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Embracing Chatbots as Learning Agent: A Scoping Literature Review

(Penerimaan Chatbots sebagai Agen Pembelajaran: Satu Kajian Literatur Skop)

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ABSTRACT

In the era of digital education, the demand for personalised and adaptive learning tools has grown significantly. AI-powered chatbots have emerged as innovative solutions, offering learners tailored guidance and real-time feedback. This paper introduces the Personalised Constructivist Agent Model (PCAM), a theoretical framework that integrates principles from constructivism, adaptive learning theories, and self-determination theory. The PCAM demonstrates how chatbots can enhance personalised learning, foster active knowledge construction, and promote intrinsic motivation by synthesising established educational theories. Through a comprehensive review of theoretical underpinnings and practical applications, this study highlights the transformative potential of chatbots in education. It also addresses key implementation challenges, including ethical considerations, cultural sensitivity, and the balance between automation and human interaction. The findings offer valuable insights for educators, researchers, and developers seeking to harness the capabilities of chatbots to create engaging, effective, and inclusive educational experiences.

Keywords: AI-powered chatbots, personalised learning, Constructivist theories, Adaptive learning, self-determination

ABSTRAK

Dalam era pendidikan digital, permintaan untuk sesuatu alat pembelajaran yang khusus dan adaptif telah berkembang dengan ketara, di mana chatbots yang dikuasakan kecerdasan buatan (AI) telah muncul sebagai penyelesaian yang inovatif, dengan menawarkan panduan yang disesuaikan dan maklum balas masa nyata kepada golongan pelajar. Kertas kerja ini memperkenalkan tentang Personalised Constructivist Agent Model (PCAM), iaitu satu rangka kerja teori yang mengintegrasikan prinsip-prinsip daripada konstruktivisme, teori pembelajaran adaptif, dan teori penentuan kendiri. PCAM menunjukkan cara chatbots boleh meningkatkan pembelajaran khusus, memupuk pembinaan pengetahuan yang aktif, dan menggalakkan motivasi intrinsik dengan mensintesis teori pendidikan yang mantap. Melalui semakan menyeluruh tentang asas teori dan aplikasi praktikal, kajian ini menyerlahkan potensi transformatif chatbots dalam pendidikan. Ia juga menangani cabaran pelaksanaan utama merangkumi pertimbangan etika, sensitiviti budaya, dan keseimbangan antara automasi dan interaksi manusia. Dapatan ini menawarkan cerapan berharga untuk pendidik, penyelidik dan pembangun sistem yang ingin memanfaatkan keupayaan chatbots untuk mencipta pengalaman pendidikan yang menarik, berkesan dan inklusif.

Kata kunci: Agen pembelajaran, chatbots, kecerdasan buatan, kajian lieratur, Malaysia

INTRODUCTION

In the era of digital education, students increasingly express a preference for personalised learning experiences. However, many educational technologies struggle to provide tailored support (Li & Wong, 2019). As the demand for scalable and accessible education grows, chatbots have emerged as a promising solution, offering one-on-one guidance and real-time feedback to students (Spaulding et al., 2021; Wollny et al., 2021).

Chatbots, are the advanced computer programs designed to simulate conversations with human users, leverage natural language processing and machine learning technologies (Kuhail et al., 2022; Wollny et al., 2021). These tools have gained significant attention in education for their capacity to deliver personalised, engaging, and efficient learning experiences (Okonkwo & Ade-Ibijola, 2021). As chatbots become increasingly integrated into educational contexts, their use must be supported by robust theoretical frameworks (Huggins & Kellogg, 2020). Despite the transformative potential of AI-powered chatbots, their design and implementation often lack grounding in established educational theories, leading to suboptimal learning outcomes (Yang & Evans, 2019). To fully harness the potential of AI in education, it is essential to base its implementation on established theoretical models that guide the development of adaptive, engaging, and effective learning tools.

RESEARCH BACKGROUND

The integration of AI-powered chatbots in education is underpinned by foundational theories of learning that emphasise active engagement, adaptability, and intrinsic motivation. These theories provide the conceptual framework for understanding how chatbots can support and enhance the learning process. By leveraging principles from constructivism, adaptive learning, and self-determination theory, chatbots can create meaningful, personalised, and motivating educational experiences that align with diverse learner needs.

