63) items were generated, grouped into ten (10) clusters shown in Table II. Finally, the clusters and their respective items were identified using the network visualization of the bibliometric analysis (Fig. 7), segmenting the clusters by their specific colors:

- Cluster 1 is colored magenta, "artificial intelligence".
- Cluster 2 is green, "application".
- Cluster 3 is colored blue, "pandemics".
- Cluster 4 is mustard-colored, "mental health".
- Cluster 5 is colored purple, "covid-19".
- Cluster 6 is light blue, "mhealth".
- Cluster 7 is colored orange, "mobile app".
- Cluster 8 is salmon-colored, "coronavirus".
- Cluster 9 is colored fuchsia, "machine learning".
- Cluster 10 is colored pink, "app quality".

TABLE II. ARTICLES, LINKS, TOTAL LINK STRENGTH, OCCURRENCES AND AVERAGE YEAR OF PUBLICATION

Article	Links	Total link strength	Occurrence	Avg. Pub. Year
Cluster 1				
artificial intelligence	12	23	10	2021.20
continuance intention	1	1	2	2022.00
covid-19 pandemic	10	10	8	2021.12
education	4	4	2	2020.50
intention to use	3	3	2	2021.00
internet	4	4	2	2021.00
online teaching	3	3	3	2020.33
outbreak	4	5	3	2021.33
prisma	3	3	2	2015.50
public health	6	8	4	2021.75
technology	8	8	3	2020.33
telehealth	4	4	2	2021.50
Cluster 2				
app	11	16	5	2021.00
application	4	6	3	2020.33
covid 19	4	4	3	2020.66
digital health	10	15	6	2021.33
intervention	5	7	2	2021.50
mobile	4	5	2	2020.50
mobile health	9	12	5	2021.20
mobility	4	6	3	2021.33
nurses	6	6	2	2021.50
protocol	6	7	2	2021.00
Cluster 3				
communicable disease control	8	12	3	2021.33
contact tracing	11	16	6	2020.50
humans	8	13	3	2021.00
mobile applications	9	12	3	2021.33
pandemics	9	12	4	2021.50
pneumonia	7	7	2	2021.00
sars-cov-2	10	14	4	2021.50
telemedicine	7	8	2	2021.50
Cluster 4				
anxiety	11	19	5	2021.20
depression	7	8	3	2020.66
mental health	9	12	5	2021.00
mobile apps	6	10	6	2021.33
prevention	6	7	3	2021.00
stress	4	5	2	2021.00
well-being	3	3	2	2021.00
Cluster 5				
big data	5	6	2	2021.00
blockchain	2	3	2	2021.00
covid-19	55	145	83	2021.10
diabetes	4	5	2	2020.50
health	5	6	2	2021.00
saudi arabia	4	5	2	2021.50
Cluster 6				
augmented reality	3	3	2	2021.50
mhealth	12	15	5	2021.20
mobile application	4	8	9	2021.22
pandemic	12	24	12	2020.75
technology adoption	4	4	2	2021.50
Cluster 7				
alcohol	5	10	2	2021.00
mindfulness	5	10	2	2021.00
mobile app	16	29	11	2020.72

Article	Links	Total link strength	Occurrence	Avg. Pub. Year
sleep	5	10	2	2021.00
Cluster 8				
convolutional neural networks	3	5	2	2020.50
coronavirus	9	11	4	2021.50
deep learning	4	7	3	2021.00
internet of things	4	4	3	2020.66
Cluster 9				
machine learning	6	11	5	2020.80
online learning	6	7	5	2021.20
prediction	5	6	2	2021.00
school closure	3	4	2	2021.00
Cluster 10				
app quality	3	6	2	2022.00
functional features	3	6	2	2022.00
mobile app rating scale	3	6	2	2022.00

Fig. 10 shows the number of selected articles grouped by database and digital technologies.

