Exploring the Trend and Potential Distribution of Chatbot in Education: A Systematic Review

Chee Ken Nee*, Mohd Hishamuddin Abdul Rahman, Noraffandy Yahaya, Nor Hasniza Ibrahim, Rafiza Abdul Razak, and Chie Sugino

***Abstract*—This study reviews recently published scientific literature on the use of chatbot in education, in order to: (a) identify the potential contribution of the incorporation of chatbot as educational tool in educational institutions, (b) present a synthesis of the available empirical evidence on the educational effectiveness of chatbot as an educational tool, and (c) define future research perspectives concerning educational chatbot. From 369 sources, 25 studies on chatbots and their application in education were selected through a step-by-step procedure based on the guidelines of the modified PRISMA framework, using a set of predefined criteria between 2016 – 2021 in five prestigious databases (a) Ebscohost, (b) Emerald, (c) ScienceDirect, (d) SpringerLink, and (e) Scopus. For each article, we analyse the purpose of the study, the content to be taught with the aid of chatbot, the type of chatbot used, the research method used, and the sample characteristics (sample size, age range of students and/or level of education) and the results observed. The articles reviewed suggest that educational chatbot usually acts as an element that enhances learning and other benefits; however, this is not always the case, as there are still few studies that have reported adverse situations. The outcomes of the literature review are discussed in terms of their implications for future research and can provide helpful guidance for educators, practitioners and researchers in terms of design, implementation and research in the area.**

***Index Terms*—Chatbot, education, chatbot in education, intelligent agent, PRISMA, systematic literature review, trend**

I. Introduction

The public's interest in chatbots has soared in recent years. According to [1], chatbot activities have enormous potential to improve classroom teaching and learning. Although the educational usage of chatbots is a relatively new area of experimentation, several recent studies demonstrate that chatbots can successfully enhance the teaching-learning process across several areas. New teaching proposals are currently being studied in mathematics [2], English, and sciences [3] and are even being used to provide HIV/AIDS sexual health education [4]. Chatbots for language learning has primarily been used to teach second languages, primarily English [5].

Chatbots have four distinguishing characteristics: 1) they attempt to simulate human speech; 2) they traditionally communicated via written messages, hence the term "chat," though subsequent advances enabled the appearance of spoken interaction; 3) unlike robots or similar devices, chatbots lack a physical presence (disembodied agents); and 4) unlike avatars, they do not represent a human being in a virtual world [6].

Numerous studies have demonstrated that insufficient individualised support can result in poor student learning outcomes, while adequate personalised support can improve student learning outcomes [7]. This microlearning technique helps alleviate student weariness [8] and can increase material retention by around 20%. [9]. In many circumstances, it aids students' comprehension of specific concepts, develops their competencies, and improves academic performance [10]. Chatbots could be used in a tutorial function to organise questions and responses with feedback for students, and they could also be used to facilitate contact with families in support of their children's teaching-learning process [11].

Educational institutions should use chatbots to provide students with an engaging e-learning environment [12] and occasionally enjoyable learning. Responses to frequently requested questions can be coded and supplied instantly [13], making it easier and more comfortable for students to ask questions and receive immediate responses. As a result, chatbots can help make learning more engaging, intriguing, and amusing for students while also facilitating the teaching process [14] by relieving teachers of repetitive inquiries and serving as virtual assistants or tutors for students [11].

Through their individualised learning support, chatbots offer considerable educational potential and a favorable impact on student learning and satisfaction [5]. While various researchers have been conducted on the successful use of chatbots, only a few have been employed for educational reasons [12]. Until recently, the use of chatbots in education was limited due to a dearth of studies on the use of chatbot technology in classrooms [15].

Numerous valuable systematic reviews of the literature on chatbots in education have been conducted, as indicated in Table I. Certain places, however, warrant additional research. While the technology behind chatbots in education is presented in the "Innovation Trigger" stage, which places high expectations on the technology, practical in-depth experience is still mostly absent [16]. For example, there is significant potential for chatbots to be utilised in education, as well as their effectiveness and future research potential, due to a number of aspects that make them distinctive and

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well-suited to the affordances of artificial intelligence (AI). However, current literature reviews released in the last decade appear to fill in the gaps left by previous reviews, which were insufficient and served as a complement. Four review articles were published, each focused on a different facet or feature of chatbot progress in education. Thus, this study employs a SWIFT-PRISMA approach to thoroughly examine research on chatbots in education in terms of the many criteria across years in the period under review to refine and update the most current research on chatbots in education. These findings may give researchers and educators, as well as policymakers, with an overview of the research on chatbots in education.

