Open Peer Review on Qeios

The Future of Education and Human Development in The Era of Generative Pre-Trained Transformer (GPT) Models

Deepu Kurian[1], Amin Alizadeh[2], Courtney M Peebles[1]

1 University of Texas Health Science Center at San Antonio
2 University of Delaware

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

The impact of generative artificial intelligence (AI) on education and human development is currently unknown and may have substantial ethical implications in these fields. In this commentary, we discuss the nature of Generative Pre-trained Transformer (GPT) models that use deep learning to produce human-like text. This is an effort to understand how GPT models can support students, educators, and human development professionals to enhance learning while assisting in developing their professions. We conclude by outlining the need for policy decisions and ethical considerations on incorporating these technologies into educational and human development settings.

Deepu Kurian

UT Health Science Center, San Antonio

Amin Alizadeh

University of Delaware

Courtney M. Peebles

UT Health Science Center, San Antonio

Keywords: ChatGPT, AI, Machine Learning, Education.

Introduction

Movies like “The Terminator,” “iRobot,” and “The Minority Report” used to be science fiction, but recent artificial intelligence (AI) technological advances force us to redefine what it is to be a human and what we want as humans. The reality is that artificial intelligence has arrived in the present and many of us regularly interact with this technology in our

daily lives. We have been using virtual assistants like Siri and Alexa, without thinking that they are AI powered technology. This technology is reshaping society, economy, human development, and business by transforming experiences and relationships amongst stakeholders and citizens. Artificial general intelligence (AI) refers to machines being capable of performing any intellectual tasks that humans can. AI is defined as a new generation of technologies capable of interacting with the environment by (a) gathering information from outside (including from natural language) or other computer systems; (b) interpreting this information, recognizing patterns, deducing rules, or predicting events; (c) generating results, answering questions, or giving instructions to other systems; and (d) evaluating the results of their actions and improving their decision systems to achieve specific objectives (Ferras-Hernandez, 2018). AI experts predict that AI systems are likely to reach overall human ability by 2075 and that some experts feel that further progress of AI towards super intelligence may be bad for humanity (Dwivedi et. al,2021). According to OpenAI's founders, AI offers a fantastic opportunity for improving the world (Makridakis, 2017), with applications ranging across industries from self-driving cars to precision personalized medicine. Modern AI is developing in a manner that blurs the boundaries between specific areas of applications and has grabbed so much attention that people are seriously contemplating how to fit the tools into their daily lives and occupations.

For example, GPT (Generative Pre-trained Transformer) is an autoregressive language model, or a computation system designed to generate human-like text from a source input, often called the prompt. Generative Pre-trained Transformer (GPT) models use large amount of publicly available digital content data to read and produce human-like text in several languages and can exhibit creativity in writing from a paragraph to full research article convincingly (or so) on almost any topic. The first iteration of GPT in 2018 used 110 million learning parameters, a year later GPT-2 used 1.5 billion parameters, and GPT-3 used 175 billion parameters (Floridi & Chiriatti, 2020). It is trained on Microsoft Azure's AI supercomputer, on a wide range of use cases, including summarization, translation, grammar correction, question answering, chatbots, composing emails, and much more (Scott, 2020). The GPT-4 model was created with the aim of improving alignment between the model's output and user intentions (Open AI GPT 4 Research Blog, 2023). Compared to its predecessor, GPT-4 has shown better performance in terms of factual correctness and lower error rates; this does not mean that it cannot generate falsities on demand.

Chat Generative Pre-Trained Transformer commonly known as ChatGPT (OpenAI, 2022) released in November 2022 is a freely accessible artificial intelligence chatbot developed using human feedback. ChatGPT is a large language model (LLM), a machine-learning system that autonomously learns from data and can produce sophisticated and intelligent writing after training on a massive data set of text (van Dis et al., 2023). ChatGPT is one of the first models that can convincingly converse with its users in English and other languages on a wide range of topics. In contrast to earlier models of GPT, ChatGPT is highly interactive and capable of not only holding a realistic human-like conversation on a wide range of topics, but also producing convincing creative content. ChatGPT is the world's most advanced chatbot, reaching one million users in just five days after its initial launch. Multiple evaluations and tests have validated its capabilities, for example, ChatGPT was able to pass graduate-level exams from law and business schools (Kelly, 2023), and the recently released GPT-4 model achieved top 10% in a law test (Koetsier, 2023)