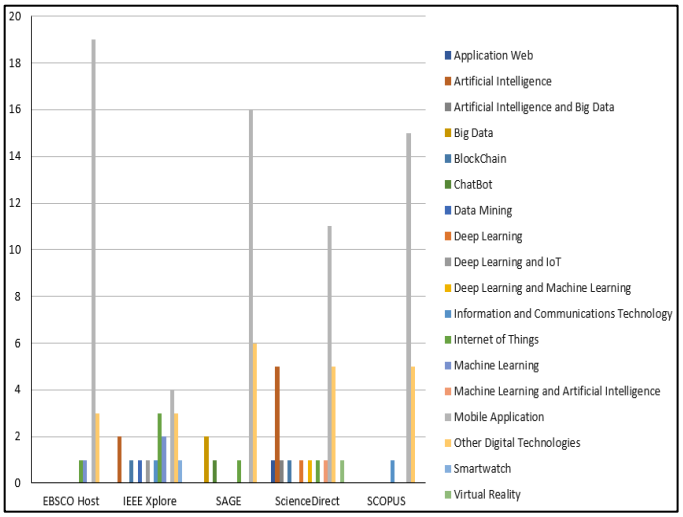

Fig. 10. Articles by Database and Digital Technologies.

Table III shows the digital technologies of the articles according to the results found.

TABLE III. CLASSIFICATION OF ARTICLES ACCORDING TO THE RESULTS OBTAINED

DIGITAL TECHNOLOGIES	ARTÍCLE
Application Web	[11]
Artificial Intelligence	[12]–[18]
Artificial Intelligence and Big Data	[19]
Big Data	[20], [21]
BlockChain	[22], [23]
ChatBot	[24]
Data Mining	[25]
Deep Learning	[26]
Deep Learning and IoT	[27]
Deep Learning and Machine Learning	[28]
Other Digital Technologies	[29]–[50]
Information and Communications Technology	[51], [52]
Internet of Things	[53]–[59]
Machine Learning	[60]–[62]
Machine Learning and Artificial Intelligence	[63]
Mobile Application	[64]–[126]
Smartwatch	[127]
Virtual Reality	[128]

Table IV shows the classification of articles according to the results found.

TABLE IV. CLASSIFICATION OF ITEMS ACCORDING TO CATEGORIES AND TOPICS OF FUNCTIONALITY

THEMES AND FUNCTIONALITY	REFERENCES
This article argues that the web pages allow informing about Covid-19, making it possible for the reader to become duly aware in order to have better sanitary control against Covid-19.	[11]
These articles argue that artificial intelligence allows a better study of the situation in order to achieve better health control against Covid-19.	[12]–[18]
This article argues that the use of artificial intelligence and Big Data make it possible to analyze a large amount of data in order to predict future Covid-19 scenarios and patterns, thus obtaining better health control against Covid-19.	[19]
These articles argue that the use of Big Data makes it possible to analyze a large amount of data in order to make a decision about Covid-19 and obtain better sanitary control against Covid-19.	[20], [21]
These articles argue that the use of the Block Chain makes it possible to share immutable data from medical research against Covid-19 and also to avoid misinformation, achieving better health surveillance against Covid-19 based on accurate information.	[22], [23]
This article argues that the use of ChatBots makes it possible to diagnose Covid-19 based on already defined questions, also, they can fulfill the role of informing to obtain better health control against Covid-19, based on truthful information.	[24]
This article argues that the use of data mining provides accurate information about a query, helps to have real statistics about Covid-19 allowing better health control Covid-19.	[25]
This article argues that the continuous use of Deep Learning makes it possible to refine it to anticipate responses and/or actions in certain scenarios in which Covid-19 is simulated, thus achieving better health control.	[26]
This article argues that the combination of Deep Learning with IoT opens up the possibility of creating intelligent objects that are refined according to their use, the IoT would be responsible for storing data while Deep Learning interprets it, obtaining tools that help health control against Covid-19.	[27]
This article argues that the combination of Deep Learning with Machine Learning opens the way to more accurate results as the algorithm to be used will adapt and learn to give us results that will help us to have better health control against Covid-19.	[28]
These articles argue that effective health control against Covid-19 requires the use of digital technologies.	[29]–[50]