Constructivism is a foundation in understanding how learners actively construct knowledge through experiences and reflection rather than passively absorbing information (Alanazi, 2016). Its' principles emphasise interactive and collaborative learning, which is well-aligned with chatbots' potential to facilitate meaningful dialogues, scaffold understanding, and promote problem-solving. By engaging learners in reflective and exploratory conversations, chatbots can operationalise fundamental tenets of constructivist learning, fostering deeper cognitive engagement and personal understanding (Perez et al., 2020). In contrast, adaptive learning theories provide the basis for tailoring educational experiences to individual learner needs, preferences, and performance levels. These theories emphasise the importance of delivering the right content at the right time, ensuring that learners are challenged at appropriate levels (Gligorea et al., 2023). Chatbots, powered by data-driven insights, can dynamically adjust instruction to support personalised learning pathways, enhancing educational technology's effectiveness and accessibility. Moreover, the Self-Determination Theory (SDT) addresses intrinsic motivation, focusing on the fulfilment of psychological needs for autonomy, competence, and relatedness. This theory is critical in education, as motivated learners are more likely to persist and succeed (Guay, 2021). Chatbots designed with SDT principles can empower learners through choice (autonomy), provide immediate and tailored feedback to enhance a sense of mastery (competence), and simulate empathetic interactions to foster connection (relatedness).

Therefore, this paper addresses the gap in theoretical frameworks guiding the integration of chatbots in education by synthesising various established theories in the literatures. Through the scoping review procedure, it aims to explore the theoretical underpinnings of chatbot functionalities and propose a framework that bridges the gap between pedagogical principles and technological advancements. This synthesis offers valuable insights for researchers, educators, and developers striving to optimise chatbots' educational potential. The objectives of this scoping review are to:

a. collate and map educational theories (Constructivism, Adaptive Learning, and SDT) that are applicable to chatbots design
b. examine existing discussions and applications of chatbots in educational contexts
c. synthesise insights into a conceptual framework for leveraging chatbots as agents in learning.

METHODOLOGY

This study employs a scoping review methodology to explore and synthesise theoretical frameworks relevant to the integration of chatbots in education. The primary aim is to identify key concepts, principles, and insights from existing literature to inform the development of a unifying framework for this integration of chatbots. The scoping review method was chosen for its flexibility in mapping broad areas of research and identifying emerging themes without a focus on rigorous appraisal or meta-analysis.

LITERATURE SEARCH APPROACH

A comprehensive but non-systematic search of academic and grey literature was conducted using the following databases: Google Scholar, PubMed and Scopus for general theoretical and empirical studies. The search focused on publications from 2000 to 2024 to include foundational theories alongside contemporary developments. The following keywords and phrases guided the search: "Chatbots in education," "AI in learning," "adaptive learning theories," "constructivism in education," and "self-determination theory."

Search terms were then combined using Boolean operators (e.g., AND, OR), and results were filtered manually to retain relevance to educational chatbots and associated theories.

INCLUSION AND EXCLUSION CRITERIAS

The inclusion criterias include articles discussing chatbots in educational settings, studies describing or applying constructivism, adaptive learning or SDT theories, and papers addressing chatbot roles in personalising or facilitating learning. On the other hand, the exclusion criterias comprise of studies unrelated to education or chatbots, articles lacking theoretical context or educational focus, and non-English publications.

DATA ORGANISATION

Essential information from the selected literatures was organised using a simple charting method, based on:

a. Theoretical Basis – the educational framework(s) discussed
b. Chatbots Role – descriptions of chatbot applications in learning
c. Outcomes/Insights – benefits, limitations, and implications for chatbots use

THEMATIC SYNTHESIS

The data collected were reviewed to identify overlapping themes and trends in the application of theories to chatbots design, specifically by:

a. Mapping to Theories – Chatbot functionalities were linked to principles from Constructivism, Adaptive Learning, and SDT theories
b. Conceptual Integration – Key themes were synthesised to develop the Personalised Constructivist Agent Model (PCAM), highlighting chatbot roles (e.g., facilitator, interactive partner, motivational coach).