This systematic literature review is to investigate the current state of study in educational Chatbot/Intelligent agent in classrooms, focusing on the following research questions:

Question 1:

What is the potential contribution of intelligent agent as an educational tool in educational institution?

Question 2:

What kind of research with its details has been done regarding intelligent agent as an educational tool in educational institution?

Question 3:

How is the educational effectiveness of intelligent agent as an educational tool in educational institution?

Question 4:

Is intelligent agent a useful teaching tool? What conclusions and future recommendations have been drawn from the research?

TABLE I: SYSTEMATIC REVIEW ARTICLES ON CHATBOT IN EDUCATION

Author	Article	Study Period	No. of articles	Main research outcome
Wollny et al., 2021	Are We There Yet? - A Systematic Literature Review on Chatbots in Education	2010-2020	74	• Chatbots can improve skills and motivate students by supporting learning and teaching activities • Chatbots can make education more efficient by providing relevant administrative and logistical information to learners • Chatbots can support multiple effects by mentoring students. • Chatbots are mostly concerned with three mentoring topics, Self-Regulated Learning, Life Skills, and Learning Skills • Three mentoring methods: Scaffolding, Recommending, and Informing. • Adaptation approaches found were mostly limited to applications within quizzes • Chatbots does not seem providing reasonable adaptations for learners requires a high level of experience.
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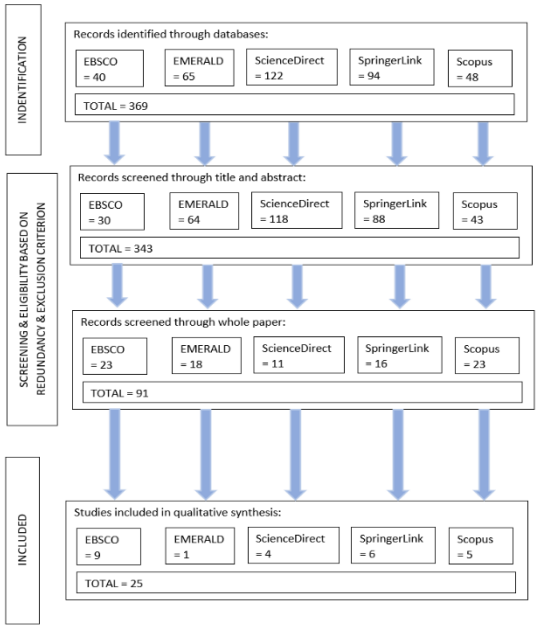

Fig. 1. Flow diagram of the SWIFT-PRISMA database searches (Simplified Swift Filtering - Preferred Reporting Items for Systematic Reviews and Meta-Analysis).

II. METHOD

A full-text review was conducted between January and February 2022 using a reproducible systematic search approach. To locate and analyse reliable literature, [17] established the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) systematic review approach. To facilitate systematic review methods, the PRISMA technique employs a structured procedure comprised of a 17-item checklist. However, our PRISMA technique has been updated to simplify and expedite the process by using two layers of filtering based on concurrent exclusion criterion and redundancy, with the first layer applied to the abstract and title and the second layer applied to the entire article. In this research, we refer to this modified PRISMA approach as SWIFT-PRISMA because it is more Simplified and swifter in its FilTering process than standard PRISMA, as illustrated in Fig. 1. Database Search Flow Diagram (Preferred Reporting Items for Systematic Reviews and Meta-Analysis). For the purposes of this study, we did a systematic review of the following worldwide online bibliographic databases: (a) Ebscohost, (b) Emerald, (c) ScienceDirect, (d) SpringerLink, and (e) Scopus. The search encompassed peer-reviewed papers published in English between 2016 and 2021. (research over the last five years). TITLE-ABS-KEY (intelligent AND agent OR chatbot AND education) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (OA, "all")) AND (LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LI AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")) was used as the search string. Table II details the procedure employed by each database.