THEMES AND FUNCTIONALITY	REFERENCES
These articles argue that ICTs play a very important role in helping us to have quick and easy access to global information and in times of pandemics they were of great help in promoting better health control against Covid-19.	[51], [52]
These articles argue that the use of the internet of things allows the development of new technologies, and, also, to rely on them, opening the way to telemedicine in times of pandemic, and obtaining better health control against Covid-19.	[53]–[58]
These articles argue that the application of Machine Learning, in the context of the topic, makes it possible to find patterns of Covid-19 infections and thus predict them in order to have better health control against Covid-19.	[60]–[62]
This article argues that the combination of Machine Learning and artificial intelligence opens the way to machines capable of learning on their own, in the present context, making possible the creation of robots that serve to monitor patients with Covid-19, thus avoiding contact with other human and the risk of contagion, achieving a better health control against Covid-19.	[63]
These articles argue that mobile applications are very useful because having an application related to Covid-19 allows us to be informed, consult and even monitor to achieve better sanitary control against Covid-19.	[64]–[126]
This article argues that the Smartwatch enables the detection of Covid-19 in the wearer as it can monitor heart rate and body temperature for diagnosis, thus achieving better health control of Covid-19.	[127]
This article argues that the use of virtual reality opens the way to being able to simulate Covid-19 patients and even scenarios to evaluate future decision-making in order to obtain a better health management of Covid-19.	[128]

Fig. 11 shows the number of selected items grouped by database and parameter.

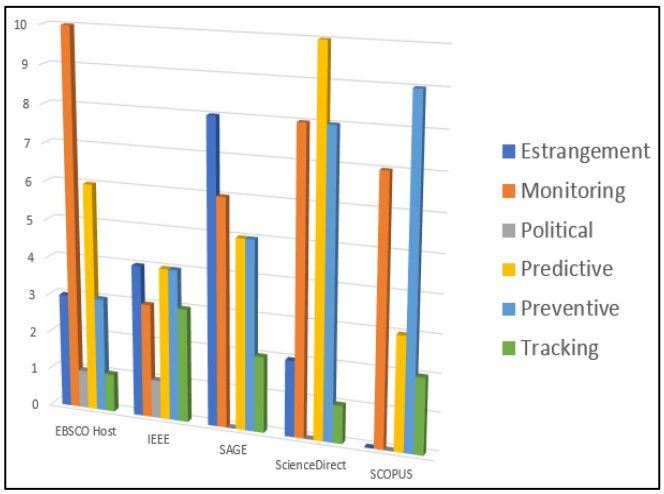

Fig. 11. Articles by Database and Parameter.

Table V shows the parameters of the articles according to the parameters found.

TABLE V. CLASSIFICATION OF ITEMS ACCORDING TO THE PARAMETERS OBTAINED

PARAMETERS	ARTÍCLES
Estrangement	[29]–[32], [51], [53], [54], [64]–[72], [127]
Monitoring	[12], [24], [27], [33]–[35], [52], [73]–[88], [90], [92]–[97], [129]–[132]
Political	[13], [98]
Predictive	[14]–[17], [19], [25], [26], [37]–[41], [60], [61], [63], [99]–[102], [104]–[109], [128], [133]
Preventive	[11], [20]–[22], [28], [42]–[47], [56]–[58], [110]–[122], [134]
Tracking	[18], [23], [49], [50], [123]–[126], [135]

Table VI shows the classification of articles according to the results found.