Individuals from all levels of society have already used ChatGPT and other large language models to write essays and

talks, academic planning, summarizing literature, draft, and improve papers, as well as identify research gaps and write computer code, including statistical analyses. The extraordinary abilities of ChatGPT to perform complex tasks within the field of education have caused mixed feelings among educators as this advancement in AI seems to revolutionize existing educational practices (Baidoo-Anu & Owusu, 2023). An impact survey (Walton Foundation, 2023) commissioned by the Walton Foundation found that teachers and students are using ChatGPT regularly and see it as a positive force in education. On the other hand, some faculty at American universities and elsewhere are in a state of panic, fearful that students will be able to use it to write term papers and essays by doing little more than typing in a few key words and allowing artificial intelligence to do the rest (McGee, 2023). Understandably, some perceive ChatGPT and related generative artificial intelligence (AI) as the future of education, while others view it as a threat to education activities and analytical thinking.

That AI will have a major impact on society is no longer in question, the current debate turns instead on how far this impact will be positive or negative, for whom, in which ways, in which places, and on what timescale (Floridi et.al,2018). AI systems are becoming increasingly sophisticated; however, they are not yet infallible and can still make mistakes or generate wrong output. (Haluza & Jungwirth, 2023). The advent of innovative technology often creates strong emotions, ranging from doomsday predictions to uncontrolled excitement (Rudolph, Tan & Tan, 2023). Thus, the purpose of this commentary is to review Generative Pre-trained Transformer (GPT) models like Chat GPT and how this technology impacts education and human development. We are not advocating whether the technology is inherently good or bad, but it certainly deserves further attention due to its capabilities. Due to the novelty of the topic, there are only a few peer-reviewed journal articles and preprints on ChatGPT and education sector. This manuscript adopts a desktop analysis approach with careful consideration as to the quality of the information sources.

Debate the Benefits

Artificial Intelligence (AI) has the potential to transform education by improving student learning outcomes, enhancing teaching practices, and optimizing educational processes. GPT is a valuable tool for providing information and answering questions in various fields, and it is clear AI will transform education in many ways. By leveraging the extraordinary capabilities of GPT-4 in natural language understanding and generation, students can access personalized and contextually appropriate information, expedite their knowledge acquisition processes, and develop more profound insights (First, 2023). However, it is important to acknowledge its limitations and supplement its use with other resources to ensure accurate and effective outcomes. In this section, we endeavor to highlight some of the positive impacts that GPT models could have on students' learning and creativity and human development.

One of the most significant impacts of AI in education is its ability to provide individualized learning paths for students based on their unique needs, learning styles, and abilities. Students can reap numerous benefits by harnessing the power of AI in their academic pursuits. By leveraging AI, students can benefit from (a) tutoring and personalized learning experiences, (b) ongoing and enhanced academic support, (c) improving efficiency in studies and (d) enhancing career readiness. The innovative technology can help educational institutions personalize students’ learning experiences

(Baidoo-Anu & Owusu Ansah, 2023). AI-driven educational platforms can evaluate individual strengths, weaknesses, and preferred learning methods, then tailor content and adjust teaching techniques to cater to that person's precise requirements. For example, if a student demonstrates a strong understanding of a specific concept, the system might present more challenging questions or propel them to the next subject. Conversely, if a student struggles with a concept, the system can provide additional explanations, examples, or practice exercises to reinforce understanding. This adaptive strategy ensures students receive personalized instruction based on their unique learning needs. This system can also provide immediate and targeted feedback to students by identifying areas for improvement and offering personalized suggestions for their learning journey. These systems can optimize the learning experience and help students progress at their own pace to achieve academic success (Baidoo-Anu, & Owusu Ansah, 2023).

AI-powered virtual assistants, like chatbots, are available to help 24/7 and can help students in resolving academic queries at any time or any location if there is an internet connection (Alam, 2021). Chatbots and virtual assistants can provide personalized language learning support, analyzing student behavior, and adapting content and delivery methods to suit each learner's needs. This adaptability guarantees students have the option to access academic assistance beyond typical class periods, including evenings, weekends, or holidays, when conventional human help might not be easily accessible. This system can manage numerous inquiries at the same time, making it possible to help a considerable number of students simultaneously without any wait time to receive support. This continual support can empower students to cultivate greater self-reliance and assurance in their pursuit of solutions to their educational inquiries. With the help of AI powered tools, students can explore complex concepts in new and immersive ways, making learning more engaging and exciting, providing real-time feedback and support to students based on their responses, and helping them improve understanding of complex concepts. Overall, AI-driven academic support systems enhance student learning experiences and academic performance with enormous potential to enhance personalized learning. Personalized learning will be one of the key benefits of AI in education, and as technology evolves, there will be more personalized learning experiences in the future.

