

The educational challenges of ChatGPT*

Geoffrey Vaughan^a, Ádám Kovács^{a,b}, Zoltán Szűts^a

^aEszterházy Károly Catholic University
geoffrey.vaughan@uni-eszterhazy.hu
kovacs2.adam@uni-eszterhazy.hu
szuts.zoltan@uni-eszterhazy.hu

^bUniversity of Debrecen, Doctoral School of Informatics

Abstract. In 2023, ChatGPT exploded onto the educational scene and started fostering a myriad of research endeavors exploring the utilization of artificial intelligence in education [8, 38]. Many scholars argue that discerning between AI-generated and original academic work has become increasingly challenging, a testament to AI's evolving capability [16]. This paper focuses on the pivotal role of education professionals in mediating the integration of such digital technologies, a key aspect as AI becomes a standard in education. It provides a thoughtful analysis of the prospective advantages and challenges of employing ChatGPT from a techno-realist perspective and formulates precise research questions to evaluate its impact on learning. Our goal is to critically explore whether ChatGPT and related AI technologies serve as assets or disadvantages in education, shedding light on the unavoidable challenges encountered during their incorporation.

Keywords: ChatGPT, artificial intelligence, learning, digital pedagogy

1. Introduction

ChatGPT, an innovation by OpenAI, is a representation of generative artificial intelligence technology, responding to user queries by leveraging Large Language Models (LLM). The rapid assimilation of this technology since its debut has set records in the domain of technological advancements. As reported by Reuters in February 2023, ChatGPT achieved an estimated 100 million active monthly users in January, establishing itself as the fastest proliferating customer application to

*This paper was supported by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences.

date [24, p. 1].

The advent of this technology, alongside comparable developments like Microsoft's Bing and Google's Bard, has ignited extensive discussions and concerns in the educational sector, given the profound implications of these AI-driven tools on learning methodologies and environments.

With the inception of LLMs, the landscape of global education at various levels has undergone significant transformations. Clark elucidates:

AI is not just a learning technology, it is a technology that learns. AI is transforming the way we live and work, and as it continues to evolve, its impact on learning is only going to become more profound [10, p. 227].

Given the transformative nature of AI, it is crucial to align research focus on pragmatic and evidence-based evaluations of the potential merits and challenges posed by AI-driven technologies like ChatGPT in the learning domain. Our research philosophy adheres to a techno-realist perspective, emphasizing the necessity for an empirical approach to digital pedagogy practices beneficial for the education sector [38].

The fast-paced evolution in this field has prompted an influx of commentary, speculations, and discussions, predominantly in the form of media articles and opinion pieces. Several academic papers, including this one, are in the exploratory phase, deliberating the prospective benefits and challenges, such as [4, 8, 15, 25, 26, 35, 39, 42]. A handful of them [13, 22, 40] have adopted an empirical approach to study learner behavior using ChatGPT, while others have concentrated on the ethical considerations and the impacts on assessment and professional development in higher education [1, 2, 12, 19, 23, 28, 30–32, 35, 41].

This research provides insights and prompts further exploration into the potentials and implications of generative AI technology, emphasizing its significance as knowledge of such innovations becomes widespread.

2. Exploring the dimensions of AI in education

2.1. Advantages

Zhai introduces the positive benefits of using ChatGPT for learning:

The potent functions of interaction, reasoning, questioning, and feedback showcased by ChatGPT offer novel opportunities for educational transformation [39, p. 1].

Zhou et al. in their investigation of ChatGPT 3.5 against previous versions (3 and InstructGPT) raise a number of potential advantages of ChatGPT, headlined as “Generalization”, “Correction”, “Safety” and “Creativity” [42, p. 2]. In their other conclusions, the authors emphasise one distinct advantage: “we believe that

ChatGPT is changing the usage of traditional search engines and causes a deep impact on this field” [42, p. 5].