TABLE VI. CLASSIFICATION OF ITEMS ACCORDING TO PARAMETERS AND FUNCTIONALITY ISSUES

THEMES AND FUNCTIONALITY	REFERENCES
These articles take into account the parameter of distancing as they focus on creating strategies, and making use of technology, for the prevention of Covid-19, in scenarios where there is no rapprochement of individuals.	[29]–[32], [51], [53], [54], [64]–[72], [127]
These articles take into account the monitoring parameter as they focus on creating mobile applications and strategies based on Machine Learning, Deep Learning, and Artificial Intelligence since they can be monitoring an area where there was Covid-19 and even monitor the relationship between individuals and Covid-19.	[12], [24], [27], [33]–[35], [52], [73]–[88], [90], [92]–[97], [129]–[132]
These articles take into account the policy parameter as they encourage the use of technological tools in daily life and work so that, in times of pandemic, we adapt to study and work virtually, they also argue to consider very seriously the measures demanded by governments, to prevent Covid-19.	[13], [98]
These articles take into account the prediction parameter as they analyze data and facts, with the help of technological tools and Artificial Intelligence, making it possible for them to predict where Covid-19 could reemerge or if a community is about to suffer from it.	[14]–[17], [19], [25], [26], [37]–[41], [60], [61], [63], [99]–[102], [104]–[109], [128], [133]
These articles take into account the prevention parameter since they postulate measures, with the help of technological tools and Artificial Intelligence focusing on events that have already occurred, against Covid-19 to reduce contagion or a new outbreak.	[11], [20]–[22], [28], [42]–[47], [56]–[58], [110]–[122], [134]
These articles take into account the traceability parameter since they are based on following people or societies that have already suffered from Covid-1toto collect data and avoid possible Covid-19 infections.	[18], [23], [49], [50], [123]–[126], [135]

Fig. 12 shows the number of selected items grouped by database and quality attributes.

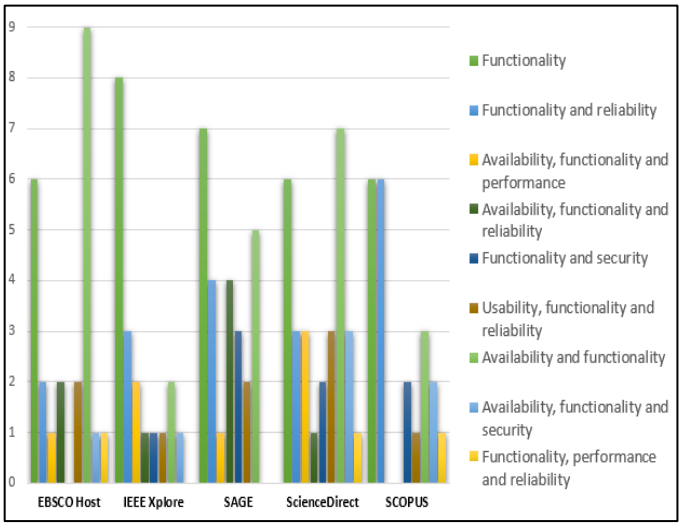

Fig. 12. Items by Database and Quality Attributes.

Table VII shows the quality attributes of the items according to the quality attributes found.

TABLE VII. CLASSIFICATION OF ARTICLES ACCORDING TO THE QUALITY ATTRIBUTES OBTAINED

QUALITY ATTRIBUTES	ARTÍCLES
Availability and functionality	[12], [25], [30], [31], [34], [35], [38], [48], [56], [63], [69], [74], [77], [79], [82], [88], [92], [105], [112], [115], [117], [120], [128], [133], [136]
Availability, functionality, and reliability	[24], [40], [66], [73], [80], [87], [100], [114]
Availability, functionality, and performance	[11], [16], [29], [46], [62], [86], [110]
Availability, functionality, and security	[37], [44], [58], [64], [95], [122], [137]
Functionality	[14], [15], [23], [27], [28], [32], [36], [39], [43], [45], [47], [49], [51], [55], [57], [60], [61], [65], [71], [72], [75], [81], [83], [90], [97], [101], [102], [108], [116], [119], [124], [138], [139]
Functionality and reliability	[17], [19], [20], [26], [41], [52], [53], [67], [68], [76], [94], [96], [99], [104], [109], [121], [123], [127]
Functionality and security	[18], [21], [22], [50], [54], [70], [125], [126]
Functionality, performance, and reliability	[107], [113]
Usability, functionality, and reliability	[33], [78], [84], [85], [89], [93], [106], [111], [118]

