Chatbots applications in education: A systematic review

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ABSTRACT

The introduction of Artificial Intelligence technology enables the integration of Chatbot systems into various aspects of education. This technology is increasingly being used for educational purposes. Chatbot technology has the potential to provide quick and personalised services to everyone in the sector, including institutional employees and students. This paper presents a systematic review of previous studies on the use of Chatbots in education. A systematic review approach was used to analyse 53 articles from recognised digital databases. The review results provide a comprehensive understanding of prior research related to the use of Chatbots in education, including information on existing studies, benefits, and challenges, as well as future research areas on the implementation of Chatbot technology in the field of education. The implications of the findings were discussed, and suggestions were made.

1. Introduction

The use of Artificial Intelligence (AI) in education is rapidly expanding (Roos, 2018). One of the most popular AI technologies used to support teaching and learning activities is the Chatbot system (Okonkwo & Ade-Ibijola, 2020). Chatbots are being considered as a useful technology to facilitate learning within the educational context (Clarizia et al., 2018, pp. 291–302). In this Fourth Indus-trial Revolution (4IR) era, educators can administer teaching either through the class-room platform or through an online platform using various technological tools such as Chatbot systems (Mendoza et al., 2020, pp. 93–107). This research looks at an online educational platform where students can learn using Chatbot technology. The use of chatbot technology in education is one of the most important approaches to enhancing and promoting a more personalised learning experience (Cunning-ham-Nelson et al., 2019, pp. 299–306).

Chatbots are conversational or interactive agents that provide instant response to the user (Okonkwo & Ade-Ibijola, 2020; Smutny & Schrei-berova, 2020). Chatbots are increasingly being used to improve student interaction in this current world of technology where communication and many other activities rely heavily on online platform. Most students in higher education own a smartphone, making them frequent users of internet applications. Chatbot systems can be deployed as mobile web applications to aid in learning. Chatbots can instantly provide students with standardised details, such as course contents (Cunningham-Nelson

et al., 2019, pp. 299–306), practice questions and answers Sinha et al. (2020, pp. 55–60); Ranoliya et al. (2017), evaluation criteria (Benotti et al., 2017; Durall & Kapros, 2020, pp. 13–24), assignment due dates, advice (Ismail & Ade-Ibijola, 2019), campus path direction (Mabunda & Ade-Ibijola, 2019), and study materials. These systems can not only improve student engagement and support, but they can also greatly lessen lecturers' administrative workload, allowing them to focus on curriculum development and research (Cunningham-Nelson et al., 2019, pp. 299–306). Although there are many ways to interact in education, such as email communication, student-to-student interaction, and student-to-lecturer interaction, none of these can facilitate individualized learning experiences that are more convenient for students. Chatbot technology can provide students with a more personalised and engaging learning environment (Benotti et al., 2017; Cunningham-Nelson et al., 2019, pp. 299–306).

Several studies have been carried out on Chatbot technology mostly on the use of Chatbot systems for educational purposes, including Chatbots used for answering students' questions (Clarizia et al., 2018, pp. 291–302; Ranoliya et al., 2017; Sinha et al., 2020, pp. 55–60), learning how to understand Computer Programming concepts (Okonkwo & Ade-Ibijola, 2020; Pham et al., 2018; Zhao et al., 2020), providing assessment of students performance abilities (Benotti et al., 2017; Durall & Kapros, 2020, pp. 13–24), and providing administrative services (Hien et al., 2018, pp. 69–76; Rohrig & Heβ, 2019). Moreover, prior research works have used literature reviews to make limited

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attempts to holistically summarise existing knowledge in the applications of Chatbot technology in education (Cunningham-Nelson et al., 2019, pp. 299–306; Pérez et al., 2020; Smutny & Schreiberova, 2020; Thomas, 2020). For example, Cunningham-Nelson et al. (2019, pp. 299–306) reviewed the applicable literature on Chatbots and introduced two scenarios in which Chatbots could be used in an educational setting, as well as a sample application for each. Smutny and Schreiberova (2020) reviewed Chatbots used to aid learning for Facebook Messenger using a screening technique in an independent web directory. Thomas (2020) examined previous studies in which chatbots benefited both learners and educators, demonstrating that the benefits outweigh the drawbacks and offer a more effective education. Pérez et al. (2020) presented a review of various Chatbots used for educational purposes using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework.

Although these review studies have added to the body of knowledge, their primary focus has been on Chatbot as a learning aid (Cunningham-Nelson et al., 2019, pp. 299–306; Smutny & Schreiberova, 2020; Thomas, 2020) and types of Chatbots and development technology (Pérez et al., 2020). However, given the breadth and range of previous research on Chatbots in education, there is a need for a systematic literature review (SLR) that will help to address the following research questions (RQ).

- **RQ1** - What is the most recent research status or profile for Chatbot applications in the education domain?
- **RQ2** - What are the primary benefits of Chatbots applications in education?
- **RQ3** - What are the challenges facing the implementation of Chatbot system in education that literature revealed?
- **RQ4** - What are the potential future areas of education that could benefit from the use of chatbots?

This research intends to address these questions by conducting an SLR on Chatbot applications in Education. Review-based studies will help address these needs by synthesising existing finding or knowledge and revealing key areas that need further research. SLRs can provide a useful summary of current knowledge in a field of study (Aznoli & Navimipour, 2017), allowing for the identification of potential knowledge gaps and, as a result, potential research directions (Gopalakrishnan & Ganeshkumar, 2013).

This study adds to the existing literature on Chatbot applications in education in the following ways.

1. It provides structured and up-to-date information on previous studies and their application areas.
2. It extracted the advantages of using Chatbot systems for educational purposes,
3. It identifies the major challenges associated with the use of Chatbot systems in education, and
4. It will aid in the identification of some important areas of education that require further investigation to advance the educational system.

The remainder of this paper is structured as follows: Section 2 presents the overview of Chatbot technology, Section 3 discusses the research methodology, and Section ?? details the results obtained from the search process. Section 4 discusses the results and Section 5 describes the implications of the research outcomes. Section 6 concludes the study with suggested future works.

