Co-sponsored By

Co-hosted By

Media Partners

IEEE Catalog Number: CFP25AD2-USB
ISBN: 979-8-3315-7385-0

2025 the 5th International Conference on Educational Technology (ICET 2025)

ISBN: 979-8-3315-7385-0

Chongqing, China
September 26-28, 2025



ICET 2025

2025 the 5th International Conference on Educational Technology

Published by

Proceedings of

2025 the 5th International Conference on Educational Technology

(ICET 2025)

September 26-28, 2025

Chongqing, China



IEEE Catalog Number: CFP25AD2-USB
ISBN: 979-8-3315-7385-0

2025 the 5th International Conference on Educational Technology (ICET 2025)

Copyright ©2025 by the Institute of Electrical and Electronics Engineers, Inc. All rights reserved.

Copyright and Reprint Permission:

Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

Other Copying, reprint, or reproduction requests should be addressed to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, P. O. Box 1331, Piscataway, NJ 08855-1331.

Compliant PDF Files

XPLORE COMPLIANT CFP25AD2-ART
ISBN: 979-8-3315-7386-7

Conference USB Version

IEEE Catalog Number: CFP25AD2-USB
ISBN: 979-8-3315-7385-0

The Emergence of Artificial Intelligence in Education: Why is ChatGPT a "Game Changer" for Teaching and Learning

Marco Bento *
Centre for Research & Innovation in Education (inED)
Polytechnic University of Coimbra,
Coimbra, Portugal
marcobento@esec.ot

Celestino Magalhães
Research in Education and Community Intervention (RECI)
Piaget Institute
Vila Nova de Gaia, Portugal
celestino.magalhaes@ipiaget.pt

Andréa Villela Mafra da Silva
Foundation to Support the Technical School
University of Estácio de Sá
Rio de Janeiro, Brazil
andreamafra.iserj@gmail.com

José Alberto Lencastre
Research Centre on Education (CIEd)
University of Minho
Braga, Portugal
jlencastre@ie.uminho.pt

***Abstract*— Technological advances have opened new horizons and expanded the frontiers of education. Among the various technologies with great educational potential, Artificial Intelligence (AI) has opened new horizons to improve teaching and learning practices. We specifically focus on applying the ChatGPT model, a cutting-edge natural language processing tool, in educational settings. Through a comprehensive approach, this essay explores how ChatGPT can increase student engagement, personalize more meaningful learning experiences, and provide immediate and constructive feedback to students. We advocate ChatGPT's potential to transform traditional teaching methods by offering a more interactive and personalized educational approach. However, we recognize that ethical considerations must be addressed for successful implementation.**

Keywords*— *Artificial Intelligence, ChatGPT, Equality and Inclusion, Ethical considerations.

I. INTRODUCTION

The dawn of the digital age has led to transformative changes across industries. One of the most influential sectors was education. Historically, educational methods have evolved at a gradual pace. From the era of gurus and disciples under the Bodhi tree to structured classrooms and e-learning, the pace of change has been constant. However, this evolution has accelerated several times with the advent of Artificial Intelligence (AI).

The emergence of AI in education began with simple computer-based training programs and adaptive testing. Systems like Carnegie Learning began using AI as early as the 2000s to provide tutoring in math. These early systems provided a glimpse of AI's potential but were scratching the surface.

The advent of AI has revolutionized several sectors, including education. Integrating AI models like ChatGPT offers promising avenues to personalize learning, increase student engagement, and improve educational outcomes.

This essay explores how ChatGPT can increase student engagement, personalize more meaningful learning experiences, and provide immediate and constructive feedback to students.

II. THE EVOLUTION OF ARTIFICIAL INTELLIGENCE

First The roots of AI date back to the mid-20th century, when mathematicians and philosophers began exploring the concept of machines that could imitate human intelligence. Alan Turing's work on the Turing Test launched the fundamental idea that machines could "think" like humans.

The 1950s and 1960s saw the formal birth of AI as a scientific discipline. Early AI research focused on symbolic AI, where researchers attempted to replicate human intelligence through rule-based systems. The Dartmouth Workshop in 1956 is often considered the starting point of AI as a field of study.

The 1980s and 1990s marked a shift toward machine learning, where algorithms were developed to allow computers to learn from data. The first neural networks, inspired by the structure of the human brain, were explored to allow machines to recognize patterns and make decisions.

The 2000s saw the emergence of deeper learning, a subset of machine learning that uses multilayer neural networks. Advances in computing power and the availability of large data sets have allowed deep learning models to excel at tasks such as image and speech recognition [1] [2].

Natural language processing (NLP) has become a prominent area of AI research, focusing on enabling machines to understand and generate human language. The development of GPT (Generative Pre-trained Transformer) models and their iterations, including ChatGPT, represents a significant milestone in NLP. These models can generate coherent and contextually relevant texts, opening up new possibilities for human-machine interaction.

The evolution of AI has raised important ethical and social considerations, such as algorithm deviations, data privacy and the potential impact on employment. This field continues to evolve, with ongoing research exploring ways to make AI more transparent, ethical, and aligned with human values.

979-8-3315-7385-0/25/$31.00 ©2025 IEEE

III. CHATGPT – A NEW PARADIGM

ChatGPT is part of the family of Generative Pre-trained Transformer (GPT) models developed by OpenAI. It is a deep learning model designed to understand and generate human text. The model is pre-trained on large amounts of text data and tuned for specific tasks.

ChatGPT's architecture is based on the Transformer model, which uses attention mechanisms to capture relationships between words in a text. This architecture allows the model to consider the entire context of a sentence or paragraph, enabling the generation of more coherent and contextually relevant texts [1] [2].

ChatGPT was first pre-trained on a large corpus of text data, allowing it to learn the structure and nuances of human language. It was then tuned for specific tasks and domains, allowing one to generate texts relevant to specific subjects or applications.

ChatGPT represents a significant advancement in natural language processing and AI. Its architecture, pre-training and improvement process, diverse applications and specific educational potential make it a notable object of study. Understanding ChatGPT's capabilities, challenges, and future directions is essential for exploring its role in improving teaching and learning and addressing the broader implications of AI in education [3] [4].

