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ANALYSING THE ROLE OF CHATBOTS IN FACILITATING FULLY AUTONOMOUS LEARNING PROCESS

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Abstract

AI chatbots have introduced a new dimension to the field of education. The rapid advancement of AI technology has enabled chatbots to provide a more engaging learning experience through instant responses, access to abundant, accurate resources, and availability from anywhere. This paper aims to identify the key attributes that influence the implementation of chatbots in higher education institutions (HEIs). The study employed a literature analysis approach, reviewing findings from previous research. The Technology Acceptance Model (TAM) and constructivist learning theory were identified as relevant frameworks to ensure that chatbot design and implementation align with intended learning objectives. The Technology Acceptance Model (TAM) was employed in this study as it provides a robust framework for examining the determinants of technology adoption within educational contexts. TAM focuses on two primary constructs—perceived usefulness and perceived ease of use—which directly influence users' attitudes toward technology and their behavioural intentions to use it. TAM offers a theoretical basis for predicting acceptance and identifying potential barriers to adoption. By applying TAM, the study ensures that chatbot design and deployment address user expectations, thereby increasing the likelihood of successful integration into teaching and learning processes. The findings reveal that the critical attributes include perceived usefulness, ease of use, specific functional features and alignment with constructivist principles. These attributes are essential considerations for the effective design and adoption of chatbots among HEI instructors and students.

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Keywords: Autonomous learning process, chatbots, TAM, constructivism, higher education

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1. Introduction

In recent years, the use of chatbots to facilitate independent learning processes has not only gained popularity but has also significantly transformed the educational landscape. Advances in natural language processing (NLP) and artificial intelligence (AI) have been key drivers of this transformation. Chatbots, particularly those powered by generative AI such as ChatGPT, now play a pivotal role as adaptive learning agents—tools capable of responding instantly, providing tailored feedback, and guiding learners through personalised learning paths. Their integration into modern educational frameworks, such as flipped classrooms and self-regulated learning environments, underscores their capacity to adapt to individual learner needs and preferences (Baskara, 2023; Chang, 2023).

Within these settings, chatbots act not merely as information providers but as interactive facilitators that engage learners, track progress, and adjust learning content accordingly. Research shows that chatbots enhance both learning outcomes and student engagement. For example, Baskara (2023) emphasises their contribution to flipped classrooms, where they deliver individualised guidance and promote collaborative learning. Pérez et al. (2020) further demonstrate that more than 75% of a chatbot's conversational knowledge can be retained and reused, making it a highly efficient and adaptive learning companion. This capability reassures educators that chatbots can consistently deliver customised learning experiences for diverse student needs. Furthermore, chatbots' ability to simulate authentic, real-world interactions and provide immediate responses fosters dynamic, engaging learning environments. This not only improves knowledge retention but also increases student motivation and optimism about academic achievement.

In summary, the role of chatbots in education extends beyond automation; they function as personalised, interactive, and adaptive learning partners, supporting the vision of fully autonomous learning environments. Their capacity to merge immediacy, personalisation, and adaptability marks them as a transformative force in 21st-century education. Overall, chatbots serve as adaptive, AI-powered learning agent that supports autonomous and independent learning by delivering personalised assistance, facilitating collaboration, simulating real-world interactions, and enabling flexible, self-paced educational experiences across various learning frameworks.

2. Literature Review

2.1. Autonomous Learning Process

Autonomous learning is a pedagogical approach that emphasises self-directedness and personal responsibility in the learning process. The process is characterised by learners' ability to direct their own educational experiences, thereby encouraging independence and self-regulation. This concept is increasingly relevant in various educational contexts, where the integration of technology enhances learning outcomes.

In educational contexts, fostering autonomy requires designing an environment that encourages learners to pursue independent learning. This can be accomplished by using approaches that motivate learners to take control of their learning, such as task-based and problem-based learning. Additionally, the shift to learner-centred education emphasises the importance of promoting autonomy as both a primary

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educational goal and a skill. As educational paradigms evolve, the integration of technology and digital literacy plays a crucial role in enhancing learners' autonomy, enabling more personalised and flexible learning experiences (Hong, 2023).