Another revolutionary benefit of AI powered chatbots is that they can learn from their interactions with students over time (Fuchs, 2023). Through machine learning algorithms, AI can improve responses and adapt to students' preferences and needs. By analyzing student performance data, AI can identify potential problems and predict future outcomes, and educators can intervene early to prevent academic difficulties and provide targeted support to struggling students. The more students interact with the chatbot, the more proficient it becomes in comprehending their questions and furnishing precise and individualized support. In addition, student collaboration and knowledge sharing become easier in this environment. This is achievable through AI-driven collaboration platforms that streamline communication and the dissemination of knowledge among students, promoting collaborative and interactive learning experiences and enabling students to connect with peers globally. By analyzing data on student behavior and learning styles, AI-powered algorithms can optimize content and delivery methods which would help students to learn more efficiently and effectively.

AI can assist students in tasks involving imaginative solutions by offering tools and materials that spark innovative thinking, such as generating alternative solutions, analyzing patterns, and facilitating brainstorming sessions (Biliuk,

Stepanenko, & Kyrychenko, 2023). AI can recommend resources from different fields or subjects, introducing students to a variety of viewpoints and methods for addressing problems. By presenting students with an extensive array of instances, case studies, or expert opinions, AI can inspire them to think creatively and adopt innovative strategies in their own problem-solving endeavors. In general, the emerging AI and chatbot era holds the potential to equip students with the ability to be resourceful and inventive when solving problems.

Utilizing AI technologies in college education prepares students for the increasing demands of the modern workforce (Ahmad, 2020). As AI continues to reshape organizations, developing AI literacy and skills becomes critical for future career achievements. Educational initiatives and courses integrating AI acquaint students with its principles, tools, and practical applications, equipping them with valuable skills in data analysis, problem-solving, and decision-making. This elevated technological adeptness and understanding of AI's ethical considerations give college students a competitive edge in the job market. Additionally, AI-powered career guidance systems have the capacity to offer insights into emerging employment trends, skill requirements, and individualized career pathways, aiding students in making informed decisions about their future professional endeavors. Artificial intelligence presents a plethora of benefits for university students, enhancing their educational journeys, support mechanisms, and overall study efficiency. Moreover, it plays a role in nurturing creativity and the exchange of knowledge. Customized learning encounters cultivate greater student engagement and bolster the retention of knowledge. AI-powered academic assistance systems furnish extensive feedback, tutoring, and swift aid, fostering student achievements. Additionally, AI-driven tools optimize time allocation and automate various tasks, increasing students' overall efficacy. Nevertheless, a cautious implementation approach and ethical considerations are imperative to address potential hurdles and maintain the human element necessary for education. By harnessing the potential of artificial intelligence, higher education can tap into innovative technologies to augment teaching, learning, and institutional efficacy.

The benefit of this technology is not limited to students, educators are using ChatGPT to generate learning content, including lesson plans and assignments, to address and achieve specific learning objectives. Researchers have successfully used large language models to generate interactive educational materials such as quizzes and flashcards, which can be used to improve student learning and engagement (Dijkstra, 2022). However, valid concerns regarding the accuracy of generated content must be addressed. It is imperative for educators to verify the accuracy of the materials generated by AI based platforms (Topsakal & Topsakal, 2022).

We anticipate technology will become more sophisticated as new players continue to enter the generative AI market, further extending its business applications and potential business risks. For example, the language learning application Duolingo is utilizing a GPT-4 model to improve personalized learning. Be My Eyes, an assistive technology provider is using it to create a solution for individuals with visual impairments to make them aware of their surroundings (Derico &Kleinman, 2023). The ability to answer natural language questions across various domains can facilitate the integration of diverse digital applications into a unified framework or application, which is also critical for expanding the bounds of educational possibilities and experiences (Ahuja et al., 2023). According to Chaudhary (2023), a few areas where ChatGPT can improve HR processes including improved cost-effective solutions; easier HR data management and analytics; enhanced employee experience based on survey input; and simplified recruiting and onboarding. Budhwar et.al

(2023) lists activities such as writing policy documents, composing job descriptions, screening of applications based on job requirements, preparing semi-structured interview questions, developing training programs and materials such as course outlines and on boarding instructions where AI can be effectively utilized.