2. Overview of Chatbot technology

A Chatbot is an intelligent agent capable of interacting with a user to answer a series of questions and provide the appropriate response (Clarizia et al., 2018, pp. 291–302). A Computer program that mimics and processes human communication, enabling people to interact with

digital devices as if they were talking with a real person (Ciechanowski et al., 2019). It is a dialogue mechanism that encourages collaborative learning (Ruan et al., 2019). A system that automatically respond to human queries (Rosruen & Samanchuen, 2018, pp. 1–5).

The Turing Test ("Can machines think?") was suggested by Alan Turing in 1950, and it was during this time that the concept of a chatbot began to gain popularity (Turing, 2009, pp. 23–65). Eliza, the first recognised chatbot, was created in 1966 with the intention of acting as a psychotherapist and returning user words as questions (Weizenbaum, 1966). It used a template-based response system and pattern matching techniques to reply to user's query (Brandtzaeg & Følstad, 2017, pp. 377–392). Next to ELIZA, in 1972, a Chatbot named PARRY was created (Colby et al., 1971). In 1995, a price winning Chatbot, ALICE was created. It won the annual Turing Test award – The Loebner Prize. ALICE became the first Chatbot that generally seen as "human Computer" (Wallace, 2009, pp. 181–210). It used Artificial Intelligence Markup Language (AIML) and pattern-matching to define its basic operations (Marietto et al., 2013). As technology advances, creation of modern Chatbots follows, for example SmarterChild (Moln'ar & Szuts, 2018), Apple Siri, Amazon Alexia, IBM Watson, Microsoft Cortana, and Google Assistant (Reis et al., 2018). From 2016, there is a rapid growth on Chatbot development which results to the creation of various types of Chatbot systems for industrial uses. Fig. 1 shows Scopus search results on Chatbot development history adapted from (Adamopoulou & Moussiades, 2020).

The introduction of AI-powered technology, especially Chatbot systems, has ushered in a batch of new opportunities for a variety of industries (Dsouza et al., 2019). In education domain, Chatbots are used not only to develop students' interaction skills, but also to assist teaching faculty by bringing automation (Dsouza et al., 2019). The use of Chatbots in education increase connectivity, efficiency, and reduce uncertainty in interactions (Ondas et al., 2019). They can easily provide a focused, personalised, and result-oriented online learning environment (Cunningham-Nelson et al., 2019, pp. 299–306), which is exactly what today's educational institutions need.

Notwithstanding the optimistic implications of Chatbots' impact on educational transformation, there appears to be a controversy about their inherent advantages and consequent benefits in relation to previously existing standards. While the use of Chatbot systems in education is highly recommended, it is fraught with ethical concerns (Murtarelli et al., 2021) such as abuse and deception, because users mistakenly think they are conversing with real people when they are conversing with Chatbots (Adamopoulou & Moussiades, 2020). Furthermore, Chatbots are non-moral and non-independent agents that manage fictitious conversations (Murtarelli et al., 2021). Adamopoulou and Moussiades (2020) suggests conducting a thorough investigation into

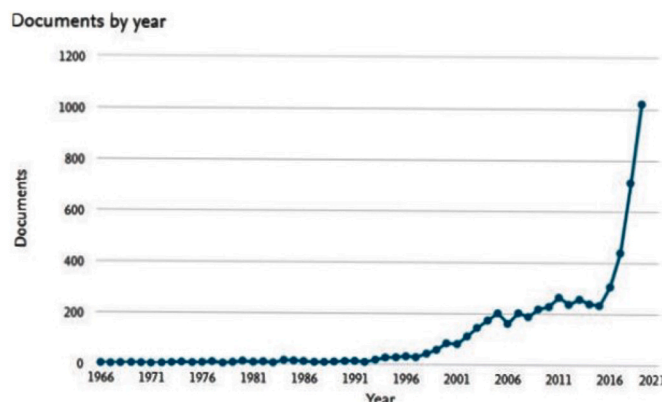**Fig. 1.** Search Results in Scopus (Scopus preview—Scopus—Welcome to Scopus, 2020), from 1966 to 2019 for the keywords "chatbot" or "conversation agent" or "conversational interface" (Adamopoulou & Moussiades, 2020) educational institutions need.

the various Chatbot platforms, as well as the degree of creativity and usefulness of existing Chatbots.

3. Methodology

This study involves a review of existing literature on the use of Chatbots systems in education; thus, the protocol guidelines for systematic reviews in software engineering outlined by (Kitchenham et al., 2007; Wohlin et al., 2012, pp. 45–54) are applied. These guidelines consist of three-step processes including planning, conducting, and reporting. Each process is broken down into several stages, and the entire process is depicted in Fig. 2. To address the **RQ1, RQ2, RQ3**, and **RQ4**, the following suggestions are followed (Aznoli & Navimipour, 2017); 1) identifying the previously studied context and its scope, 2) summarizing the study's findings and limitations, 3) Identifying the most important practical and theoretical implications, and 4) identifying emerging research gaps and potential future work areas.

3.1. Planning

The applications of Chatbot technology in education is on the rise. Studies have proposed, developed, and applied Chatbot systems in education (Augello et al., 2016, pp. 637–647; Clarizia et al., 2018, pp. 291–302; Okonkwo & Ade-Ibijola, 2020). It is there-fore imperative to provide the reader with a wide range of knowledge on the applications of Chatbot in education including the state of art of the Chatbot technology in education, various aspect of educational domain where the technology has been applied, advantages of using Chatbots in education, and the challenges that faces Chatbot technology implementation in education.

3.1.1. Inclusion and exclusion criteria

Prior studies proposed that articles be chosen based on clear inclusion and exclusion requirements (Behera et al., 2019; Snyder, 2019). For the purpose of this study, below are the inclusion and exclusion criteria.

The inclusion criteria are as follows:

1. Studies published in English.
2. Articles published before May 2021.
3. Full text Journal and Conference articles.
4. Studies on proposed framework and models related to this study.

The exclusion criteria are as follows:

1. Remove duplicate/matching studies.
2. Remove studies based on quality evaluation criteria.
3. Remove papers that does not address the research questions.

