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Article

Survey of Robotics in Education, Taxonomy, Applications, and Platforms during COVID-19

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Abstract: The coronavirus disease 2019 (COVID-19) is characterized as a disease caused by a novel coronavirus known as severe acute respiratory coronavirus syndrome 2 (SARS-CoV-2; formerly known as 2019-nCoV). In December 2019, COVID-19 began to appear in a few countries. By the beginning of 2020, it had spread to most countries across the world. This is when education challenges began to arise. The COVID-19 crisis led to the closure of thousands of schools and universities all over the world. Such a situation requires reliance on e-learning and robotics education for students to continue their studies to avoid the mingling between people and students. In relation to this alternative learning solution, the present study was conducted. A systematic literature review on educational robotics (ER) keywords between 2015–2020 was carried out for the purpose to review a total of 2253 articles from the selected sources; Scopus (452), Taylor & Francis (311), Science Direct (427), IEEE Xplore (221), and Web of Science (842). This review procedure was labelled as Taxonomy 1. After filtering Taxonomy 1, it was found that 98 scientific articles formed the so-called Taxonomy II that was categorized into six categories: (i) Robotics concepts, (ii) Device, (iii) Robotic applications, (iv) Manufacturing robots, (v) Robotics analysis, and (vi) Education/taxonomy. For this study, only 35 articles in this specific field were selected, of which were then assigned into three categories: (i) Application, (ii) Platform, and (iii) Educational. The results show that the application category carries 17.4%, platform 20%, and education 22.85%. This study serves as the application platform to help students, academics, and researchers.

Keywords: COVID-19; educational; educational robotics; taxonomy; application platform

1 Introduction

At the end of 2019, in particular in December, COVID-19 only appeared in some countries. However, soon after the beginning of 2020, it spread to most countries across the world. This was the point where the education challenge started. The COVID-19 crisis has led to the closure of thousands of schools and universities all over the world. Therefore, the majority of educational institutions in many of the COVID-19 affected countries, such as America, France, Britain, Italy, Germany, Malaysia, Singapore, Indonesia, and the Arab countries have resorted to the option of online education. Such move was made in order to continue with the established school curricula, and to fill educational gaps resulting from the exacerbation of the crisis in those countries.

One of the online education modes that have also been highlighted is the education-robotics symbiosis model. This model discusses some of the major elements that can ensure that the idea of a viable and effective education-robotics symbiosis can be materialized at different levels [1]. Prior to the COVID-19 crisis, some prestigious universities have already implemented online education, such as Columbia, Oxford, Harvard, Cornell, Yale, and Pennsylvania.

The Educational Robotics (ER) approach is multidisciplinary. ER includes architecture, assembly, and the utilization of robots based on engineering principles, computing, mathematics, physics, and others. Hence, ER has been used to teach Science, Technology, Engineering, and Mathematics (STEM) as well as various levels of computer science pedagogy [2–4]. The use of robots in teaching, deals with many problems and challenges facing the educational process today. However, we think robots can play a role in this, as robots can provide a personalized instruction directed at the individual, and we can imagine that in the future the classroom has a number of robots that are helping students who need more support, or who want to learn more. This shows that the robot is actually a part of most aspects of life. Within the context of this realm, this paper presents a research review literature on robotics in education in view of the possibility of using robots in the classrooms to improve the human condition [5].

Everyone in the field of education tries to both avoid problems and put in place solutions in the era of COVID-19. In suburban areas in Malaysia, people face many challenges in this difficult time. Hence, the current study aimed to offer some solutions that may help people deal with the challenges. Literary studies are classified according to their variables and results. Based on this concept, the following research questions were formulated for this study:

1. Is the introduction of robotics into education recognized by the government and educational institutions?
2. Are projects supported and developed in order to introduce robotics in education? For example, specializing in projects that run for a full academic year, college or university projects or holding competitions such as Olympiads?
3. Is there a focus on ways to develop and introduce the integration of robotics in the early stages of education?
4. How can teachers, practitioners, instructors, and students accept robotics in education?

This paper is organized into several sections. Section 2 presents the related articles about robotics in education. Section 3 develops the methods used in the study. Section 4 describes the requirements for eligibility and the search criteria of the selected articles from 2015–2020. Section 5 describes the data collection process and taxonomy. Section 6 presents the results and finally, Section 7 concludes the paper from the aspects of the advantages, disadvantage, and challenges of the research.

Robotics in Education

Educational robotics programmers have grown in popularity in the most advanced countries and are also becoming increasingly popular in developing countries. Robotics is used to teach problem solving, programming, design, physics, mathematics, and even music and art to students at all stages in their schooling. Robots are physical agents that perform tasks by manipulating the physical world. Robotics is a branch of artificial intelligence (Al), which comprises electrical engineering and computer science for the design and construction of robots [6]. It is applicable in practical tasks that require cooperation between man and robot [7]. Designing widespread priors optimizes the computing time [8], computing and machine learning [9].