GPT models, and particularly ChatGPT, have set a new benchmark. Unlike traditional systems that follow a rules-based approach, ChatGPT uses deep learning to generate human-like text based on the information it is trained on. With the vast amount of data and the sophistication of the architecture, it can generate contextually relevant responses that are insightful and adaptable to user needs.

ChatGPT continues to be an area of active research and development. Ongoing efforts are focused on improving its interoperability, reducing drift, enhancing its adaptability to specific domains, and exploring its long-term impact and effectiveness.

ChatGPT has many applications, from creative writing and content generation to customer support and conversational agents. Its ability to generate coherent and contextually appropriate text makes it a valuable tool for various sectors, including education [1] [2] [3] [4].

IV. CHATGPT IN EDUCATIONAL CONTEXT

The integration of AI in education has evolved over several decades [5]. Early applications focused on computer-assisted teaching and intelligent tutoring systems, which aimed to provide personalized learning experiences and support teachers in assessing student performance [6].

Nowadays, ChatGPT features offer a wide range of possibilities to enhance teaching and learning [7].

In the context of education, ChatGPT can be used (1) to create more engaging and adaptable educational content, (2) to create interactive learning materials, (3) to provide real-time feedback, (4) to facilitate collaborative learning environments, and (5) to facilitate personalised learning experiences for students. The effectiveness of ChatGPT in educational environments may vary based on implementation, training, and alignment with educational goals [1] [2] [3] [4].

ChatGPT can also democratize learning by being an app accessible anywhere, anytime, providing quality educational resources beyond traditional classroom or geographic limitations.

V. LITERATURE REVIEW ON ARTIFICIAL INTELLIGENCE AND EDUCATION

This literature review examines seventy-five scientific articles that explore the use of Artificial Intelligence (AI) in Education. The aim is to comprehensively synthesise existing research and identify critical trends and challenges in this emerging field. Scientific articles, dissertations and theses were selected, specifically in Education, excluding other non-relevant areas. We defined the inclusion and exclusion criteria, therefore using the search terms (TS) “artificial intelligence”, “education”, and “curriculum” using the Boolean language “and” (AND) and “or” (OR) as follows: (Artificial Intelligence and Education OR Artificial Intelligence and Curriculum).

The databases used to compile scientific articles were Education Resources Information Center (ERIC), Open Access Scientific Repositories of Portugal (RCAAP) Capes and Scielo Periodicals, using the descriptor Artificial Intelligence and Education, from 2018 to 2024. The time frame (2018 to 2024) is justified by the educational applications of AI in the global market, worth US$ 3.68 billion, located in three technologies: ML, PLN and Big Data [8] [9]. Among the criteria adopted to prepare this review are the assessment of methodological quality and data synthesis (meta-analysis).

#	Referência ABNT
1	BRITO, Robson Souto. A pesquisa brasileira em robótica pedagógica: um mapeamento sistemático com foco na educação básica. Dissertação de Mestrado, 103f.: il., Universidade Federal de Pernambuco, CE. Programa de Pós-graduação em Educação Matemática e Tecnológica, 2019.
2	CAMADA, Marcos Yuzuru; DURÃES, Gilvan Martins. Ensino da Inteligência Artificial na Educação Básica: um novo horizonte para as pesquisas brasileiras. In: Anais do XXXI Simpósio Brasileiro de Informática na Educação. SBC, 2020. p. 1553-1562.
3	CARDOSO, Fábio Santos et al. O uso da Inteligência Artificial na Educação e seus benefícios: uma revisão exploratória e bibliográfica. Revista Ciência em Evidência, v. 4, n. FC, p. e023002-e023002, 2023.
4	CORREIA, Virginia Marlene et al. Aplicações em inteligência artificial na educação, na química e no ensino de química: uma revisão sistemática de literatura. 2021.
5	COSTA, Roberto Douglas da. Classificação dos estilos de aprendizagem baseado em sistemas inteligentes: um estudo de caso na educação mediada por tecnologia. 2020. 81f. Tese (Doutorado em Engenharia Elétrica e de Computação) - Centro de Tecnologia, Universidade Federal do Rio Grande do Norte, Natal, 2020.
6	COSTA, R. M.; WERNECK, Vera Maria Benjamin. Sistemas Tutoriais: aplicação das Tecnologias de

