



## **Language and Creativity: A Comparative Study of the Language Used by Chat GPT and Indian ESL Students**

**Ambily John**

*National Institute of Technology*

**R. Joseph Ponniah**

*National Institute of Technology*

### **Introduction**

Creativity is a higher-order cognitive function that human beings possess, which not only shapes our thoughts and actions but also finds a profound reflection in the structure and use of language. Language acts as a vehicle for us to communicate information and our most innovative and inventive ideas. The interplay between language and creativity is relevant at this time, as artificial intelligence and machine learning algorithms emerged as creative force challenging human intelligence by creating chatbots like Chat GPT, which makes creative responses.

While some studies suggest that Chat GPT can be used to enhance teaching and learning experience (Firat, 2023; Kasneci et al., 2023; Rospigliosi, 2023), other studies have pointed in the opposite direction, that is, it is a threat to the academic community (Herrera Ortiz, 2023; Hill-Yardin et al., 2023; Kasneci et al., 2023). Educators across the globe are concerned that students would misuse it to cheat on assignments and writing tasks (Kasneci et al., 2023). With the ability to write scientific papers and abstracts, Chat GPT was added as a co-author in scientific articles, which led to the ban on using large language models in research writing (Alser & Waisberg, 2023). Some schools and colleges banned the use of Chat GPT for fear of plagiarism and misinformation (Mearian, 2023). The abstracts written by the Chatbot deceived reviewers, as they couldn't identify the difference between human-written and machine-generated text (Theocharopoulos et al., 2023). Overall, it has remained unclear whether there is much difference between the language of chat GPT and human beings. Studies supporting the application of Chat GPT in different areas like health medicine, psychology and climate change exist, and research is done to look at the capability of the Chatbot concerning its performance on various exams (Biswas, 2023; Johnson et al., 2023; Elkins & Chun, 2020). Research has been done to check the biases in the answers generated by the chat bot as we are unaware of corpus data used in developing the Chatbox (McGee, 2023) There is no significant research done to address this issue, that is, to distinguish between the language of Chat GPT and humans. There is a need to explore the considerable difference between machine-generated and human writing language.

The present article compares the language and style of writing by Chat GPT and ESL students. For this purpose, we look at how language is constructed in Chat GPT and the similarities in the architecture of



Chat GPT and the human brain. We also gave three writing tasks with the same prompt for Chat GPT and a group of undergraduate Indian ESL engineering students. We qualitatively analysed the language based on the creativity and style of writing. We predict that since meaning lies outside the structure of language, there would be a remarkable difference in how large language models like Chat GPT use language and how human beings use it. For human beings, complex cognitive factors like language communicate through shared experience, making the utterances meaningful (Buccino et al., 2016).

## **The Language Construction of Chat GPT**

Imagine A and B are stranded on two different islands, and they find an underwater cable to communicate. There is an intelligent Octopus, O, who is tapping their communication. Even though it does not understand it, it observes the pattern and can replicate the responses after quite a bit of exposure. This Octopus test, explained by Bender and Koller (2020), gives a picture of the functioning of Large Language Models (LLM). Chat GPT is one such large language model which got exposed to the massive corpus of data written by humans (Zhang & Li, 2021). While the earlier works on human-computer interaction focused on training the system with rules and syntax, the LLMs learn language through simple exposure to different documents, including books, articles, and websites on various topics, styles and genres (Elkins & Chun, 2020). The exposure alone couldn't derive the desired result; more was required.

The Chatbot must understand the statistical pattern and connection in the exposed text data. There was a requirement to capture the grammar, syntax, context and semantic information from the training data to equip the Chatbot with a broad understanding of the language. This was made possible with the help of Transformer Neural Network Architecture which closely resembles the human brain (Brown et al., 2020). These neural networks are complex and layered, allowing Chat GPT to learn patterns and relationships in language. This phase in the development of the Chatbot is called pre-training. In the next stage, 'fine tuning' was necessary because the Chatbot can give undesirable answers (Bender et al., 2021). For example, it could provide a realistic solution to the question, "How to kill me?"

The fine-tuning phase consists of human trainers who weighted each response of Chat GPT and gave an understanding of the desired response. Humans review and rate the model outputs for a range of example inputs, and the rating is based on parameters like accuracy, safety, and quality. This human feedback weighting each answer is again fed to the system, which enables it to give the desired response. This process of fine-tuning is called Reinforcement Learning from Human Feedback (RLHF) (Ouyang et al., 2022). Thus, the system was optimised to give the desired response.

So, when we ask questions to Chat GPT, the system analyses the prompt based on the statistical patterns and relationship it learned, and the desired answer is given based on the fine-tuning it received. Also, the capability to provide responses based on the previous chat allows the conversation to be continued without breaking the thread (Kalla & Smith.,2023). The workings of Chat GPT is complex and sophisticated, but its results are human-like.

## **The "Humanness" in the Architecture of Chat GPT**

The fields of neuroscience and artificial intelligence have a long and intertwined history. Neuroscience provides a rich source of inspiration for new types of algorithms and architecture (Hassabis et al., 2017), while results from artificial intelligence offer insights into how the human brain works (Dupoux, 2018). The architecture of the human brain inspires the transformer architecture behind the functioning of Chat GPT, and we look closely at the similarities of both.