TABLE II: THE SPECIFIC PROTOCOL EXECUTED IN EACH DATABASE

Database	Protocol	Total Article From The Search Result
EBSCOHOST	AB intelligent agent OR AB chatbot AND AB education	40
…	…	…

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To select which papers would be included in the review, the following criteria were used:

1) The article discusses the use of chatbot/iIntelligent agent as a teaching tool; in other words, the goal is not to teach chatbot/intelligent agent per se (as is the case with AI courses), but to use chatbot/intelligent agent as an educational tool.
2) The article discusses educational chatbots/intelligent agents in contexts such as kindergarten, elementary school, middle school, high school, and college/university.
3) Articles were included only if they included a quantitative evaluation of the learning, adhering to the recommendations proposed by [18], who recommend conducting tests before and following the training to assess learning.
4) Five criteria for exclusion (EC) articles were also identified:
   - Technical use of chatbot/intelligent agent
   - Chatbot/Intelligent agent/AI as teaching subjects
   - Did not mention the use of chatbot/intelligent agent in education
   - Other than full empirical paper
   - Other language than English

Three hundred and sixty-nine articles met the search parameters in total. After a first filtering based on exclusion criteria and redundancy throughout the title and abstract, and a second filtering based on exclusion criteria and redundancy throughout the entire paper, 25 full-text articles meeting the inclusion criteria were selected for the review, as illustrated in Table III Summary of article selection. Two separate researchers extracted the data and evaluated its quality. Most of the papers rejected are unrelated to education and theoretically belong to the field of computer science.

TABLE III: SUMMARY OF ARTICLE SELECTION

Database	Articles resulting from the search	First filtering based on exclusion criterion and redundancy (title and abstract)	Second filtering based on exclusion criterion and redundancy (full paper)	Selected
EBSCOHOST	40	30	23	9
Emerald	65	64	18	1
Science Direct	122	118	11	4
SpringerLink	94	88	16	6
Scopus	48	43	23	5
Total	369	343	91	25

III. RESULTS

By categorising the relevant publications according to their publication date, it is clear that chatbots in education are currently through a period of heightened attention, with the trend continuing to grow exponentially, as illustrated in Fig. 9.

Table IV lists the Authors in column 1, the database source in column 2, publisher in column 3, country in column 4 and year in column 5, indicate some details of research regarding chatbot in education in the systematic review.

TABLE IV: CONTEXT OF THE ARTICLES AND MAJOR FINDINGS

Authors	Sample Group	Approach	Educational Context	Learning Domain	Major findings	Effectiveness
Kamsa, I., Elouahbi, R., & Khoukhi, F.E. (2018).	50 students enrolled in the History course at the Faculty of Arts and Humanities	Quantitative	Formal	Computer Module	• effectively in the acquisition and the performance of learners. • Success rates with a growing satisfaction.	Positive
…	…	…	…	…	…	…

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Table V summarises the reviewed research papers for the benefit of the stakeholder. Table V displays the following characteristics for each article: (a) The first column contains the paper's author; (b) the second column contains the sample group to indicate the age of the research subjects and/or (if available in the article) the educational level at which the study was performed. (c) column 3, research approach type shows information on how the study was performed. (d) column 4, educational context on the chatbot used, either formal or informal or both, (e) column 5, learning domain involved (f) column 6, major Findings summarises the study's main findings; and (g) column 7 shows either positive or negative effects or both or even neither.

TABLE V: CONTEXT OF THE ARTICLES AND ITS SOURCES

Article	Database	Publisher	Country	Year
Study Smart Not Hard	EBSCO	Turkish Online Journal of Distance Education	Morocco	2018
…	…	…	…	…

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IV. ANALYSIS AND DISCUSSION

This section examines the systematic review's findings to address the identified four research concerns.

Question 1: What is the potential contribution of chatbot as an educational tool in educational institution?

A. Educational Context

As illustrated in Fig. 2, formal learning (72 percent) was more prevalent in chatbot education research than informal learning (16 percent) or a combination of both (12 percent). Although the results indicate that formal education is more prevalent than informal education, we believe that chatbots can be used in both formal and informal settings, which aligns with [19]'s assertion that chatbots in education are used to integrate formal learning into informal network spaces. While the majority of chatbot research has been conducted in formal schooling, when we examine the study, we can see that chatbots can be employed in both formal and casual settings.

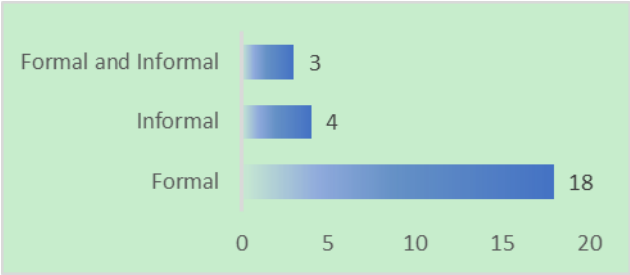

Fig. 2. Distribution of chatbot in education studies by educational context across years from 2016 to 2021.

