



Chatbots Adoption for Gamification of Programming Language Learning: A Comprehensive Literature Review

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ABSTRACT

Chatbots are an emerging form of AI application, hold significant potential for learning experiences in academic settings across various disciplines. In educational context, chatbots are an upcoming educational technology used to transform traditional teaching and learning approaches into more modern methods. Integrating chatbot usage in the classroom gives the educational system potential to revolutionize students' learning experiences. As the use of these AI-driven systems grows, educators could strategize to leverage chatbots and streamline the learning process, particularly to gain modern learning experiences. The objective of this study is to undertake a comprehensive review of prior research on the use of chatbots in the gamification of programming language learning. The aim of this systematic review is to further investigate the utilization of chatbots in education. Through a thematic analysis, three key themes were identified: cognitive, affective, and benefits. Additional themes include computational thinking skills, personalized learning, behaviours, and student engagement were other frequently discussed themes. Findings show that the use of chatbots in computer science and programming courses has been seen as a key factor in the emergence of the technology.

Keywords:

Chatbots; Gamification; Programming language learning

1. Introduction

Recent studies in the area of educational technology have revealed that chatbots, one application of Artificial Technology (AI) technology, have various advantages and benefits, particularly for teachers and students. A study by Sidhu *et al.*, reported that students from Generation Z is growing more interested in and aware of the benefits of Industry 4.0 (IR4.0) technology [44]. The utilization of chatbots based on appropriate pedagogical approach can help students become more motivated to study, improve their engagement in class, develop their computational skills, enhance

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technological abilities and boost their retention rates. Chatbots have been widely employed across discipline including education, banking, customer service, and health sector. Among the well-known existing Chatbots applications before are ELIZA, ALICE, Claude and Hex. Chatbots also known as conversational agents or assistant bot that has been develop to convince users that they are interacting with a person instead of a computer. In addition to that, chatbots can provide instant communication in real-time to make interaction more interactive and valuable for user.

Chatbots are an emerging form of AI application that beneficial to students and educators for academic settings as well as in other disciplines. It is an upcoming educational technology used in educational context to transform traditional to modern approaches of teaching and learning. Integration of chatbots usage in classroom give potential to educational system to revolutionize students' learning experience. AI-driven technology in the classroom is well-received by students, and teachers' direction is crucial in helping students explore pertinent technological innovations for educational purposes [43]. In order to improve students' technological learning, educators or teachers emphasize teaching strategies and frameworks that allow them to evaluate their own competency with AI technology. As this AI-driven system becomes more prevalent, educators have the opportunity to strategize chatbot usage to streamline the learning process, particularly to create individualized learning experiences.

There is a substantial body of research dedicated to the study of chatbots, which has examined several aspects such as their adoption, possibilities and difficulties, motivating reasons, advantages or benefits, computing abilities, awareness, and technological literacy as variables that influence their use. This review paper examines the use of chatbots in the context of gamifying the process of learning programming languages. This article presents a comprehensive examination of the implementation and use of chatbots in educational settings around the nation. There are significant gaps in our understanding of the use of chatbots, namely in terms of their technique, applications, topic areas, and educational methods.

To facilitate the development of a thorough and pertinent comprehensive evaluation, the primary research question that guides this inquiry is as follows: What are the existing practises pertaining to the use of Chatbots for the purpose of gamifying the learning of programming languages? This project is focused on the implementation of chatbot technology to enhance the educational experience for students studying programming languages. Furthermore, the primary objective of this study is to conduct a thorough examination of previous research that has used chatbot technology as an instructional tool in the context of teaching and learning.

This systematic review fills a significant gap in the empirical research on the use of chatbot gamification in programming language learning that has been done in the past. Although the use of chatbots in education was further discussed, there is still limited to explore how gamification techniques in chatbots for computer programming language learning are affected. This study's primary contribution may help academics better comprehend the gamification elements used into chatbot platforms to give students an engaging educational experience. Educational technologists can create relevant and productive chatbot-assisted learning environments by refers to the key themes categories in systematic reviews for achieve learning objectives.

This work is organised into five distinct parts, which are outlined as follows: Section 1 introduces the research background and goals. Section 2 contains an account of the research methodology. Section 3 shows the findings and themes that emerged from the research. Section 4 offers a discussion of the review. Finally, Section 5 delivers the conclusion of the study. The following parts of this article include Acknowledgements and References.

2. Methodology

2.1 Systematic Literature Review Guidelines

The systematic review of this study was guided to existing systematic literature review's principle and guidelines by Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) [41] and also refers to another study conducted by Chu *et al.*, [42]. Guidelines of systematic literature review including the steps taken including identification, screening, eligibility, data analysis and reporting phases. All these steps are described later. Initial steps of identification are focus on three databases namely Scopus, Taylor of Francis and ScienceDirect.

2.2 Review Process

2.2.1 Identification

The identification procedure involves the use of keywords that pertain to terminology used in previous research, synonymous words found in thesauri, and terms associated with the usage of chatbots for the gamification of programming language acquisition. The search queries used standardised terminology and logical operators to optimise the pertinence of the results. Table 1 presents the terms used in the search queries for the Scopus, Emerald, and ScienceDirect databases. The search queries were deliberately designed to include a wide range of relevant literature. Subsequently, a systematic application of inclusion and exclusion criteria was used to refine the data and choose the most relevant research. The primary objective of this extensive search method was to minimise the impact of publication and selection bias, resulting in a diverse collection of literature that accurately reflects the current state of knowledge and practises related to the use of chatbots in gamified programming education. The subsequent stage will include a meticulous evaluation of the evidence base, using standardised procedures to assess the potential for bias and the applicability of findings across various contexts.