2 Method

The scope of this study is covered by the most important keywords, namely, 'educational robots,' 'education in robots,' 'human-robot interaction,' 'higher education,' 'academic,' 'smart pedagogy,' 'teachers,' 'student,' and 'tutors.' Our study is limited to papers containing studies published in the English-language only. The selected digital databases to search for target papers in this study were the Web of Science (WoS) database, Scopus, Taylor & Francis Group, Science Direct, and IEEE Xplore. All of these discreet and reliable research engines were accessed via our academic accounts at the University Sains Malaysia (USM) and Basrah University. In the first iteration, duplicate articles were excluded, and only articles published in the past five and a half years, from 2015–2020 were selected. The studies expired in June 2020. The papers were collected using the Mendeley-Desktop 1.19.4-win32 software. The second iteration sorted the articles according to their titles and abstracts as well as articles outside the scope of our domain. The articles were filtered in the third iteration by reading the full text. Articles outside the scope of our domain and did not meet our criteria were excluded.

The keywords were combined using the 'OR' and 'AND' operators followed by 'academic,' 'smart pedagogy,' 'teachers' and 'student,' or combined with the 'OR' and 'AND' operators followed by 'tutors.' The explicit query text is shown at the top of Fig. 1. We used other additional options in the search engines of the five databases as well as some book chapters and accurate reports. We omitted journals and conference papers because we considered these two sources as being the most likely to provide up-to-date and acceptable research work applicable to our survey. Articles which met our eligibility criteria were included in our work. The initial goal was to map the field of research into a taxonomy.

2.1 The Requirements for Eligibility (Search Criteria)

The articles shown in Fig. 1, which met our criteria were part of our work. Its initial objective was to map the research scope in general. Coarse-grained taxonomy consists of six categories (only three categories were focused on in this study) derived from a previous study of the literature with no restrictions. We used five sites to learn directions in the literature. After removing duplicate papers between databases, we excluded the articles through three iterations of filtering and screening when the articles did not meet our eligibility criteria. Articles were excluded if (1) they are not clear and focuses on a limited side, (2) they are not written in English, (3) they are repeated on research sites, one of which was excluded, and (4) the papers focus on the overview. Our work focuses on the shaded domains in Fig. 2 because these domains contain rich information covering the study.

2.2 Data Collection Process and Taxonomy

The data were collected from the five scientific sites mentioned in the summary and protected through the authors' accounts. After that, the initial screening process was performed, which included three stages; (1) screening out duplicates, (2) scanning the titles and abstracts, and (3) reading the full texts. Finally, after the articles had been read, analyzed, and summed up according to their content, their initial categories, summaries, and charts were derived using the Word, Excel, and Mendeley-Desktop-1.19.4-win32 software. All research papers were taxonomy into six categories (first stage). Then, it focused on three main categories (the second stage) that covered the topic of robot education broadly, including the 35 research articles, application, platform, and educational. The other three categories will be discussed in another paper.

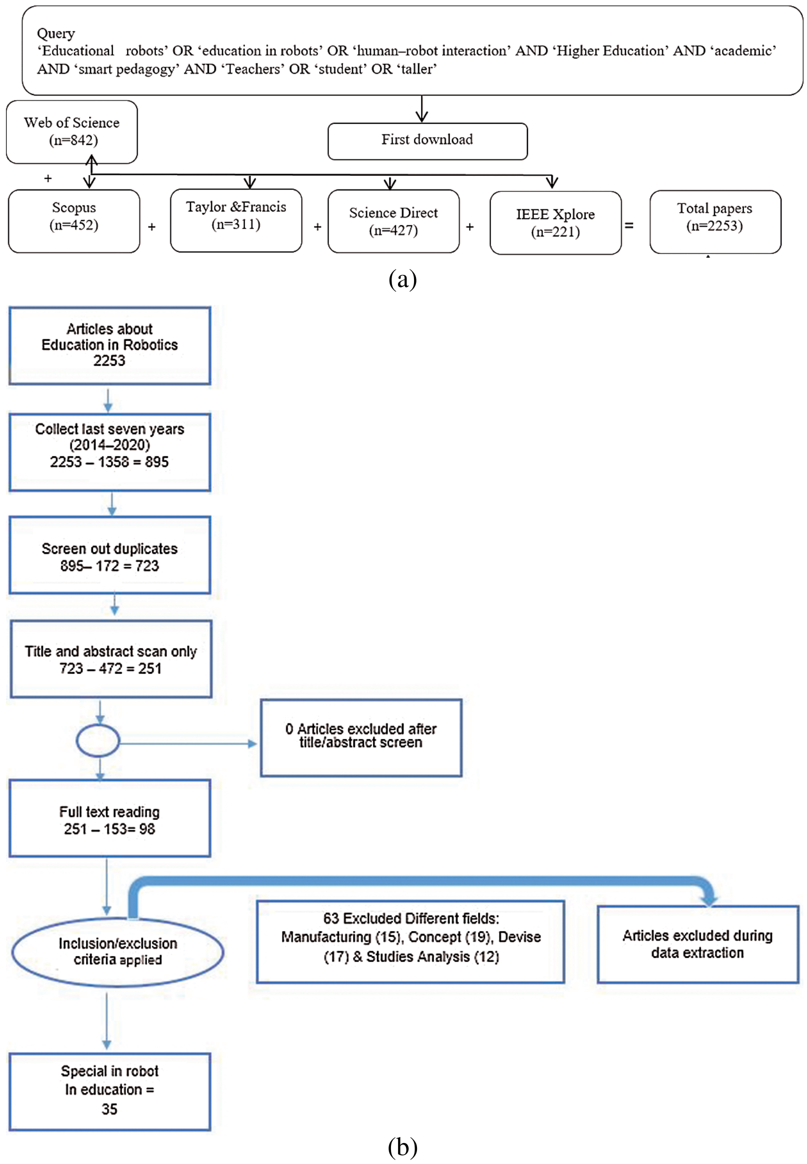

Figure 1: (a) Flowchart study query words used, (b) the algorithm extraction, screening, and inclusion of articles