Table VIII shows the classification of articles according to the results found.

TABLE VIII. CLASSIFICATION OF ITEMS ACCORDING TO QUALITY ATTRIBUTES AND FUNCTIONALITY ISSUES

THEMES AND FUNCTIONALITY	REFERENCES
These articles take into account the quality attributes of availability and functionality, mentioning that these quality attributes are the priorities for the development of effective and viable software for sanitary control against Covid-19.	[12], [25], [30], [31], [34], [35], [38], [48], [56], [63], [69], [74], [77], [79], [82], [88], [92], [105], [112], [115], [117], [120], [128], [133], [136]
These articles take into account the quality attributes of availability, functionality and reliability, taking into account this, it will be possible to develop software for sanitary control against Covid-19 with high-quality standards.	[24], [40], [66], [73], [80], [87], [100], [114]
These articles take into account the quality attributes of availability, functionality and performance, which would serve to develop software with the necessary functions to solve the problems presented by Covid-19.	[11], [16], [29], [46], [62], [86], [110]
These articles take into account the quality attributes of availability, functionality, and security, since the development of software that is ready for use at any time, works as designed, and contains a level of resistance to be breached, would be completely viable to combat Covid-19.	[37], [44], [58], [64], [95], [122], [137]
These articles take into account the quality attribute of functionality since they consider that it is the main quality attribute for the software to be able to perform the functions for which it was programmed or developed, being highly effective in time of pandemic by Covid-19.	[14], [15], [23], [27], [28], [32], [36], [39], [43], [45], [47], [49], [51], [55], [57], [60], [61], [65], [71], [72], [75], [81], [83], [90], [97], [101], [102], [108], [116], [119], [124], [138], [139]
These articles take into account the quality attributes of functionality and reliability since a software must fulfill the functions for which it was created, but also that software must remain operational over time, these requirements are perfectly aligned to address the problems that Covid-19 is presenting.	[17], [19], [20], [26], [41], [52], [53], [67], [68], [76], [94], [96], [99], [104], [109], [121], [123], [127]
These articles take into account the quality attributes of functionality and security since they emphasize that all software must do the job for which it was developed and, nowadays, all software must have a decent degree of security since the Covid-19 pandemic has increased the rate of cybercrime.	[18], [21], [22], [50], [54], [70], [125], [126]
These articles take into account the quality attributes of functionality, performance, and reliability, they mention these quality attributes because they consider that software must perform its functions correctly with speed and accuracy, being able to operate with a large amount of data, such as the data generated by the Covid-19 pandemic, without having a long waiting time.	[107], [113]
These articles take into account the quality attributes of usability, functionality, and reliability, since a viable and effective software that is focused on the study of Covid-19, must be simple and understandable for all audiences, with correctly programmed and operational functions.	[33], [78], [84], [85], [89], [93], [106], [111], [118]

IV. DISCUSSION

This systematic literature review is intended to answer the following questions.

RQ1. What digital technologies allow for better control, follow-up, and monitoring of the health status of students, teachers, and staff in educational centers against Covid-19?

According to Fig. 10, it can be seen that the articles related to the present topic in question use the digital technologies of; Mobile Application, Artificial Intelligence, Other Digital Technologies, etc. This result indicates that these technological categories allow sanitary control against Covid-19.