Table 1

Summary of keywords used for the search string

Database	Search String
Scopus	TITLE-ABS-KEY (("chatbot*" OR "conversational agent*" OR "assistant bot" OR "automated agent*" OR "chatting") AND ("game" OR "gamified" OR "gamification*" OR "engagement" OR "edutainment") AND ("programming language" OR "computer programming" OR "programming" OR "coding" OR "program")) AND PUBYEAR > 2017 AND PUBYEAR < 2024 AND (LIMIT-TO (SRCTYPE , "k") OR LIMIT-TO (SRCTYPE , "p") OR LIMIT-TO (SRCTYPE , "j")) AND (EXCLUDE (DOCTYPE , "er") OR EXCLUDE (DOCTYPE , "re")) AND (LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "ENGI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "MATH")) AND (LIMIT-TO (LANGUAGE , "English"))
Taylor and Francis	[[Abstract: "chatbot*"] OR [Abstract: "conversational agent*"] OR [Abstract: "assistant bot"] OR [Abstract: "automated agent*"] OR [Abstract: "chatting"]] AND [[All: "game"] OR [All: "gamified"] OR [All: "gamification*"] OR [All: "engagement"] OR [All: "edutainment"]] AND [[All: "programming language"] OR [All: "computer programming"] OR [All: "programming"] OR [All: "coding"] OR [All: "program"]] AND [Publication Date: (01/01/2018 TO 12/31/2023)]
ScienceDirect	("Chatbot" OR "conversational agent" OR "assistant bot") AND ("game" OR "gamification") AND ("programming language" OR "computer programming" OR "programming")

2.2.2 Screening

The screening process involved the chosen criteria of the studies; inclusion and exclusion criteria. The article search from the databases was selected from years between 2018 to 2023. This inclusion

year is important to review the trends of chatbots use especially in education sectors. For literature search type was focus on conference paper and article journal with existing empirical finding to compare among previous studies. Regarding the language, this was screening to English language only.

Table 2
Summary of inclusion and exclusion criteria

Criterion	Eligibility	Exclusion
Language	English	Non-English
Literature type	Journal (research articles), conference proceeding (research paper)	Erratum, review, systematic review, book series, book, chapter in book
Timeline	Year 2018 to 2023	Less than 2018

2.2.3 Eligibility

The third step of the review procedure constitute process of reading the article journal's title and abstract. This procedure was used to make sure the research topic was relevant to the use of chatbots in the gamification of programming language learning. This phase dictates that the title and abstract adhere to the criteria for inclusion as well as exclusion for the potential articles review.

2.2.4 Data analysis

For this phase of data analysis, the quality assessment of articles included was made based on Kitchenham and Charters quality assessment framework [40]. All the articles included in systematic review has analysed using the following questions to determine the quality of the article journals.

- i. Is the purpose of the study clearly stated?
- ii. Is the interest and the usefulness of the work clearly presented?
- iii. Is the study methodology clearly established?
- iv. Are the concepts of the approach clearly defined?
- v. Is the work compared and measured with other similar work?
- vi. Are the limitations of the work clearly mentioned?

Each article was evaluated based on the aforementioned questions, and a score of 1, 0, or 0.5 was given for each. Then, for data extraction, articles with more than 3 points were selected. Steps of database searching process visualize based on Figure 1.

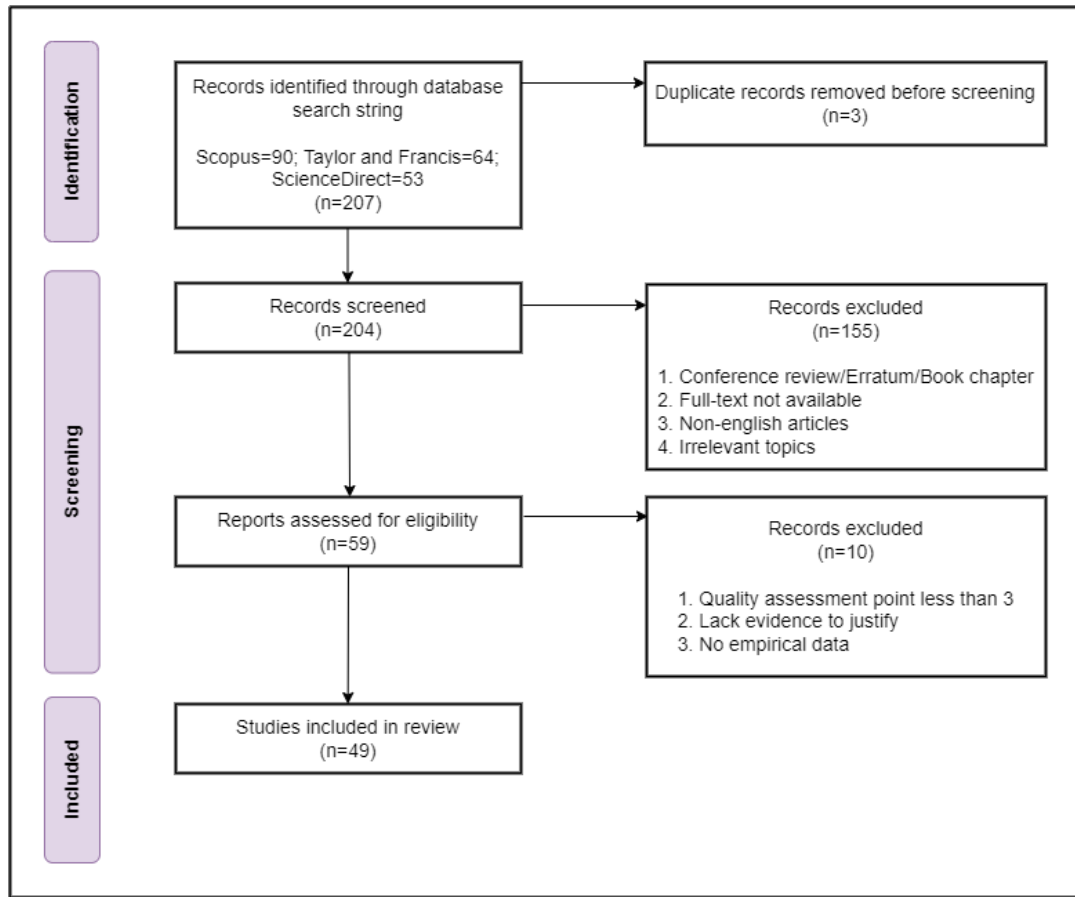


Fig. 1. Steps of database searching process

3. Results

3.1 Background of the Study

The numbers of studies included for systematic review is 39. Based on Table 3, it shows the list of studies' articles according to year published for 2018 until 2023.