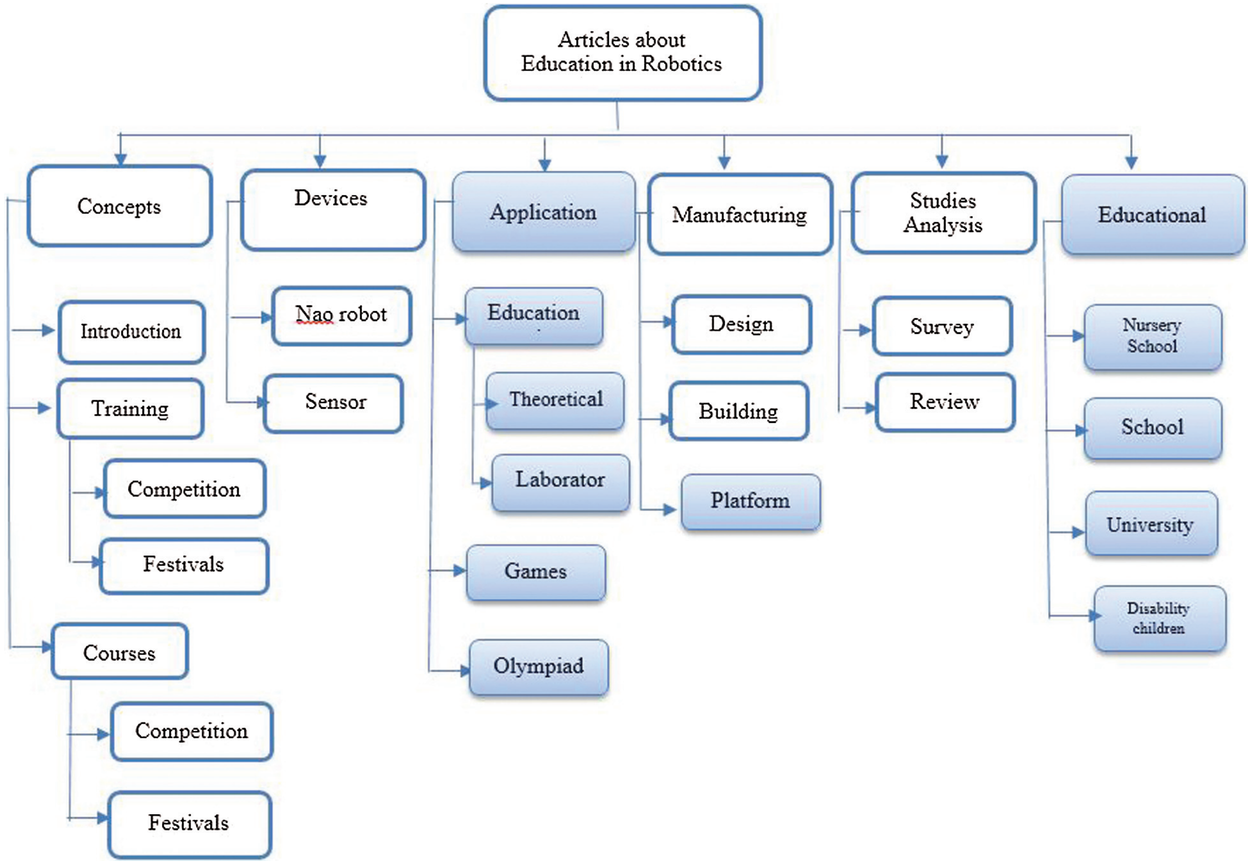

Figure 2: Taxonomy of articles on robotic education

3 Result

When the search in education in robot finished, refereed journal articles were retrieved using the query method. In this study, the total of the articles was 2253; 842 articles from Web of Science, 452 articles from Scopus, 311 articles from Taylor & Francis, 452 articles from Science Direct, and 221 articles from IEEE Xplore, for the timeframe from 2015 to mid-2020. We could not download two scientific papers from Scopus because they lost a few days for the year 2020. The items were filtered according to the sequence adopted in this investigation, by using two types of sequence; 895 previously written articles within five and a half years (2015–2020) and 172 papers were published in all three databases, which led to 723 papers. Following a full session screening of the titles and abstracts, 427 more papers were ruled out. Subsequent to the final screening, 153 papers were ruled out after reading the full texts. In this paper, we worked on taxonomy articles in two phases. The first phase in general, involved six categories. The final set was made up of 98 papers in this category, and the second, in particular, focused on education (three categories). The final set was made up of 35 papers in this category, as shown in Fig. 2.

The following study criteria were applied to all research articles in this study:

1— The study in the journal article or conference paper must be in the English language
2— The main focus of the study in the articles should be educational in robots in either one or more of the following aspects:

- Author's name, year, the title of the study, and nationality of the author.
- Variables (independent and dependent).
- Methodology and outcome.
- The gap between the previous study and now.
- What is needed in this era (pandemic era)?