	Hipermídia e de Inteligência Artificial em Educação. Rio de Janeiro: COPE/Sistemas/UFRJ, 1997.
7	DOS SANTOS, Leidiane Aparecida; ZIMMERMANN, Jussara Aparecida Teixeira; GUIMARÃES, Ueudison Alves. A INTELIGÊNCIA ARTIFICIAL NA EDUCAÇÃO. RECIMA21-Revista Científica Multidisciplinar-ISSN 2675-6218, v. 3, n. 7, p. e371714-e371714, 2022.
8	GIRAFFA, Lucia; KHOLS-SANTOS, Pricila. Inteligência Artificial e Educação: conceitos, aplicações e implicações no fazer docente. Educação em Análise, v. 8, n. 1, p. 116-134, 2023.
9	PARREIRA, Artur; LEHMANN, Lúcia; OLIVEIRA, Mariana. O desafio das tecnologias de inteligência artificial na Educação: percepção e avaliação dos professores. Ensaio: avaliação e políticas públicas em educação, v. 29, p. 975-999, 2021.
10	POZZEBON, Eliane; FRIGO, Luciana Bolan; BITTENCOURT, Guilherme. Inteligência artificial na educação universitária: quais as contribuições. Campinas: Revista CCEI, v. 8, n. 13, p. 34-41, 2004.
11	RODRIGUES, Olira Saraiva; RODRIGUES, Karoline Santos. A inteligência artificial na educação: os desafios do ChatGPT. Texto Livre, v. 16, p. e45997, 2023.
12	RUSSEL, Stuart; NORVIG, Peter. Inteligência Artificial. Rio de Janeiro: Elsevier, 2013.
13	SILVA, Eva Sónia Moreira da; FREITAS, Pedro Miguel (orgs.). Inteligência Artificial e Robótica desafios para o direito do século XXI. Coimbra: GESTLEGAL, 2022.
14	SOUZA, Paulo Vitor Teodoro de. Modelos de simulação qualitativos como estratégia para o ensino de Ciências. 2019. 285 f., il. Tese (Doutorado em Educação em Ciências) —Universidade de Brasília, Brasília, 2019.
15	TAVARES, L. A., MEIRA, M. C., & AMARAL, S. F. do. (2020). Inteligência Artificial na Educação: Pesquisa / Inteligência Artificial na Educação: Pesquisa. Revista Brasileira de Desenvolvimento, 6(7), 48699–48714. https://doi.org/10.34117/bjdv6n7-496
16	TELES, Lúcio; NAGUMO, Estevon. Uma inteligência artificial na educação para além do modelo behaviorista. Revista Ponto De Vista, v. 12, n. 3, p. 01-15, 2023.
17	BOULAY, Benedict du. Inteligência Artificial na Educação e Ética. RE@D - Revista de Educação a Distância e Elearning. Volume 6, Número 1, Jan – Jun 2023.
18	HARASIM, L. Educação online e as implicações da inteligência artificial. Revista da FAEEBA - Educação e Contemporaneidade, [S. l.], v. 24, n. 44, p. 25–39, 2015.
19	OLIVEIRA, B. N. DE .; FRAGA, A. B. Prescrição de exercícios físicos por inteligência artificial: a educação física vai acabar? Revista Brasileira de Ciências do Esporte, v. 43, p. e002921, 2021.
20	GIORDANO, C. V., SOUZA, R. A. de . Prognóstico da Evasão Escolar em Instituição de Educação Profissional e Tecnológica por meio da Inteligência Artificial. Revista Interacções, 19(66), 1–20, 2023.
21	MARTINS, Rodrigo Henrique, VIANA, Helena Brandão. Inteligência artificial na educação: uma revisão integrativa da literatura. Internet Latent Corpus Journal. vol. 12, n. 2, 2022.
22	DIOGO, José, MAMEDE, José Henrique. Pesquisa de Conceitos em Microsoft Cognitive Search. Revista de Ciências da Computação, nº17, 2022.
23	JUNIOR, Guanis de Barros Vilela, PASSOS, Ricardo Pablo. Inteligência Artificial, disrupção educacional e as margaridas do campo. Internet Latent Corpus Journal. vol. 13 –edição especial EDETEC, 2023.
24	SILVA, Liliane Inácia da, PARESCHI, Claudinei Zagui, OLIVEIRA, Jailda Nonato dos Santos. Metodologias ativas: utilidades do ChatGTP no contexto da sala de aula invertida. RE@D - Revista de Educação a Distância e Elearning. Volume 6, Número 2, jul-dez, 2023.
25	CAMPOS, L. F. A. DE A.; LASTÓRIA, L. A. C. N.. Semiformação e inteligência artificial no ensino. Pro-Posições, v. 31, p. e20180105, 2020.
26	ROCIO, Vitor Rocio, WESLEY, Anila. Building a chatbot for student support. Revista de Ciências da Computação, nº15, 2020.
27	SILVAI, Ederson Carlos, VIANAII, Helena Brandão, VILELA JR, Guanis de Barros. Metodologias ativas numa escola técnica profissionalizante. Revista Portuguesa de Educação. vol.33 no.1 Braga jun. 2020.
28	ARRUDA, Campos, Luis Fernando Altenfelder De, NABUCO, Lastória, Luiz Antônio Calmon. Semiformação e inteligência artificial no ensino 1. Pro-Posições. UNICAMP - Faculdade de Educação, v. 31, p. -, 2020.
29	MOURA, Adelina, CARVALHO, Ana Amélia. Literacia de Prompts para potenciar o uso da inteligência artificial na educação. RE@D – Revista de Educação a Distância e eLearning. Vol. 6, nº 2, julho-dez, 2023.
30	TORI, R. Metaversos na Educação: conceitos e possibilidades. Video Journal of Social and Human Research, 2(1), 53-66, 2023.
31	TEIXEIRA, João de Fernandes, GONZALES, Maria Eunice Quilici. Inteligência artificial e teoria de resolução de problemas. Trans/Form/Ação. Universidade Estadual Paulista, Departamento de Filosofia , v. 6, p. 45-52, 2014.
32	ABDO, Adriano; DE SOUZA LUIZ, Ronilson. A educação como direito social: desafios e perspectivas na área jurídica com usos de inteligência artificial. Peer Review, v. 6, n. 2, p. 77-91, 2024.
33	SANTOS, Silvana Maria Aparecida Viana et al. INTELIGÊNCIA ARTIFICIAL NA EDUCAÇÃO. Revista Contemporânea, v. 4, n. 1, p. 1850-1870, 2024.
34	DE OLIVEIRA FILHO, Fernando Luiz Cas et al. Inteligência artificial na educação: uma revisão sistemática e abrangente dos benefícios e desafios. Caderno Pedagógico, v. 21, n. 1, p. 1086-1102, 2024.