Chatbots were first developed by Professor Joseph Weizenbaum from MIT in the 1960s, with the introduction of ELIZA. Subsequently, chatbots underwent significant evolution, particularly during the 20th century, leading to the advanced versions we use today. One notable advancement is the initiative by the Chinese company WeChat, which developed a sophisticated chatbot now widely used. Today's Chatbots serve as interactive tools that facilitate autonomous learning by providing immediate feedback and personalised learning experiences. They enable students to engage with educational content at their own pace, fostering independence and self-regulation in learning (Haristiani & Rifai, 2021; Pérez et al., 2020). Research indicates that chatbots can enhance metacognitive strategies, allowing learners to reflect on their learning processes and adapt their approaches accordingly (Manuel, 2023; Al-Abdullatif et al., 2023). Moreover, the interactive nature of chatbots encourages students to engage in self-directed learning, as they can practice language skills or subject-specific knowledge in a low-pressure setting (Yang et al., 2022). However, several areas for improvement remain and should be carefully considered by researchers.

The current landscape of chatbots is still in the early stages of research, resulting in unclear features tailored to the needs of the educational sector (Rapp et al., 2021). This ambiguity hinders the development of chatbots that align with learning requirements. Consequently, integrating chatbot technology into human life risks failure, as educators and students cannot fully utilise this technology, thereby failing to achieve learning objectives (Rapp et al., 2021).

To address these challenges, researchers and developers should consider incorporating educational theories to bridge this gap. One such theory is constructivism, which emphasises fostering students' motivation and intention to use chatbots by supporting learning methods that emphasise critical thinking and creativity (Almulla, 2023).

2.1.1. The Importance and Benefits Of Autonomous Learning

One of the major benefits of autonomous learning is the enhancement of learner motivation and engagement. Research indicates that when learners are given the autonomy to direct their own learning, they exhibit higher levels of intrinsic motivation, which is crucial for sustained engagement in educational activities (Heidari et al., 2021; Rizki et al., 2023; Toporek, 2022). Chatbots, for example, can offer personalised feedback and assistance, enabling students to study subjects at their own pace and in accordance with their interests. Effective learning outcomes require a sense of ownership over the learning process, which is fostered by this personalisation. Furthermore, by giving users instant access to knowledge and educational resources, chatbots can be a useful tool for supporting self-directed learning. The immediacy can help learners overcome barriers to participation, particularly in contexts where traditional educational resources may be limited (Ardinengtyas & Himawan, 2021; Caris et al., 2018). The ability to interact with chatbots in real time allows learners to clarify doubts, practice language skills, and receive tailored guidance, thereby enhancing their learning experience (Bozorgian & Shamsi, 2022; Watson et al., 2022). Additionally, the integration of chatbots in e-learning environments has been shown to improve

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learners' self-regulation skills, as they can monitor their progress and adjust their learning strategies accordingly (Jeong, 2022; Ling-ling, 2021).

There are many advantages to integrating chatbots into the autonomous learning process, such as improved access to resources, increased motivation, and the development of critical thinking skills. Leveraging technology to facilitate self-directed learning will be crucial as educational paradigms continue to evolve in order to equip learners for the modern knowledge economy.

2.2. Underpinning Theory

Artificial Intelligence (AI) is a rapidly developing technology that is being explored across many fields and is crucial for the future. As IR 4.0 has emerged, AI has also become a key area of demand across sectors, especially in education. Education is a broad field, and in this paper, we focus on learning in general. Learning is an important thing in human development. People always need to learn to acquire knowledge and skills. Learning takes place throughout life, either through formal methods, such as schools and institutions of higher learning, or through informal methods, such as television, parenting, and socialising with others (Juanda, 2010). Theory, on the other hand, is a basic matter in any field of science, including the field of psychology in education. For this reason, learning theory is closely related to the description and discussion of learning principles that are intertwined and interdependent in the mastery of knowledge and information (Juanda, 2010).