3.1 Distribution Results

Fig. 3 shows that many papers were published by the five digital databases. The application consists of Education (theoretical laboratory), games, and Olympiad. The platform is one of the components under manufacturing, while educational consists of nursery schools, schools, universities, and children with disabilities. Web of Science published 9 papers, IEEE Xplore published 6 papers, Scopus published 7 papers, Taylor & Francis published 4 papers, while Science Direct published 7 papers and 2 other papers.

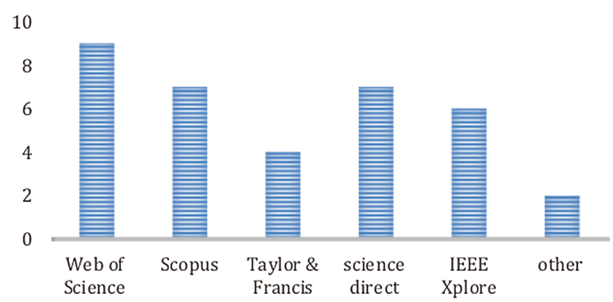

Figure 3: Publishing sites by numbers

3.2 Distribution by Articles' Publication Years

The distribution by publication years of the articles from 2015–2020 is provided in Fig. 4. Approximately one paper had been published since 2015. Five papers were published in 2016. Three papers had been published since 2017. Eight papers had been published since 2018, 13 since 2019, and 5 from 2020 until June.

3.3 Distribution by Nationality of the Author

Fig. 5 shows that 21 countries and nationalities implemented triage. We observed that the literature studies were conducted in certain countries or they covered cases in these countries. The nationality distribution of the 21 robotics in Education papers in numbers and percentages shows that the most productive authors are from Germany (5), Brazil (4), Australia (3), Italy, Greece, UK, Indonesia, and Portugal (2 each), South Africa, Israel, Mexico, Slovenia, Norway, Switzerland, Qatar, Canada, India, Finland, Malaysia, Chile, and Netherland (1 each).

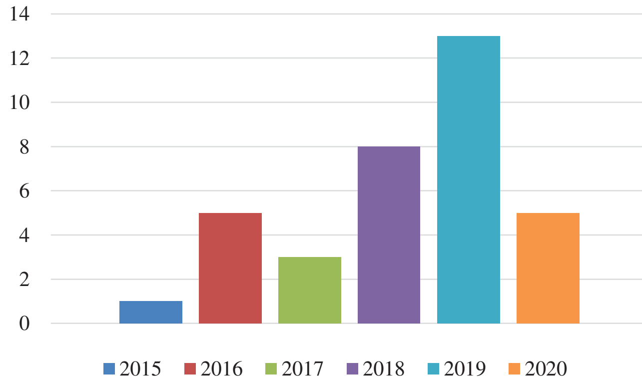

Figure 4: Statistics of the included papers in different categories by publication year

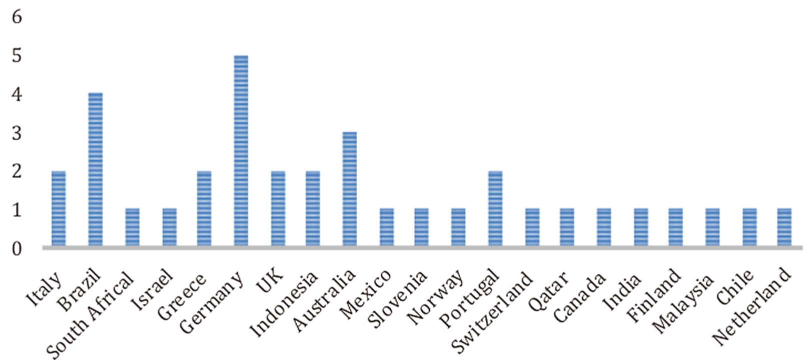

Figure 5: Nationality of author

Table 1: Taxonomy to phases

No.	Taxonomy (1)	No. articles	Ratio study (%)
1	Concepts	**19**	19.39
2	Device	**14**	14.28
3	Application	**6**	6.12
4	Manufacturing	**23**	23.46
5	Studies analysis	**12**	12.44
6	Educational	**22**	22.44
	Total	**98**	**100**
No.	Taxonomy (2)	No. articles	Ratio study (%)
1	Applications	**6**	17.14
2	Platform	**7**	20
3	Educational	**22**	22.85
Total		**35**	**100**

Tab. 1 presents a summary of the taxonomy of the two phases. The first, in general, in robotics in Education and the second is in Special Education (teaching and education in universities, institutes, schools, and kindergartens) only. Tab. 1 also displays the results for the ratios of the varieties depending on the number of research articles included in the study.

4 Discussion

35 papers of study articles were reviewed according to the three categories; application, platform, and educational. These categories will be discussed in detail in the sections that follow.

4.1 Application

This section describes the three important categories. The first category is Education (theoretical/laboratory), the second category is games, and the third category is Olympiad. These categories will be discussed in detail.