The review, however did not claim a rigorous or exhaustive evaluation of all available literature. Instead, it seeks to provide an overview of the most relevant theories and practices to form a conceptual basis for further exploration.

RESULTS

AI-powered chatbots are transformative technologies in education, fulfilling diverse roles for students, instructors, and researchers. By leveraging advanced AI algorithms and language models, chatbots provide personalised learning experiences, offer real-time support, and facilitate collaborative learning (Onat & Gulsecen, 2023). Additionally, they automate administrative tasks, such as grading and scheduling, allowing educators to focus on instructional priorities (Abedi & Ackah-Jnr, 2023).

As intelligent tutors, chatbots assist students in enhancing their skills and knowledge by delivering real-time feedback, addressing inquiries, and providing educational resources (Tack & Piech, 2022). They also enable collaborative learning by facilitating group discussions and promoting peer interaction (Abedi & Ackah-Jnr, 2023). Studies have shown that chatbots significantly improve student performance and motivation while reducing educators' workload (Gökçearslan et al., 2024). By providing on-demand support, chatbots alleviate pressure on educators, enabling them to prioritise critical tasks (Onat & Gulsecen, 2023). These tools utilise natural language processing (NLP) and artificial intelligence (AI) technologies to interact with students and offer real-time, tailored responses. As a result, educators can enhance student engagement and motivation, reduce their own workload, and improve access to educational resources (Gökçearslan et al., 2024).

Chatbots also provide personalised assistance in advanced and specialised subjects, supporting lecturers and students with tasks such as literature reviews and research methodology advice (Chukwuere, 2024). Examples include tools like Quizlet's Q-Chat and Khan Academy's GPT-4-based chatbot, designed to assist students in a supportive, non-directive manner (Frankford et al., 2024). The implementation of chatbot technology In education offers numerous advantages. Chatbots provide students with on-demand support, enabling self-paced learning and easy access to educational materials, provided adequate infrastructure is available. Moreover, they enhance student motivation and self-efficacy by offering personalised feedback (Onat & Gulsecen, 2023). However, their integration is not without challenges. Concerns related to privacy, cultural sensitivity, and language barriers remain prominent. Future research is essential to explore the full

potential of AI chatbots in education and establish best practices for their deployment (Gökçearslan et al., 2024).

In addition, there are persistent concerns about the potential replacement of human educators, the need for thoughtful design and implementation, and the risks of bias and cultural insensitivity. Further research is also needed to examine chatbots' influence on pedagogical practices, technology acceptance, usability, individual learner characteristics, and instructional design (Gökçearslan et al., 2024).

THEMATIC ANALYSIS OF REVIEW FINDINGS

AI-powered chatbots have demonstrated significant potential in enhancing personalised, interactive, and accessible education while alleviating educators' administrative burdens. The application of well-grounded educational theories ensures that chatbots are not only functional tools but also catalysts for deeper learning and sustained engagement. However, the challenges of ethical design, cultural sensitivity, and balanced integration remain critical areas for future research and refinement. Based on the narrative review provided, the findings can be categorised into the following themes:

ROLES AND CAPABILITIES OF AI-POWERED CHATBOTS IN EDUCATION

Chatbots serve diverse functions across educational contexts, leveraging AI algorithms and natural language processing (NLP) to enhance learning experiences via:

a. Personalised Learning – Chatbots offer tailored educational experiences, providing real-time feedback, addressing student inquiries, and delivering materials adapted to individual needs (Tack & Piech, 2022; Onat & Gulsecen, 2023).
b. Administrative Support – They automate tasks like grading and scheduling, freeing instructors to focus on pedagogy (Abedi & Ackah-Jnr, 2023).
c. Interactive Learning – Chatbots foster collaborative and constructivist learning environments by facilitating discussions and encouraging peer interaction (Abedi & Ackah-Jnr, 2023).
d. Specialised Assistance – Chatbots assist with advanced subject learning and research-related tasks, providing methodological advice and even literature review assistance (Chukwuere, 2024).
e. Increased Accessibility – Chatbots provide on-demand, location-independent support, enabling self-paced learning with flexible access to materials (Onat & Gulsecen, 2023).