3.1.2. Information source

This study needed relevant literature on the topic under study from appropriate articles, so the following digital databases were searched:

1. IEEE Digital Library
2. ScienceDirect
3. SpringerLink

4. Scopus
5. Taylor and Francis
6. ERIC

3.1.3. Search procedure

Five keyword combinations are found to be appropriate for the search based on prior studies that include SLRs and other related research on Chatbot ap-plications in education. These keywords are: Chatbots in education, Chatbot for teaching, and Chatbot for learning, Conversational agents, and Intelligent systems. Manual and automatic search approaches were applied. With manual approach, we search references of related papers and automatic search was used to search the digital libraries of the selected databases (IEEE, Scopus, Springer- Link, ScienceDirect, Taylor and Francis, and ERIC) for all articles related to the topic under study.

3.2. Conducting the review

3.2.1. Search syntax

The search was based on the title, abstract, and keywords (TITLE-ABS- KEY). The defined search words were combined in various ways to search for the appropriate articles in the selected databases. The search follows the order of **AND** and **OR** operators' processes. In AND operator, all search syntax or keywords must be present while in the OR operator, either of the search syntax must be present. The review sought to locate all related papers, Journal articles, and Conference proceedings published in English between 2015 and May 2021. The same search syntax was used to search all the databases and these syntax or keywords are as follows.

(Chatbot* OR Conversational Agent*) AND (education* OR teaching OR learning OR student* OR school*)

The sample of a search format in Scopus is displayed below.

TITLE-ABS-KEY (chatbots **AND** in **AND** education) AND (**LIMIT-TO** (SUBAREA," COMP")) **AND** (LIMIT-**TO** (PUBYEAR, 2021) **OR** (LIMIT-TO (PUBYEAR, 2020) **OR** LIMIT-TO (PUBYEAR, 2019) **OR** LIMIT-TO (PUBYEAR, 2017) **OR** LIMIT-TO (PUBYEAR, 2016) **OR** LIMIT-TO (PUBYEAR, 2016)).

3.2.2. Data extraction

Using the inclusion, exclusion, and quality criterion, the extraction of quality data was performed. Fig. 3 displays the data extraction processes. The Figure depicts the search approaches, which include the manual and automatic search processes, the selection process, and the final data set of selected articles. The extraction procedure began with the creation of search syntaxes. The syntaxes were used to search the specified databases for articles relevant to the study. The initial search yielded 2048 articles and 312 articles were downloaded. The number of articles was reduced to 117 using the inclusion/exclusion criteria as indicated in Table 1. These articles were then subjected to quality control as described in the following section.

3.2.3. Quality evaluation (QE)

According to Behera et al. Behera et al. (2019), it is critical to examine and evaluate the quality of the articles chosen for the final sample. In relation to the research objectives, the quality of all articles
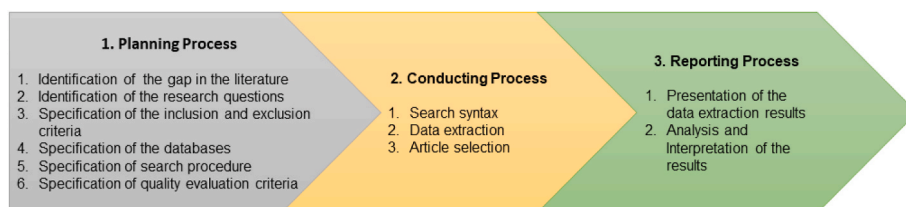

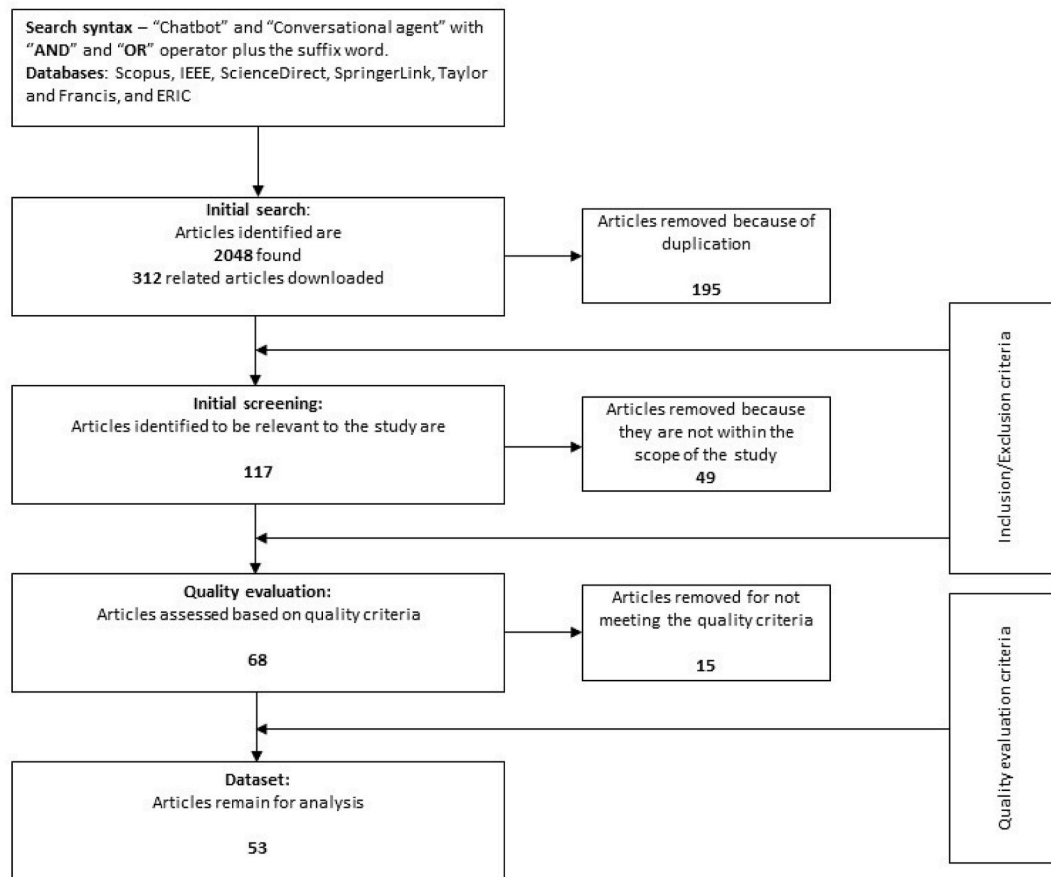**Fig. 2.** Research processes (Source: Authors-compilation).