A study in an article examined the advancing critical reasoning skills for students' academic robotics. The study in this article provides the data on the students' age and school level; first, 15 years old and second 18 years old, covering 164 students of different levels of education (Junior Medium, 89; Medium Vocational, 75). The methodology used in the study was the didactic approach to encourage the development of analytical thought for the students' computational thinking (CT) and professional robotics (ER) skills. This approach had also been used for different assessment modalities cooling systems (written and oral). The findings of this study are (1) the students eventually reached the same level of development of CT skills regardless of their age and gender, (2) computational thinking (CT) skills in most cases require time to develop fully (students' scores—the students improved substantially towards the completion of the activity), (3) significant variations in age and gender, and (4) the modality when analyzing the score of the students in different specific dimensions of the computational thinking (CT) skill model. The skills assessment instrument may affect the performance of students [10]. The weakness of this study is that it was conducted in 2016, and the researchers stated that none of the participants in the study had previous experience with robotics—this is a pioneer study for previous studies, as studies on robots started from the year 2000. This study also contains sources from 1980–1991. Our addition to this previous work is the development of students' computational thinking skills in the context of educational robotics.

Another study is on the role of robotics in education using the constructivist approach to machine taught in the 21st Centuries. The article was not in the working paper. The methodology used in the study was articles analysis to show that the constructivist approach to education is a prominent approach. The study found previous business contributions and the development of computational thinking skills [11]. The study's weakness is that the number of papers and details in the abstract and submitted sections was unknown, and thus not specified.

Another article is a study on the course in robotics in Brazil. The study in the article had a sample of 71 students in high school who attended a three-year short course, of which several students participated in the practical phase the next year. The students in the study joined the course for teaching robots without a time limit during the three-day course. The studies included two theoretical and practical parts, which were giving them baskets and training them [12].

The weakness of the study is that it calls for the same Olympiad and hackathon, and announced more and included more in the number that encouraged the building of Olympiad in all states. In each session the winners were racing between states. There are a lot of Olympiad and hackathon states built in Italy, Spain, Holland, Qatar, Iraq, Saudi Arabia, and Emirates. However, these countries did not promote them. Hence, our addition to their work represents its usefulness. It is one of these Olympiads that all students and teachers should be familiar with, which is the science of asthma. If it had been available in the past, it would have reduced the pause that occurred in a pandemic era.

Some researchers present a study on the Brazilian Robotics Olympiad. The study in the article included more than 300,000 students who took part in the Brazilian Robotics Olympiad and of them, 58% were school and university students. The approach used in the study was by dividing into multilevel functional and theoretical elements, each built for a certain student's age, after that they carried out the tests and competitions. The study concludes that the student and faculty surveys show considerable positive results for the behavioural aspects of the participating students in the Brazilian Robotics Olympiad (OBR), and it supports students in the OBR. In addition, the students make a more confident decision, on which career to pursue.

The collected information also indicates that the OBR assists the students in robotics and other technologies, in which they work together to enhance skills and participation, especially in the practical dimension. It also helps in the basic robotic tracking, robotics kits, robotics materials at high school, classrooms, courses, and additional products are now available [13]. The study is lacking in the encouragement of the establishment of Olympiad games in all countries, where each participant cycles individually and the winners race among countries.

Our work is an addition to their work in terms of its usefulness. It is one of these Olympiads, of which all student participants, the green participants, and teachers should be familiar with the science of Robot. The second and third categories in education are games and Olympiad as one of the studies. The researchers presented a study on an algorithm used in an educational computer programming game for beginners. In the study, an educational computer game was used to beginner students giving basic concepts of programming. The methodology, which was used in the game was a basic language and a virtual world where coding that used execution could be easily tracked. The conclusion of the study in this paper is that the game is an effective method for laying the foundations for computer programming, which bases could be more difficult to prove with other teaching instruments. This indicates the necessity of including toys and robots in education [14]. The study's weakness is that it did not explain the use of a mini-language micro world in the study. Our addition to their work is in including games and using robots, for the purpose of generating relationships between children and the computer, and for occupying the children's free time in the time of the COVID-19 pandemic. The summary of games and Olympiad is shown in Tab. 2.

4.2 Platform

The second category is a platform in robotics in education articles. Seven out of the 102 articles extracted (20%) were in this category. In one of the articles, the researchers presented a study on the robot teaching platform (AMiRo). The software, hardware and further components of this robot, the software AMiRo design covers two main parts; real-time and non-real-time, and includes lighting, power control, wheel drive, and image processing sections. The non-real-time contains cognition parts and circular hardware with a diameter of 100 mm, the height of 76 mm, and a weight of almost 500 g. The educational pattern used in the study in the article starts at the top of the curriculum and leads to a review of the lecturers' and students' views. The platform works with digital data processing, sensors, communications, and engine technology. The article concludes that the AMiRo platform helps teachers and students in computer science, electronic

Table 2: Summary of games and Olympiad

No.	References	Variables	Methodology	Outcome	What is the gap between the previous study and now	What is needed in this era (pandemic era)
1	[15]	Open source system—the use of PiCam camera in robotics education	Calculates obstacle distances beyond standard camera's limited field of view	The vision system proposed was tested + obstacle avoidance	Mentioned in the title of the search devices and prices. But the researchers touch on it in the article	Enabling the robot to navigate health navigation
2	[16]	Students + internet + recording and audio devices + laboratory	The current online learning technologies + a lecture-style environment	Designing a prototype framework + translate physical laboratory	The researchers did not touch. It is possible to allocate a place to be in the age of a pandemic with lectures and advanced techniques	Courses, classes, meeting, discussion, and workshop continue at Universiti Sains Malaysia (USM)
3	[17]	Software tools + a set of programming blocks and learning block	Learning block provides a built-in educational programming environment	Use android learning programming For the purpose of improving the motives of the extras for programming	–	It is important to teach children to prepare them at other stages