2.2.1. Constructivist Theory

Constructivism or constructive learning theory is the most popular theory in the field of education (Azwani, 2011). Famous figures such as Jean Piaget, Bruner, and Lev Vygotsky view the learning process as a mental, knowledge-building activity involving the acquisition of new information (Mu'min, 2013). The learning process is built as a result of merging information with existing knowledge through restructuring by linking new ideas with old ones (Mu‟ min, 2013). According to the theory of constructivism, learning is not just memorising but a process of constructing knowledge through experience. It is because each individual has their own representation of knowledge through their experiences (Mu‟ min, 2013). In other words, overcoming something depends on the individual's own efforts and experience, not on others'. Therefore, constructivist theory emphasises students' involvement in problem-solving during the learning process, generating new ideas based on existing knowledge and experience (Syahida Nadia Zakaria, 2015). For example, when solving a problem, the student will think of the solution himself. The teacher only acts as a facilitator for the students. According to Kumari (2022), constructivist learning theory is a method in which a student builds their own thoughts and knowledge without the help of a lecturer or teacher. Furthermore, Nurhidayati (2017) argued that the learning process is active and dynamic, developing gradually throughout an individual's life.

The learning process involves social activities and language development among students (Syahida Nadia Zakaria, 2015). This social activity can be described as a social interaction in which the interaction is an important element in the learning process. In this process, students will learn and receive new input. The next principle is that activities carried out together foster students' cognitive development, physical movement, and prior knowledge (Utami, 2016). Therefore, each student's knowledge and ideas will be used

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in the learning process. Lecturers also play the role of facilitators in the teaching and learning process and activities carried out (Utami, 2016).

Jean Piaget (1896-1980) proposed that students of various ages are actively involved in acquiring information and using it to develop their own knowledge. According to Piaget, knowledge is the construction or formation of a person's activities and actions. Piaget also believes that it is not static but continues to evolve (Nurhidayati, 2017). Vygotsky (1986) also believed that intellectual development occurs when individuals encounter new experiences and try to solve the problems that arise from them. To provide clarity, intellectual development involves acquiring new knowledge and building on prior knowledge (Syahida Nadia Zakaria, 2015).

In the context of learning that occurs either face-to-face or through technology and communication media such as web-based learning or a Learning Management System (LMS), constructivist theory can be applied to autonomous learning using a chatbot. In this context, knowledge is actively developed by the student himself and not passively received from his environment (Masouleh & Jooneghani, 2012). Technology is widely used to help the smoothness of the teaching and learning process. For example, Facebook and WhatsApp are popular social media platforms used by students, so they are accepted and used for both formal and informal learning activities (Suci et al., 2022). Therefore, understanding the level of user acceptance of a technology is also important, especially in teaching and learning.

2.2.2. Technology Acceptance Model (TAM)

Technology acceptance theory has been widely used to understand and predict user acceptance of new technologies (Musa et al., 2024). Acceptance of technology is closely related to how a person adopts and uses it (Musa et al., 2024). User acceptance is an important factor in the successful implementation of technology (Taherdoost, 2019). This can show the effectiveness of a developed technology. It is also a general acceptance model for certain technologies, such as information technology, microcomputers, and the internet (Raida & Néji, 2013). Furthermore, technology acceptance theory is often used in studies of technology's application in society (Ishak, 2014). Several theories and models have been developed and widely used by researchers to understand the factors that affect the acceptance and use of technology (Aslina Saad, 2016).

TAM model suggests that when consumers are presented with an innovation or technology, several variables will influence their decisions, namely how and when they will use it (Taherdoost, 2019). TAM, first introduced by Davis (1989), is an adaptation of the Theory of Reasoned Action (TRA). This theory was developed specifically for modelling user acceptance of an information system. The technology acceptance model is the earliest model, introduced before the UTAUT model. According to Davis (1989), the Technology Acceptance Model (TAM) was developed specifically to predict computer users' behaviour. It predicts technology use based on two (2) important variables: perceived usefulness (PU) and perceived ease of use (PEOU). Usefulness (perceived usefulness, PU) is defined as the degree to which individuals believe that the use of technology can improve their job performance (gain benefit).

Perceived ease of use (PEOU) is defined as the degree to which a system is easy to use without requiring much effort. TAM was chosen and used because it is a model developed specifically to predict user acceptance based on usage beliefs, namely usability and ease of use (Davis, 1989).

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Figure 1 shows the variables involved in the TAM model.