Deng and Lin, whilst focusing on the business benefits and dangers of ChatGPT, also recognise similar advantages: “Increased efficiency”, “Improved accuracy” and “Cost savings” [15, p. 82]. Rudolph et al. provide a wealth of evidence both for and against the use of such technology in higher education, especially concerning assessment. In reflecting on the general capacity of ChatGPT for higher education use the author’s state, “in the rapidly expanding field of education technology, AIED represents an opportunity to demonstrate a broad spectrum of tools and applications at an entirely new level” [35, p. 9]. Chen et al. come to a similar conclusion:

AI systems are likely to be used more widely, which is expected to thrive on all aspects of students, i.e., personal skill, knowledge mastery, learning ability, and career development, instead of just assisting students in understanding specific knowledge [8, p. 14].

2.2. Challenges

The challenges facing education with regards to using ChatGPT are significant, so some schools and districts in the US have reacted with surprising speed and have banned the algorithm [3]. Banning ChatGPT may be because schools do not want students to use ChatGPT to circumvent learning or to share information from dubious sources with others. Indeed, ChatGPT can also write an essay or solve a maths problem on demand. In addition, schools may feel that using ChatGPT can affect students’ writing skills and human communication.

Cheating and plagiarism stand out as the most distinctive educational challenges. Cotton et al., in outlining these challenges and providing suggestions for combating them in higher education, conclude that:

These tools also raise a number of challenges and concerns, particularly in relation to academic honesty and plagiarism. ChatAPIs and GPT-3 can be used to facilitate cheating, and it can be difficult to distinguish between human and machine-generated writing [12, p. 6].

Neumann et al. in their analysis of pre-print (grey) academic literature highlight 5 challenges (C1–5) that ChatGPT poses for education. These are summarised as: “C1: Unknown handling by students, C2: Heterogeneous evaluation C3: Acceptable/unacceptable use of ChatGPT C4: More time-consuming assessments C5: Unknown potential” [31, p. 3]. By analysing from the “grey” literature the authors identify what could be seen as more valid, live concerns at this stage of ChatGPT use.

2.3. Ethical considerations

Ethical considerations of the use of AI generative applications are becoming increasingly significant. Already, many international educational establishments and

organisations have drawn up ethical guidelines for the use of Artificial Intelligence in regions, countries, and organisations. The 2021 EU AI Act seeks to regulate the use of AI across Europe. The European Trade Union Committee for Education position paper states five “key demands of education trade unions on the impact of ChatGPT and other generative artificial intelligence on the teaching profession” [17]. The European Universities Association Learning and Teaching Steering Committee [18] released an initial position statement with regard to the use of ChatGPT and similar technologies.

Our research work is informed by local, national, and international ethical and legal developments pertaining to this field and the research team will also act as a partner in the development of organisational, local, national, and international AI policy. These considerations provide the initial focus domains for the research of generative AI technology such as ChatGPT for learning which are proposed below.

3. Research design and methods

Four initial domains frame our research stage with accompanying questions: Teaching, Learning, Assessment, and Evaluation.

Domain 1: Teaching Teachers across all education sectors are under increasing time pressure. Many of the administrative and resource production tasks that currently overburden teachers across all educational phases can be offloaded to AI generative tools. Clark recognises the advantages that teachers can possibly benefit from:

It is not the case of dispensing with teachers, but reducing workload, giving them support, and raising their game. Teachers should welcome something that takes away the administration and pain, so let us embrace possible solutions [9, p. 75].

Academics and teachers need as many ways to reduce the ineffective administrative burdens to concentrate on the essential nature of pedagogy: helping students learn.

Learning curation is essential to learning. With careful prompting, sophisticated learning content and resources can be produced and curated in a fraction of the time that they would normally have taken teachers to create. Fitzpatrick [20] has called this the “PREP prompting method”. Intelligent prompting produces output that can then be checked for accuracy by the expert teacher, curated through the learning management system, and delivered in the classroom saving hours of preparation time. Specific applications that combine text with image and video are already aligning with ChatGPT and other generative chat tools across the major platforms. We are seeing the real-life integration of tested e-learning theory with regards to “multimedia presentation” [11, p. 70].