(Continued)

Table 2: (Continued)

No.	References	Variables	Methodology	Outcome	What is the gap between the previous study and now	What is needed in this era (pandemic era)
4	[18]	Platform	A mobile robots research platform for testing GuiaBot, has a differential robot steering, weighs 75 Kg and can run 1 h only as shown in Fig. 6	Robotic mobile health and safety research	Notifications were not addressed more broadly	Good ideas in any catastrophic accidents + Avoid friction between people + get rid of the transmission of diseases
5	[19]	The robot reconfgurability are two types: inter + intra-reconfgurability	The framework for taxonomy and evaluation (TAEV) + the evaluation metrics are implemented to measure autonomy levels	The taxonomy and assessment of self-configuring robotic systems	–	Shift from international formation to automated and electronic systems and programs

engineering, and other electrical engineering fields. The article lacks information on the price of the robot and the cost of using the robot. The AMiRo robot is used to present lectures, and in projects in various fields associated with the robotics, but the most important field in computer science and engineering. We are going to make a platform that will lower the cost of teaching. Teachers can then focus on the course and curriculum design [12]. In one article, the researchers presented a study on teaching robotics with an open-source technology. The study explored images and image processing with a low-level robot control. The article features a system that uses three environments: (a) A simulated environment, (b) An augmented environment, and (c) A real-world environment. In the simulated environment, work was manipulated. In the augmented environment, students used real cameras to perceive and detect objects in the scene. In the real-world environment, the system consisted of a real camera and a real robot manipulator [20]. The study concluded that the platform production is an open-source, an educational robotic platform that integrates multiple levels of interaction using an additive vision sensor. Our addition to their work is applying actions similar to the readiness of any stop that is put forward in the future at a stop of time.

In another article, the researchers presented a study on robot education inspired by biological systems. The study included a hexapod robot with the following dimensions: Weight of 1.5 Kg, body width of 83 mm, and body length of 193 mm. The methodology for university students learning to create hexapod robots relies on an open platform that requires basic robotic skills, such as mechanics, control, and energy management.

Robots can walk on flat surfaces (flat). Furthermore, a Hexapod robot has been used to stabilize different terrain and environments. This study concludes that unlike the fastest but very unstable tripod gait, wave gait is the strongest and stable alternative. Some other ways of minimizing the power consumption is by observing animals in nature and applying the same methods of mobility for robots [21]. The study lacks a comparison based on the number of foot robots. Our addition to their work is in motivating students to compete and establish activities using robots, the participation of all students, and the benefit from assessing and knowing the strengths and weaknesses in presenting the scientific material to do a SWAT analysis.

In a different selected article, the researchers presented a study on an educational mobile robot. The RoboCarts contest consisted of up to five fully autonomous robots. The robots all worked simultaneously and earned points at the finish line, based on their order. The micro mouse competition was a case where 1616 was solved by a small robot in an 18 cm wide labyrinth at 18 cm height. The robot started in the cell at the bottom left and the goal was to enter the four main cells. The mechanical, hardware, and software architecture are from the three parts. The important purpose of this platform is that it helps the students to learn. The study stated that this device was tested in the Czech Republic throughout the Robotic Day 2017 [22]. The researchers achieved satisfactory results in the study. The study's weakness is that it used a semi-circle sensor. Our addition to their work is that ours is good for tests and assessments for students.

In another article, the researchers presented a study on teaching mathematics education by a robot at a junior high school. The study sample was divided into two groups. The first classroom was managed by a robot. The second classroom was run in a traditional way. In the study, the researchers worked on integrating the robot in the first and second semesters in secondary schools to represent a support tool for teachers and teachers with multidisciplinary materials using the NAO robot. At Level I, the student solved problems that involve comparing or performing calculations with natural numbers. At Level II, the student solved problems with decimal numbers and simple linear equations. At Level III, the student solved problems with fractional numbers, with sign or powers of natural numbers, adding and subtracting algebraic expressions. At Level IV, the students solved problems using multiply algebraic expressions. The results of the study show improvement in the level of focus and motivation [23]. The weaknesses of the study are that the time and location of the study sample were not determined. Our addition to their work is the suggestion and possibility that can be applied by all high schools and doing the aunt study.

In this article, the researchers presented a study on the educational platform. The study included 24 degrees of Liberty. The NAO robot was used to teach simple robotics introduction pupils in a kindergarten. A graphical user interface called GUI was designed. It helped the teachers download slides to the robot. It worked on the following points: (a) The slice was read randomly during its birth, similar to the body language, (b) the robot used his camera to calculate the number of the faces directed to him, which was the measure of attention upon observing the number. If the number of the destination addressed to him are few, it had been proven that it was not forcing the students to do a recreational period, such as reading a joke, story or dancing. During the experiments, the fifth and sixth grades pupils were divided into two groups. The attendance of one of the groups was done in the classroom by the teacher of information technology. As for the second group, their attendance was done by the robot. The researchers designed a questionnaire before and after attending the semester.

The results indicate that the robot could attract students and give them a deeper understanding of the technical terms [24]. The weakness of the study is that there was no measure in place to control the row of pandemonium and return to the scientific material in class. Our addition to their work is that our study is very useful in compensating for the lack of teachers and the issue between students and teaching in the pandemic era.