Fig. 3. Data extraction processes (Source: Authors-compilation).

Table 1
Database search.

Database	Related Articles	Full Text Downloaded
Scopus	624	73
ScienceDirect	241	59
ERIC	337	48
IEEE	601	61
SpringerLink	174	37
Taylor & Francis	71	34

was evaluated with criteria presented in Table 2. The assessment was performed independently by the re-searchers using the QE criteria. All the QE questions are measured with a scale.

Rating of 1–3 (1 - Not good, 2 - Good, and 3 - Very good). The

Table 2
Quality Evaluation (QE) criteria.

QE Questions	Criteria
QE1	Inclusion and Exclusion criteria – does the study meet these criteria?
QE2	Standard development platform – does the design follows well-defined development principles or concepts?
QE3	Evaluation – does the paper presents experimental or simulation-based performance evaluation and quantitatively/qualitatively analyzed?
QE4	Justifiable outcomes – does the study results compare well with the aim?
QE5	Credible source – does the paper published in a recognised source?

evaluation was conducted by two researchers. One researcher extracted the data, while the other double-checked it. Any conflicts of opinion were discussed and resolved. The authors achieved an agreement by consensus on the ultimate inclusion and exclusion of the articles. There was total agreement on the selected publications before they were included in the study. The minimum threshold value for inclusion is 7.5 (50% of the maximum). 53 papers were selected because they are $\geq$7.5. Table 3 shows the quality assessment results.

3.3. Reporting the review

In this section, we provide the results obtained from the search processes. A literature search was conducted on Journal and Conference articles related to the use of Chatbot technology in education. Some recognised article databases were selected and used for the search. Only the most important papers were chosen after a careful review of these articles. Furthermore, quality evaluation was applied to ensure that the selected articles are the most suitable for the study. A total of 53 articles formed the final dataset for the current research. The results of the search were presented in relation to the research questions.

3.3.1. RQ1 - what is the most recent research status or profile for Chatbot applications in the education domain?

The status of research on Chatbot applications in education was profiled using the reviewed articles. According to the review, the number of studies on the use of Chatbots in the educational domain is rapidly increasing due to the large number of studies that have been conducted in this area. This indicates that Chatbot technology has seen extensive integration in the education sector. An examination of the studies chosen for this study revealed that Chatbots have been used for educational purposes in a variety of ways (Cunningham-Nelson et ai,

Table 3
Quality evaluation results.

S/N	Article (A)	Type	QE1	QE2	QE3	QE4	QE5	Score
1	Paschoal et al. (2018)	Conf	3	3	3	3	3	15
2	Lin and Tsai (2019)	Conf	3	3	3	3	3	15
3	Sreelakshmi et al. (2019)	conf	3	3	0	3	3	12
4	Cunningham-Nelson et al. (2019)	Conf	3	0	0	3	3	9
5	Clarizia et al. (2018)	Journal	3	3	3	3	3	15
6	Medeiros et al. (2018)	Journal	3	0	0	3	3	9
7	Chatterjee and Bhattacharjee (2020)	Journal	3	0	0	3	3	9
8	WU et al., 2020	Journal	3	3	3	3	3	15
9	Sandu and Gide (2019)	conf	3	0	0	3	3	9
10	Chen et al. (2020)	Journal	3	0	0	3	3	9
11	Kumar et al. (2016)	Journal	3	3	3	3	3	15
12	Molnar & Szuts, 2018	Conf	2	0	0	3	3	8
13	Huang et al. (2020)	Journal	3	0	0	3	3	9
14	Abu-Alsaad (2019)	Journal	3	0	0	3	3	9
15	Pham et al. (2018)	Conf	3	3	3	3	3	15
16	Hiremath et al. (2018)	Journal	3	3	3	3	3	15
17	Smutny and Schreiberova (2020)	Journal	3	0	0	3	3	9
18	Ranoliya et al. (2017)	Journal	3	3	3	3	3	15
19	Adamopoulou and Moussiades (2020)	Journal	3	0	0	3	3	9
20	Ruane et al. (2019)	Journal	3	0	0	3	3	9
21	Akcora et al.., (2018)	Conf	3	0	0	3	3	9
22	Graesser (2016)	Journal	3	3	2	3	3	12
23	Rooein (2019)	Con	3	3	3	3	3	15
24	Mor et al. (2018)	journal	3	3	0	3	3	12
25	Lam, 2018	Conf	3	3	3	3	3	15
26	Alias et al. (2019)	Journal	3	3	3	3	3	15
27	Ho et al. (2018)	Journal	3	3	3	3	3	15
28	Lin and Chang (2020)	Journal	3	3	3	3	3	15
29	Mckie and Narayan (2019)	Journal	3	0	0	3	3	9
30	Ondas, 2019	Journal	3	3	3	3	3	15
31	Troussas, 2017	Conf	3	3	3	3	3	15
32	D'Silva et al. (2020)	Journal	3	0	0	3	3	9
33	Nguyen et al. (2019)	Conf	3	3	0	3	3	12
34	Song et al. (2017)	Conf	3	3	3	3	3	15
35	Ciupe et al. (2019)	Conf	3	3	3	3	3	15
36	Murad et al. (2019)	Conf	3	3	3	3	3	15
37	Ismail and Abejide, 2019	Conf	3	3	3	3	3	15
38	Shumanov and Johnson (2021)	Journal	3	0	0	3	3	9
39	Yang and Evans (2019)	Conf	3	3	3	3	3	15
40	Crockett et al. (2017)	Journal	3	3	0	3	3	12
41	Rahman et al. (2017)	Conf	3	0	0	3	3	9
42	Okonkwo and Ade-Ibijola (2020)	Journal	3	3	3	3	3	15
43	Elnozahy et al. (2019)	Journal	3	0	0	3	3	12
44	Hobert (2019)	Journal	3	0	0	3	3	9
45	Rapp et al. (2021)	Journal	3	0	0	3	3	9
46	Mikic-Fonte et al. (2018)	Conf	3	3	3	3	3	15
47	Ureta and Rivera (2018)	Conf	3	3	3	3	3	15
48	Hwang et al. (2020)	Journal	3	0	0	3	3	9
49	Ndukwe et al. (2019)	Conf	3	3	3	3	3	15
50	Durall and Kapros (2020)	Conf	3	3	3	0	3	12
51	Hien et al. (2018)	Journal	3	3	3	3	3	15
52	Grosz (2018)	Journal	3	3	0	3	3	12
53	Lee et al. (2019)	Conf	3	3	3	3	3	15