In addition, where learning occurs is an important factor. With the proliferation of personal smartphones, the mobility of learning has elevated to an unprecedented level, allowing for continuous access to knowledge 24/7, both within and beyond traditional educational environments. In this evolving technological paradigm, parental expertise and guidance become paramount, especially in relation to the application of generative AI tools for educational purposes at home.

Teachers across all sectors need to be provided with effective training and ongoing professional development in using this new technology efficiently and effectively. Academic guides are beginning to be published that address the professional development needs of educators using this technology. Atlas [2] provides a thorough academic guide that would serve academia well in terms of initial professional development training. In England, there has been a flourishing of evidence-informed and research-aligned teacher professional development. Figure 1 shows Sherrington and Goodwin's [37] professional development "Five Ways To..." series, which has seen huge take up from the teaching profession. Training and ongoing professional development about ChatGPT and generative technology must develop teachers' ability to understand and use the technology in a practical, rational manner that supports their professional practice.

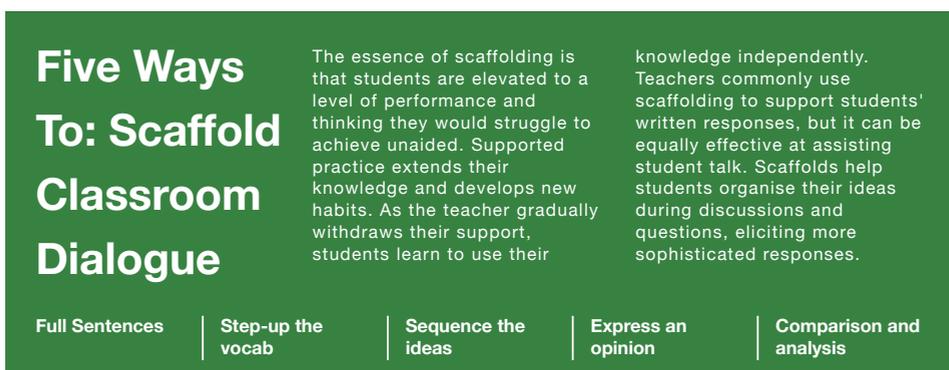


Figure 1. Five Ways to: Scaffold Classroom Dialogue.

Research focus 1: Teaching

- How can generative AI technology such as ChatGPT reduce teacher workload?
- How can generative AI technology such as ChatGPT improve teaching content quality and curation to ensure maximum impact for learning?

Domain 2: Learning At the heart of learning is the learner's ability to interact with content. This functionality is starting to appear across the major learning platforms. The new KhanAcademy adaptive technology, Khanmigo and the initial

release of Microsoft's CoPilot, which introduces the intelligent tutor into everyday software are obvious examples. Adaptation through the use of AI generative tools and applications is likely to be at the forefront of AI for learning.

ChatGPT can engage each learner at the dialogic level that they are at, and, with the addition of voice activation, the dialogue will be increasingly conversational and realistic. Borkowsky stresses the importance of this dialogic approach to teaching and learning: "it's a very effective way to engage children and focus them on thinking and expressing themselves" [6, p. 59].

This return to a dialogic interaction with knowledge brings the learner far closer to their personal, individualised learning cognitive processes than has been able to be realised previously.

Generative AI technology such as ChatGPT also has the potential to deliver learning to those who have been economically the most difficult to reach, at potentially a minimal cost (a smartphone and an internet connection). Globally, the Organisation for Economic Co-operation and Development [33] reports that: "total public spending on education (from primary to tertiary level) averages 10.6% of total government expenditure across OECD countries". The implications for learning and for a drastically reduced economic investment for helping to support those who face more severe economic disadvantages are huge.

The importance of feedback in learning is crucial for student success. Black and Wiliam make it clear that "formative assessment can be a powerful weapon if it is communicated in the right way" [5, p. 8]. With ChatGPT learner feedback, in the form of formative assessment is immediate, personalised, and relevant, allowing for the learner to immediately see areas that they can improve upon. All these factors are hugely significant to the future of learning; promising to provide truly individual and adaptive learning content to all students.