4.3 Educational

The third category is educational, which consists of four categories; nursery school, school, university, and children with disabilities (special needs schools). This section has four subsections as follows: (1) Nursery School (4/22 articles), (2) School (8/22 articles), (3) University (5/22 articles), and (4) Children with Disabilities (5/22 articles). The details of these subsections are presented in Tabs. 1 and 2, and in the University section.

4.3.1 Nursery School and School

The Summary of Nursery School and School section explains in Tab. 3.

4.3.2 Playful Learning (Children with Disability)

The summary of playful learning (children with disability) Section is presented in Tab. 4.

4.3.3 University

This section covers an important part of studies that introduced robots in learning. The study operated mainly on the definition of cognition and the knowledge as well as accreditation in the initial stages of the study—kindergarten, schools, and institutions for children with special needs. One of the studies is about the current perspective in the design and coding of a robot for students with different majors. The study examined views of children with different specialities, girls, and curricula in elementary schools. The participants' areas of study and the number of participants for each area of study were as follows: Biology (1), math (1), medicine (3), art (2), dentistry (2), geography (1), informatics (2), computer science (2), architecture (2), business (3), engineering (1), and chemistry (1). In the article, the symposium required a team of 19 specialists

Table 3: Summary of nursery school and school

No.	References	Technical	Variable (indepen-dent and dependent)	Type of data	Methodology	Study weakness	Our addition to their work in the era (pandemic era)
1	[25]	Innovation	Children + teachers for children + materials Educational	Qualitative	Learn to synthesize speech to read and teaching games and ones Toy runaround Using the principle of testing +LEGO mind storm EV3robotics	Explain the components of the robot's work mechanism. The focus is only on the robot output, the desire of children as a producer of cartoons and others	A very important topic and highly applicable in schools for children At the time of the pandemic
2	[26]	–	Robotics laboratory + Third and fourth class (51 stu-dents),	Qualitative	1. Compared with control of (32 students) from the same classrooms classes. 2. Take a test with be bras for being a comprehensive measure of skills.	What are the reasons for applying the Bebras tasks? There are several criteria	We need to apply it on all levels with many scales Except for children
3	[27]	Computational thinking	17 primary school students+ primary school teachers	Qualitative	The developed concept for teacher training in robotics for Learning.	Most schools were not included	Correct preparation and preparation of teaching staff For example, COVID-19 Through regular courses and training + workshops.
4	[28]	Test	Women in computer science by using robots+ Python program	Quantitative	Tests were conducted + used requirements engineering methods on LEGO + videos were shown	The non-specific mention of the study objectives Its purpose and the scales used	Important to get rid of female isolation from teaching Especially in the pandemic era

(Continued)

Table 3: (Continued)

No.	Author name	Technical	Variable (independent and dependent)	Type of data	Methodology	Study weakness	Our addition to their work in the era (pandemic era)
5	[29]	Q & A	100 children from Europe and Africa	Qualitative	Conducting three questionnaires containing 17 questions + video streaming and programming.	How was the sample divided between South Africa and Europe?	–
6	[30]	MadaTech	97 students in the basic workshop + 249 in the extended workshop for 9 h.	Qualitative	Taking the introduction to robotics and explaining to RoboDog	–	Can apply
7	[31]	–	65 students, six 9th grade classes, for 6 schools in 6 weeks.	Qualitative	Conducted in two stages: (i) Data collection + the second analysis, (ii) taking notes on each teacher's behaviour in two sessions; before and after the end of the semester.	Limited study/included only two specializations, namely engineering and computers.	The study includes all human educational and medical studies specialities to avoid urbanization during pandemic time
8	[32]	–	A group of students from hidden schools from Sweden and Austria. It lasted for 8 months.	Quantitative	The survey, around 14 different subjects explored and arranged according to three main categories. The emphasis was on pupils' attitudes related to technical/social skills and science. .	The study should be applied more broadly according to geographical areas + Why was one school introduced from Austria countryside and seven schools from Sweden? Likewise, the standards used were limited.	–

(Continued)

Table 3: (Continued)

No.	Author name	Technical	Variable (independent and dependent)	Type of data	Methodology	Study weakness	Our addition to their work in the era (pandemic era)
9	[33]	Evaluate	A visual programming environment, student, and robot.	Quantitative	The analysis of each physical phenomenon at IDEE consisted of the following schemes: Observation, robot assembly, and experimental hypothesis testing.	–	Can apply
10	[34]	Interview and questionnaires	12 pupils of age 10–11 years.	Qualitative	The metrics were studied using three processes of co-creation; human–computer, human–human, and Human–human -computer process of co-creation.	The reasons for targeting children between ages 11–12 years were not provided.	Strengthen people's skills and self-reliance.
11	[3]	–	Students apply their skills. Acquired in secondary education.	Quantitative	Interdisciplinary character methodology for robot learning. Presented a Metabotix project that included scientific research work.	–	Can apply