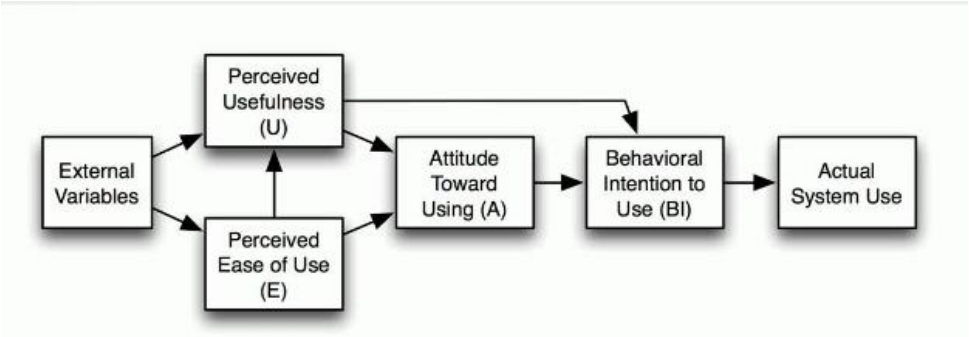

Figure 1. TAM model

2.3. Chatbot in Education

Chatbots in education are defined as artificial intelligence applications that support communication and learning through user-friendly interfaces (Hwang & Chang, 2021). Chatbots in education, initially studied in the early 1980s, are now being used for intensive discussion in academia, such as personalised learning experiences and writing tools (Stöhr et al., 2024). As technology has increased efficiency and introduced time- and cost-saving features, it appears to be a significant platform for supporting the educational field. Table 1 below presents a definition of chatbot from an educational perspective.

Table 1. Definition of chatbots

Definition	Sources
Provide an interactive platform that simulates learner dialogue using natural language processing and machine learning algorithms.	Stöhr et al. (2024)
Smart technology that can conduct text-based conversations with users	Gupta and Chen (2022)
A computer program that uses artificial intelligence (AI) to conduct a conversation (auditory or textual)	Belda-Medina & Kokošková, (2023)
Simulate human interactions and hold spontaneous discussions in real time.	Li et al. (2025)

2.3.1. Advantages of AI chatbots in education

Technology acceptance theory has been widely used to understand. Recently, the use of AI in education has expanded significantly by ChatGPT. It provides advanced learning tools that can assist the learner in completing their task and assignment in a short time. Additionally, this AI tool promotes user-friendly learning and interactive interfaces that may reduce barriers across different learner backgrounds, thereby overcoming many learning obstacles such as time, place, and delay (Hwang & Chang, 2021). Thus, AI features can serve as self-study tools, enabling real-time information acquisition, question answering, and problem resolution. As a result, this AI potentially adds new learning experiences by challenging educators and learners to integrate their pedagogical skills with AI technology.

Chatbots are one example of AI technology, sharing the same potential as other AI applications such as Canva, QuillBot, ChatGPT, and plagiarism-detection tools. It can be customised to meet the needs of

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learning objectives and the learner's requirements. Gupta and Chen (2022) suggest suitable chatbot features that can be considered during the development of the applications, as presented below in Table 2:

Table 2. Chatbots criteria presented by Gupta and Chen (2022)

Criteria	Description
Connect with campus resources.	Provide a platform for learners with limited access to resources.
Support learners with learning disabilities.	Creating a tailored learning environment for varied learning abilities
Support learners with multiple commitments.	Aid the study by connecting to the peer discussion.
Support different types of learners.	Multiple options for delivering sources, such as video, verbal, games and music for non-native learners

Therefore, when designing a chatbot platform, certain criteria should be considered to ensure its effectiveness and its utilisation across age groups. Especially in the pedagogical aspect, it needs to be applied so that the learning objective can be achieved and contribute to a better learning environment.

2.3.2. Limitations of AI Chatbots in the Education Field

AI chatbots have sparked debate and controversy over their impact on teaching and learning practices in higher education. Chatbots have been deployed across different fields, including education, government, and social contexts. Although AI is a recent trend in learning, several constraints prevent these applications from being utilised effectively. If this constraint is not resolved, it will prevent the learning objectives from being achieved and will cause students' skills in analysing and synthesising information to deteriorate. Table 3 below presents the possible obstacles and their descriptions.