2016; Medeiros et al., 2018; Smutny & Schreiberova, 2020), including teaching and learning, administration, assessment, advisory, and research and develop. The extracted scholarly reports related to the current study on the respective aspects are displayed in Fig. 4. The Figure depicts the extent to which Chatbot technology has been used in various areas of education. including teaching and learning (66%), administration (5%), assessment (6%), advisory (4%), and research and development (19%).

Teaching and Learning: According to the review, Chatbot systems are primarily used in the educational context for teaching and learning. Studies have shown that Chatbots can be used to deliver course content to students via an online platform as a conversational agent capable of providing accurate information to users (Akcora et al., 2018, pp. 14–19; Chen et al., 2020; Lin & Tsai, 2019; Medeiros et al., 2018; Mor et al., 2018, pp. 94–101; Nguyen et al., 2019; Okonkwo & Ade-Ibijola, 2020; Rooein, 2019). Educators are seeing the value of utilizing Chatbots in educational settings to provide students with an engaged experience (Clarizia et al., 2018, pp. 291–302; Hobert, 2019; Sandu & Gide, 2019; Wu et al., 2020). Students can use these bots to ask questions, get responses (Hiremath et al., 2018; Mikic-Fonte et al., 2018), and get
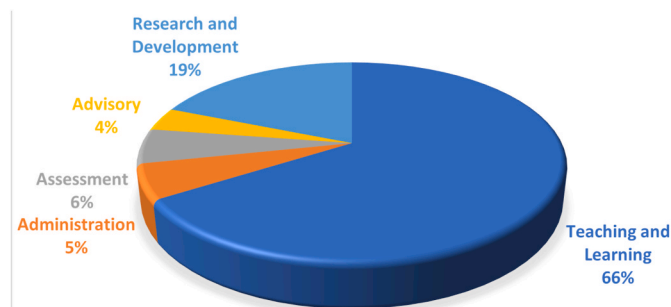

Fig. 4. The use of Chatbots in different aspects of Education.

individualized help (Pham et al., 2018; Sinha et al., 2020; Song et al., 2017; Troussas et al., 2017; de Barce-los). The introduction of learning pedagogy such as Chatbot system in education has personalised the online learning and made learning materials accessible to students anywhere and anytime. Wartman and Combs Wartman and Combs (2018) argued that education is evolving in lockstep with changes in the professional sector, demanding the use of Artificial Intelligence (AI) in teaching and learning. During tutoring, a Chatbot may be used to model a student's learning style using natural language discourse in order to forecast and personalise their learning session with passion (Crockett et al., 2017). From their studies (Lin & Chang, 2020; Murad et al., 2019; Troussas et al., 2017), Chatbots are good technological innovations that improve student learning interest, acquisition of cognitive skills, and achievement.

Administration: From the evaluation and analysis of the selected articles, some studies presented Chatbots that can be used to deliver administrative tasks in educational institutions (Hien et al., 2018, pp. 69–76; Lee et al., 2019, pp. 348–354; Ranoliya et al., 2017). In their study, Hien et al. (2018, pp. 69–76) described a Chatbot system that automatically responds to a student question on how the education system is delivered in their studies on behalf of the academic faculty. The Chatbot will function as a digital assistant, advising tertiary institutions on how to improve their current services, generate new innovative ideas, and cut labour costs. Another study evaluated a conversational agent that can provide administrative support to students on matters such as orientation, recruitment, and retention (Elnozahy et al., 2019). One of the recent AI applications introduced to education is the Chatbot technology, used to support teaching and administrative tasks (Okonkwo & Ade-Ibijola, 2020). Chen et al. (2020) highlighted that one of the key areas in education identified as potentially impacted by Chatbot is the execution of various administrative tasks in the education process, such as evaluating students' assignments, scoring, and providing feedback to students. The use of Chatbots for administrative matters enable student to have easy access to important information such as admission processes, scholarship, and tuition fees (Hwang et al., 2020).

Assessment: It is evident from the analysis of the identified articles used for this study that Chatbot systems are being used for student assessments (Durall & Kapros, 2020, pp. 13–24; Ndukwe et al., 2019, pp. 365–368; Sreelakshmi et al., 2019). AI-powered Chatbots can be used to create an automated and intelligent teaching system that enables teachers to analyse and assess a student's learning ability. These chatbots assist teachers in assessing students' levels of understanding of a subject by recording their answers and responses. Chatbots, like classrooms, provide students with learning materials, tests, and quizzes. When the tests are finished, the chatbots collect the results and send them to the teachers, allowing them to keep track of their students' progress and speed up activities.

Advisory: Another important aspect where Chatbot technology has been ap-plied in education is advisory interactions. The review indicates that Chatbots are being used to provide advice to students on academic issues thereby helping them to make some vital decisions on their various aca-demic programmes or activities (Ho et al., 2018; Ismail & Ade-Ibijola, 2019). D'Silva et al. (2020, pp. 1–9) designed a Chatbot that can assist an individual in better understanding himself/herself as well as job trends, allowing them to make more educated decisions about career and education.