B. Learning Domain

As demonstrated in Fig. 3, the majority of published chatbot in education studies focused on two topic areas: technology (37.5 percent) and language and art (4.16 percent) (25 percent). Additional research was undertaken in the subjects of social science (4.16 percent), others (12.5%), engineering (8.33 percent), science (4.16 percent), and mathematics (4.16 percent) (4.16 percent).

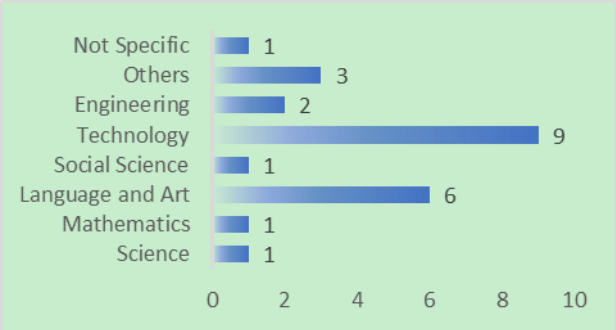

Fig. 3. Distribution of chatbot in education studies by learning domain across years from 2016 to 2021.

It's worth emphasising that the benefits of chatbots are directly related to STEM fields. In terms of the learning domain, research indicates that chatbots can assist students in improving learning variables such as performance, interest, experience, activities, engagement, attitude, and motivation in a variety of STEM (Science, Technology, Engineering, and Math) subjects, as well as language and art concepts, as [20] and others have demonstrated. Mathematics [21]; computer science [22]; health literacy education [23]; science [20]; and engineering [24] are included in the STEM domain, whereas language and art include English as a foreign language [25]; English [26] These findings differ with those of a prior systematic review conducted by [27] and [28], which determined that language is the most involved domain in chatbot integration. By extensive, research showed that chatbots could be deployed successfully across multiple learning domains. However, we cannot state categorically that using chatbots to teach STEM principles or others will constantly improve students' learning, as some writers have discovered that in certain situations, using chatbots results in a decrease in task interest after the initial task when compared to using a human partner [29].

C. Contribution

Chatbots have evolved into a fashionable, cutting-edge method of teaching and learning [30]. The benefits of the chatbot to education, along with a few noteworthy features, include the following: Interactive [6, 19, 30, 31]; Easy to understand [32]; and Easy to use intelligently, systematically, and efficiently [6, 31, 33]; ubiquity [6, 31]; and instant reaction [6, 32, 34].

Due to the chatbot's ability to automate tedious operations [35] and recognise patterns is primarily utilised to aid teachers or reinforce repetitive chores [28]. A chatbot with a high level of personality is more likely to succeed [27]. Apart from being used as a supplement to teaching and learning agents, either as service assistants or teaching assistants [27], chatbots are also used as supplementary mentoring to ensure high-quality mentoring, as they foster emotional-relational bonding through their positive user interface and perceived trustworthiness [36]. Additionally, chatbots aid in youngsters' cognitive and emotional development [37]. According to a review by [16], chatbots in education addressed three mentoring topics: Self-Regulated Learning, Life Skills, and Learning Skills, and three mentoring methods: scaffolding, recommending, and informing.

Apart from being used to supplement teaching and learning agents as service assistants or teaching assistants [27], chatbots are also used to supplement mentoring to obtain high-quality mentoring due to the emotional-relational bonding created by their positive user interface and perceived trustworthiness 2020 [36]. Additionally, chatbots assist youngsters with their cognitive and emotional requirements [37]. According to [16], chatbots in education address three mentoring topics: Self-Regulated Learning, Life Skills, and Learning Skills, and three mentoring methods: scaffolding, recommending, and informing.

Educators are constantly attempting to integrate technology into their classroom instruction to augment the traditional instructional style. However, technology convergence will not result in beneficial outcomes unless it is properly adopted and implemented, as [38] asserted. To be effective as part of the educational process, chatbots must complement the teaching-learning processes that occur outside the classroom, allowing students to interact with them naturally [39]. For example, [22] discovered that an exhibit's excessive duration may have resulted in the exhibit's premature abandonment in several cases during the summative evaluation, despite the fact that it promotes engagement, interest, and enjoyment in learning computer science in the museum. This research proposed that chatbot integration should be accompanied by a 'live' teacher, either asynchronously or synchronously, because chatbots may not

produce the same responses as genuine human interaction [40], and numerous studies have confirmed that chatbots can be used in conjunction with but not in place of a 'live' teacher.