Table 3

Title of studies included for comprehensive reviews

No.	Title	Year
1.	A novel use of an artificially intelligent Chatbot and a live, synchronous virtual question-and answer session for fellowship recruitment	2023
2.	A Phenomenological Exploration of Students' Perceptions of AI Chatbots in Higher Education	2023
3.	Aisha: A Custom AI Library Chatbot Using the ChatGPT API	2023
4.	Aladdin's Genie or Pandora's Box for Early Childhood Education? Experts Chat on the Roles, Challenges, and Developments of ChatGPT	2023
5.	Assessing the effectiveness of a chatbot workshop as experiential teaching and learning tool to engage undergraduate students	2023
6.	Chatbot-based learning of logical fallacies in EFL writing: perceived effectiveness in improving target knowledge and learner motivation	2023
7.	Chatbot-based training on logical fallacy in EFL argumentative writing	2023
8.	ChatGPT versus engineering education assessment: a multidisciplinary and multi-institutional benchmarking and analysis of this generative artificial intelligence tool to investigate assessment integrity	2023

9.	Collaborative Work Alternatives with ChatGPT Based on Evaluation Criteria for its Use in Higher Education: Application of the PROMETHEE-SAPEVO-M1 Method	2023
10.	Decision-guided chatbots and cognitive styles in interdisciplinary learning	2023
11.	Developing E-Learning Courses in a Gaming Environment with an Integrated Assistant Bot for Secondary School Students	2023
12.	Does intrinsic motivation mediate perceived artificial intelligence (AI) learning and computational thinking of students during the COVID-19 pandemic?	2023
13.	Exploring English language learning via Chabot: A case study from a self-determination theory perspective	2023
14.	Investigating students' engagement in chatbot-supported classroom debates	2023
15.	Performance matters: students' perceptions of Artificial Intelligence Coach adoption factors	2023
16.	Social Presence and Imagery Processing as Predictors of Chatbot Continuance Intention in Human-AI-Interaction	2023
17.	The effect of generative artificial intelligence (AI)-based tool use on students' computational thinking skills, programming self-efficacy and motivation	2023
18.	Using chatbots for English language learning in higher education	2023
19.	Engaging Undergraduate Students in an Introductory A.I. Course through a Knowledge-Based Chatbot Workshop	2022
20.	Enhanced engineering design behaviour using chatbots with user experience	2022
21.	Exploring AI chatbot affordances in the EFL classroom: young learners' experiences and perspectives	2022
22.	Impersonating Chatbots in a Code Review Exercise to Teach Software Engineering Best Practices	2022
23.	Online chat and chatbots to enhance mature student engagement in higher education	2022
24.	ScratchThAI: A conversation-based learning support framework for computational thinking development	2022
25.	A Video Game-Like Approach to Supporting Novices in Learning Programming	2021
26.	Effects of self-regulation scaffolding on online participation and learning outcomes	2021
27.	Using Chatbots in Flipped Learning Online Sessions: Perceived Usefulness and Ease of Use	2021
28.	Using Learning Analytics to Explore Responses from Student Conversations with Chatbot for Education	2021
29.	Design architecture of FAQ chatbot for higher education institution	2020
30.	QLearn: Towards a framework for smart learning environments	2020
31.	The impact of chatbot conversational skill on engagement and perceived humanness	2020
32.	User Engagement with Chatbots: A Discursive Psychology Approach	2020
33.	Would You Lie to Me Bot? Supporting Decision-Making Processes with Deceiving Virtual Agents	2020
34.	A Conversational Assistant on Mobile Devices for Primitive Learners of Computer Programming	2019
35.	Cloud-based conversational agents for user acquisition and engagement	2019
36.	I Believe in a Thing Called Bot: Perceptions of the Humanness of "Chatbots"	2019
37.	Imikode: A VR game to introduce OOP concepts	2019
38.	A Tool for Introducing Computer Science with Automatic Formative Assessment	2018
39.	An Architectural Design of ScratchThAI A conversational agent for Computational Thinking Development using Scratch	2018

To summarize, Figure 2 has shown the statistics of research conducted regarding chatbots adoption in educational institutions has progressively risen each year. The pattern of the line graph indicated that, from year 2022 to 2023 the research conducted was increasing about 66.7%. The use of chatbots in education is a growing trend in the application of cutting-edge pedagogical technology, which has several advantages for students, institutions, and decision-makers.

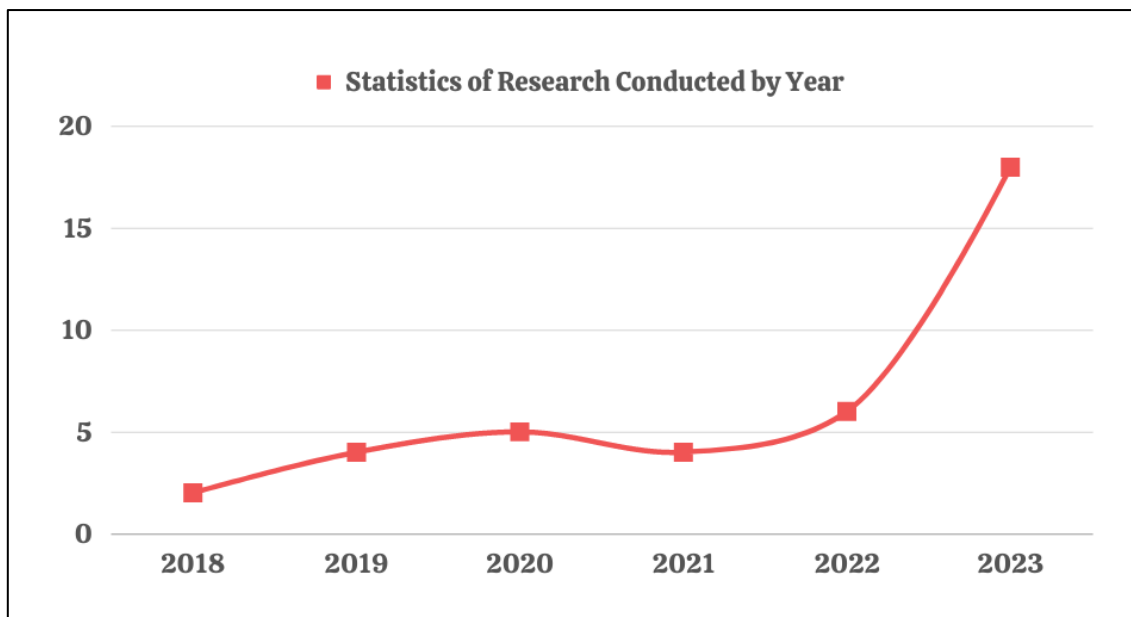


Fig. 2. Statistics of research conducted by year

Research on the use and acceptance of chatbots was undertaken in multiple countries. According to Figure 3, it has shown the distribution of research conducted based on countries. In comparison to other nations, the United States does the most research on the use of chatbots. Following Taiwan, Malaysia, and China, each of which had three studies completed from 2018 to 2023. There were only eight research papers that exposed the trends for chatbot adoption, especially in educational settings, and they were all undertaken in ASEAN countries: Malaysia [13,18,28], Philippines [29], Singapore [5,19] and Thailand [24,39].