Table 3. Barrier's descriptions

Barriers	Description	Sources
Law barriers	There are no specific laws against the abuse of AI chatbots, and copyright controls are weak.	Li et al. (2025)
Ethics barrier	Plagiarism is rampant and makes the use of information uncontrollable.	Senadheera et al. (2025), Stöhr et al. (2024)
Lack of experts in delving into a topic	Lack of expert involvement to validate search information, where the role of lecturers is still needed for better explanation	Li et al. (2025). Gupta and Chen (2022), Sandu and Gide (2019)
Require digital data and the unavailability of a workforce specialised to operate.	Lack of a skilled workforce for the purpose of updating digital data from time to time	Senadheera et al. (2025)
Unrestricted application	Data and information can be accessed and used by all parties, resulting in a lack of cognitive skills being used.	Li et al. (2025), Hwang & Chang (2021)
Time needed for training	Students and lecturers need to spend more time attending Training on using each version of the AI chatbot.	Gupta and Chen (2022),

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On the other hand, chatbots could not replace the role of an educator. Since the implementation of chatbots in higher education institutions is still in its early stages, many issues remain that chatbots are unable to address, as presented in Table 3. This highlights opportunities to develop a more efficient higher education platform that includes intelligent chatbots. For example, emotional barriers play a significant role in inclusive human-computer interaction; thus, a chatbot might be able to detect and help learners use it effectively.

3. Methodology

This qualitative study employs a literature analysis to investigate the role of chatbots in facilitating fully autonomous learning by conducting an internet search on the subject. The review focuses on publications from 2021 to 2024, drawing from reputable peer-reviewed journals and conference proceedings. The selected literature includes significant research contributions in the domains of autonomous learning, chatbot technology, and higher education. This approach enables a critical synthesis of recent findings, allowing for the identification of key themes, trends, and gaps in existing research.

3.1. Data sources and Databases

To ensure the inclusion of high-quality studies, we conducted searches in several reputable electronic databases, including IEEE Xplore, SpringerLink, ScienceDirect, Taylor & Francis, Scopus, and Google Scholar. These sources were selected for their extensive coverage of research on technology and education, particularly in artificial intelligence (AI) and autonomous learning.

3.2. Keywords and Search Strategy

The search strategy used specific keywords related to autonomous learning processes, chatbot functionality, and applications in higher education institutions. The primary keywords included “Autonomous Learning Process,” “chatbot,” “AI,” and “Artificial Intelligence,” combined with terms such as “education,” “higher education,” “tertiary education,” and “higher education institutions.” Searches were conducted using the TITLE-ABS-KEY field to ensure relevant articles in titles, abstracts, and keywords were captured. A sample search query is illustrated as follows:

TITLE-ABS-KEY ((“Autonomous Learning Process” OR “chatbot” OR “AI” OR “ARTIFICIAL INTELLIGENT”) AND (“education” OR “Higher education” OR “Tertiary education” OR “higher education institutions”))

3.3. Inclusion and Exclusion Criteria

To refine the results, specific inclusion and exclusion criteria were applied:

3.3.1. Inclusion Criteria

Articles published between 2021 and 2024, studies focused on autonomous learning systems, chatbot technology in educational settings, and those relevant to AI applications in higher education.

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3.3.2. Exclusion Criteria

Non-peer-reviewed papers, articles unrelated to educational applications, studies focusing solely on primary or secondary education, and papers published in sources known to be predatory or unreliable.

3.4. Screening and Selection Process

Following the initial search, the results were screened by title and abstract to remove duplicates and irrelevant studies. The remaining articles underwent a full-text review to assess their relevance to this study's objectives. Articles were then organised and categorised by theme, including the role of chatbots in promoting learner autonomy, adaptive learning processes, and challenges in implementing AI-driven educational tools.

3.5. Data Extraction and Synthesis

For each selected study, key data points were extracted, including study aims, methodologies, findings, and conclusions related to autonomous learning processes and chatbot applications in higher education. These data points were synthesised to identify patterns, common challenges, and insights into the efficacy of chatbots as autonomous learning tools.