Research focus 2: Learning

- How can generative AI technology such as ChatGPT be used to improve dialogic learning?
- How can access to generative and adaptive AI tools such as ChatGPT improve personalised learning for specific groups of learners (low socioeconomic status, special educational needs, high ability, EFL/ESL)?
- How can generative AI technology such as ChatGPT improve the quality and personalisation of learner feedback?

Domain 3: Assessment Changing approaches to assessment is a significant consideration in this new era of generative AI technology. Cheating and plagiarism are at the forefront of academic concerns with the adoption and adaptation of this new technology and they are going to remain so as the educational system develops its policies and practices to reflect this new reality. Dehouche details the concerns of plagiarism using the technology and in the conclusion of the opinion piece states:

“the advent of this powerful NLP technology calls for an urgent update of our concepts of plagiarism” [14, p. 22]. Cassidy [7] reports on the measures being taken by Australian universities to ban ChatGPT for assessment and Roose [34] reports on New York City public schools blocking access and Seattle schools restricting access to ChatGPT.

Several countries are now reconsidering a return to oral or pen/paper examinations to negate the possibility of plagiarised student submissions. Sankaranarayanan [36] poses the question, “Is there a place for oral exams in today’s fast-paced, hi-tech world?” and refers to European models of oral assessment (the French baccalaureate and Norwegian oral assessment practices). Indeed, the European model of oral assessment and, more locally, the strong Hungarian tradition of oral examination assessment could be poised for an assessment renaissance. Initial research work will look at whether the benefits of more traditional forms of personal examination assessment that have been an important element of the Hungarian education system are a model that could influence international approaches to assessment in the new era of concerns about the use of ChatGPT and assessment.

Ultimately, there may need to be a fundamental reconfiguring of what skills are needed to be assessed, particularly in the domain of written subject content. As Zhai emphasises:

To meet societal demands and evolving educational objectives, educators must consider innovative assessment tasks and evaluation forms that assess and improve these skills [39, p. 75].

Research focus 3: Assessment

- What are the issues, concerns, and possible solutions for assessment in the era of generative AI tools and applications?
- What, specifically, can the Hungarian education assessment model provide to international assessment research and development to influence assessment practice and policy?

Domain 4: Evaluation The field of education has often suffered from being unable to measure the effectiveness of a new technology or a new intervention. Indeed, it is often the cause of both scepticism and hostility within the profession to any new programme, strategy, or tool. These are valid concerns but they should be addressed through applied research that gives teachers increasing confidence about the use and effectiveness of new technological advances focused on learning outcomes.

Can evaluation of learning become more focused on learning and are there ways to capture learning data in the form of learning analytics that reflect this? A systematic review of empirical studies on learning analytics dashboards proposes a model, MULAS, with the core objective of optimizing learning. The MULAS model aims “to guide developers, researchers, evaluators, and practitioners in their

endeavors that aim to understand and optimize learning and environments in which learning occurs” [29, p. 16]. This model to evaluate learning is one that may have real benefits when it comes to evaluating learning improvement through the use of generative AI tools and applications such as ChatGPT.

Education needs to improve its ability to collect realistic and worthwhile data that relates to learning. That data capture may actually be more effective, especially in the initial stage of evaluating new technology, by being collected and analyzed on a smaller scale. Clark states that:

It is far better to focus on the use of data in adaptive learning or small-scale teaching and learning projects where relatively small amounts of data can be put to good use [9, p. 195].

Data analysis needs to show initial trends that can be analyzed, discussed, and shared by professionals in the education sector who will then be far more actively involved in the process of analysis to inform future pedagogical approaches.

Research focus 4: Evaluation

- How can the use of generative AI technology such as ChatGPT for learning be measured, disseminated, implemented, and evaluated?

This initial research overview has set out an outline of the specific pedagogic advantages and challenges of new generative AI technology such as ChatGPT and how these may be addressed through a research focus. The goal has to be to see if this new technology, which is with us here and now, truly has the ability to improve learning.