Country Distribution for Research Conducted for 2018 - 2023

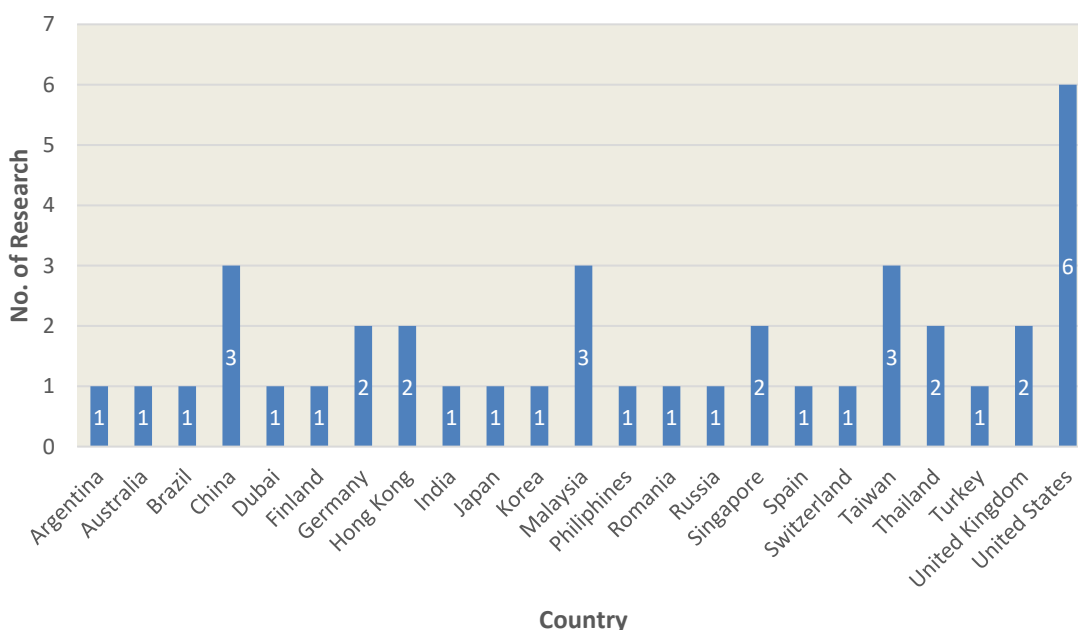


Fig. 3. Country distribution for research conducted for 2018 – 2023

Table 4 shows a summary of the 39 included articles together with their year, purpose and its main findings of the studies. In general, studies conducted has discussed about the computational skills, writing skills, communication skills, students' engagement, students' behavioural, thinking ability and decision-making skills. These construct measure mainly for higher educational institution that utilizing chatbots technology in their academic purpose. Meanwhile, chatbots technology was applied in several level of academic such as childhood education, primary and secondary level and also students in higher education. Among these studies [2,9-11] were example studies to focused on the use of chatbots available and others were more to explore and develop the new chatbots technology for their purpose [1,3,7,16,17].

Table 4
 Summary of the 39 included studies

References	Year	Purpose	Main finding
[1]	2023	To describes the development process, perceived benefits and capabilities, explore current limitations and future planning of the chatbot development using Phyton and ChatGPT API.	According on research findings, the chatbot Aisha was created to help students and faculty members discover references quickly and effectively, even outside office hours.
[2]	2023	To explore the roles, challenges and future development of ChatGPT in early childhood education (ECE).	According study findings, ChatGPT may transform pedagogical practices by helping students in a variety of ways and enhancing learning and teaching for students.
[3]	2023	To investigated the perceived effectiveness of chatbots in developing knowledge of logical fallacy in English Foreign Language (EFL) writing and enhancing learner motivation.	Based to research, chatbots are capable of helping students avoid logical fallacies in their writing as well as enhance their EFL writing skills.
[4]	2023	To develop and implement chatbot-based training for EFL argumentative writing by implementing self-regulated training on logical fallacies.	The findings demonstrate that self-regulated training methods combined with chatbot-based learning techniques increased students' ability to write persuasively in EFL even if they might decrease students' writing self-efficacy.
[5]	2023	To analyse the possible intertwined relationship between students' intrinsic motivation for learning Artificial Intelligence (AI), the relationship between students' computational thinking and understanding of AI concepts, underlying dynamic relation and computational thinking building efforts.	According to this empirical investigation, intrinsic motivation influences both computational thinking and AI learning in along with mediating the relationship between perceived AI learning and computational thinking abilities.
[6]	2023	To apply Self-Determination theory in exploring learning English language using chatbot application.	According to this qualitative study, chatbots personalize teaching and learning by assisting learners' psychological demands for competence, autonomy, and relatedness.
[7]	2023	To investigated students' behavioural, cognitive and affective engagement in utilizing chatbot in debates class.	The results of the study show that while the Argumate chatbot is capable of helping students produce ideas, it is insufficient to support students' cognitive and affective engagement.