EDUCATIONAL OUTCOMES AND BENEFITS

AI chatbots impact both students and educators positively, supporting learning and streamlining instructional workflows via:

a. Enhanced Student Performance and Motivation – Studies suggest significant improvements in learner engagement, intrinsic motivation, and self-efficacy, driven by personalised and responsive interactions (Gökçearslan et al., 2024).
b. Reduced Educator Workload – By automating routine tasks, chatbots allow educators to prioritise complex, creative, or relational aspects of teaching (Onat & Gulsecen, 2023).
c. Fostering Autonomy and Competence – Chatbots align with Self-Determination Theory (SDT) principles, empowering learners to take charge of their education while boosting confidence through immediate, constructive feedback (Guay, 2021).

CHALLENGES IN IMPLEMENTATION

The literature highlights that despite their potential, integrating chatbots in education is fraught with challenges such as:

a. Ethical and Privacy Concerns – Issues around data collection, storage, and privacy need careful consideration to ensure secure and trustworthy implementations (Gökçearslan et al., 2024).
b. Design and Cultural Sensitivity – Poorly designed chatbots may lead to bias, cultural insensitivity, or language barriers, reducing their effectiveness across diverse learner populations (Onat & Gulsecen, 2023).
c. Replacement Fears – Concerns about chatbots replacing human educators persist, emphasising the need for balanced integration that maintains a human touch (Gökçearslan et al., 2024).
d. Need for Further Research – Additional studies are required to assess the influence of chatbots on pedagogy, technology acceptance, usability, and the interplay with individual learner characteristics (Gökçearslan et al., 2024).

THEORETICAL FOUNDATIONS SUPPORTING CHATBOTS

Theories of learning underpin the design and implementation of AI chatbots, ensuring they meet pedagogical goals effectively, as such:

a. Constructivism – Emphasises the active role of learners in constructing knowledge through interaction and reflection. Chatbots can scaffold learning experiences, fostering active engagement and collaboration (Isik, 2018; Alanazi, 2016).
b. Adaptive Learning Theory – Focuses on customising educational experiences to meet learner needs, supporting differentiated instruction and optimising outcomes through personalised feedback (Okonkwo & Ade-Ibijola, 2021).
c. Self-Determination Theory (SDT) - Highlights the importance of autonomy, competence, and relatedness in sustaining motivation and engagement. Chatbots aligned with SDT principles can create supportive environments conducive to effective learning (Guay, 2021).

Consequently, Table 1 depicts the overall thematic analysis of the scoping review conducted in this study.

Table 1 Thematic Analysis of Scoping Review Findings

Theme	Key Insights	Supporting Literature
Roles and Capabilities	Personalised Learning: Tailored feedback and adaptive content delivery.	Onat & Gulsecen (2023); Tack & Piech (2022)
	Administrative Support: Automation of grading, scheduling, and other routine tasks.	Abedi & Ackah-Jnr (2023)
	Interactive Learning: Facilitation of group discussions and peer interactions.	Abedi & Ackah-Jnr (2023)
	Specialised Assistance: Guidance in advanced subjects and research tasks.	Chukwuere (2024)
Educational Outcomes	Increased Accessibility: Anytime, anywhere support for self-paced learning.	Onat & Gulsecen (2023)
	Enhanced Performance and Motivation: Improved engagement and self-efficacy through chatbots.	Gökçearslan et al. (2024)
	Reduced Educator Workload: Freed time for critical instructional activities.	Onat & Gulsecen (2023)
	Fostering Autonomy and Competence: Alignment with SDT principles through feedback and choice.	Guay (2021)
Challenges in Implementation	Ethical and Privacy Concerns: Risks related to data collection and security.	Gökçearslan et al. (2024)
	Design and Cultural Sensitivity: Risks of bias, insensitivity, and language barriers.	Onat & Gulsecen (2023)
	Replacement Fears: Concerns about replacing human educators.	Gökçearslan et al. (2024)
	Need for Further Research: Pedagogical impact, usability, and learner-specific effects.	Gökçearslan et al. (2024)
Theoretical Foundations	Constructivism: Supports active knowledge construction through interaction and reflection.	Isik (2018); Alanazi (2016)
	Adaptive Learning Theory: Customises educational experiences to optimise learning outcomes.	Okonkwo & Ade-Ibijola (2021)
	Self-Determination Theory (SDT): Enhances motivation via autonomy, competence, and relatedness.	Guay (2021)