These positive aspects of AI present the opportunity to apply principles of connectivism (Siemens, 2005) wherein learning and knowledge are achieved through a diversity of opinions, connecting specific sources of information and data, and applying those across fields. With its ability to provide personalized and on-demand learning, up-to-date and relevant information, improved efficiency, and increased accessibility, Chat GPT has the potential to transform the way we learn and develop new skills. Importantly, Siemens (2005) also highlights that making decisions is a learning process unto itself. An individual's cursory review of information presented by AI or ChatGPT and subsequent acceptance and incorporation of it as fact presents the potential for errors, critical examination of the information is necessary to ensure learning occurs for the user.

Debate the Challenges

Despite the enormous opportunities that AI might afford to education and human development, ethical implications and risks come with the development of AI applications (Zawacki-Ritcher et.al, 2019). The use of AI-based technology is inevitable, and it is imperative that educators and human development experts are aware of potential pitfalls of this disruptive technology. Many people are concerned that this disruptive technology will eventually replace humans in certain functions. There are concerns about the generation of inaccurate content, risk of bias and discrimination, lack of transparency and reliability, cybersecurity, ethical consequences, and societal implications (Tobore, 2019). For example, Borji (2023) predicts the end of essays as assignments in education while Stokel Walker and Van noorden (2023) share their concern about factual inaccuracies, ethical issues, and the fear of misuse including the spread of misinformation in healthcare practice and academic writing. From an education perspective, there are still knowledge gaps and uncertainties when it comes to the successful and responsible integration of large language models into learning and teaching processes; more specifically, customizing models to specific needs, addressing biases in specific use cases, dealing with ethical considerations and copyright issues requires multidisciplinary evidence-based research and evaluation (Kasneci et. Al, 2023).

GPT and other LLMs produce text that is convincing but sometimes wrong, and uncritical use can distort scientific facts and spread misinformation. Absence of articles in the model's training set can produce errors or misinformation when responding to a prompt. Due to their generative nature, it is difficult to control outputs (Huet al., 2017), and even harder to guarantee the generated output is factually consistent with all current information sources. GPT models' failure to distill relevant information and inability to distinguish between credible and less-credible sources will result in biased or even false information being provided as accurate. Additional concerns about potential misuse, such as the creation of deepfake audio or text or spreading false or misleading information. Human verification of generated text would be the best tool to avoid human automation bias, and thus prevent dissemination of non-credible information.

Plagiarism, defined as the use of another person's ideas, words, or concepts without proper attribution, is also a concern. Because this technology typically reproduces text without reliably citing original sources or authors, users are at risk of not giving credit to earlier work or misattributing concepts and ideas. They may unintentionally plagiarize a multitude of unknown texts, and even give away their own ideas. Khalil and Er (2022) found that AI generated text can bypass plagiarism detectors by generating original content. Additionally, there is potential for legal issues arising from unintentional copyright infringement, as the model may generate text that is similar or identical to existing copyrighted content. Thus, responsibility lies with the user to identify and utilize proper citations, author-contribution statements, and acknowledgements to ensure that the generated text is original and/or properly cited. It is essential to train instructors on how to identify the use of ChatGPT in student assignments, which can be achieved by using AI detection tools, and update institutional policies to address the challenges posed by the emergence of AI-generated content in student assignments (Lo, 2023). Course designers should also consider adjustments to the assessment process, especially considering new AI tools such as ChatGPT becoming a feature of the work environment (Sweeney,2023).

Large language models can perpetuate and amplify existing biases and unfairness in society, which can negatively impact teaching and learning processes and outcomes (Kasneci, 2023). The digital divide is real and, as with most innovations, citizens of developed countries or privileged constituents from developing or underdeveloped countries will quickly find ways to utilize the benefits of this technology. Most AI models are done for the English language which can potentially make use by English-speaking users easier and more efficient than for other users, causing unfair access for non-English speaking users. Mbakwe et al. (2023) noted that bias may stem from the use of research primarily conducted in high-income countries or textbooks that are not universally applicable. These fragilities are exacerbated by sampling content from high-powered academic institutions dominating certain fields. Underrepresented groups and communities across the world may not be able to reap the benefits of this technology and subsequently widen inequities. Additionally, as organizations try to monetize their AI capabilities, access becomes cost-prohibitive which can lead to further deterioration of access by marginalized and underrepresented communities. GPT3 and similar models are trained on a massive amount of data, which may come from reliable and/or questionable sources. Concerns about unintended bias in output, as well as the transparency of the model's decision-making process, are valid and should be explored further.