Although chatbots facilitate discussion [23], there are still some snags, and the chatbots are not effectively implemented, adopted, or adapted. For example, two studies in our review contain findings on both sides of the effect. [25] discovered that learners with low language levels benefit the most from interactions, while those with high language levels showed unhappiness and a low degree of involvement in their interactions. Another study, [41] discovered that children who read with a conversational agent responded to questions with the same level of intelligibility and assistance in improving children's story comprehension as children who read with an adult language partner, but children who read with an adult responded to questions with greater productivity, linguistic diversity, and topical relevance.

Despite this, we are unable to identify the components that contributed to the studies' success (increased learning, interest or motivation). However, researchers such as [26] have identified specific characteristics associated with chatbots. 1) prior interest in human conversation partners was the best predictor of future interest in chatbot conversations; 2) prior language competency was more strongly associated with interest in chatbot conversations than with human conversations; and 3) qualitative experience of having learned more with the chatbot was strongly associated with task interest, even when communicating difficulties were reported.

Question 2: What kind of research with its details has been done regarding intelligent agents as educational tool in educational institution?

To thoroughly address this question, several things must be looked into: what types of databases and journals were searched, research approach, participant country, sample group, and the research trend?

D. Sample Group

By excluding review papers, Fig. 4 demonstrates that chatbot research in education is primarily focused on higher education institutions (70.83 percent), not specific (8.33 percent), high or secondary school (8.33 percent), pre-school (8.33 percent), and elementary or primary school (8.33 percent) (4.17 percent).

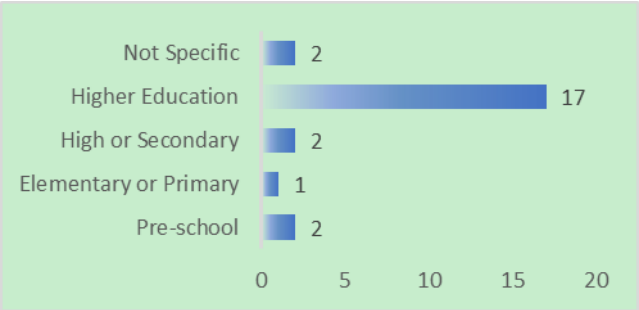

Fig. 4. Distribution of chatbot in education studies by sample group across years from 2016 to 2021.

E. Research Approach

When the papers utilised in a systematic review were examined, it was determined that the majority of research used a quantitative technique (52%), followed by a mixed method (36%), and a qualitative approach (12%), as illustrated in Fig. 5.

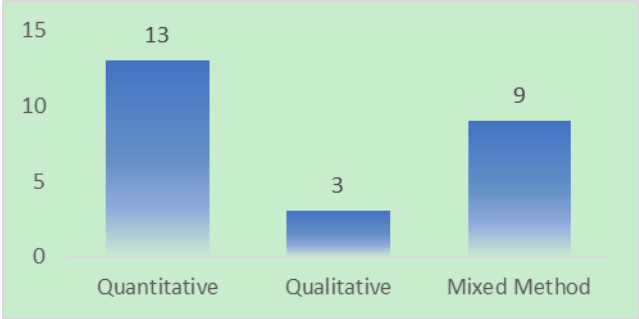

Fig. 5. Distribution of chatbot in education studies by research approach across years from 2016 to 2021.

F. Database

According to Fig. 6, the majority of papers on chatbots in education research were retrieved from EbscoHost (36 percent); SpringerLink (24 percent); Scopus (20 percent); Science Direct (16 percent); and Emerald (14 percent) (4 percent). This study has limitations due to the random elimination of redundant paper from the database.

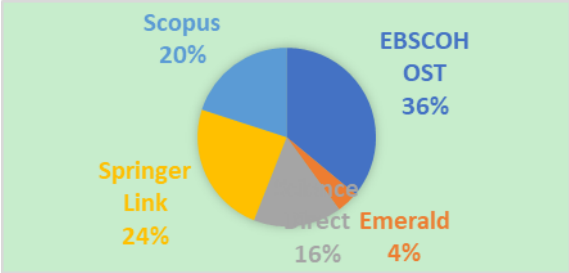

Fig. 6. Distribution of chatbot in education studies by database across years from 2016 to 2021.

Fig. 7. Distribution of chatbot in education studies by publisher across years from 2016 to 2021.

G. Publisher

As illustrated in Fig. 7, out of twelve journals selected

from databases to examine research on chatbots in education from 2016 to 2021, three publications stood out: Computers in Human Behavior, Computers & Education, and Education and Information Technologies.