DISCUSSION

The findings of this scoping review highlight the significant potential of AI-powered chatbots in revolutionising education by offering personalised, interactive, and accessible learning experiences. Rooted in established educational theories, chatbots have proven effective in enhancing student motivation, reducing educator workload, and supporting collaborative and adaptive learning. However, challenges such as ethical concerns, cultural sensitivity, and the risk of undermining human interaction underscore the importance of a well-designed framework to guide their implementation. Building on these insights, this discussion proposes a new conceptual framework to integrate the strengths of chatbots while addressing their limitations, ensuring their effective and ethical use in educational settings.

PROPOSED FRAMEWORK: THE PERSONALISED CONSTRUCTIVIST AGENT MODEL (PCAM)

The Personalised Constructivist Agent Model (PCAM) we propose here synthesises three foundational educational theories—Constructivism, Adaptive Learning Theories,

and Self-Determination Theory (SDT)—to provide a comprehensive framework for the design and deployment of AI-powered chatbots in education. The PCAM conceptualises chatbots as multi-faceted agents that facilitate personalised learning, support active knowledge construction, and enhance learner motivation. The key components of PCAM (refer Figure 1) include:

a. Personalisation through Adaptive Learning-interactions to adjust instructional content, pacing, and complexity. This dynamic adaptation ensures that learners receive relevant challenges aligned with their unique needs, promoting efficient and effective learning.
b. Knowledge Construction through Interaction-Leveraging constructivist principles, chatbots facilitate active engagement by encouraging learners to articulate thoughts, reflect on understanding, and solve problems. Scaffolding techniques are employed to support learners as they progress, gradually increasing task complexity to deepen cognitive engagement.
c. Motivation and Engagement via SDT Principles Chatbots foster autonomy by allowing learners to make choices about their learning paths, enhance competence through immediate and tailored feedback, and simulate empathetic interactions to fulfil the need for relatedness. This ensures that learners remain intrinsically motivated and engaged throughout their educational journey.

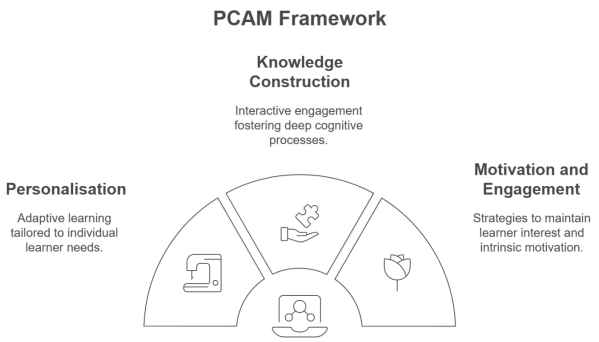

Figure 1 Key components of the proposed framework for AI Chatbots in Education

ROLES OF CHATBOTS IN THE PCAM FRAMEWORK

By utilising advanced natural language processing and adaptive technologies, chatbots perform diverse roles that go beyond simple question-answering. They serve as intelligent tutors, facilitators of collaborative learning, and motivational coaches, delivering personalised instruction and automating administrative tasks. Chatbots' ability to provide real-time feedback, foster engagement, and adapt to individual learning paths underscores their potential to enhance traditional teaching methods. These capabilities make chatbots valuable tools for addressing modern educational challenges while supporting personalisation, interaction, and learner engagement (Tetzlaff et al., 2021). Figure 2 illustrates the varied roles chatbots play in improving educational experiences for students, instructors, and researchers.