[8]	2023	To understand factors that promote or inhibit adoption of AI coach	Finding from qualitative study exposed that, important roles in chatbot adoption and engagement are positive attitude and performance expectations.
[9]	2023	To explore the predictors of chatbots used among consumer in Human-AI-interaction.	The result of the study revealed that social presence and imagery processing are positive predictors of AI-chatbot continuance intention.
[10]	2023	This study investigated the effect of programming education using the ChatGPT on students' computational thinking skills, programming self-efficacy, and motivation toward the lesson.	According to the research finding the computational thinking abilities, self-efficacy in programming and lesson motivation of the experimental group students were significantly higher than those of the control group students.
[11]	2023	To examine the factors of chatbot usage in English language and to explore students' experience.	Performance and effort expectancies are the most factors in chatbot usage among students for English language class.
[12]	2023	To analyse collaborative work alternatives with ChatGPT in higher education.	The study discovered that "Support for Autonomous Learning" performed the best among the ChatGPT collaborative work alternatives in higher education. It had the highest positive flow and lowest negative flow, which suggested that it was naturally preferred over the other options.
[13]	2023	To examine the ChatGPT may influence the assessment in engineering education.	Study finding have shown that ChatGPT can be utilized as a tool to promote student learning and foster critical thinking in engineering education.
[14]	2022	To determine whether it is feasible for students to practice speaking with emerging chatbots technology that include multiple real-life users' product experiences.	Research finding indicated that chatbot group of students had better concepts and had more significant design behaviours in the design process compared to others group.
[15]	2022	To produce an inventory of affordances of chatbot provide in EFL class, to explore the affordance affect for psychological aspects.	The study discovered that the usage of chatbots in EFL classes boosted students' engagement and self-confidence in utilizing the language, as well as their drive to learn English.
[16]	2021	To investigate whether an interactive self-regulation scaffolding increases levels of online learners' self-regulated learning skills, course participation, and learning performance.	Study finding indicated that the self-regulated learning levels for interactive scaffolding group were highest compared to control group.
[17]	2020	To investigates students' performance for programming courses learning that use QLearn as AI assisted technology in teaching and learning.	According to research, QLearn is a cutting-edge approach to a student-centred approach in educational contexts that supports and provides smart learning environments that assure optimum knowledge transfer from instructors.
[18]	2020	This study investigates the impact of chatbot conversational skill on engagement and perceived humanness.	The finding revealed that chatbot indicate perceived humanness via conversational skill that be more socially and anthropomorphic.

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| [19] | 2020 | To show the deceptive virtual agents has positive significant to decision-making process. | The results showed that deceptive virtual agents can encourage students to think on their decisions and consider a wide variety of options, which can result in a better trained decision-making process. |
| [20] | 2019 | To investigate how the presence of specific typographic indications (such as capitalized words and errors) in written language correlated with various user impressions, including assessment of the user's humanity. | The research discovered that while capitalized words had no discernible influence, typos had a negative effect on perceptions of responsibility and ability. |
| [21] | 2023 | The study examines how secondary school students use various digital technologies and propose integrate Minecraft game and development of chatbot. | The study finds that technology integration is vital because this could boost the engagement of learners in the learning process. |
| [22] | 2023 | To develop a decision-guided chatbot for interdisciplinary learning and explore the effect of learning model use. | Research finding has shown that experimental group score is highly compared to the control group in terms of learning achievements, extrinsic motivation, collective efficacy, cognitive engagement, emotional engagement and satisfaction while utilizing a decision-guided chatbot. |
| [23] | 2023 | To investigated how chatbot useful in trainee recruitment by utilizing chatbots with extended tool for static faculty website. | Study revealed that using chatbots to seek information is more useful than searching on accessible static faculty websites because they are able to communicate and ask various inquiries. |
| [24] | 2023 | To investigate the effects of AI chatbots as a form of communication on student support and engagement in higher education. | According to a study, effective chatbot integration can personalize students' support and involvement in the classroom. |
| [25] | 2023 | To assess a chatbot workshop's performance as an experience teaching and learning method for engaging undergraduate students. | The empirical study discovered that giving undergraduate students chatbot workshops can affect their intrinsic motivation, degree of engagement, and proficiency in fundamental AI. |
| [26] | 2022 | To measure the effect of chatbot workshop on students' engagement and motivation for their AI course. | Study revealed that hands-on knowledge of chatbot workshop influence students' engagement and motivation in developing their competency skills such as in natural language processing. |
| [27] | 2022 | To investigate the role of chatbots application for code review exercise for software engineering best practice. | Study revealed that student perceived usability in simulating the code using online platform. Analysis of quantitative study indicated that there is no significance difference between treatment and control group. |

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|------|------|---|---|
| [28] | 2022 | To propose pilot an online chat platform named Differ, integrated with a chatbots to encourage students' engagement in class. | According to research, students who have utilized Differ have seen its value in fostering peer collaboration, increasing motivation and engagement, and strengthening their sense of belonging. |
| [29] | 2022 | To investigates the ScratchThAI as a conversation-based learning support framework for computational thinking development to support both students and teachers. | Finding from the study exposed ScrathThAI can personalize learning performance in computational thinking skills and get more understanding the fundamental concept of related topics. |
| [30] | 2021 | To explore the chatbot usage in flipped learning, perceived usefulness, perceived ease of use and students' engagement. | According to result, chatbot usage in flipped learning provide usefulness and easily used by students in their teaching and learning process. It also promotes students' engagement to actively get involved to the learning approach. |
| [31] | 2021 | To investigate how chatbots might assist students in searching the information of web programming learning such as code description, coding and problem-solving. | The research discovers that successful response of the chatbot is high. The educational material that students most want to access are regarding hypertext preprocessor (PHP), database and structured query language (SQL) and hypertext markup language (HTML). |
| [32] | 2021 | To propose a video game-like approach to supporting novices in learning and gain knowledge of programming. | Study revealed that the proposed video game-like approach that consists of two concepts of block-based programming system; staging mechanism which helps beginner to acquire more complicated programming concept and assistant chatbot as supports for beginner. |
| [33] | 2020 | To designed a high-level architectural framework that focuses on the data flow of the chatbot which can be adapted to implement a FAQ chatbot for higher education institution. | Research finding exposed that by offering a platform for students and the institution to communicate messages and respond to students' inquiries, chatbots can also be utilized to improve student engagement. |
| [34] | 2020 | To identify the user engagement with chatbots as intelligent conversation. | Study found that user expectation and behaviour during conversation are similar to human-to-human sharing but there is more diversity in the type of information provided. |
| [35] | 2019 | To develop a conversational assistant or chatbot of IBM Watson Assistant and Facebook Messenger to assist non-technical students to learn computer programming. | Research finding indicate the controlled experiment method by utilizing chatbots can establish students' engagement and in improve the students' engagements and motivated to learn programming. |
| [36] | 2019 | To explore how chatbots integrated into instant messaging apps to attract new user in their services. | Study found that, chatbot can enhance customer service and attract more people. |
| [37] | 2019 | To elaborates the use of Imikode (VR) based learning game to support the teaching and learning in OOP with extended AI tools. | Results show that the Imikode game can improve students' learning outcomes in OOP classes and being cost-effective. |

[38]	2018	To investigated the chatbots usage among students for CS concept in modern learning.	Study indicated that, girls’ engagement with chatbot was higher than boys for most indicators. Based on online competition, task completion rate for students that used chatbot get higher score compare to other students.
[39]	2018	To develop a conversational agent, ScratchAI which is it an alternative to overcome the lack of skills and improve students' understanding.	Study revealed that ScratchAI can improve students’ learning integrated with the gamification element of chatbot. chatbots enhances students' engagement and motivation in computational thinking development.