According to Table III, and commenting on it in Table IV, it can be seen that the digital technologies related to the present topic use the digital technology of "Mobile Application". This result indicates that this digital technology is one of the most used in allowing to have sanitary control against Covid-19 and is aligned to today's technological era, where we all use a mobile device.

RQ2. What parameters should be taken into account to make effective sanitary control against Covid-19 in educational centers through the use of a mobile application?

According to Fig. 11, it can be seen that the articles related to this topic use the technology of distancing, monitoring, policy, prediction, prevention, and tracking. This result indicates that these parameters allow sanitary control against Covid-19. According to Table V, and commenting on it in Table VI, it can be seen that the parameters related to the present topic use the "Monitoring" parameter. This result indicates that this parameter is one of the most used in allowing sanitary control against Covid-19 since constant monitoring makes possible the collection of data and its subsequent analysis.

RQ3. What quality attributes must it contain for the viability of the mobile application for the implementation of a sanitary control against Covid-19 in educational centers?

According to Fig. 12, it can be seen that the articles related to the present topic use the quality attributes; functionality, availability and functionality, functionality and reliability, etc. This result indicates that these quality attributes allow the creation of an effective software directed to have sanitary control against Covid-19.

According to Table VII, and commenting on it in Table VIII, it can be seen that the parameters related to the present topic use the "functionality" parameter. This result indicates that this quality attribute is one of the most used in allowing sanitary control against Covid-19 since this attribute focuses on the ability of the system to perform the task for which it was developed.

RQ4. Which countries have the most research, in the last three years, related to health monitoring against Covid-19 in schools?

According to Fig. 5, it can be seen that the articles related to this topic come from the continents of Asia, America, and Europe (from highest to lowest). This result indicates that there is a greater knowledge of the technologies related to sanitary control of Covid-19.

According to Fig. 6, it can be seen that the articles related to this topic come mostly from the United States and China. This result indicates that there is more experience in sanitary control against Covid-19 in these countries.

V. Proposed Model

The following is a proposed model based on mobile applications for the implementation of sanitary control against Covid-19 in educational centers, aligned with the data collected from the articles related to the present topic (Fig. 13). The proposed model is related to the article [140]. In Fig. 12 we can see the proposed model, which includes the phases of the data set: It is the literature systematization of all articles found related to the topic and complying with the standards of the article inclusion chart (Fig. 1) and the inclusion and exclusion criteria (Table I). In the ideal characteristics of the mobile applications for the implementation of sanitary control against covid-19 in educational centers, three main characteristics have been taken into account, which are:

Additional digital technologies: After systematizing the literature, we were able to identify, according to Fig. 10 and commenting on it in Tables III and IV, the additional digital technologies that are most used at the time of the development of a mobile application for the implementation of a sanitary control against Covid-19. Beginning to order them by their level of use (except for mobile applications and digital technology), in the first instance we have artificial intelligence because the additional technology mentioned would allow a better study based on complex algorithms which would be interpreted by the machines making more effective the functions of the mobile application. In the second instance, we have the internet of things since the implementation of communication between the mobile application and the intelligent sensors of the mobile device would make the mobile application more complete and could use data provided by the user himself, such as his location via GPS his daily steps or speed of movement through the accelerometer.

Parameter: Another ideal characteristic for the development of an effective and viable mobile application is the parameter on which it will be based. In the present systematic review of the literature, the parameters on which the cited articles were based to obtain a better sanitary control against Covid-19 were identified according to Fig. 11 and commented in Table V and VI. It was evident that the most used parameter was monitoring, since it allows collecting, studying, and analyzing the information obtained for a constant follow-up, i.e. it will be possible to analyze the information of patients or communities where there was Covid-19 to identify symptoms of the virus, precedents and even to identify where it could outbreak, Following this parameter, it would be possible to have a better sanitary control against Covid-19 since it would be evaluating, in every certain period, the health avoiding contagions, identifying possible resurgence and possible people prone to contract Covid-19, currently, the mobile device would be aligned to support itself in the monitoring to give more accurate results of an individual diagnosis and that would be thanks to the sensors contained in each mobile device. The second most used parameter is preventive since its main objective is to reduce future Covid-19 infections, that is to say,

to study real, truthful, and reliable data so that later they can carry out a better control against Covid-19, besides, with the help of technology and the creation of software and apps, more accurate data could be obtained to identify the infected areas, obtaining, as a result, an alert in that area, achieving to reduce infections or a new outbreak.