4. Findings

The analysis of relevant literature reveals that AI-powered chatbots play a significant role in facilitating autonomous learning in higher education, with benefits that extend across pedagogical, technological, and inclusivity dimensions. These benefits are closely aligned with established educational theories, particularly constructivism. They are supported by the Technology Acceptance Model (TAM), which together offers a comprehensive framework for understanding and optimising chatbot adoption in higher education. The findings are summarised across several key dimensions that are listed below:

4.1. Data Sources and Databases

Chatbots enhance learner autonomy by providing immediate feedback, personalised guidance, and on-demand access to diverse learning resources (Baskara, 2023; Haristiani & Rifai, 2021). These features strengthen key competencies such as self-regulation, critical thinking, and independent problem-solving. Through the integration of artificial intelligence and machine learning, chatbots can dynamically adapt content to suit individual learners' needs, preferences, and pace, thereby improving the overall learning experience.

In addition, chatbots' ability to operate across multiple platforms increases accessibility and supports inclusive learning environments. This is particularly beneficial for students with disabilities or those facing resource limitations. Features such as multilingual support and multimodal content delivery (e.g., text, audio, and video) further promote equitable participation. Moreover, the interactive nature of chatbot communication helps sustain learner engagement, making it especially valuable in large-scale online learning contexts where direct instructor interaction may be limited.

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4.2. Theoretical Alignment with Educational Paradigms

The findings confirm a strong alignment between chatbot-based autonomous learning and the principles of constructivist learning theory. Constructivism emphasises active knowledge construction through experience, reflection, and interaction. Chatbots, by facilitating interactive dialogues, problem-solving scenarios, and immediate feedback loops, create learning environments where students are not passive recipients of information but active participants in meaning-making. This aligns with the constructivist view that learning is most effective when students are engaged in reflective, self-directed processes that integrate new knowledge into existing cognitive frameworks.

In parallel, the Technology Acceptance Model (TAM) offers a practical lens to examine the factors influencing chatbot adoption. The results reaffirm that perceived usefulness (PU) and perceived ease of use (PEOU) are pivotal in shaping users' behavioural intention (BI) to adopt chatbots. When learners and educators perceive chatbots as both beneficial to learning outcomes and easy to operate, their willingness to integrate them into regular teaching and learning practices increases significantly.

The results demonstrate how well-established theoretical frameworks and chatbot-based autonomous learning align. Constructivist theory and the technology acceptance model (TAM) are two theories that have been thought to merit more research. Because chatbots enable students to construct knowledge through interactive and reflective learning experiences actively, they align with constructivist principles. The technology supports the learner's critical thinking and problem-solving abilities by acting as a facilitator. Regarding the Technology Acceptance Model (TAM), the results confirm that perceived utility and ease of use are important factors in determining chatbot acceptance among educators and students. Because of these qualities, chatbots are a useful tool for promoting self-directed learning. The proposed model, which integrates constructivism and TAM, is depicted in Figure 2:

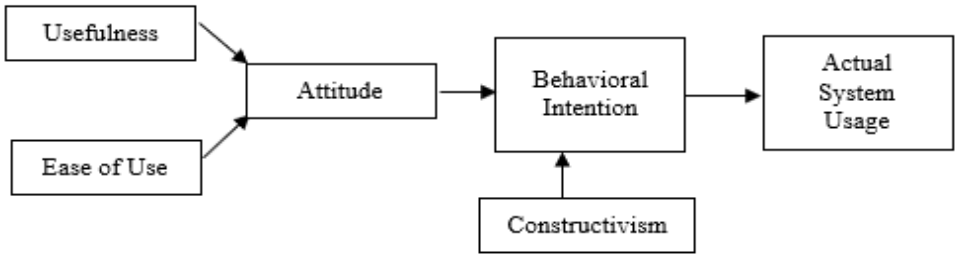

Figure 2. Extended TAM with constructivist attribute

Constructivism is proposed to connect directly with BI as knowledge will be generated during the use of chatbots, i.e. learners construct knowledge rather than passively take in information. AI becomes a tool for generating this knowledge. As people experience the world and reflect upon those experiences, they build their own representations and incorporate new information into their pre-existing knowledge. Therefore, this model promotes knowledge generation when students tend to use chatbots as learning aids.