Figure 4 presents the application domain in educational context from the numbers of extracted articles. Based on the review, computer science or programming courses (n=14, 35.9 %) is the most frequently used chatbots, followed by 25.6 % for general education (faculty / administration). About 15.4% (n=6) comprise from language domain and 10.3% from business, accounting and finance (n=4). Fewer study conducted for early childhood education (n=1, 2.6%).

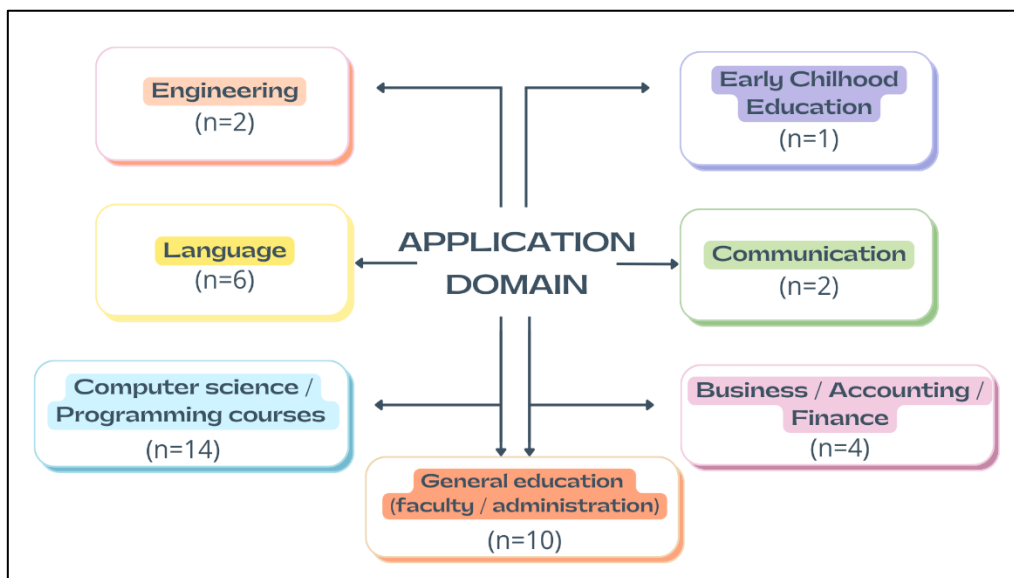


Fig. 4. Application domain in educational context use chatbots

3.2 Thematic Analysis

Three key themes, namely cognitive, emotive and benefits, emerged from the thematic analysis of this paper. 11 sub-themes were identified through further analysis of the topics. Table 5 shows the summary of thematic analysis construct from research issues for systematic review.

Table 5
 Summary of thematic analysis construct from research issues

Themes	Sub-themes	Study reference
Cognitive	Critical thinking	[13]
	Computational thinking	[5,10,29,39]
	Students’ engagement	[7,9,16,21,24-26,28,33,35,36]
Affective	Writing skill	[3,4]
	Conversational skill	[18,20]

	Behaviour / attitude	[8,9,11,14,15,34]
	Decision making	[19]
Benefits	Efficiency	[1,23,31]
	Perceived usability / usefulness	[27,30]
	Supportive	[12,32]
	Personalize learning	[2,6,17,22,37,38]

3.2.1 Cognitive

3.2.1.1 Critical thinking

Based on the sub-themes of cognitive, only one study included for critical thinking. In Australian university has observed how ChatGPT influence to students' learning performance for engineering education assessment. The authors of the studies reported that ChatGPT can be used as a tool in engineering education to enhance student learning and develop critical thinking [13].

3.2.1.2 Computational thinking

Four study relates for chatbots adoption research which discussed effects and development of computational thinking skills. According to Martin *et al.*, [5], intrinsic motivation influences both computational thinking and AI learning, as well as regulating the relationship between perceived AI learning and computational thinking abilities. Additionally, Yilmaz and Karaoglan [10] examined the impact of using the ChatGPT to teach programming on students' computational thinking abilities, programming self-efficacy, and lesson motivation. According to research findings, students in the experimental group considerably outperformed those in the control group in terms of computational thinking skills, self-efficacy in programming, and lesson motivation.

The next included research is about chatbot named ScratchAI has developed for increasing computational thinking skills to support students and teachers. Research conducted by Katchapakirin, Anutariya and Supnithi [29] believe that ScrathThAI can customise learning outcomes for computational thinking abilities and increase understanding of related topics' key concepts. Before that, study conducted by Katchapakirin *et al.*, [39] discussed the use of ScratchAI, integrated with chatbot gamification, it can enhance students' learning. Chatbots improve student motivation and involvement in the development of computational thinking.

3.2.1.3 Students' engagement

A large number of studies (n=11) focus on the impact of chatbot use on students' engagement in learning. Students' engagement seen the vital for success in academics. Due to that, recent study from Guo *et al.*, [7] has investigated students' engagement in chatbot supported classroom debates that used chatbot named Argumate to help them in debates class. In term of the use Argumate as assistive technology tool in class, it can assist students to generate the ideas of topic discusses through multiple data source as chat logs and audio recording. However, utilizing chatbots in debates class not support students in students' cognitive and affective engagement. Similarly, a purposive sampling study conducted by Antony and Ramnath [24] to gain insight into how student support and engagement in higher education are affected by AI chatbots as a way of communication. From the study's result, it agrees that chatbot integration in teaching and learning context can personalize students' support and engagement in the classroom.

Integration of technology tools in classroom give students opportunity to explore the modern approach nowadays. For instance, a study examines how students in secondary school use various

digital technologies in their learning. Varnavsky *et al.*, [21] has proposed the integration of Minecraft game and chatbots application for basics of digital circuitry and programming in Python. Finding of the study revealed that, the use of technology integration impact students' engagement and involvement in the learning process. In turn, another study from Song and Kim [16], was evaluate whether an interactive self-regulation scaffolding improves learning performance, learning level, and course engagement. The result of the experimental study showed that when compared to the control group, the interactive scaffolding group had the highest levels of self-regulated learning. Furthermore, Lin and Tsai [35] agreed that, using IBM Watson Assistant and Facebook Messenger as chatbots for control group can increase student engagement, get them more excited about learning programming and determine their level of interest.