35	MENTA, Eziquiel; DA SILVA BRITO, Glaucia. O papel da Inteligência Artificial no Ensino Tecnológico: implicações emergentes. Educitec-Revista de Estudos e Pesquisas sobre Ensino Tecnológico, v. 10, n. jan./dez., p. e232524-e232524, 2024.
36	ASSUNÇÃO, Bárbara Aline Ferreira et al. Redefinindo a educação: estratégias inovadoras na formação docente por meio da inteligência artificial. Cuadernos de Educación y Desarrollo, v. 16, n. 1, p. 2974-2993, 2024.
37	LIMA, Gean Paulo Trabuco et al. Inteligência artificial na educação. Seven Editora, 2024.
38	DAS NEVES MEROTO, Monique Bolonha et al. Revolucionando a educação: explorando o potencial da inteligência artificial para transformar métodos de ensino e aprendizado. REVISTA FOCO, v. 17, n. 1, p. e4124-e4124, 2024.
39	MAIA-LIMA, Cláudia; BALTAZAR, Alexandra; SANTOS, Miguel F. Educação Maker, uma abordagem agregadora. Sensos-e, v. 11, n. 1, p. 41-50, 2024.
40	DA SILVA, Íris Costa et al. Aplicações da matemática no campo da inteligência artificial: inovações e desafios para o ensino de matemática. Revista Contemporânea, v. 4, n. 1, p. 2121-2144, 2024.
41	DA SILVA BARROSO, Sheilla; CRUZ, Laurides Batista; CASTRO, Daniele Carvalho. Produção científica sobre Inteligência Artificial e ética: Uma análise bibliométrica. In: Abec Meeting. 2024.
42	GUIMARÃES, Renato Ribeiro; MALACARNE, Vilmar; ALVES, Fábio Lopes. CHATGPT, Metaverso, Web3 e outras tecnologias: desafios à educação do futuro. Debates em Educação, v. 16, n. 38, p. e16114-e16114, 2024.
43	NARCISO, Rodi et al. Ferramentas colaborativas na educação EAD. Revista Contemporânea, v. 4, n. 1, p. 1941-1959, 2024.
44	DE MELO LUSTOSA, Marllus; FARIAS, Maria Giovanna Guedes; DE FARIAS, Gabriela Belmont. Inteligência Artificial e Comunicação Científica: uma revisão sistemática. Brazilian Journal of Information Science: research trends, v. 18, p. e024004-e024004, 2024.
45	DE ALCÂNTARA, Jeferson Alves. Integrando a abordagem cts no ensino de química: avaliação de material didático gerado com o auxílio do chatgpt. Pesquisas em ensino de Ciências: da teoria à prática, p. 21, 2024.
46	GAGLIETTI, Mauro. A Confluência Transformadora: A Inteligência Artificial, Inteligência Emocional e Mediação de Conflitos. REVISTA CIENTÍFICA FADESA, v. 1, n. 1, p. 1-14, 2024.
47	DE OLIVEIRA LEMES, David; JUNIOR, José Carlos Buesso; RODRIGUES, Julya Joplin Freitas. Metaverso e educação: um novo paradigma de aprendizagem? RECIMA21-Revista Científica Multidisciplinar, v. 5, n. 1, p. e514790-e514790, 2024.
48	DAS NEVES MEROTO, Monique Bolonha et al. Prática colaborativa e taxonomia de bloom: integração das tecnologias na implementação da prática colaborativa na educação básica. REVISTA FOCO, v. 17, n. 1, p. e4258-e4258, 2024.
49	GUERREIRO, Evandro Prestes. Educação digital e a senoide holística de aprendizagem. Educação, p. e3/1-28, 2024.
50	DOS SANTOS ABREU, Marcella; DA COSTA DIAS, Lorrana Crystina; DE SOUSA OLIVEIRA, Maria Eduarda. Curadoria digital e decolonial de vídeos e podcasts na educação linguística em francês. Texto Livre, v. 17, p. e47937-e47937, 2024.
51	COELHO, Luciano Figueiredo et al. Influência e percepções do ChatGPT na aprendizagem de programação: um estudo de caso na Faculdade Senac Palhoça. Contribuciones a las ciencias sociales, v. 17, n. 1, p. 5819-5829, 2024.
52	DE AZEVEDO, Mario Luiz Neves; DE MORAES, Karine Nunes; CATANI, Afrânio Mendes. Determinantes da expansão da ead em cursos de licenciatura de instituições privadas no Brasil. RTPS – Rev. Trabalho, Política e Sociedade, Vol. 8, nº 13, p. 01-14, 2023.
53	DE SOUSA, Ligiane Corrêa. Ensino Híbrido: novas perspectivas rumo ao metaverso. Rebena-Revista Brasileira de Ensino e Aprendizagem, v. 8, p. 77-88, 2024.
54	FRANCK, Kewry Mariobo et al. Sistema especialista para prognóstico de distúrbios de aprendizagem: situações de dislexia e discalculia. Contribuciones a las ciencias sociales, v. 17, n. 1, p. 5159-5178, 2024.
55	DANIEL, Eulanda Maria Pedro; WIVES, Leandro Krug; LORANDI, Alexandra. Análise comparativa dos processos de avaliação da qualidade do Ensino Superior. Revista internacional de educação superior. Campinas. Vol. 11 (2025), e025014, p. 1-21, 2024.
56	DA SILVA, Romézio Alves Carvalho et al. Gamificação no ensino de química. Contribuciones a las ciencias sociales, v. 17, n. 1, p. 4472-4483, 2024.
57	DE ARAÚJO, Fábio José et al. O ensino da matemática nos anos iniciais: as ferramentas de chatbots na construção de sequências didáticas. Contribuciones a las Ciencias Sociales, v. 17, n. 1, p. 7721-7740, 2024.
58	SANTOS, Silvana Maria Aparecida Viana et al. A formação docente sua dificuldade em inserir novas tecnologias no currículo: o currículo escolar e a implementação de novas tecnologias. Revista Foco, v. 17, n. 1, p. e4257-e4257, 2024.
59	BORGES, Bruno Gonçalves. As tecnologias de individuação e o discurso biopedagógico sobre a educação. Linguagens, Educação e Sociedade, v. 28, n. 56, p. 1-21, 2024.
60	PERISSÉ, Gabriel. Penso, logo ensino. Revista Expressão, v. 13, n. 1, p. 8-13, 2024.
61	RENÓ, Débora et al. Chatbot como estratégia multietária de ensino. EducEaD-Revista de Educação a Distância da UFVJM, v. 4, n. 1, p. 130-144, 2024.
62	DE OLIVEIRA PAULA, Maurício; DA SILVA, Patric Anderson Gomes; LIMA, Kátia Regina Rodrigues. A nova formação de professores na contemporaneidade do capital. Cadernos de Educação, n. 68, 2024.