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5. Discussion and Future Directions

This section will highlight the discussion of the findings and future directions for the potential of chatbots to revolutionise autonomous learning in higher education. The findings underscore the value of leveraging artificial intelligence (AI) to create personalised, accessible, and engaging educational experiences (Rapp et al., 2021). Chatbots, as discussed, can facilitate a learner-centred environment, enabling students to take control of their learning processes and thereby fostering autonomy and self-regulation.

Based on the study, we found that integrating chatbots into education offers various advantages, including instant feedback, access to resources, and adaptive learning pathways. However, challenges such as a complex landscape, humanised technology (Rapp et al., 2021), and reliance on technology without regard for learning theories (Almulla, 2023) remain significant issues. These barriers highlight the need for comprehensive strategies to address these limitations while maximising the potential of chatbots in learning environments, especially in higher education.

In addition, the alignment of chatbots with educational theories, such as Constructivism and the Technology Acceptance Model (TAM), demonstrates the theoretical foundation of this approach. The ability of chatbots to simulate social interactions, promote collaborative learning, and provide tailored feedback underscores their relevance to contemporary educational paradigms. Nevertheless, the role of educators remains irreplaceable, particularly in addressing complex topics and fostering critical thinking skills that chatbots may not fully cover (Stöhr et al., 2024).

5.1. Future Research

For future research and directions, this study has proposed six key areas. Improving ethical and legal frameworks is vital, emphasising the development of comprehensive guidelines and regulations to govern the ethical use of AI in education. This is crucial to address concerns such as plagiarism, data privacy, and intellectual property. It is important for sustainable implementation. Enhancing emotional intelligence in chatbots is another promising avenue. Equipping chatbots with emotional intelligence capabilities is an area yet to be explored. This would enable them to detect and respond to learners' emotional states, thereby providing more empathetic and effective support.

Expanding accessibility is crucial, with a focus on making chatbot-based learning accessible to diverse learner groups, including those with disabilities or limited access to digital resources. This may involve designing multilingual interfaces and integrating assistive technologies to improve communication between learners and educators. Customising learning models is also essential and requires further refinement of chatbots' adaptability across various learning styles and disciplines. By incorporating advanced analytics and machine learning, chatbots can offer more dynamic and individualised learning experiences.

Longitudinal impact studies are needed to evaluate the long-term impact of chatbots on learning outcomes, student engagement, and skill development. Such studies will provide deeper insights into the effectiveness and sustainability of this approach. Finally, hybrid models that integrate chatbots with traditional teaching methods offer a promising direction. Exploring hybrid models in which chatbots

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complement human educators could enhance learning while maintaining technology's transformative potential for higher education. By addressing current challenges and leveraging advancements in AI, chatbots can become integral to fostering autonomous learning, ultimately redefining the educational landscape for future generations.

6. Conclusion

The concept of a fully autonomous learning process facilitated by a chatbot presents a transformative approach to education. By harnessing artificial intelligence and natural language processing, chatbots have the potential to serve as virtual educators, bringing a human touch to education.

Overall, the evolution of chatbot technology has empowered learners by providing on-demand guidance, personalised feedback, and adaptive learning pathways that address their individual needs. This ecosystem empowers learners to take charge of their education, building critical thinking and problem-solving skills in a self-directed environment. Autonomous learning through a chatbot also overcomes traditional barriers, such as the need for constant instructor supervision, limited access to resources, and uniform pacing, which often overlook individual learning speeds. By creating a supportive, conversational space, a chatbot can encourage engagement, sustain motivation, and address learners' questions immediately, fostering a continuous and self-sufficient learning experience.

Ultimately, the integration of chatbots in educational settings could redefine learning by promoting independence, accessibility, and scalability. However, future research is needed to refine this technology, ensuring it can fully meet diverse educational needs, address ethical considerations, and maintain pedagogical quality. With continued advancements, chatbot-driven learning has the potential to democratize education and reshape the learning landscape for students worldwide.

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Author Contributions

Author A.: Abstract, Chatbot in Education (LR), finding, editing (as corresponding author) - Original Draft.

Author B.: Project Administration, review, editing, validation

Author C.: Methodology, Funding Acquisition, Theory Acceptance Model writing.

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All authors are employees of Universiti Poly-Tech Malaysia. The institution did not influence the study outcomes or the decision to publish.

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