4. Results

In our theoretical exploration of the implications and effectiveness of AI generative tools like ChatGPT in education, we sought to answer several pertinent questions regarding their capability to transform educational practices and learning experiences. Our findings propose that tools like ChatGPT can significantly alleviate teacher workload by automating numerous administrative tasks and content curation, allowing educators more time to focus on instructional strategies and student interactions, thus potentially enhancing the efficacy and impact of teaching content.

Additionally, the investigation provided insights into the use of ChatGPT in enhancing dialogic learning, fostering environments where enriched and dynamic dialogues can occur, potentially aiding in the development of a more reflective and cooperative learning environment. By generating nuanced and diverse responses, it can facilitate meaningful interactions between students and between students and educators. Our scrutiny also highlighted the potential of such generative AI technology in creating more personalized and adaptable learning experiences for various groups of learners, such as those with special educational needs, high ability, and

EFL/ESL learners. By addressing individual learning needs and preferences, it offers tailored content and feedback, which is especially crucial for ensuring equitable access to quality education for learners from low socioeconomic backgrounds.

In response to concerns over assessment, our research suggests a critical examination of the validity and fairness of AI-mediated assessments is paramount, with the Hungarian educational assessment model emerging as a potential influencer in international assessment research, offering novel insights and solutions to shape assessment practices and policies in an AI-driven educational landscape.

Furthermore, the analysis underscored the need for a structured approach to measuring, disseminating, implementing, and evaluating the integration of AI tools in learning environments, with emphasis on continual assessment of their efficacy, reliability, and inclusivity. Comparing our theoretical insights with existing studies reveals a shared acknowledgment of the transformative potential and the inherent challenges of incorporating AI generative tools in education, and emphasizes the urgency for studies to unravel the complexities of AI integration in varied educational scenarios.

These assertions, grounded in theoretical analysis and literature, echo the necessity for nuanced discussions and rigorous empirical studies to validate the proposed benefits and to address the challenges of integrating AI tools in education, paving the way for informed implementations and ethical practices in AI-driven educational interventions.

5. Conclusion

The exploration and theoretical analysis of newly introduced AI technologies, particularly exemplified by ChatGPT, illuminate their transformative potential in the realm of education, whilst also bringing forth substantial challenges. The nuances of this technological evolution have sparked varied perspectives and dialogues within the academic and tech communities. Marcus [27] has vociferously critiqued the swift proliferation of generative AI chat applications by tech giants since the unveiling of ChatGPT in November 2022, emphasizing the urgent need for transparency and ethical considerations in their deployment. Conversely, Gates [21] envisions a future where AI-driven software significantly revolutionizes teaching and learning methodologies within the next decade.

The detailed theoretical exploration conducted in this paper has aimed to bridge the gap between optimistic projections and critical viewpoints, offering a balanced, techno-realist perspective on the opportunities and impediments presented by ChatGPT and similar innovations. It has underlined the imperative for the education sector to engage in informed, evidence-based discussions and strategies to navigate the intricate landscape of AI enlightenment effectively. Our findings, grounded in theoretical conjectures and existing literature, serve as a precursor to more rigorous empirical research required to validate the implications and challenges of integrating AI in diverse educational settings. The highlighted potential benefits and challenges necessitate extensive, focused, and meticulous research en-

deavors to foster a comprehensive and nuanced understanding of the implications of intertwining AI with education.

In conclusion, this paper's theoretical discourse seeks to contribute to the ongoing dialogue on AI's role in education, emphasizing the need for empirical validations and robust academic discussions to refine the understanding of the multifaceted impacts of AI tools in educational environments.