63	NOVAIS, Alessandra Ferreira Salgado et al. Promovendo segurança online no ambiente educacional moderno. Revista Foco, v. 17, n. 1, p. e4113-e4113, 2024.
64	DE FARIA, Glauciene Soares; FREITAS, Neliane. Estratégias para a diminuição da dispersão dos estudantes do ensino médio através das tecnologias educacionais. EducEaD-Revista de Educação a Distância da UFVJM, v. 4, n. 1, p. 65-82, 2024.
65	DE OLIVEIRA MORAIS, Marcos et al. O Uso da Tecnologia no Ensino Médio em São Paulo. Journal of Technology & Information (JTnI), v. 4, n. 1, 2024.
66	NASCIMENTO, Daniel et al. Ensino Tecnológico e Inovação: perspectivas para o Futuro Próximo. Educitec-Revista de Estudos e Pesquisas sobre Ensino Tecnológico, v. 10, n. jan./dez., p. e234824-e234824, 2024.
67	DOS SANTOS, Domingos Sávio et al. Inovação pedagógica: integrando aprendizagem colaborativa e taxonomia de Bloom no contexto virtual. Contribuciones a las Ciencias Sociales, v. 17, n. 1, p. 1669-1676, 2024.
68	PICÃO, Fábio Fornazieri et al. Inteligência artificial e educação: como a IA está mudando a maneira como aprendemos e ensinamos. Revista Amor Mundi, v. 4, n. 5, p. 197-201, 2023.
69	DA SILVA, Keila Ramos et al. Inteligência Artificial e seus impactos na educação: uma Revisão Sistemática. RECIMA21-Revista Científica Multidisciplinar, v. 4, n. 11, p. e4114353-e4114353, 2023.
70	DE ANDRADE MATIAS, Klesia; MORESI, Eduardo Amadeu Dutra; DOS SANTOS, Pricila Kohls. Tendências em inteligência artificial e educação híbrida: um estudo exploratório. Poíesis Pedagógica, v. 20, n. Publicação contínua, p. 76-96, 2022.
71	DE ALMEIDA MACHADO, João Luís. Inteligência artificial e educação. Trem de Letras, v. 8, n. 1, p. e021011-e021011, 2021.
72	SILVA, Cristiani Lopes et al. Educação e tecnologia: aproximações da inteligência artificial e a educação a distância. Revista Amor Mundi, v. 4, n. 7, p. 175-181, 2023.
73	DA SILVA, Marcos Vinícius Malheiros et al. Inserção da inteligência artificial nos cursos a distância. Revista Amor Mundi, v. 4, n. 5, p. 215-221, 2023.
74	GROSSI, Márcia Gorett Ribeiro et al. Contribuições da inteligência artificial para a educação: uma entrevista com Chatgpt. Revistal Digital FAPAM, v. 12, n. 1, p. 1-20, 2023.
75	CENTURIÓN, Diosnel. A inteligência artificial: investir no futuro da educação. InterEduc, v. 1, n. 1, p. 19-19, 2023.
76	DOS SANTOS, Ademar Alves et al. A aplicação da inteligência artificial (ia) na educação e suas tendências atuais. Cuadernos de Educación y Desarrollo, v. 15, n. 2, p. 1155-1172, 2023.
77	GOMES, Fabiana Fagundes Barros et al. Contribuições da inteligência artificial no contexto educativo. Revista Ilustração, v. 4, n. 2, p. 37-46, 2023.

Seventy-seven articles were found in the databases, but two were repeated, leaving 75 for review.

The qualitative analysis of the seventy-five text articles reveals a significant diversity of approaches to applying Artificial Intelligence (AI) in Education, reflecting the field's breadth and depth. From an analysis categorization perspective, the selected material ranges from specific studies on the application of AI in educational contexts to investigations into the potential impact of AI on the development of teaching and learning methodologies based on the main trends and dimensions of analysis identified, namely: (1) Practical Applications of AI in Education - personalization of learning, intelligent tutoring systems and adaptive platforms. There is a significant focus on how AI can be used to create more adaptive and personalized learning environments, meeting individual student needs; (2) Ethical Challenges and Implications - Issues such as data privacy, algorithmic bias and digital inclusion are frequently discussed, pointing to the need for an ethical and responsible implementation of AI in the education sector; (3) Active Methodologies and Pedagogical Innovation - Another significant dimension found in the analysis is the relationship between AI and the development of active learning methodologies. Some studies explore how AI tools, including chatbots and virtual assistants, can be integrated into flipped classroom methodologies to promote more student-centred learning; (4) Teacher Training and Professional Development - The need for ongoing teacher training to effectively incorporate AI into their teaching practices is a recurring theme. There is recognition of the importance of equipping educators with the skills needed to utilize AI technologies critically in educational contexts; (5) Impact on Teaching and Learning -Several works discuss the potential impact of AI on the teaching-learning process, including improving student performance, encouraging critical thinking and promoting autonomous learning.

The integration of AI in the educational sector is perceived as a potentially transformative force capable of promoting more personalized, inclusive education adapted to the needs of the 21st century. However, realizing this potential depends on a critical, ethical, collaborative approach between educators, technology developers, and policymakers. Regarding keyword recurrences, these can be identified and/or grouped into main categories, reflecting the predominant focuses of the studies:

1. Practical Applications of AI: Artificial Intelligence, pedagogical robotics, intelligent tutoring systems, personalized learning.

2. Teaching Methodologies: active methodologies, flipped classroom, online collaborative learning, and technology-mediated education.

3. Ethics: data privacy, algorithmic bias, digital inclusion, and equity issues.

4. Teacher training: in-service teacher training and digital skills for educators,

5. Theoretical Approaches: problem-solving theory, prompt literacy, and learning theories applied to AI.

6. Teaching and Learning: personalization of teaching, benefits of AI in education, and reconfiguration of teaching practice.

7. Emerging Technologies: metaverses in education, education 4.0, disruptive artificial intelligence, and chatbots for student support.

These keywords reflect the growing interest in exploring how AI can enrich the educational experience for both students and teachers, addressing issues of pedagogical effectiveness, ethics, digital inclusion and teacher training.

CHAPTER 1: CHATGPT IN CREATING MORE ENGAGING AND ADAPTABLE EDUCATIONAL CONTENT

From creating personalized and interactive content to supporting teachers and promoting inclusion, ChatGPT represents a promising educational tool. Understanding its potential applications is essential for teachers, researchers, and policymakers seeking to harness the benefits of ChatGPT responsibly and effectively.

Teachers can leverage ChatGPT to automate specific tasks, such as creating quizzes, generating examples, and providing supplementary materials. This automation allows teachers to focus more on individual student interaction and higher-level teaching responsibilities, as referenced in Bloom's New Taxonomy.