Quality attributes: Finally, we have identified a third and last ideal characteristic. When the systematization of the literature was done, quality attributes were identified to reach the development of a mobile application for the implementation of sanitary control against Covid-19. According to Fig. 12 and comments in Tables VII and VIII, the most frequent quality attribute is the functionality, since it allows the system to perform the work for which it was created, that is, to give us accurate results of the operations we perform, so that when we want to consult the Covid-19 infection rate or perform a diagnosis of Covid-19 using the software, Another example is when we use a mobile application that by me using bits, our daily route and monitoring it by means of using us with certain information for which it was developed and thus fulfills its functionality. The second quality attributes were availability and functionality, previously we have already explained the functionality so we would complement the explanation now with reference to concerning, then when you mention availability, we refer to the ability of all software to be executed when the user needs it, i.e. it must be accessible and usable.

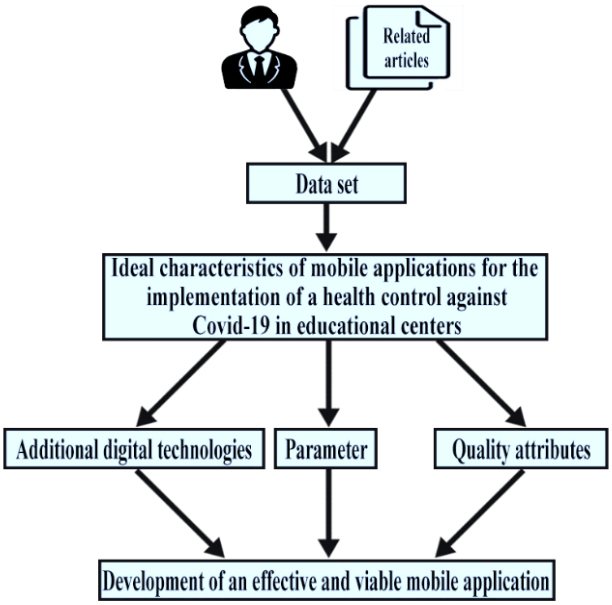

Fig. 13. Proposal Template.

Development of an effective and viable mobile application: With the three ideal characteristics, identified at the time when the systematization of the literature was performed, this point could be fulfilled, because while a mobile application contains additional digital technologies then the final product will be more complete, will contain many functions, will obtain more precision in its results or final functions. Do not forget that the parameter on which the mobile application will be based can get improved and be clearer about the functions that we would like to fulfill for the mobile application to develop. Finally, the quality attributes are very essential in all software because they are indicators that reflect how well the system meets the needs of stakeholders.

VI. Related Articles

Other systematic literature review studies conducted such as [141] based on the identification of the factor affecting the intention of continuous use of the mHealth application, compared to the present systematic review, they identified 354 articles which by removing the irrelevant and duplicated ones, 25 selected articles were left for the systematization of the literature. From this, they identified the factors for the continued use of mHealth applications (identifying a total of 39) some factors are satisfaction, quality of service, monetary cost, age, and education, among others. It concludes by identifying the five most frequent factors, which are satisfaction, the usefulness of the mHealth, quality service, training of the service, and ease of use of the service. It shows that users prefer mHealth to meet this expectation, since a mobile application should not only be easy to use but also have quality service and trust in it.