H. Country

As illustrated in Fig. 8, more countries have contributed research on chatbots in education, following the emergence of emerging countries such as Ukraine, Thailand, South Korea, India, Greece, Brazil, Sweden, Afghanistan and Myanmar. This could be because there is a growing awareness of the value of chatbots in education as a new and trendy teaching and learning paradigm in this era of technology, particularly artificial intelligence. Clearly, the United States of America takes the lead due to its dominance in chatbot education research, followed by Morocco and China. Japan, Malaysia, Taiwan, and Spain are all members.

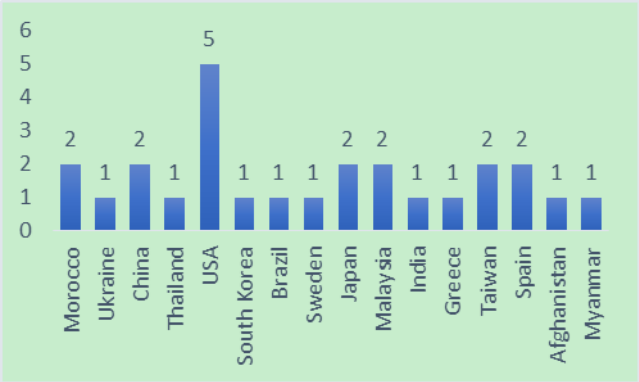

Fig. 8. Distribution of chatbot in education studies by country across years from 2016 to 2021.

I. Trend

Between 2016 and 2021, the line graph in Fig. 9 demonstrated a progressive and tremendous increase in chatbot in education studies. It is projected that this trend will continue to accelerate because this type of research is still in its 'infancy,' which is consistent with [16], who state that technology surrounding chatbots in education may be in the "Innovation Trigger" phase but is still largely lacking in practical in-depth experience.

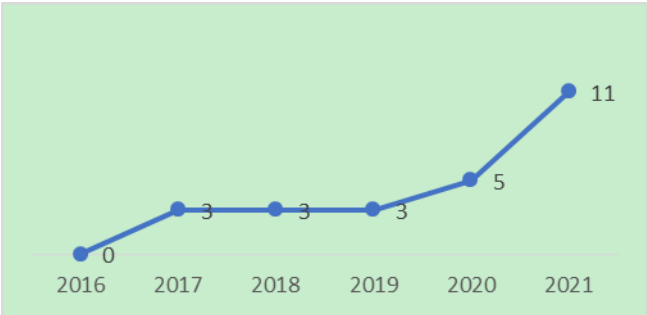

Fig. 9. Distribution of chatbot in education studies across years from 2016 to 2021.

Question 3: How is educational effectiveness of intelligent agent as an educational tool in educational institution?

According to Fig. 10, 84% of studies reported positive research outcomes, 8% reported outcomes that could be either positive or negative (depending on the implementation), and only 4% reported negative and more positive than adverse outcomes generated from the journal with the purpose of evaluating the effect.

Fig. 10. Distribution of chatbot in education studies by effectiveness across years from 2016 to 2021.

Many of them concur that chatbots are an incredible reservoir of energy that can be used to motivate learners to learn. The publications' findings indicate that employing robotics enhances a variety of variables, including learning performance, curiosity, and motivation. On the other hand, the articles selected demonstrate that there are a few instances in which the use of chatbots does not result in a significant increase in student learning, interest, or motivation, as demonstrated in studies of specific situations (see the column "major findings" in Table IV) in [22, 25, 26, 41].

On the other hand, the empirical data are regarded as conclusive, given they include both outcomes with considerable improvement and results with no significant change for each ability examined. In this sense, additional study is necessary to find the most effective and efficient way to employ chatbots to assist students in their learning across various variables.

We discovered that there are numerous positive effects of chatbots in education, as reported in other systematic reviews such as [16], in terms of improving students' skills and motivating them through support for learning and teaching activities, but our paper discovered that chatbots could do more than that in education, including chatbots are effective in learning performance [20, 32, 42]; enhance the learning experience [24]; make the classroom more engaging [22, 24, 30] by stimulating student-teacher conversation [30]; increase student satisfaction [42, 43]; assist students in transforming negative emotions into positive ones [43]; increase student interest [22]; improve students' attitude toward learning and technology acceptance [44]; accomplish more in terms of problem-solving activities [44], and provide a more personalised learning experience [32, 47] and promote idea generation and reinforcement [34].