Additionally, worries regarding data privacy, security, and the potential improper utilization of personal data in the long-term are lingering concerns. Similarly, AI-powered models have high computational demands, which can result in high energy consumption. There is a risk that personal data may be used for unwanted or malicious purposes or that it may be compromised in a data breach. The increasing use of AI is likely to challenge cultural norms and function as a potential barrier within certain sectors of the population (Dwivedi et. al,2021). Excessive dependence on AI could result in a decline in human interaction and the cultivation of social skills among students, along with a diminished sense of community within the classroom as well as society. Effortlessly generated information could negatively impact critical thinking and critical thinking skills. Thus, it is important to debate the trade-off that comes with the use of AI, creating a potential acceleration in knowledge generation and the loss of human potential, connection, and autonomy. People's creativity, originality, education, training, and productive interactions with others will remain essential for conducting relevant and innovative research.

Concluding Thoughts

Artificial intelligence is here to stay, and we need to prepare to embrace the good and mitigate the bad. Like any other innovative technology, AI and GPT models can be change-inducing and disruptive with clear potential and unknown consequences. AI-enabled technology presents an unprecedented opportunity to develop a responsive, adaptive, supportive “relationship” with human users that can not only yield a wealth of benefits but also be a source of significant threat (Glikson & Woolley, 2020). According to Murati (2022), there will be growing tension between the roles of human and machine in creativity, and it will be interesting to see how we resolve them. This technology could democratize the dissemination of knowledge, since the chatbot can receive and produce copy in multiple languages, circumventing English-language requirements that pose a barrier for speakers of other languages (Liebernz et.al, 2023). ChatGPT's ability to provide personalized and interactive assistance that is tailored to the user’s needs and preferences can not only promote autonomy but also enhance their experience. However, the valid concerns raised regarding its potential misuse and bias, appropriate guidelines and regulations are needed to ensure the safe and responsible use of ChatGPT powers (Sallam, 2023). We agree with Schmidt (2021) and colleagues’ argument that human-computer interaction is the key discipline for creating meaningful tools, systems, applications, and devices that incorporate AI. Integrating GPT models into diverse levels of society must therefore meet stringent privacy, security, and - for sustainable scaling - environmental, regulatory, and ethical requirements, and must be done in conjunction with ongoing human monitoring, guidance, and critical thinking (Kasneci, 2023). Replication of humility and critical thinking may be alien to the technology at this moment, but as the machines learn more from our interactions, those will become part of the technology. The development and use of AI holds the potential for both positive and negative impact on society, to alleviate or to amplify existing inequalities, cure old problems, or cause new ones (Floridi & Cowls, 2022). Nevertheless, harnessing the power of this technology holds enormous potential and it is exciting to consider the possibilities for AI technology in the future. Academics and researchers should also conduct more formal studies on this technology to examine how humans and computers may collaborate to accomplish goals that benefit our planet.

References

- Ahmad, T. (2020). Scenario based approach to re-imagining the future of higher education which prepares students for the future of work. *Higher Education, Skills, and Work-Based Learning,* 10(1), 217-238. https://doi.org/10.1108/HESWBL-12-2018-0136
- Ahuja, A. S., Polascik, B. W., Doddapaneni, D., Byrnes, E. S., & Sridhar, J. (2023). The digital metaverse: Applications in artificial intelligence, medical education, and integrative health. *Integrative Medicine Research*, *12*(1), 100917. https://doi.org/10.1016/j.imr.2022.100917
- Alam, A. (2021). Possibilities and apprehensions in the landscape of artificial intelligence in education. In 2021 International Conference on Computational Intelligence and Computing Applications (ICCICA) (pp. 1-8). IEEE.
- Baidoo-Anu, D., & Owusu Ansah, L. (2023). Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning.