Table 4: Summary of playful learning

No.	References	Motivation	Technical	Variables	Methodology	Outcomes	The study weakness	Our addition to their work (pandemic era)
1	[35]	Therapy	Bee-Bot	Down Syndrome Kids (DS): Eight (8) DS children (2 F, 6 male; M age) + weekly meetings for 8 weeks + Bee-Bot ranging.	Dependent on (diagnosis of Down Syndrome due to free trisomy 21, age, level of disability, and consent of the child's parent).	Fostering participant interactions using words and using educational robotics (ER).	Application of the study to a larger group. 8 children are not enough.	Applying techniques that mimic students.
2	[36]	Therapy	–	Two boys aged 15 and a girl aged 14 participated in the study.	Three working sessions + lasted for 50 mins each. Participants were selected according to the criteria set.	Using educational words and robots (ER) The ER intervention was interrupted by the difficulties faced by students.	In the Abstract section, it is mentioned two boys aged 15 and a 14 year-old girl, but in the Introduction section it mentions three participants.	Includes some patients who are unable to extend and come into contact with other causes of disease transmission.
3	[37]	Training	Bee-Bot	65 children, 28 boys and 37 girls kindergarteners.	Used questions that Bee-Bot help children with, which strengthened their ability to answer.	The study concluded that the use of robots strengthened children's capabilities.	Why not applying the intervention to different samples and levels for students?	The possibilities of robots as a test instrument.
4	[38]	Robotic Trains/ Training	Desire/ Directions	10 children with autism spectrum disorder + ages) 7 to 10 years), male, English-speaking.	Trained the Bubbles. It is considered a neutral and attractive platform. It fulfilled all the requirements and desires of children, each one according to his desire.	Trains are a desirable form for a broader variety of children with autism spectrum disorder (ASD).	Why choosing autistic children?	Applied to infected children with COVID-19.
5	[39]	Learning for special needs children	RoboThe-rapist	A group of children with special needs. Their ages were from 4 to 6 years old.	The robotic device can teach simple expressions such as happy faces, sad and angry.	Making teaching and learning more mindful of children with special needs.	–	Proposing mechanisms for using robot learning for children with the disease.

in various fields to record their observations on the presentation of a 3-min educational video clip on building and programming a robot [40]. The participants commented on multiple aspects of spatial reasoning without priming or prompting. This study can be applied to the Pandemic Era

In another article, the researchers presented a study on students and society in the 2020s. The article discusses how development data processing systems, such as AI can have an adaptive or predictive effect on computing software, clouds, and platform. Three scenarios were formed in the article: The first scenario explored social-technical developments over the 1920s, and the second scenario examined the roots of developments in educational policy in Germany and Europe in general, in 2010, and the third scenario explored the effects of socio-political technical developments on students, such as Progress 2020s. The study concludes with three scenarios; (1) smooth users, competent subjects, (2) virtual nomads leveraging on individualistic digitalization, and (3) collective agents in institutions as spaces to explore new life forms [41]. This study, which supports embracing modern technology, can be applied to the Pandemic Era.

In a different study, the researchers examined the use of social innovation in the education system with robots. The study included students, examinations, and examination results. The study analyzed examination results and concluded that the analysis was without error. The study also took about 94.44% less time to conduct compared to manual research conducted by humans. However, the weakness of the study is that it did not show the mechanism to clarify the methods of analysis and extracting results [42]. Our study can help organizations utilize fewer human resources by automating certain processes with robots, to effectively save time and produce an error-free analysis.

4.4 Advantages

Some platforms have submitted studies on robotics in education. Students were prepared to advance to the next stage by the setting up of courses, classes, meetings, discussions, and continuous workshops. The shift from international formation to automated and electronic systems and programs could be applied to bookshops, restaurants, and libraries, in order to avoid contact among people and the transmission of diseases. Robotics should be applied at every level and on a large scale, not just to students. The correct preparation of teaching staff, for example during COVID-19, is through courses, training, and regular workshops. In addition, it is important to not practice female isolation from teaching, especially in the Pandemic Era. Therefore, it is the strength of the current study that it included all human educational and medical studies specializing in avoiding urbanization during the time of a pandemic. The development of students' computational thinking skills in the context of educational robotics, strengthens people's skills and self-reliance based on the results of some studies' evaluation and benchmarking gap [43].

4.5 Disadvantages

In our assessment, the risk was not addressed more broadly. It is necessary to allocate a place in the era of a pandemic, with lectures requiring advanced broadcasting techniques to take full advantage during times of crisis in order to benefit the disabled, those with special needs, and underperforming students. However, this study has a limitation because it only included two specializations; engineering and computer science. In addition, the research papers did not call for proposals to adopt the idea of working more in the area of educational institutions, or urge the establishment of festivals, Olympiads and competitions as done in Brazil, Japan, and the United Arab Emirates.

4.6 Challenges

The challenges of the universities and schools closing are: (a) A lack of preparation of students and parents to follow classes at home, (b) disruption of learning, (c) the teaching staff are not prepared for online lectures, (d) students have less experience using technology to learn, (e) the problems of the presence of students at home throughout the day, and (f) difficulty in obtaining practical materials and educational laboratories.

5 Conclusion

In this paper, we reviewed the role of robots in the mechanisms, teaching, monitoring, and testing processes at all stages, in order to be the best assistant to the teacher inside the classroom, the laboratory, and outside. The articles were initially divided into six categories. The focus was on three of the categories because they were within the field of study during the era of COVID-19. The study concludes that there must be a strong government approval of this new mechanism on top of the old applications used in discoveries where they are most needed—in the fields of medicine, finance, agriculture, and other specialities. In the same line, this mechanism should also be used in parallel and as an assistant to the teacher both inside and outside the classroom, through the recognition and a gradual introduction by the school. It is also necessary to introduce educational staff and students to introductory courses, competitions and Olympiads as well as educational games and applications for children with special needs.

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