References

- [1] J. K. M. ALI, M. A. A. SHAMSAN, T. A. HEZAM, A. A. Q. MOHAMMED: *Impact of ChatGPT on Learning Motivation: Teachers and Students' Voices*, Journal of English Studies in Arabia Felix 2.1 (Mar. 2023), pp. 41–49, DOI: [10.56540/jesaf.v2i1.51](https://doi.org/10.56540/jesaf.v2i1.51).
- [2] S. ATLAS: *ChatGPT for Higher Education and Professional Development: A Guide to Conversational AI* (Jan. 2023), URL: https://digitalcommons.uri.edu/cba_facpubs/548.
- [3] D. AVERY: *New York City Schools Ban ChatGPT Amid Cheating Worries*, Jan. 2023, URL: https://www.cnet.com/tech/computing/new-york-city-schools-ban-chatgpt-amid-cheating-worries/?fbclid=IwAR1IoRK6yvLuD86cBylf8JHNjdJUM-5nhm_Bx00Hd2jLsolPdIU5qV2DTMw (visited on 03/31/2023).
- [4] Ö. AYDIN, E. KARAARSLAN: *Is ChatGPT Leading Generative AI? What is Beyond Expectations?* (Jan. 2023), DOI: [10.2139/ssrn.4341500](https://doi.org/10.2139/ssrn.4341500).
- [5] P. BLACK, D. WILLIAM: *Inside the Black Box: Raising Standards through Classroom Assessment*, Phi Delta Kappan 92 (Sept. 2010), pp. 81–90, DOI: [10.1177/003172171009200119](https://doi.org/10.1177/003172171009200119).
- [6] F. BORKOWSKY: *"If Only I Would Have Known...": What I wish the Pediatrician would have told me about Language, Literacy, and Dyslexia*, New York: High Five Literacy Publishing, 2019, ISBN: 9781734068801.
- [7] C. CASSIDY: *Australian universities to return to 'pen and paper' exams after students caught using AI to write essays*, Jan. 2023, URL: <https://www.theguardian.com/australia-news/2023/jan/10/universities-to-return-to-pen-and-paper-exams-after-students-caught-using-ai-to-write-essays> (visited on 03/31/2023).
- [8] L. CHEN, P. CHEN, Z. LIN: *Artificial Intelligence in Education: A Review*, IEEE Access 8 (2020), pp. 75264–75278, DOI: [10.1109/ACCESS.2020.2988510](https://doi.org/10.1109/ACCESS.2020.2988510).
- [9] D. CLARK: *Artificial Intelligence for Learning: How to use AI to Support Employee Development*, London, New York, Daryaganj: Kogan Page, 2020, ISBN: 9781789660821, URL: <https://books.google.hu/books?id=bhnODwAAQBAJ>.
- [10] D. CLARK: *Learning Technology (1st ed.)* London, New York, Daryaganj: Kogan Page, 2023, ISBN: 9781398608764, URL: <https://books.google.hu/books?id=7ICHEAAAQBAJ>.
- [11] R. C. CLARK, R. E. MAYER: *e-Learning and the Science of Instruction (4th ed.)* Hoboken: John Wiley & Sons, Ltd, 2016, chap. 4, pp. 67–87, ISBN: 9781119239086, DOI: [10.1002/9781119239086.ch4](https://doi.org/10.1002/9781119239086.ch4).
- [12] D. R. E. COTTON, P. A. C. COTTON, J. R. SHIPWAY: *Chatting and cheating: Ensuring academic integrity in the era of ChatGPT*, Innovations in Education and Teaching International 0.0 (Mar. 2023), pp. 1–12, DOI: [10.1080/14703297.2023.2190148](https://doi.org/10.1080/14703297.2023.2190148).
- [13] J. CRAWFORD, M. COWLING, K.-A. ALLEN: *Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI)*, Journal of University Teaching and Learning Practice (JUTLP) 20 (2023), DOI: [10.53761/1.20.3.02](https://doi.org/10.53761/1.20.3.02).
- [14] N. DEHOUCHE: *Plagiarism in the age of massive Generative Pre-trained Transformers (GPT-3)*, Ethics in Science and Environmental Politics 21 (Mar. 2021), pp. 17–23, DOI: [10.3354/sep00195](https://doi.org/10.3354/sep00195).