Attending hands-on workshops is one of the pedagogical approaches used to encourage students' participation, particularly with regard to digital competencies. As such, chatbot workshop has organized for non-STEM students to giving the chance to learn fundamental skills to develop chatbot application using Dialogflow. In this workshop, Shim *et al.*, [25] assessing chatbot workshop's performance as an experiential learning for engaging undergraduate students. This empirical study found that, providing undergraduate students with chatbot workshops can have an impact on their intrinsic motivation, level of engagement, and competency in foundational AI. Furthermore, research carried out in Singapore, revealed that students' interest and engagement in learning competency abilities like natural language processing are influenced by their hands-on experience with chatbot workshops. This finding is concluded from Menkhoff and Teo [26] based on their study to assess how the chatbot workshop affected the interest and drive of the students in their AI class.

Everyone needs technology in the classroom to support their learning needs. For instance, giving students access to a range of materials and promoting greater independence are just two examples of how technology can assist learning needs. In line with study employed by Abbas *et al.*, [28], the use of online platform Differ integrates with chatbot named "Bo" for adults' learner in higher education have recognized its benefits in promoting peer collaboration, elevating motivation and engagement, and enhancing their sense of belonging.

Dialogflow has been used for developing chatbots in many areas. The use of Dialogflow as chatbots beneficial in communicate and giving feedback from students' inquiry for higher education purposely to ask about the institution itself. According to research finding, Villanueva *et al.*, [33] has confirmed that chatbots can be used to raise student engagement by giving students and the institution a forum to exchange messages and address their questions.

Several researches shown the use of chatbots among the consumer. Chatbot also use other context; i.e. for business purpose in user acquisition and engagement. Study conducted by Bello [36] discussed the integration of chatbots technology for cloud-native application (Platform as a Service) versus an authoring tool (Software as a Service) was measure in terms of effectiveness of implementation. It also explains that chatbots can assist them to attract customers and improved engagement and customer services. A few years later, Jin and Youn [9] examine the drive factors to use Artificial Intelligence (AI) chatbot among consumer. The study's findings showed that social presence and image processing are reliable indicators of the intention to continue using AI chatbots.

3.2.2 Affective

3.2.2.1 Writing skill

Numerous studies have shown how chatbots may be employed in educational settings. Chatbots are also utilised in language learning to enhance student performance and learning outcomes. In English Foreign Language (EFL) education, chatbot can be use as assistive technology for improving

learners' performance. Based on study found in Zhang, Zou and Cheng [3], an exploratory study conducted with 15 of Chinese students to learn the logical fallacies in EFL writing by utilizing a chatbots or website provided. It indicated that chatbots capable to enhanced student learning specifically for avoiding logical fallacies in their writing skills.

Additionally, the analysis of *Zhang et al.*, [4] demonstrate chatbot-based learning with self-regulated training methods can increased students' capability in writing. Student were used the chatbot for their writing task, and they need to answer pre and post questionnaires to measure their writing self-efficacy. Chatbot has seen the technology tools that support student learning and boost their argumentative writing in EFL.

3.2.2.2 Conversational skill

There are two studies related to the conversational skills adopt form the use of chatbots used. Firstly, Schuetzler *et al.*, [18] apply Social Presence Theory in this study to explain how conversational skills influence perceived social presence. Based on the finding, it endorsed that chatbots use conversational skills that are more socially and anthropomorphically oriented to suggest perceived humanness.

Secondly, study from Werterman *et al.*, [20] has investigated how people perceive chatbots to be human and how they relate to one another. Participants in the study asked pre-generated questions to a chatbot, and the results revealed that mistakes in the responses had significant effects. The typos mistake was harmful to perceptions of the respondent's humanity and other perceptions.

3.2.2.3 Behaviour/attitude

Early research on 2020 from Dev and Camp [34], they investigate the human behaviour in using conversational agents or chatbots in terms of how they express their emotion while interacting to chatbots. Finding reveals that, user expectations and behaviour during conversation are similar to human-to-human sharing but there is more diversity in the type of information provided. Then, In Korea, the exploratory study proposes an inventory of affordance that chatbots use among thirty-six of primary school students. Jeon [15] investigated how the affordance affects psychological factors in the use of chatbots. Using Google's Dialogflow application, the study found that the use of chatbots in EFL lessons increased students' motivation to learn English as well as their engagement and self-confidence in using the language.

In addition to that, discussion from Chien and Yao [14], authors have used Dialog Flow system as chatbots for enhancing engineering design behaviour to compare the student groups in utilizing chatbots. The results of the study showed that the chatbot group of students outperformed the other groups in terms of conceptual clarity and design behaviours. A mixed-method study investigated by Annamalai *et al.*, [11] which explore Malaysian university students' experience in utilizing chatbots for their English language learning. Among the four aspects of Push-Pull Mooring-Habit (PPMH) theoretical framework, the most important elements influencing chatbot use among students in English language classes are performance and effort expectations. Also, research conducted by Jin and Youn [9] examine the drive factors to use Artificial Intelligence (AI) chatbot among consumer. The study's findings showed that social presence and image processing are reliable indicators of the intention to continue using AI chatbots.

Finally, Terblanche *et al.*, [8] examine the perception of university students on the use of AI chatbots in their learning. Findings from a qualitative study showed that performance expectations

and a positive attitude play crucial roles in chatbot adoption and engagement. In addition to that, students agreed that the AI coach was accessible, simple to use, smart, and quick to answer.

3.2.2.4 Decision-making skill

Students must evaluate and determine if the information provided by chatbots is legitimate or not. Process to evaluate the chatbots' content, student developing their decision-making skills. As has been stated, the findings demonstrated by Braun *et al.*, [19] indicated that incorrect virtual agents can drive students to evaluate a wide range of possibilities and think through their choices, which can lead to a better trained decision-making process.