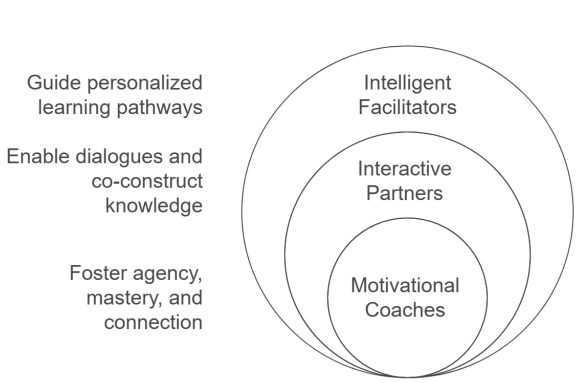

Figure 2 Roles of AI Chatbot in Education

ADDRESSING CHALLENGES IN IMPLEMENTATION

While chatbots hold significant promise in transforming education, several challenges must be carefully addressed to ensure their effective and ethical implementation. Ensuring the authenticity of chatbot interactions is crucial, as learners require supportive, responsive, and meaningful engagements to build trust and enhance learning outcomes. Additionally, a balance must be maintained between the efficiency of automation and the irreplaceable value of human interaction. Human educators remain essential for addressing complex issues, fostering deep connections, and providing emotional support.

The ethical use of data is another paramount concern. The collection and analysis of learner data, which drive the personalised functionality of chatbots, must strictly adhere to privacy laws and ethical standards to safeguard sensitive information and maintain user trust. Addressing these challenges is vital to realising the full potential of chatbots in education while ensuring a learner-centred and ethical approach (Lakkaraju et al., 2024).

The Personalised Constructivist Agent Model (PCAM) explicitly integrates ethical considerations, prioritising privacy and data security while promoting cultural sensitivity and inclusivity in chatbot interactions. By balancing automation with human touchpoints, the framework alleviates concerns about replacing educators, ensuring that chatbots complement rather than compete with traditional teaching roles. The key challenges include:

a. Authenticity of Interaction – Ensuring supportive, responsive, and meaningful engagements to foster trust and learning.
b. Balancing Automation and Human Touch – Leveraging chatbot efficiency while preserving opportunities for human interaction to address complex issues and provide emotional support.
c. Ethical Use of Data – Adhering to privacy laws and ethical standards in the collection and analysis of learner data.

The PCAM also highlights the potential of chatbots to transform education via:

a. Enhanced Learning Outcomes – Personalised support and active engagement lead to deeper understanding and improved retention.
b. Scalable Personalisation – Chatbots enable individualised education at scale, accommodating diverse learning styles.
c. Sustained Motivation – By fulfilling psychological needs, chatbots keep learners engaged and reduce dropout rates in online and distance learning environments (Yang & Evans, 2019).

CONCLUSION

In a nutshell, the proposed framework of the Personalised Constructivist Agent Model serves as a blueprint for designing educational chatbots that are not only technically advanced but also pedagogically sound and ethically responsible. It offers a holistic approach to integrating chatbots into diverse learning environments, ensuring their positive impact on both learners and educators. It proposes a theoretical foundation for integrating chatbots into education, that can be scientifically tested in the future. By synthesising adaptive learning theories, constructivism, and SDT, the model elucidates how chatbots can personalise learning, support active knowledge construction, and enhance intrinsic motivation. Embracing this model can lead to more engaging, effective, and inclusive educational experiences, leveraging technology to meet the unique needs of learners.

REFERENCES

Abedi, E., & Ackah-Jnr, F. 2023. First-order barriers still matter in teachers' use of technology: An exploratory study of multi-stakeholder perspectives of technology integration barriers [Non-refereed case study]. *International Journal of Education and Development Using ICT, 19* (2). Open Campus, The University of the West Indies. http://ijedict.dec.uwi.edu/viewarticle.php?id=3164

Alanazi, A. S. 2016. *A Critical Review of Constructivist Theory and the Emergence of Constructionism*. https://doi.org/10.21694/2378-7031.16018

Chukwuere, J. E. 2024. *Developing generative AI chatbots conceptual framework for higher education* (arXiv:2403.19303). arXiv. https://doi.org/10.48550/arXiv.2403.19303

Frankford, E., Sauerwein, C., Bassner, P., Krusche, S., & Breu, R. 2024. *AI-Tutoring in Software Engineering Education* (arXiv:2404.02548). arXiv. https://doi.org/10.48550/arXiv.2404.02548