- [15] J. DENG, Y. LIN: *The Benefits and Challenges of ChatGPT: An Overview*, *Frontiers in Computing and Intelligent Systems* 2.2 (Jan. 2023), pp. 81–83, DOI: [10.54097/fcis.v2i2.4465](https://doi.org/10.54097/fcis.v2i2.4465).
- [16] H. ELSE: *Abstracts written by ChatGPT fool scientists*, *Nature* 613.7944 (2023), p. 423, DOI: [10.1038/d41586-023-00056-7](https://doi.org/10.1038/d41586-023-00056-7).
- [17] EUROPEAN TRADE UNION COMMITTEE: *The impact of ChatGPT on the teaching profession*, Mar. 2023, URL: <https://www.csee-etuice.org/en/news/etuice/5128-the-impact-of-chatgpt-on-the-teaching-profession> (visited on 03/31/2023).
- [18] EUROPEAN UNIVERSITY ASSOCIATION'S LEARNING AND TEACHING STEERING COMMITTEE: *Artificial intelligence tools and their responsible use in higher education learning and teaching*, Feb. 2023, URL: <https://eua.eu/resources/publications/1059:artificial-intelligence-tools-and-their-responsible-use-in-higher-education-learning-and-teaching.htm> 1 (visited on 03/31/2023).
- [19] R. FIRAINA, D. SULISWORO: *Exploring the Usage of ChatGPT in Higher Education: Frequency and Impact on Productivity*, *Buletin Edukasi Indonesia* 2.1 (Mar. 2023), pp. 67–74, DOI: [10.56741/bei.v2i01.310](https://doi.org/10.56741/bei.v2i01.310).
- [20] D. FITZPATRICK: *AI Won't Replace Teachers, but it will replace teachers who don't use AI*. Feb. 2023, URL: <https://www.linkedin.com/pulse/ai-wont-replace-teachers-who-dont-use-dan-fitzpatrick/?trk=pulse-article> (visited on 03/31/2023).
- [21] B. GATES: *The Age of AI has begun*, Mar. 2023, URL: <https://www.gatesnotes.com/The-Age-of-AI-Has-Begun> (visited on 03/31/2023).
- [22] D. GRUDA, J. A. SCHERMER: *C-H-A-T-G-P-T, Find Out What it Means To Me: ChatGPT, Artificial Intelligence, and the Study of Individual Differences* (Mar. 2023), DOI: [10.31234/osf.io/5ctfq](https://doi.org/10.31234/osf.io/5ctfq).
- [23] M. HALAWEH: *ChatGPT in education: Strategies for responsible implementation*, *Contemporary Educational Technology* 15 (Mar. 2023), DOI: [10.30935/cedtech/13036](https://doi.org/10.30935/cedtech/13036).
- [24] K. HU: *ChatGPT sets record for fastest-growing user base - analyst note*, Feb. 2023, URL: [https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/#:~:text=Feb%5C%201%5C%20\(Reuters\)%5C%20%5C%2D%5C%20ChatGPT,a%5C%20UBS%5C%20study%5C%20on%5C%20Wednesday.](https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/#:~:text=Feb%5C%201%5C%20(Reuters)%5C%20%5C%2D%5C%20ChatGPT,a%5C%20UBS%5C%20study%5C%20on%5C%20Wednesday.) (visited on 03/31/2023).
- [25] C. KARTHIKEYAN: *Literature Review on Pros and Cons of ChatGPT Implications in Education*, *International Journal of Science and Research (IJSR)* 12 (Mar. 2023), pp. 283–291, DOI: [10.21275/SR23219122412](https://doi.org/10.21275/SR23219122412).
- [26] E. KASNECI ET AL.: *ChatGPT for good? On opportunities and challenges of large language models for education*, *Learning and Individual Differences* 103 (Jan. 2023), p. 102274, DOI: [10.35542/osf.io/5er8f](https://doi.org/10.35542/osf.io/5er8f).
- [27] G. MARCUS: *The Sparks of AGI? Or the End of Science?*, Mar. 2023, URL: <https://garymarcus.substack.com/p/the-sparks-of-agi-or-the-end-of-science> (visited on 03/31/2023).
- [28] R. MARUSENKO: *New challenges in assessing students' knowledge: chatbot ChatGPT and real-time deepfakes* (Feb. 2023), DOI: [10.13140/RG.2.2.21715.25120](https://doi.org/10.13140/RG.2.2.21715.25120).
- [29] W. MATCHA, N. A. UZIR, D. GAŠEVIĆ, A. PARDO: *A Systematic Review of Empirical Studies on Learning Analytics Dashboards: A Self-Regulated Learning Perspective*, *IEEE Transactions on Learning Technologies* 13.2 (2020), pp. 226–245, DOI: [10.1109/TLT.2019.2916802](https://doi.org/10.1109/TLT.2019.2916802).
- [30] D. MHLANGA: *Open AI in Education, the Responsible and Ethical Use of ChatGPT Towards Lifelong Learning*, *SSRN Electronic Journal* (Feb. 2023), DOI: [10.2139/ssrn.4354422](https://doi.org/10.2139/ssrn.4354422).
- [31] M. NEUMANN, M. RAUSCHENBERGER, E.-M. SCHÖN: *"We Need To Talk About ChatGPT": The Future of AI and Higher Education* (Mar. 2023), p. 4, DOI: [10.25968/opus-2467](https://doi.org/10.25968/opus-2467).
- [32] E. C. OPARA, A. M.-E. THERESA, C. A. TOLORUNLEKE: *ChatGPT for Teaching, Learning and Research: Prospects and Challenges*, *Glob Acad J Humanit Soc Sci* 5 (Mar. 2023), pp. 33–40, DOI: [10.36348/gajhss.2023.v05i02.001](https://doi.org/10.36348/gajhss.2023.v05i02.001).