3.2.3 Benefits

3.2.3.1 Efficiency

Regarding the sub-themes of efficiency, there are three studies included as follows. In Dubai, Lappalainen and Narayanan [1] proposed the development of chatbot named Aisha for Zayed University Library (United Arab Emirates) to assist student to search the information and references from their library. Finding concludes that Aisha was develop by integration of Python and ChatGPT can support library service efficiently and quickly for students while accessing the resources although in outside office hours. In 2021, study conducted by Wan Hamzah *et al.*, [31] revealed that chatbots have a high success rate of finding the right topic for web programming class. Most students are interested in searching about hypertext pre-processor (PHP), database and structured query language (SQL) and hypertext mark-up language (HTML). Two year later, Yi *et al.*, [23] discovered how chatbots with additional tools for static faculty websites were helpful in trainee recruitment. The authors of this study highlight how using chatbots to seek information is more beneficial and productive because they give users the chance to ask a variety of questions.

3.2.3.2 Perceived usability/usefulness

Perceived usefulness and ease of use of chatbot are two predictors that support student engagement in their online learning. In 2022, experimental research conducted in Switzerland by Farah *et al.*, [27] examined the perceived usability, students' engagement with the code review process and learning performance while utilizing chatbots in software engineering practices. The author discusses student perceive usability by doing the code in online platform and for quantitative analysis reported that there are no significance differences between treatment and control group. As research conducted from Hew *et al.*, [30], flipped learning online session that integrated with chatbots for quiz and self-regulated learning chatbot promotes students' engagement to be actively involved to the learning approach.

3.2.3.3 Supportive

One of the factors of chatbots adoption among students is supportive system. In Brazil, a study conducted to apply the method of Multicriteria Decision Support to analyse collaborative work alternatives with ChatGPT. Pinochet *et al.*, [12] assert that it had the highest positive flow and the smallest negative flow, indicating that it was naturally chosen over the other possibilities. Another study about the integration of block-based programming system as Blockly and Scratch into programming learning was more effective compared to use a text-based language. It refers to finding

from Sakakibara and Hosobe [32], authors have proposed a video game-like approach to support beginners' learners in learning programming. Study results showed that the suggested block-based programming system has two principles: a staging mechanism that aids beginners in learning more complex programming concepts, and a chatbot assistant that provides assistance to beginners.

3.2.3.4 Personalized learning

From the thematic analysis review, this personalized learning construct from previous studies from 2018 until 2023. A qualitative study conducted by Luo *et al.*, [2] emphasize that ChatGPT valuable in teaching and learning practices because it provides personalised learning experience among students to ensure they fulfil their learning objective for early childhood education (ECE). Using purposive sampling method, six experts has contributed to this study to give response and opinion regarding the roles, challenge and future development of ChatGPT. Despite this, Annamalai *et al.*, [6] was applied Self-Determination theory to conduct qualitative for their student in English class to assess student's motivation in learning. Study reported that, the use of chatbots either Duolingo, Mondly or Andy in English learning can personalize learning experience that comply the psychological needs of learners that were; competence, autonomy and relatedness.

Subsequently, an experimental study conducted in Taiwan has investigated the use of information technology tools among secondary school in classroom. The information technology tools as such are decision-guided chatbot were develop and the effectiveness of the tools was explored. Based on the finding, students in experimental group obtain high score for learning achievements, extrinsic motivation, collective efficacy, cognitive engagement, emotional engagement and satisfaction while utilizing a chatbot [22].

In 2020, Şerban and Ioan [17] remarks that QLearn as e-learning platform integrating with AI features is a cutting-edge approach to a student-centred strategy that supports and offers intelligent learning environments that ensure the best information transfer from teachers. Previous study conducted by Bouali *et al.*, [37] has proposed Imikode as virtual reality (VR) based learning game to support student learning in object-oriented programming (OOP). According to the results, the Imikode game can enhance students' learning outcomes in OOP classrooms while also being reasonably priced. Lastly, based on reported study from Benotti *et al.*, [38], girls were more engaged with chatbots than males were for the majority of the study's metrics. According to an online competition, students who employed chatbots to complete their assignments received higher grades than other students.

4. Discussion

AI tools in education is quickly becoming widespread of modern pedagogical approached used by educators as well as students in educational settings. As technology perceived many advantages and beneficial to educational institutions, it pertinent to examine the chatbots adoption for gamification of programming language learning. According to chart shown in Figure 3, statistics of research in chatbots usage were growing annually. The main themes construct of this study namely cognitive, affective and benefits. Based on finding of the main themes shows that, sub-themes of cognitive whereas students' engagement and personalize learning from benefit sub-themes has played a leading role in chatbots utilization in academic sectors.

Other elements from affective perspective that influence the use of chatbots technology is students' behaviour. It was agreed Chien and Yao [14] which students in the chatbots group show

high performance compared to control group. A limited number of researches have examined the effects of chatbot usage on critical thinking [13] and decision-making skills [19].

In addition to that, predominant country that conducted research in chatbots adoption is United States. It coincides with the rise of the United States as one of the world's technologically most technologically advanced countries. In turn, the article reviewed studies indicated that majority of the finding of application domain comprises from computer science or programming courses.

5. Conclusion

This section provides a concise overview of the systematic literature review conducted in accordance with the specified study aim. The primary objective of this study is to examine the use of chatbots in the context of gamifying the process of learning programming languages. The 39 papers were acquired from three databases, namely Scopus, Taylor, and Francis, and ScienceDirect, after the completion of a systematic review procedure that included identification, screening, appraisal of eligibility, and final inclusion. In addition, the studies included in the analysis were examined based on the year of publication, the nation in which the research was done, the educational context domain, and the thematic contents. The inclusion of publications in this study is restricted due to the growing interest in chatbot technology since this sector is still in its early stages of development. The study's results are given and summarised to provide a more comprehensive knowledge for both scholars and practitioners.

The full aggregation of the current evidence base was achieved by a systematic search and rigorous screening approach, according to the principles outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses. The inclusion of a formal quality evaluation would enhance the review by assessing the potential for bias and the generalizability of the findings. The use of meta-analysis to synthesise research results has the potential to provide more accurate assessments of impact sizes, if there is enough homogeneity across the papers being analysed. As the integration of chatbots in educational settings continues to increase, the availability of updated evaluations will be crucial in obtaining insights that can be used across different contexts. The success of integrating chatbots may be better assessed by using longitudinal studies that measure learning outcomes before and after the integration, as opposed to relying just on qualitative implementations. Future study should explore the potential benefits and drawbacks of cost-benefit assessments and comparative studies when evaluating various learning methods. One of the limitations of the present study is to its primary emphasis on computer science education environments, which may restrict the generalizability of the findings to other academic subjects. However, this systematic study is an early inquiry aimed at providing preliminary evidence-based suggestions for the integration of chatbots in programming education.

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