Question 4: Is intelligent agent is a useful teaching tool? What conclusions and future recommendations have been drawn from the research?

Without a doubt, learners were encouraged and will continue to be enabled to use chatbots in future courses [31]. In the future, chatbots may be pursued as a cloud-based solution [45]. Some chatbots have already gone the extra mile

by incorporating a function that recognises and automatically fixes learners' limitations [46]. While chatbots have a lot of potential for assisting teachers, there are other elements that can affect the outcome. In conclusion, the authors of the selected studies emphasise many critical reasons for the successful integration of chatbots into education:

- Increase the amount of research content and interactive learning; increase the amount of examples and pictures in the chatbot; if no keywords were mentioned, more information about locating appropriate responses, such as links, should be provided rather than leaving those queries unanswered; the possibility of selecting from a list of questions or keywords [32].
- a new dimension of educational agent design in which agents actively modify their functions in response to students' involvement and learning demands [37].
- provide contextually and temporally adaptable and individualised learning experiences. [19].
- Chatbot as tutor and tutee roles [37].

The research supports these criteria and recommends various features and prospective applications, such as enabling learners to attain results and performance using essential inputs. As a result, chatbots should be employed to facilitate access to student performance information. Chatbots will be successful only if their scripts enable them to comprehend students' questions and offer well-crafted responses. Educators can create a tailored learning environment for pupils by utilising a chatbot. Artificial intelligence chatbots and voice bots can make learning more enjoyable, but they can also help simplify learning and alleviate administrative strain. Teachers may shorten their homework assignments and use the time to develop techniques to ensure their pupils receive a high-quality education through the usage of AI chatbots. With AI-enabled chatbots, it's simple to tailor instruction to each student's ability. Additionally, chat scripts frequently incorporate software instructions. Chatbots, which use a simple question-and-answer style, are committed virtual teacher assistants who are available 24/7 to aid students in clarifying ideas. Additionally, the chatbot can serve as a virtual adviser, adapting to the pupils' abilities. Whereas artificial intelligence and chatbots can be utilised to enhance student learning, they can also be employed to facilitate the learning process. Throughout their studies, students can utilise educational chat bots to gain access to pertinent course information and grades. Students can use the school's chatbot to gain access to pertinent academic and non-academic information. Human-controlled AI chatbots can also be used to enhance on-campus mental health counselling and to assist students in managing stress efficiently, while chatbots are typically intended to teach information or skills.

V. Conclusion

This article summarises recent research on the use of chatbots in education with the goal of defining the potential contribution of chatbots as educational instruments in elementary, middle, and high schools, as well as higher education institutions, as well as summarising related empirical findings and suggesting future research directions. In reality, 25 studies on chatbots and their application in education were chosen from 369 sources using a step-by-step procedure based on the SWIFT-PRISMA framework and a set of predefined criteria between 2016 and 2021, allowing for a more effective study of chatbots' ability to serve as a teaching tool or other role for educational institutions in the future. As a result of the study, it appears that chatbots can assist students in improving learning variables such as performance, interest, experience, activities, engagement, attitude, and motivation across multiple learning domains, levels of education, and countries throughout the world in the near and distant future. The potential contribution of integrating a chatbot as an educational tool in an educational institution is recognised as a supplement to teaching and learning, as a mentor, and possibly as a future counsellor. There is still a dearth of empirical evidence demonstrating the educational efficiency of Chatbots as educational tools. More study is needed to delve deeper into the field as future research views and directions for educational Chatbots.

Another possibility for future research is to examine the practical application of chatbots as a platform for skill development (thinking skills, problem-solving skills and teamwork skills). The creation of evaluation instruments and their application to a large sample size is a critical and necessary research topic in this subject. Due to redundancy and an unrelated chatbot in education, this research concentrated on 25 papers out of 365 found in five bibliographic databases using distinct search parameters. Perhaps if different standards and databases had been utilised, additional publications might have been discovered. As a result, rather than presenting a detailed description, the research might be viewed as an attempt to assess the educational chatbot's potential and future advice or direction.

Because this research has demonstrated that educational chatbots have enormous potential as a learning tool, this paper is expected to provide practical suggestions for students, professionals, and researchers in the education field who are interested in chatbots.