Research and Development: Some studies have highlighted the existence of Chatbots systems that can provide research and development assistance to students by appropriately responding to conversations on academic re-search related issues. Research forms part of the postgraduate curriculum and Chatbot technology is being used to offer the necessary guidelines towards a successful research output. Ureta and Riveria created a Chatbot system that can Teach STEM Related Research Concepts to Students (Mckie & Narayan, 2019; Ureta & Rivera, 2018). Furthermore, the re-view revealed a Chatbot that can assist students in

retrieving information from various sources such as Wikipedia and supporting the training of students from various areas of knowledge in order for them to gain practical knowledge of their profession (Paschoal et al., 2018, pp. 839–848).

3.3.2. RQ2 - what are the primary benefits of chatbots applications in education?

In this section, we present the benefits of Chatbots applications in education as revealed in the analysis of the selected articles used for this study. From the review, the introduction of Chatbot technology in education is changing the educational system. The use of Chatbots in education have the potential to significantly improve learning outcomes and student happiness (Winkler & Soellner, 2018). Several studies have shown that chatbots can be successfully implemented in educational context (Durall & Kapros, 2020, pp. 13–24; Hien et al., 2018, pp. 69–76; Ho et al., 2018; Kumar et al., 2016; Mikic-Fonte et al., 2018; Mor et al., 2018, pp. 94–101; Ndukwe et al., 2019, pp. 365–368; Nguyen et al., 2019; Okonkwo & Ade-Ibijola, 2020; Ranoliya et al., 2017; Ureta & Rivera, 2018). These chatbots have been perceived to benefit the educational system in a variety of ways, including:

Integration of Contents: Content integration refers to the ability of teacher-s/instructors to upload all necessary information about a specific subject to an online platform for easy access by authorized students. This content includes the topics covered, as well as a timetable for assignments, tests, assistance, and examination. Chatbots can assist you in providing tailored information to students. You can keep students informed about upcoming school events such as sports, workshops, and other activities that may be of interest to them. The results from the review indicate that some studies noted that the use of Chatbot in Education facilitates the integration of a subject content for easy access to the students anytime and anywhere (Akcora et al., 2018, pp. 14–19; Wu et al., 2020; Yang & Evans, 2019, pp. 79–83).

Quick Access: One of the benefits mentioned in the reviewed article is that Chatbot promotes quick access to educational information (Ciupe et al., 2019; Murad et al., 2019; Wu et al., 2020). Having an easy and quick access to required information helps to save time (Ranoliya et al., 2017), maximise student learning abilities, and achievement (Clarizia et al., 2018, pp. 291–302; Murad et al., 2019).

Motivation and Engagement: Nowadays, students learn through online plat-forms. They would rather use their smartphones to browse and read in-formation online than read textbooks or subject materials. According to the evidence from the review articles, students are kept motivated and engaged by interactive systems such as Chatbots, which allow them to study in an exciting and comfortable environment (Chen et al., 2020; Pham et al., 2018; Rooein, 2019; Troussas et al., 2017). Learning with a conversational agent does not bore students but allows them to acquire knowledge in a more convenient manner. As a result, the use of Chatbots in education aids in increasing student engagement (Moln'ar & Szuts, 2018; Lam et al., 2018, pp. 18–19; Adamopoulou & Moussiades, 2020).

Allow Multiple Users: Another significant advantage of using Chatbots in education that was discovered through the analysis of the selected articles is the ability to allow multiple users to access the system at the same time. This implies that many students from different locations can interact with a particular Chatbot without interruptions and obtain the required information. Wu et al. (2020) pointed out that one of the major benefits of using a Chatbot for educational purposes is that it allows multiple users to access it at the same time. Rooein (2019) agreed and stated that a Chatbot has the ability to handle multiple questions at the same time, saving the user time to do other tasks.

Immediate Assistance: One of the most significant advantages of utilizing chatbots for educational purposes is that they can provide students with immediate support. The usage of Chatbots in education enables academics and students to obtain rapid replies to their queries and activities (Alias et al., 2019, pp. 263–270). The review results revealed that Chatbot can provide instant support during individual

learning (Okonkwo & Ade-Ibijola, 2020), helps students to automate their activities such as such as submitting homework, responding to emails (Molnar & Szuts, 2018; Murad et al., 2019), adaptive to learners' actions ad emotions (Graesser, 2016), as well as getting instant answers to their questions (Sreelakshmi et al., 2019).

3.3.3. RQ3 - what are the challenges facing the implementation of Chatbot system in education that literature revealed?

The use of Chatbots in education is becoming more visible and popular, and it is attempting to cover all aspects of the educational domain. The technology has the potential to provide quick and personalised services to people in the sector, including institutional staff and students. However, the adoption and use of Chatbots in education, also raise some challenges. According to the findings of the selected article's evaluation, the implementation of Chat-bot technology in education faces some significant challenges, including ethical, insufficient evaluation, user attitude, programming, and data integration issues (Chatterjee & Bhattacharjee, 2020; Cunningham-Nelson et al., 2019, pp. 299–306; Paschoal et al., 2018, pp. 839–848; Rahman et al., 2017; Ruan et al., 2019).

Ethical Issue: A chatbot system is a sort of AI technology that has crept into people's daily lives. Users use natural language to communicate with Chatbots automatically. As a result, the use of Chatbots, particularly in education, raises some ethical concerns. Ruane et al. (2019) highlighted some ethical issues facing the use of a conversational agent including plurality of approaches, trust and transparency, privacy, and agent persona. The authors explained that it is important to consider the application do-main and target user group in the creation of a Chatbot and suggested that contextual and plural approaches should be used in Chatbot development instead of abstract principles. The functions of any Chatbot should be explicitly detailed and users should decide on how to interact with the bot. Understanding a user's expectations of an agent is critical for avoiding abuse of the user's trust. A Chatbot system must have a consistent personality in order to gain consumers' trust and confidence (Huang et al., 2020). The privacy aspect raised a question "What happens to the collected data and their storage?" User privacy is critical, and it is becoming increasingly so as Chatbot systems are implemented in various sectors of society, including education. As a result, when attempting to comply with regulatory requirements or any established privacy guidelines, the context of Chatbots in terms of privacy should be recognised. Gender, age, colour, cultural affiliation, and class are all factors that influence agent persona. It's critical to evaluate the impact of the agent persona on the kind of relationships users might want to form with the agent, as well as to assess whether the agent persona's design and associated conversations encourage potentially harmful behaviour. Other studies (de Barcelos Sinha et al., 2020; Shumanov & Johnson, 2021) have mentioned that ethical issues like usability, privacy, and security may have a direct impact on users' willingness to adopt and use technology.