On the other hand, the following systematic review of the literature [142], searched for articles in the PubMed and Scopus databases to identify mHealth applications used for the prevention, treatment, or management of COVID-19. They identified a total of 728 articles of which, using the PRISMA methodology, they were left with 12 articles for the systematization of the literature. The author concluded that the studies in the articles he reviewed were not of high quality since Covid-19 had to generate responses and very premature development of digital tools for health by the scientific community. He emphasizes that a more longitudinal study with a rigorous design is required for a better evaluation of mobile applications against Covid-19.

Finally, in the following systematic review of the literature, [143] based on the study of data privacy during pandemics: a systematic literature review of smartphone applications Covid-19, identified 808 articles, using Liao's methodology, they were left with 35 articles for systematization of the literature. It relates that data privacy or information privacy often revolves around whether or not the data stored in the mobile application is shared with third parties. He also emphasizes that there are security policies for users and this is very important because in pandemic times there was a high increase in the use of mobile applications, especially against Covid-19, so this point of data protection is vital for the current technological era.

VII. Conclusion

After having carried out systematic literature research of 119 articles related to the topic in question, it is concluded that:

The digital tools or technologies that allow better control, follow-up, and monitoring against Covid-19 of the health status of students, teachers, and staff in educational centers are the digital technologies associated with "Mobile application", "Digital technology" and "Artificial intelligence". Likewise, most of the authors, from the articles reviewed, choose to base their article on a parameter focused on monitoring Covid-19.

Therefore, it was evident that most authors rely on the parameter "Monitoring" because they can observe and study patients who have contracted Covid-,19 and even take a study of the locality where there was Covid-19 which would help them to obtain updated reports and conduct accurate research.

Regarding the quality attributes that must be contained for the viability of the mobile application for the implementation of a sanitary control against Covid-19 in educational centers, they are availability, and functionality since this allows the system to perform the work for which it was created and to be available for use, meeting the needs of users. It was also concluded that the countries with the most research, in the last three years, related to sanitary control against Covid-19 in educational centers are the United States and China, showing that these countries have greater experience in sanitary control against Covid-19.

Finally, a proposed model was postulated to achieve the development of an effective and viable mobile application based on the three ideal characteristics previously explained. This systematic review can also be useful for use in future research on digital technologies, parameters, and quality attributes for the implementation of a health control against Covid-19 in educational centers, as well as identifying the countries that have more experience in this subject. In contrast, we can also rescue from the article [140] a graphic suggestion aligned to our conclusion (Fig. 14):

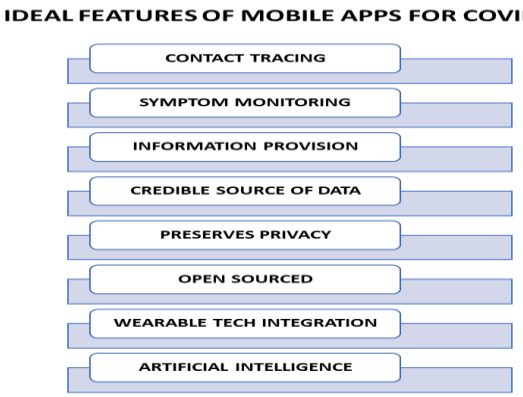

Fig. 14. Ideal Features of Mobile Apps for COVID-19.

Fig. 13 suggests some features that should be available in mobile applications for Covid-19. Other important functionalities that can be integrated into these contact-tracking apps include features for automatic symptom monitoring and information provision. The addition of these features will provide a more holistic public health approach in response to the situation. As technology advances, the symptom tracking algorithm can be enhanced and adapted to the pandemic to improve its diagnostic accuracy. Wearable devices, such as smartwatches and smart bracelets, will become more common and integrated into everyday life; therefore, these can potentially assist in vital monitoring of the health status of vulnerable populations. Through machine learning and artificial intelligence methods, automatic and rapid identification of suspicious infections will be more accurate in the future.

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