Exploring ChatGPT in education contributes to a broader dialogue about the role of AI in shaping the future of education. It offers insights into how emerging technologies can be leveraged to support diverse and dynamic learning environments [3].

While ChatGPT presents itself as a revolutionary tool for personalized learning, a hybrid approach that combines the strengths of AI with the irreplaceable qualities of human teachers offers a more effective educational model [7] [9]. ChatGPT is a powerful tool, but it should be used as a complement to traditional educational methodologies.

Currently, teachers often need to work on teaching and administrative responsibilities, which can undermine their primary role of imparting knowledge to their students through their teaching practice.

Teachers today face classrooms with a wide variety of learning needs, which makes their role in serving each student individually challenging.

ChatGPT can help with tasks like tracking student progress, answering frequently asked questions about curricula, or even scheduling parent-teacher conferences, freeing teachers to focus more on teaching [8].

While the teacher provides general instruction, ChatGPT can serve as an on-demand assistant for students who need additional clarification, allowing teachers to manage diverse learning needs effectively.

Teachers can use ChatGPT to create or reflect educational content, from creating quiz questions to formulating real-world examples to explain complex concepts.

In schools where blended learning is implemented, ChatGPT can complement in-person instruction by offering students an AI-driven platform as additional support.

Teachers looking to stay current or familiarize themselves with new educational trends can use ChatGPT as a resource to provide information or answer questions. They can use ChatGPT to collect student feedback, analyse common problems, and adapt their teaching strategies according to their student's individual needs.

When administrative tasks are streamlined, teachers can engage more deeply with their students, leading to better student-teacher relationships and learning outcomes.

With tools like ChatGPT, teachers always have a resource to assist their professional development.

With the assistance of AI, teachers can better serve students from diverse classes, ensuring that no student is left behind [10].

ChatGPT, when well-integrated, can be a powerful ally for teachers, expanding their reach and effectiveness. It is not about replacing the human touch in education but about increasing the capabilities of teachers, allowing them to do what they do best – inspire and educate future generations [8].

CHAPTER 2: CHATGPT IN CREATING INTERACTIVE LEARNING MATERIALS

The era of unimodal and autonomous learning techniques is disappearing, paving the way for an era in which diverse and integrated approaches begin to complement each other. ChatGPT, in harmony with other advanced technologies, is at the forefront of this evolution, promising richer, more comprehensive, and personalized learning experiences for everyone [10].

ChatGPT's ability to generate text allows for creating interactive and engaging learning materials. ChatGPT can create content related to students' needs and interests, from personalized textbooks to conversational study guides [5] [11].

Auditory students: These students benefit most from hearing information orally. Although ChatGPT is primarily text-based, its integration with voice-enabled devices or text-to-speech technologies can make it an invaluable tool for auditory students.

Visual students: Students who prefer to use images, maps, and graphic organizers to capture information. While ChatGPT can provide textual explanations, it can be paired with platforms that offer visual content, guiding students to infographics, diagrams, or video explanations (Figure 1).

Kinesthetic students: Individuals who learn best through practical experiences or physical activities. ChatGPT can provide step-by-step guidance for hands-on experiments and DIY (Do It Yourself) projects or suggest interactive platforms where kinesthetic students can actively engage [4] [11].

Pairing ChatGPT with more advanced educational technologies:

Virtual Reality (VR) immerses users in a simulated environment, giving them a first-hand experience of scenarios, places or events that would otherwise be impossible to visualize.

Imagine a virtual reality history lesson about ancient Rome, with ChatGPT as an interactive guide, answering questions and providing deeper information in real-time [11] [12].

Augmented Reality (AR) overlays digital information on the real world, improving understanding of concepts and content. For example, during an AR-based biology class, while students view the layers of human skin, ChatGPT can provide additional information or answer questions about each layer.

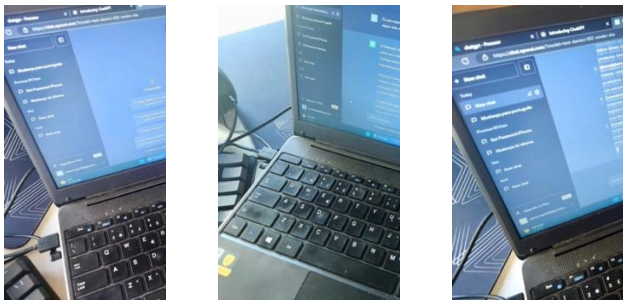

Fig. 1. Use of ChatGPT: students explored and worked on History content in a personalized and/or collaborative way.

In a virtual reality science lab, students can perform experiments while ChatGPT provides guidance, safety tips, and explanations of observed reactions [12] [13] [14]. Through AR glasses, students exploring a historic site can see overlapping facts. Together with ChatGPT, they can delve deeper into historical events, figures, or the meaning of certain artefacts. Kinesthetic students can engage in hands-on art projects as they create them, ChatGPT can explain techniques, offer suggestions, or provide the story behind specific art styles.

By making quality educational resources accessible, the global educational divide can be significantly reduced. However, for its potential to be fully achieved, it must be integrated thoughtfully into educational communities, considering local challenges and cultural characteristics.

CHAPTER 3: CHATGPT IN PROVIDING REAL-TIME FEEDBACK

The accelerated evolution of technology requires teachers to continually adapt and integrate new tools into their teaching methodology and pedagogical practices. Although human teachers provide a great personalized experience, they cannot be present 24/7 to serve all their students simultaneously. ChatGPT can. Each student gets a consistent quality of responses. Availability 24 hours a day, seven days a week; learning does not need to be limited by schedules. With ChatGPT, students can learn anytime, anywhere, helping them with self-paced learning. On the other hand, ChatGPT does not have fixed responses. Based on user prompts, can provide explanations suited to the user's level of understanding. For example, a primary school student and a university student can ask the same question and receive answers adapted to their educational levels [10]. Students can ask questions as they learn and receive immediate feedback. This real-time interaction can help resolve misconceptions immediately before they become more complex. ChatGPT can provide immediate and constructive feedback on each student's work, whether it is grammar correction, suggestions for improvement or answering questions; ChatGPT's real-time response enhances the learning experience and supports the student's academic growth [10] [12].