Evaluation Issue: According to Rapp et al. (2021) evaluating chatbot design just based on its effectiveness, utility, and ability to fulfil and engage people do not seem to be sufficient. Paschoal et al. (2018, pp. 839–848) makes similar observations and justifications, stating that the majority of the evaluations performed to test the effectiveness of Chatbot systems used a small and insignificant sampling population. Song et al. (2017) proposed an empirical investigation to prove that learners can learn more success-fully when they engage on their learning activities through an interaction with a Chatbot system in an online learning environment. To test the usefulness of Chatbot systems, an appropriate process for evaluating the effectiveness of a software engineering product should be used, along with a larger and significant sampling population.

User Attitude Issue: Another challenge facing the use of Chatbot systems in education revealed by the review of the selected articles is user's attitude. In a study on the adoption of AI in higher education, Chatterjee and Bhattacharjee (2020) revealed that individuals'

behavioural intentions to use AI in higher education are influenced by their attitudes. Likewise, another research on the adoption of software engineering product proved that user attitude influences the adoption of software tools (Okonkwo et al., 2019). This leads to the conclusion that higher education authorities would find it useful and beneficial to mould stakeholders' attitudes to shape their intentions and behaviour (Chatterjee & Bhattacharjee, 2020). As a result, if students have negative perceptions of Chatbot technology applications in education, they will be hesitant to adopt and use the technology. Positive perception of an innovation accelerates adoption.

Programming Issue: One of the key challenges in Chatbot development is programming (Rahman et al., 2017). The creation of a Chatbot involves the use of Natural Language Processing (NLP). NLP is a technology that enables machine to comprehend, analyse and interpret natural human languages. The issue is" How can a Chatbot be programmed to give an ac-curate response?". User's questions can come is different forms requesting for the same response. For example," What is the time" and" Could you check the time". The Chatbot system may respond accurately to the first question but might not provide accurate response to the second question. According to Grosz (2018), computational linguistics and NLP systems also raise some of the most serious potential issues, such as dialogue system failure, the impact of social Chatbots on how people communicate with one another, and system performance issues. A Chatbot, as a dialogue system, should be able to understand the content of the dialogue and identify the users' social and emotional needs during the conversation (Cunningham-Nelson et al., 2019, pp. 299–306; Huang et al., 2020). Chatbot systems should be able to learn how to provide appropriate answers to users, which can be accomplished through effective programming.

Supervision and Maintenance Issue: From the review, the development and implementation of Chatbot in education requires proper supervision and maintenance. Supervision ensures that the Chatbot's input and output data are correct, and that the system's operation meets the design objectives. Maintenance ensures that the Chatbot is working properly and that the system's data bank is up to date. The accuracy of the information delivered by the bot is determined by the input data (Cunningham-Nelson et al., 2019, pp. 299–306). The user expects the Chatbot system to provide accurate answers to each question. This is only possible if the input data are correct. Furthermore, the information stored in the bot should be updated on a regular basis so that the Chatbot can provide current and accurate information on any subject. Adding a new information is not an easy task. To add new information, you must first ensure that it does not already exist in the knowledge bank. You should also consider whether adding new data will disrupt the search experience for existing data. The more data the bot has to deal with, the longer the search takes. Occasionally, the same keyword appears in multiple data sets. Because of the larger data sets, only certain data appear during the search process for a specific phrase, and sometimes the most important one is missing. Building a Chatbot system is a continuous process that necessitates consistent supervision and maintenance, which can be difficult.

3.3.4. RQ4 - what are the potential future areas of education that could benefit from the use of chatbots?

We now address areas in education that would benefit from more scholarly study, based on the review. From the previous studies, various recommendations for future research works have been made, including technical advancements (Hwang et al., 2020; Lin & Tsai, 2019; Paschoal et al., 2018, pp. 839–848; Pham et al., 2018), development of Chatbot model or implementation frameworks (Hwang et al., 2020; Smutny & Schreiberova, 2020), practical integration (Medeiros et al., 2018; Sreelakshmi et al., 2019), open educational resource (Paschoal et al., 2018, pp. 839–848), establishing ethical principles for the use of Chatbots in education (Hwang et al., 2020), and usability evaluation (Hwang et al., 2020; Paschoal et al., 2018, pp. 839–848; Smutny & Schreiberova, 2020). These future areas are grouped into three categories including

technical advancements, developing ethical principles, and usability testing.

Technical Advancements: The review results indicated the importance of focusing on improving previously created models by addressing some high-lighted technical challenges that can improve the model's functionality when used in an educational context. As a result, more research should be conducted on issues such as expanding the knowledge bank and making Chatbot an open educational source (Paschoal et al., 2018, pp. 839–848), increasing the entities and intents for each type of query/request as well as automating the technical tests at every stage of development (Lin & Tsai, 2019). To improve the intelligent of a Chatbot, (Pham et al., 2018), suggested more work on advancing the features of a Chatbot and learning content. According to Smutny and Schreiberova Smutny and Schreiberova (2020), future research should focus on developers' support for creating and offering tools that allow teachers to easily use chatbots in classrooms, as well as guidelines for successfully supporting teaching and learning methods for students (Smutny & Schreiberova, 2020). To promote the growth of the Chatbot technologies in education (Hwang et al., 2020), proposed for an implementation framework and new design strategies or concepts.

Developing Ethical Principles: It is evident from the review that the use of Chatbot in education raises some ethical issues (See Section 3.3.3). It is therefore important for researchers to seek possible policy solutions by setting the ethical codes and principles for using Chatbot systems in education (Hwang et al., 2020).