First, there are nodes or neurons in both neural networks and the human brain. In the human brain, neurons are specialised cells that transfer electrical signals for communication. Like in neural networks, artificial neurons process and transmit information through weighted connections (Choi et al., 2020; Wang et al., 2020). These networks can adapt and learn with the help of human trainers. From the human feedback,

weights are assigned to each connection, which helps bring the desired responses (Liu et al., 2023). This is analogous to how genetics and external stimuli help the brain learn and adapt.

Similar to how multiple neurons in the brain process information by parallel connections, neural networks like transformers also have parallel processing (Roberts & Yaida, 2022). In the brain, different regions are responsible for processing different levels of abstraction. Similarly, there is a hierarchy in the neural networks for simple and complex tasks (Huang & Yau, 2020; Marblestone et al., 2016). Even though these are similarities, these neural models are just a base replica of the neural system in human beings. Both are having its complexities and are experimented with for new possibilities.

## Purpose of Study

There are two purposes for the comparative study of the language created by Chat GPT and humans are:

1. To find out if there are any differences in language created by Chat GPT and humans.
2. To investigate the similarities in answers generated by Chat GPT.

## Method

### Participants

The chatbot version used is Chat GPT 3.5, the one available to the public for experimentation. The study participants were 25 first-year undergraduate Engineering students aged 16-19 from the National Institute of Technology, Tiruchirappalli, India. They had English as a second language in their schooling and had taken a course on Technical English in their first semester.

### Design

The study adopted a qualitative research design which was conducted using the document analysis technique, which involves the close reading and analysis of handwritten and computer-generated texts (Bowen, 2009). The document was analysed for its creativity and style of writing. The categories for analysis were adopted from the creativity parameters put forward by Guilford (1976) and Torrance (1966). These includes fluency, originality and elaboration. Along with it to look at the style of writing persuasive and logical devices were looked into (O'Neill, 2012). Table 1 gives the categories and explanation of the parameters.

### Procedure

In this study, participants had 30-40 minutes to write a letter on any of the three topics presented. They had to do free writing without any help from online sources. The first topic was related to the real world, the second one to the abstract world, and the third one to the future. The handwritten documents were collected and grouped based on topics. Chat GPT also got the same prompt, and the answers were documented. All the writings were qualitatively analysed by close reading.

The probe for writing was given as follows:

*The editor in charge of Time Magazine is in search of a relevant theme for the special edition. Write a letter convincing her/him to consider the following topic as the theme. Choose any one.*

- a) Meme Culture and how it represents society.*
- b) Everything we see is Perspective, not truth.*
- c) The pervasive technological developments that are bound to happen in the next 100 years*

In the topics given, nine participants chose to write about Meme Culture, seven on Perspectives and nine on Technological advancement.

TABLE 1  
*The Categories of Analysis and Criteria Used:*

Categories	Explanation
Fluency	The total number of ideas generated in the text.
Originality	The unique ideas in the text in contrast to all other texts.
Elaboration	How well the ideas are elaborated.
Persuasive techniques	The use of emotive language or other persuasive techniques that serves the purpose of the text.
Reasonable devices	Logical devices like data or statistics, or studies to support the idea

## Results

Before the writings were analysed, they were categorised based on topic. Each paper was closely read. Grammatical and punctuation errors were ignored, and the focus was on the content and writing style. All the writings were marked based on fluency, originality, elaboration, persuasive techniques, and logical devices used.

### Fluency

The total number of ideas discussed in the letter is considered under the topic. The three letters written by Chat GPT had three significant points each. It could be categorised under similar themes: popularity, versatility, and relevance. The three writings had identical structures, and the division of the paragraphs was also the same. Table 2 provides a glimpse into the similarity in ideas, even though the topics differ.

TABLE 2

*The Significant Points Created by Chat GPT Are Categorised Based on Themes*

Topics	Popularity	Versatility	Relevance
Meme Culture	"...memes have become ubiquitous part of our online and offline lives."	"There is a wealth of interesting and diverse topics that could be explored under the umbrella of meme culture."	"...special issue on meme culture would be timely and engaging for your readership."
Technological advancement	"...technology has become integral part of our life"	"...would be of interest to a wide range of readers, from tech enthusiasts to business leaders, educators and policy makers."	"... developments that are bound to happen in the next 100 years would be incredibly timely and relevant"
Perspective	"In a world where media and information are readily available at our fingertips, it can be challenging to distinguish between what is factual and what is merely a perspective."	"... this theme could explore a range of issue, from politics and social justice to science and technology"	"The topic of perspective versus truth is particularly relevant in today's society..."

The students' writings had varied numbers of ideas from two to six. The average number of ideas by students who wrote on meme culture was 3.2; the highest was four, and the least was two. When evaluating the letters on Perspective, the average number of ideas was 2.875, with the highest being five and the lowest two. The students who wrote about Technological advancement have the highest number of ideas six, the lowest three and an average of 3.55.