ChatGPT provides information and clarification instantly, meeting immediate learning needs. ChatGPT can facilitate learning across many domains, from science and arts to professional skills. Over time, interactions with a student allow ChatGPT to recognize patterns in a given student's questions and answers, enabling even more personalized assistance [14] [15].

CHAPTER 4: CHATGPT IN FACILITATING COLLABORATIVE LEARNING ENVIRONMENTS

The student can stimulate group discussions and collaborative problem-solving by generating prompts, questions and scenarios, promoting a more interactive learning experience.

ChatGPT's natural language processing capabilities make it a valuable tool for language learning and supporting students from diverse linguistic backgrounds. It can also be used to create accessible content for students with some disability, increasing their inclusion in education.

Use of ChatGPT in a disadvantaged school: Example of a school located in a rural environment where resources were limited and the teacher-student ratio was high. The introduction of ChatGPT allowed students to receive more personalized attention, leading to improved test scores and greater engagement.

Special Education Needs: Personalized learning is crucial in special education. ChatGPT has been adapted to support students with specific needs, ensuring inclusion in the learning process (Figure 2).

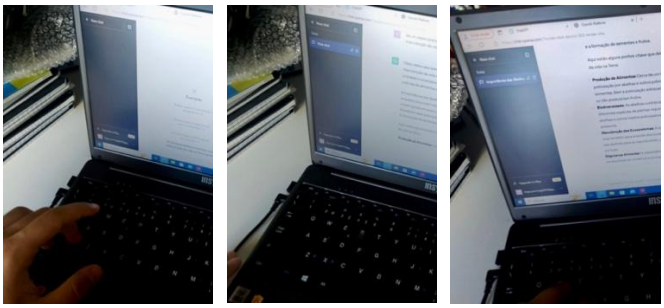

Fig. 2. Use of ChatGPT: students explored and worked on Sciences content in a personalized and/or collaborative way

CHAPTER 5: CHATGPT IN FACILITATING PERSONALISED LEARNING EXPERIENCES FOR STUDENTS

Each student has a unique learning style and pace. Personalized learning is an educational approach in which teaching methods and learning experiences are tailored to each student's needs, interests, and background. It contrasts with the traditional "one-size-fits-all" teaching method.

Personalized learning recognizes this diversity, ensuring that each student can learn in an environment best suited to their needs, leading to better learning outcomes and greater student engagement in their academic journey.

ChatGPT can help create personalized learning paths by analysing learner performance and preferences. These

personalized experiences can guide students through subjects at their own pace, adapting to their unique learning styles and needs (Figure 3).

Students can chart their educational path based on their interests, needs and academic goals, with ChatGPT offering guidance along the way.

Through interactions, ChatGPT can identify areas where a student may need more understanding or practice, helping to identify skill gaps in some students [13].

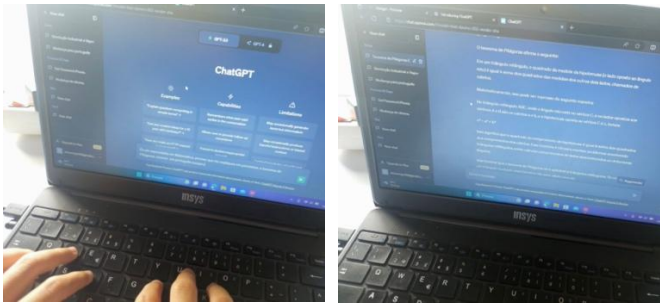

Fig. 3. Use of ChatGPT: students explored and worked on Mathematics content in a personalised and/or collaborative way.

Challenges and Considerations:

Regarding Depth vs. Breadth, although ChatGPT offers a wide range of information, students need assurance that they achieve the expected depth in specific areas essential to their academic goals.

Regarding Motivation and Discipline, self-directed learning requires high involvement, motivation, and discipline, which may be challenging for some students [15].

Although ChatGPT is designed to provide accurate data, students should cultivate the habit of cross-referencing with other reliable sources of information.

In the mosaic of continuous learning and skills development, ChatGPT plays a significant role. It presents opportunities to reshape how some individuals approach learning, adapt to educational changes and 'navigate' their academic paths. By harnessing the power of ChatGPT responsibly and strategically, the future of lifelong learning looks brighter, more meaningful, and more exciting.

CHAPTER 6: CHATGPT IN THE DEMOCRATISATION OF LEARNING

Quality and access to education are unevenly distributed across the world. While developed countries generally have robust educational infrastructures, developing countries need more resources, leading to significant disparities in academic outcomes.

Significant contrasts can exist between urban and rural, coastal, and inland educational resources within countries. Urban centres generally have better-equipped schools and more prepared teachers, while rural areas lag.

Accessibility influenced by economic factors can be a barrier. Many families cannot afford private tutoring or extra support, leading to significant disparities in learning outcomes and even in early dropout situations

ChatGPT offers a viable solution for many who cannot afford extra support, making it a powerful educational tool. With an Internet connection, ChatGPT can be accessed from anywhere and at any time, making it an accessible quality educational assistant for remote locations and those with needs of some type [12].

With the proliferation of smartphones, many students use ChatGPT as a complementary learning tool, overcoming the need for educational resources in their localities. Places with scarce educational resources but with an Internet connection (community or shared) allow students to access ChatGPT to obtain academic help.

Certain entities linked to the educational process use ChatGPT to reinforce extracurricular programs, allowing students to update themselves and stand out. As more people access quality education, social and economic inequalities tend to decrease.

ChatGPT breaks the boundaries of traditional classroom schedules, allowing students to participate when and where it is most convenient for them.

While ChatGPT can help in education, there is still a digital divide. Only some have access to the internet or reliable technological devices.

Thus, ChatGPT presents itself as a powerful tool in the search for the democratization of education.

In some communities, new technologies, especially in education, face resistance. The implementation of ChatGPT requires acceptance, involvement, and adherence on the part of the educational community [16].

As a powerful AI tool, ChatGPT is poised to play a vital role in helping every individual in the educational ecosystem on their ongoing learning journey [16].

CHAPTER 7: ETHICAL CONSIDERATIONS AND CHALLENGES

The ethical challenges associated with implementing ChatGPT in education are recognized, and concerns related to data privacy, possible biases in the model, the need for adequate training for teachers and the importance of ensuring that the technology does not increase educational inequalities are highlighted.