Gligorea, I., Cioca, M., Oancea, R., Gorski, A.-T., Gorski, H., & Tudorache, P. 2023. Adaptive learning using artificial intelligence in e-learning: A literature review. *Education Sciences, 13*(12), 1216. https://doi.org/10.3390/educsci13121216

Gökçearslan, Ş., Tosun, C., & Erdemir, Z. G. 2024. Benefits, challenges, and methods of artificial intelligence (AI) chatbots in education: A systematic literature review. *International Journal of Technology in Education, 7*(1), Article 1. https://doi.org/10.46328/ijte.600

Guay, F. 2021. Applying self-determination theory to education: Regulations types, psychological needs, and autonomy-supporting behaviors. *Canadian Journal of Education Administration and Policy, 37*(1), 75–92. https://doi.org/10.1177/08295735211055355

Huggins, E. S., & Kellogg, S. 2020. Technology□enabled personalised learning: A promising practice in need of robust research. *School Science and Mathematics*, *120*(1), 1–3. https://doi.org/10.1111/ssm.12384

Isik, A. D. 2018. Use of technology in constructivist approach. *Educational Research and Reviews*, *13*(21), 704–711. https://doi.org/10.5897/ERR2018.3609

Kuhail, M. A., Alturki, N., Alramlawi, S., & Alhejori, K. 2022. Interacting with educational chatbots: A systematic review. *Education and Information Technologies*, *28*(1), 973–1018.

Lakkaraju, K., Khandelwal, V., Srivastava, B., Agostinelli, F., Tang, H., Singh, P., Wu, D., Irvin, M., & Kundu, A. 2024. Trust and ethical considerations in a multi-modal, explainable AI-driven chatbot tutoring system: The case of collaboratively solving Rubik's Cube. *arXiv.* https://doi.org/10.48550/arXiv.2402.01760

Li, K. C., & Wong, B. T. M. 2019. How learning has been personalised: A review of literature from 2009 to 2018. In J. M. Spector, D. Ifenthaler, D. Sampson, & P. Isaías (Eds.), *Digital technologies: Sustainable innovations for improving teaching and learning* (pp. 72–81). Springer. https://doi.org/10.1007/978-3-030-21562-0_6

Okonkwo, C. W., & Ade-Ibijola, A. 2021. Chatbots applications in education: A systematic review. *Computers and Education: Artificial Intelligence, 2,*

100033. https://doi.org/10.1016/j.caeai.2021.100033
Onat, O., & Gulsecen, S. 2023. Reducing Perceived Transactional Distance in Distance Education: The Impact of the Chatbot. *International Journal of Technology in Education and Science*, *7*(4), 483–499. https://doi.org/10.46328/ijtes.511
Pérez, J., Daradoumis, T., & Puig, J. M. M. es. 2020. Rediscovering the use of chatbots in education: A systematic literature review. *Computer Applications in Engineering Education*, *28*(6), 1549–1565.
Spaulding, S., Shen, J., Park, H. W., & Breazeal, C. 2021. Lifelong Personalization via Gaussian Process Modeling for Long-Term HRI. *Frontiers Media*, *8*. https://doi.org/10.3389/frobt.2021.683066
Tack, A., & Piech, C. 2022. *The AI Teacher Test: Measuring the Pedagogical Ability of Blender and GPT-3 in Educational Dialogues* (arXiv:2205.07540). arXiv. https://doi.org/10.48550/arXiv.2205.07540
Tetzlaff, L., Schmiedek, F., & Brod, G. 2021. Developing Personalised Education: A Dynamic Framework. *Educational Psychology Review*, *33*(3), 863–882. https://doi.org/10.1007/s10648-020-09570-w
Wollny, S., Schneider, J., Di Mitri, D., Weidlich, J., Rittberger, M., & Drachsler, H. 2021. Are We There Yet? - A Systematic Literature Review on Chatbots in Education. *Frontiers in Artificial Intelligence*, *4*.
Yang, S., & Evans, C. 2019. Opportunities and challenges in using AI chatbots in higher education. *Proceedings of the 2019 Learning and Technology Conference.* https://doi.org/10.1145/3371647.3371659

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