Usability Testing: One of the primary advantages of implementing an AI- based chatbot system in education is that it will improve students learning performance and experience while also assisting teachers to advance their teaching practices. As a result, one unresolved issue is assessing the effects of Chatbot use on students' learning abilities. Abu-Alsaad (2019) emphasised the importance of improving the usability and trustworthiness of an e-learning system. According to Hwang et al. (2020), It is critical to investigate the students' learning motivation, anxiety, performance, and perception of using the Chatbot system. Smutny and Schreiberova (2020) proposes a content analysis of actual student-chatbot conversations. Regarding the adoption of Chatbot systems, Medeiros et al. (2018) suggested that it is important to figure out why promising teaching methods are not widely used in higher education. To that end, researchers should conduct additional research on the usability of Chabot systems in education.

4. Discussion

The purpose of this study was to conduct a systematic review of the literature on Chatbot applications in education to gain a better understanding of their current status, benefits, problems, and future potential. Four broad research questions were specified in relation to the objectives.

RQ1 investigated the current state of research into chatbot applications in education. To answer this question, 53 published research articles were examined. According to the findings, the majority of Chatbot system applications in Education are focused on teaching and learning, administration, assessment, advisory, and research and development. This is possible because these are potential areas of education where Chatbot systems can be used. According to Fig. 4 and 66% of the reviewed studies on Chatbot applications in education were applied to the teaching and learning aspect of education, 19% dealt with research and development areas, and 6% focused on student assessments. Administration and advisory research accounted for 5% and 4% of the total proportion, respectively. The results show that teaching and learning aspects of education receive more attention from scholars than other areas. Table 3 contains a list of the articles that were used in this study.

RQ2 explored the benefits of the use of Chatbots in education. The re-view identified and discussed several benefits obtained from the applications of Chatbots in the educational domain. Some of these benefits

highlighted by the reviewed articles are integration of contents, quick access, motivation, and engagement, allow multiple users, and immediate assistance. According to the findings, the usage of Chatbots allows for the gathering of various forms of in-formation and storage in a unit (Information unit) for rapid and easy access by authorised users. Furthermore, Chatbots encourage personalised learning, provide instant support to users, and allow multiple users to access the same information at the same time.

RQ3 examined the challenges that face the use of Chatbots in education as revealed by the selected articles used for this study. It is clear from the re-view that some factors, such as ethical, evaluation, user attitude, supervision, and maintenance issues, may have an impact on the adoption and use of Chat-bots in education. This implies that these factors may skew users' perceptions, limiting the applications of Chatbots systems in educational settings. To improve the penetration of Chatbot technology in education, researchers and stakeholders must define adequate solutions that can mitigate the negative effects of these challenges.

RQ4 attempted to propose the potential future areas of education that could benefit from the use of Chatbots. The study revealed some significant areas that require future research work that may result in the improvement of the education system, such as technological advancements, ethical principles development, and usability testing. This implies that the frameworks for the development and implementation of Chatbots, as well as the design features and contents, must be improved. It is also necessary to have well-defined rules for using Chatbots that are compatible with user ethics. More research into the functionality of Chatbot systems is also required. These will contribute to Chatbots' positive impact on education.

5. Implications

This study provides the most recent research findings and classifications of previous studies on the applications of Chatbot technology in the educational sector. It offers a structured understanding of the use of Chatbots in educational processes including teaching and learning, administrative tasks, student assessment, and research and development (Medeiros et al., 2018; Durall & Kapros, 2020, pp. 13–24; Hien et al., 2018, pp. 69–76; Durall & Kapros, 2020, pp. 13–24; Ho et al., 2018; D'Sinha et al., 2020, pp. 1–9). These organized insights will help researchers understand the main points of the research and plan future research strategies. The benefits of Chat-bots in education were identified (Clarizia et al., 2018, pp. 291–302; Pham et al., 2018). This implies that Chatbot technology is a good innovation with the capabilities of improving not only teaching and learning but all other aspects of education. Furthermore, the key challenges facing the use of Chatbots for educational activities were elucidated in line with the reports of (Cunningham-Nelson et al., 2019, pp. 299–306; Huang et al., 2020; Rapp et al., 2021; Ruane et al., 2019), helping the innovators and other stakeholders in the creation, adoption, and sustainability of this modern technology, to take proper decision in the design principles and policy as well as the use of Chatbots in education. Finally, based on the issues identified in the study, implications emerge for the need for broader re-search in order to expand the field's existing understanding in the aspects of technical advancements, ethical principles development, and usability testing as noted by some studies (Hwang et al., 2020; Paschoal et al., 2018, pp. 839–848; Smutny & Schreiberova, 2020). The findings of this study may help stakeholders involved in the development and deployment of Chatbot technology in education enhance the design and use of Chatbots in the educational sector. Knowing the existing domains of Chatbot applications and prospective future work areas may assist researchers and developers in classifying crucial areas that require more research and development. Identifying the benefits and challenges of using Chatbots in education sheds additional light on the importance of using Chatbots in education and reveals the potential barriers to acceptance and usage of Chatbots in education. Considering the benefits

and difficulties may aid in encouraging users and defining appropriate principles that will support the creation and use of Chatbot technology in education.

6. Conclusions, limitations, and future works

6.1. Conclusions

In this study, we presented a systematic literature review of Chatbot applications in education. A systematic review protocol was used to analyse 53 articles from well-known digital databases such as Scopus, IEEE, ERIC, ScienceDirect, SpringerLink, and Taylor and Francis. The findings explained the current state of knowledge on Chatbot applications in education and identified the benefits and challenges of using Chatbots in education. Furthermore, future areas of education that may benefit from this modern AI technology were identified and explained as recommended by the literature. Finally, the research findings were discussed in terms of their implications.

6.2. Limitations

While the current study yielded some noteworthy findings, it did have several drawbacks. The selected articles were collected from six well-known digital databases including solely journal and conference publications, with no regard for book chapters or other forms of publications. Similarly, the study focused primarily on the use of Chatbots for teaching and learning at tertiary institutions, with little consideration given to other types of education such as health, social, and so on. These constraints may be overcome in the future by utilizing keywords relating to those areas of education.

6.3. Future works

This study identified the benefits and challenges of using Chatbots in education. Previous studies that were reviewed highlighted and explained these factors without empirical investigation. In future works, the identified benefits and challenges will be empirically examined to determine the extent to which they impact Chatbot development and implementation in education.

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