Implementing ChatGPT in educational environments requires careful consideration of data privacy and security. Model training and operation may involve using students' confidential information and raising concerns about how this data is collected, stored, and used. Because AI tools often require data to function optimally, concerns arise about what data is collected, how it is stored, and who has access to it. Without proper protection, students' confidential information can be accessed by malicious entities or used for unauthorized purposes. Implementing strong encryption, allowing users to opt out of data collection, and ensuring transparent data handling practices can alleviate these concerns.

ChatGPT can provide vast information but sometimes needs to offer the depth or nuance that expert teachers do. ChatGPT was trained on large amounts of text data, which may contain biases in the source material. These deviations can be inadvertently replicated in the model output, leading to potential ethical issues and representation in educational content. AI tools learn from large amounts of data. If this data has deviations (intentional or not), AI can reproduce it. Biased AI can perpetuate stereotypes, misinform students, and create a non-inclusive learning environment. Regularly updating training data, utilizing multiple data sources, and actively seeking feedback from a broad user base can help reduce bias [17]. No AI is infallible. There is a possibility of errors or outdated information. Although ChatGPT is a powerful learning tool, exclusive dependence can prevent students from accessing diverse perspectives and critical interpersonal interactions. Encouraging students to cross-check the information received with other reliable sources is crucial.

Effective integration of ChatGPT into education requires adequate training for teachers. Teachers must be equipped with the knowledge and skills to use ChatGPT responsibly and align it with pedagogical objectives. On the other hand, ChatGPT can change the dynamics of human interaction in educational environments. Concerns about the potential reduction of human-to-human engagement and the role of AI in shaping student-teacher relationships must be addressed carefully. Assessing the effectiveness of ChatGPT in achieving educational results is a complex challenge. Rigorous evaluation methods must be developed to understand the impact of ChatGPT on learning, engagement, and overall educational quality. Only with a balanced and vigilant approach can we ensure that ChatGPT serves as a genuine asset in the field of education [7].

Ensuring that ChatGPT is accessible to all students, regardless of their socioeconomic background, language proficiency or disabilities, is a critical challenge. Inclusion should be a central concern in designing and implementing educational tools based on ChatGPT [17].

Chapter 8: Future path of AI in education

With AI already leaving an indelible and unequivocal mark on education, it is crucial to look to the future and imagine how this synergy can evolve, shaping the future of teaching and learning. Predictions for the next 5 to 10 years in educational technology [10].

Using AI data analysis capabilities, educational tools can select individual learning paths, adapting to each student's progress and preferences in real time.

Beyond the traditional classroom, technologies like VR and AR, powered by AI, will transport students to simulated environments, from historical eras to molecular structures.

Traditional testing can give way to continuous AI-driven assessments, assessing a student's proficiency based on regular interactions and tasks, ensuring a holistic view of their capabilities [14].

Tools like ChatGPT can break down geographic and economic barriers, offering quality educational resources to students everywhere, regardless of their characteristics and circumstances.

As content evolves and new information emerges, AI can help teachers stay up to date, ensuring they always bring the latest knowledge to their students.

AI tools can support students with learning difficulties or who need extra help, ensuring no student is left behind.

Collaborative opportunities between teachers and technologists. By working together, teachers and technologists can create AI-powered curricula that unite curriculum knowledge with cutting-edge technology, resulting in interactive, effective, and engaging learning experiences.

Education policymakers are crucial in defining guidelines for incorporating AI into education, ensuring its ethical use, data privacy and equitable access. Collaborative dialogues between everyone involved can help develop progressive and protective policies [13].

REFERENCES

[1] Aoun, J. E. (2017). Robot-Proof: Higher Education in the Age of Artificial Intelligence. The MIT Press.

[2] Furey, H., & Martin, F. (2019). *AI education matters: a modular approach to AI ethics education*. Association for Computing Machinery (ACM).

[3] Lee, J., Lamb, R., & Kim, S. (2021). *Artificial Intelligence and Learning*. Oxford University Press.

[4] Su, J., & Yang, W. (2022). 'Artificial intelligence in early childhood education: A scoping review'. *Computers and Education: Artificial Intelligence.*

[5] Sprague, N. (2022). AI education matters: Model AI assignment. *AI Matters*, 7(4), 8-11. Association for Computing Machinery (ACM).

[6] Yu, S., & Lu, Y. (2021). *Introduction*. Springer Singapore.

[7] Popenici, SAD, & Kerr, S. (2017). 'Exploring the impact of artificial intelligence on teaching and learning in higher education'. *Research and Practice in Technology Enhanced Learning, 12(1),* 1-13.

[8] Johnson, W. L., & Lester, J. C. (2016). 'Face-to-face interaction with pedagogical agents, twenty years later'. *International Journal of Artificial Intelligence in Education, 26(1)*, 25-36.

[9] OpenAI. (2020). ChatGPT: Overview and applications. OpenAI Press.

[10] Brown, E. T. (2015). 'Educational technology, reimagined'. *New Directions for Community Colleges, 2015 (172),* 25-32.

[11] Chen, H., Engkvist, O., Wang, Y., Olivecrona, M., & Blaschke, T. (2018). 'The rise of deep learning in drug discovery'. *Drug Discovery Today, 23(6)*, 1241-1250.

[12] Weller, M. (2018). 'Twenty years of EdTech'. *EDUCAUSE Review, 53(4)*, 34-48.

[13] Reimers, F., & Schleicher, A. (2020). A framework to guide an education response to the COVID-19 Pandemic of 2020. OECD.

[14] Russell, S. J., & Norvig, P. (2020). *Artificial Intelligence: A Modern Approach*. Pearson Education Limited.

[15] du Boulay, B., Mitrovic, A., & Yacef, K. (2023). *Introduction to the Handbook of Artificial Intelligence in Education*. Edward Elgar Publishing.

[16] Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence Unleashed: An argument for AI in Education*. Pearson.

[17] Bostrom, N., & Yudkowsky, E. (2014). 'The ethics of artificial intelligence'. *The Cambridge handbook of artificial intelligence, 1*, 316-334.