In summary, the following are ten significant conclusions from the publications reviewed:

1) Studies on chatbots in education have increased steadily and fiercely over the years from 2016 to 2021, and extrapolation of the graph indicates that this trend will continue.
2) Although most chatbot research has been conducted in the context of formal education, chatbots can be employed in both formal and informal settings.
3) A chatbot can assist students in improving learning variables such as performance, interest, experience, activities, engagement, attitude, and motivation in a variety of STEM (Science, Technology, Engineering, and Mathematics) subjects, as well as language and art concepts.
4) While current research on chatbots in education is primarily focused on higher education institutions, future research should expand to other levels of education.
5) The quantitative methodology is the most frequently used study design for chatbots in education research, followed by the mixed method and qualitative

approaches.

6) The reviewers sought out papers on chatbots in education research mostly through EbscoHost and SpringerLink, followed by Scopus, Science Direct, and then Emerald. (This discovery is limited by the random elimination of redundant paper from the database.)
7) Three journals were particularly influential in the field of chatbot education research: Computers in Human Behavior, Computers & Education, and Education and Information Technologies.
8) The United States of America leads due to its dominance in chatbot research in education, followed by Morocco and China. Japan, Malaysia, Taiwan, and Spain are all part of the Asia-Pacific region. Other rising countries may benefit from increased awareness of using chatbots in education as a new and trendy teaching and learning paradigm in the information age, particularly artificial intelligence.
9) Chatbots boost student achievement, enhance the learning experience and stimulate student-teacher conversation. Assist learners in transforming negative emotions into positive ones; foster interest by increasing students' learning attitudes and acceptance of technology; accomplish more in terms of problem-solving activities; provide a more personalised learning experience, and promote idea generation and reinforcement.
10) Chatbots can be used as supplemental teaching and learning agents, either as service assistants or teaching assistants, but they must be accompanied by a 'real' teacher either asynchronously or synchronously. They can also be used as supplemental mentoring.

The crucial point is that if educators take a less critical stance toward the deployment of chatbots in education, it will almost certainly have a deleterious effect on learners' future ability to think creatively and imaginatively. As a result, a new direction for education is required, one in which humans may play a critical part in the development of more intelligent and well-rounded robots capable of comprehending their users' mental states and expectations. It contends that, while fear of replacement is driving present behaviour, there is also the possibility of learning via AI-driven agent interactions, which may be perceived as more interesting and dynamic than traditional ways.

VI. Implications for Research and Practice

The findings of this study add to a more complete knowledge of chatbots in education by giving a comprehensive and longitudinal assessment of decent articles based on a specific database. It provides a concise, thorough summary of articles on chatbots in education for scholars. For example, when chatbots in education take their place, researchers know which journals to target. Additionally, it identified the themes and areas that have received the most attention regarding chatbots in education. Additionally, the findings identify regions and themes that require additional investigation to fill in the gaps. Thus, researchers should focus their efforts on the gap created by a lack of study and development of chatbots in education, in order to synthesise knowledge in the field. SWIFT-PRISMA is a new research tool that combines a modified PRISMA model and -mining techniques to enable researchers to get summative information on nearly any topic quickly. The purpose of this study is to demonstrate the power and promise of text-mining tools for identifying research patterns, themes, and trends. In comparison to traditional information processing or data (content) analysis, these methodologies enable scholars to devote greater attention to data interpretation and pattern analysis. For government policymakers, the findings will provide supporting evidence to help them better comprehend the research's strengths and shortcomings, which can impact decision-making and policy change in favour of educational discipline advancement. For researchers, this data paints a clearer picture of the importance of chatbots in education as they garner increasing global attention as a result of the expansion of countries adopting this new and current paradigm of teaching and learning in education areas. Researchers and educators will know where to identify and target publications on chatbots in education research due to the volume and quality of the articles. For journal publishers, this finding will inform them of the statistics regarding chatbot in education research that has been published in their journal or even in their database, allowing for the introduction of calls for papers on chatbot in education in order to attract additional papers on chatbot in education to a particular journal publisher, if necessary, and to foster healthy competition in the publication battlefield.

VII. Limitations of Study

The findings and conclusion are circumscribed and are not intended to be exhaustive. Indexed journals adhere to rigorous peer review criteria. Articles may take up to two years to publish. Additionally, the database does not include educational conference proceedings. As a result, the findings of this study may not reflect current research trends. This study analysed chatbots in education articles from the beginning of 2016 to the end of 2021 using only two search phrases (intelligent agent and chatbot). Additional research with better resources and a broader search term set is required to confirm and expand these findings.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Chee Ken Nee, the correspondence author led the team through this work of analysis and research. Moreover, all authors worked evenly in writing and approving the final version of the study.

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