- [33] ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT: *Education at a Glance 2022: OECD Indicators*, Paris: OECD Publishing, 2022, ISBN: 9789264341647, DOI: [10.1787/3197152b-en](https://doi.org/10.1787/3197152b-en).
- [34] K. ROOSE: *Don't Ban ChatGPT in Schools. Teach With It.* Jan. 2023, URL: <https://www.nytimes.com/2023/01/12/technology/chatgpt-schools-teachers.html> (visited on 03/31/2023).
- [35] J. RUDOLPH, S. TAN, S. TAN: *ChatGPT: Bullshit spewer or the end of traditional assessments in higher education?*, *Frontiers of Information Technology & Electronic Engineering* (Jan. 2023), DOI: [10.37074/jalt.2023.6.1.9](https://doi.org/10.37074/jalt.2023.6.1.9).
- [36] A. SANKARANARAYANAN: *Should we have more oral exams?*, Feb. 2023, URL: <https://www.thehindu.com/education/should-we-have-more-oral-exams/article66461975.ece> (visited on 03/31/2023).
- [37] T. SHERRINGTON, D. GOODWIN: *Five Ways to Scaffold Classroom Dialogue*, Dec. 2021, URL: <https://teacherhead.com/2021/12/01/five-ways-to-scaffold-classroom-dialogue/> (visited on 03/31/2023).
- [38] Z. SZÚTS: *A digitális pedagógia elmélete*, Budapest: Akadémiai Kiadó, 2020.
- [39] X. ZHAI: *ChatGPT and AI: The Game Changer for Education* (Mar. 2023), DOI: [10.13140/RG.2.2.31107.37923](https://doi.org/10.13140/RG.2.2.31107.37923).
- [40] X. ZHAI: *ChatGPT User Experience: Implications for Education* (Dec. 2022), DOI: [10.2139/ssrn.4312418](https://doi.org/10.2139/ssrn.4312418).
- [41] B. ZHANG: *Preparing Educators and Students for ChatGPT and AI Technology in Higher Education: Benefits, Limitations, Strategies, and Implications of ChatGPT & AI Technologies* (Jan. 2023), DOI: [10.13140/RG.2.2.32105.98404](https://doi.org/10.13140/RG.2.2.32105.98404).
- [42] J. ZHOU, P. KE, X. QIU, M. HUANG, J. ZHANG: *ChatGPT: potential, prospects, and limitations*, *Frontiers of Information Technology & Electronic Engineering* (Feb. 2023), DOI: [10.1631/FITEE.2300089](https://doi.org/10.1631/FITEE.2300089).