https://dx.doi.org/10.2139/ssrn.4337484

- Biliuk, O., Stepanenko, O., & Kyrychenko, V. (2023). Modern Tools for Distance Education: Information and Analytical Prospectus. *Futurity Education*, *3*(2), 233-247. https://doi.org/10.57125/FED.2023.06.25.15
- Borji, A. (2023). A categorical archive of chatgpt failures. *arXiv preprint arXiv:2302.03494*.
- Budhwar, P., Chowdhury, S., Wood, G., Aguinis, H., Bamber, G. J., Beltran, J. R., Boselie, P., Lee Cooke, F., Decker, S., DeNisi, A., Dey, P. K., Guest, D., Knoblich, A. J., Malik, A., Paauwe, J., Papagiannidis, S., Patel, C., Pereira, V., Ren, S., Rogelberg, S., Saunders, M. N. K., Tung, R. L., … Varma, A. (2023). Human resource management in the age of generative artificial intelligence: Perspectives and research directions on ChatGPT. *Human Resource Management Journal*, 1–XXX. https://doi.org/10.1111/1748-8583.12524
- Derico, B., & Kleinman, Z. (2023). OpenAI announces ChatGPT successor GPT-4. BBC News Online. Web Link https://www.bbc.com/news/technology-64959346. Accessed on 31 May 2023.
- Dijkstra, R., Genç, Z., Kayal, S., & Kamps, J. (2022). Reading Comprehension Quiz Generation using Generative Pre-trained Transformers. In *The 23rd International Conference on Artificial Intelligence in Education (AIED*.
- Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T.,... & Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice, and policy. *International Journal of Information Management*, *57*, 101994. https://doi.org/10.1016/j.ijinfomgt.2019.08.002
- Ferras-Hernandez, X. 2018. The future of management in a world of electronic brains. *Journal of Management Inquiry*, 27(2): 260–263.
- Firat, M. (2023). How chat GPT can transform autodidactic experiences and open education. *Department of Distance Education, Open Education Faculty, Anadolu Unive*.
- Floridi, L., & Chiriatti, M. (2020). GPT-3: Its nature, scope, limits, and consequences. *Minds and Machines*, *30*, 681-694. https://doi.org/10.1007/s11023-020-09548-1
- Floridi, L., & Cowls, J. (2022). A unified framework of five principles for AI in society. *Machine learning and the city: Applications in architecture and urban design*, 22, 535-545. https://doi.org/10.1002/9781119815075.ch45
- Floridi, L., Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V.,... & Vayena, E. (2021). An ethical framework for a good AI society: Opportunities, risks, principles, and recommendations. *Ethics, governance, and policies in artificial intelligence*, 19-39. https://doi.org/10.1007/978-3-030-81907-1_3
- Fuchs, K. (2023). Exploring the opportunities and challenges of NLP models in higher education: is Chat GPT a blessing or a curse? *In Frontiers in Education* 8,; 1166682. Frontiers. https://doi.org/10.3389/feduc.2023.1166682
- Glikson, E., & Woolley, A. W. (2020). Human trust in artificial intelligence: Review of empirical research. *Academy of Management Annals*, *14*(2), 627-660. https://doi.org/10.5465/annals.2018.0057
- Haluza, D., & Jungwirth, D. (2023). Artificial Intelligence and Ten Societal Megatrends: An Exploratory Study Using GPT-3. *Systems*, *11*(3), 120. https://doi.org/10.3390/systems11030120
- Hu, Z., Yang, Z., Liang, X., Salakhutdinov, R., & Xing, E. P. (2017, July). Toward controlled generation of text. In *International conference on machine learning* (pp. 1587-1596). PMLR.
- Kasneci, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F.,... & Kasneci, G. (2023). ChatGPT for

good? On opportunities and challenges of large language models for education. *Learning and individual differences*, *103*, 102274. https://doi.org/10.1016/j.lindif.2023.102274

- Kelly, S. M. (2023). ChatGPT passes exams from law and business schools | CNN Business. CNN. https://www.cnn.com/2023/01/26/tech/chatgpt-passes-exams/index.html Accessed July 12, 2023.
- Khalil, M., & Er, E. (2023). Will ChatGPT get you caught? Rethinking plagiarism detection.*arXiv preprint arXiv:2302.04335*.
- Koetsier, J. (2023). GPT-4 Beats 90% Of Lawyers Trying To Pass The Bar. Forbes. https://www.forbes.com/sites/johnkoetsier/2023/03/14/gpt-4-beats-90-of-lawyers-trying-to-pass-the-bar/ Accessed July 12, 2023.
- Liebrenz, M., Schleifer, R., Buadze, A., Bhugra, D., & Smith, A. (2023). Generating scholarly content with ChatGPT: ethical challenges for medical publishing. *The Lancet Digital Health*, *5*(3), e105-e106.
- Lo, C. K. (2023). What is the impact of ChatGPT on education? A rapid review of the literature.*Education Sciences*, *13*(4), 410. https://doi.org/10.3390/educsci13040410
- Lund, B.D. and Wang, T. (2023), "Chatting about ChatGPT: how may AI and GPT impact academia and libraries?", *Library Hi Tech News*, 40 (3), 26-29. https://doi.org/10.1108/LHTN-01-2023-0009
- Mbakwe, A. B., Lourentzou, I., Celi, L. A., Mechanic, O. J., & Dagan, A. (2023). ChatGPT passing USMLE shines a spotlight on the flaws of medical education. *PLOS Digital Health*, *2*(2), e0000205.
- Open AI (2022). ChatGPT. Weblink https://openai.com/blog/chatgpt/. Accessed May 07, 2023
- Open AI GPT 4 Research Blog (2023). Weblinkhttps://openai.com/research/gpt-4. Accessed July 12, 2023
- Makridakis, S. (2017). The forthcoming Artificial Intelligence (AI) revolution: Its impact on society and firms. *Futures*, *90*, 46-60.
- McGee, R. W. (2023). Is Chat GPT Biased against Conservatives? An Empirical Study.*An Empirical Study (February 15, 2023)*. https://dx.doi.org/10.2139/ssrn.4359405
- Murati, E. (2022). Language & coding creativity. *Daedalus*, *151*(2), 156-167.
- Rudolph, J., Tan, S., & Tan, S. (2023). ChatGPT: Bullshit spewer or the end of traditional assessments in higher education? *Journal of Applied Learning and Teaching*, *6*(1). https://doi.org/10.37074/jalt.2023.6.1.9
- Sallam, M. (2023, March). ChatGPT utility in healthcare education, research, and practice: systematic review on the promising perspectives and valid concerns. In *Healthcare* 11(6), 887. MDPI AG. https://doi.org/10.3390/healthcare11060887
- Schmidt, A., Giannotti, F., Mackay, W., Shneiderman, B., & Väänänen, K. (2021). Artificial intelligence for humankind: a panel on how to create truly interactive and Human-Centered AI for the benefit of individuals and Society. In *IFIP Conference on Human-Computer Interaction* (pp. 335-339). Cham: Springer International Publishing.
- Scott, K. (2020). Microsoft teams up with OpenAI to exclusively license GPT-3 language model.*Official Microsoft Blog*.
- Siemens, G. (2005). Connectivism: A learning theory for the digital age.*International Journal of Instructional Technology and Distance Learning, 2*(1), 3-10.
- Stokel-Walker, C., & Van Noorden, R. (2023). What ChatGPT and generative AI mean for science.*Nature*, *614*(7947), 214-216.

- Sweeney, S. (2023). Who wrote this? Essay mills and assessment–Considerations regarding contract cheating and AI in higher education. *The International Journal of Management Education*, *21*(2), 100818. https://doi.org/10.1016/j.ijme.2023.100818
- Tobore, T. O. (2019). On energy efficiency and the brain's resistance to change: The neurological evolution of dogmatism and close-mindedness. *Psychological Reports*, *122*(6), 2406-2416. https://doi.org/10.1177/0033294118792670
- Topsakal, O., & Topsakal, E. (2022). Framework for a foreign language teaching software for children utilizing AR, voicebots and ChatGPT (Large Language Models). *The Journal of Cognitive Systems*, *7*(2), 33-38.
- van Dis, E. A., Bollen, J., Zuidema, W., van Rooij, R., & Bockting, C. L. (2023). ChatGPT: five priorities for research. *Nature*, *614*(7947), 224-226.
- Walton Foundation (2023). ChatGPT Used by Teachers More Than Students, New Survey from Walton Family Foundation Finds.
- Zawacki-Richter, O., Marín, V.I., Bond, M. *et al.* Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal for Educational Technology in Higher Education***16**, 39 (2019). https://doi.org/10.1186/s41239-019-0171-0