## Originality

The originality of the text is evaluated based on grading the ideas based on their uniqueness and how different an individual's views are from others' opinions (Crossley et al, 2016). We eliminated all the points repeated by different individuals and investigated unique ideas. The selected experts are as follows, Participant 1 on Meme Culture wrote, "*A meme is the cultural equivalent of a gene that are passed from generation to generation through various means, similar to how DNA is propagated. As a result of this, they naturally evolve and adapt to reflect society.*" The same participant also wrote that "*...they are used as coping mechanism to deal with the uncertainties of life similar to Camus' philosophy of absurdism*".

Participant 13 on Perspective gives an example as so: "*Some people think society's expectation are bringing the best out of them, giving them motivation to go on, whereas some people think these expectations are bringing down their lives, they are losing themselves in the process of fulfilling the expectation. But neither of the points are entirely true; it depends on how we see things*". When most of the letters wrote that it is curious to know about the technology of the future, Participant 21 wrote: "*Multiple patients who are suffering with incurable diseases should know about these technological improves, as to gain a hope for their future.*"

There is a clear distinction in the originality of ideas between Chat GPT and humans. There was no novel perspective or opinion in the writing of the Chatbot, which failed to meet the required evaluation criteria.

## Elaboration

This category examines individual ideas and how well they are elaborated to make them more meaningful. All the points put forward in Chat GPT's writing were elaborated. There was clarity in the arguments, and statements to support the argument were best laid out. While coming to the students' ideas, only 7 of 25 writings could be labelled as elaborated. In other papers, there were transitions from one point to another

without much elaboration, indicating that clarity was lacking. In some writing, the students elaborated on a few issues, while others were ignored.

### Persuasive Techniques and Logical Devices

The purpose of these two rubrics was to analyse how the writing style contributes to the purpose given in the probe. The letter was to convince the editor to choose a particular topic for the special edition. We look at all the aspects of language that contribute to the purpose: to convince the editor. The primary persuasive techniques we found were having an identity or choosing an identity best suited for the topic, appreciation of the magazine, using emotive language, desire to collaborate in the work and using statistics and data to convince the editor. Table 3 provides a glimpse into the points. Chat GPT chose no identity, while students chose their real or fake identity to convince the editor. Also, a few students decided to appreciate the magazine's contents, while Chat GPT directly started the letter. We could observe wordiness in the writing of GPT and emotive language. Some students also preferred to use emotional language in writing. Students showed interest in expressing facts through data and statistics to convince the editor of the topic's relevance.

TABLE 3  
*Persuasive Techniques and Logical Devices Used by Participants and Chat GPT*

Topic	Participants	Chat GPT
Identity/ Fake Identity	Participant 3: "I am xyz, student of NIT Trichy, pursuing Mechanical Engineering." Participant 15: "I am xyz, an author and social activist, at xxxx(NGO)" Participant 10: "I am xyz, a psychology scholar at xyzz university" Participant 13: "I am xyz, a fellow editor of your company"	No identity chosen.
Appreciation for the magazine	Participant 5: "I never missed even a single week article. I want to appreciate the people of the Times working behind the release of every article, the editor, content writer, the story collector and each and every one of them" Participant 2: "Being a regular reader of Times magazine, I love each and every section of it, it had helped me a lot in enjoying the reading experience and solving crossword, sudoku etc."	No appreciation
Emotive Language	Used	Used "Incredibly timely" "Strongly urge" "Sophisticated and impactful" etc
Statistics or data	Participant 1: "...cryptocurrencies that were created as a joke based on the meme doge, quickly rose and at their peak, had a net value of 80 billion dollars" Participant 7: "Our country is one of the few countries that has the largest youth population, as per the survey data 2022"	Not used

*Note.* Only some student points are included in the table for ease of documentation.

### Discussion and Conclusion

Drawing on the recent advances in Artificial Intelligence to make machines that interact with humans, the present article aimed to compare the language of Chat GPT and ESL Students. By closely observing the language of the Chatbot and students, we found out that there is a remarkable difference in the

originality of ideas and the styles of language used. We saw that all three answers Chat GPT gave were analogous in structure and content. We could easily categorise the answers based on the themes (Table 2). Also, all the ideas presented were well elaborated for clarity. We discovered that Chat GPT and human beings showed similarities in fluency but striking differences in the originality of ideas. The Chatbot couldn't generate original ideas in any of the three topics. More importantly, when looking at how well the writing probe is understood, human writings showed more exploration through persuasive techniques and logical devices.

There are two possible explanations for the observations. Human language is a product of complex cognitive processes, creativity, cultural influence and social interaction which cannot be narrowed down to statistical patterns (Mirolli & Parisi, 2009). The experience, knowledge and context all contribute to understanding a language, which cannot be comprehended in pre-defined rules and patterns learned from data (Hoff, 2006). So, the participants' writing from the experience and cultural influence showed originality and clarity in understanding the task. Another possible explanation is that, even though the architecture is similar, machines are trained and supervised in learning, like nineteenth-century schooling bombarding with information and training for desired responses. It contributes to a well-layered structure and elaboration of the ideas. But human language is acquisition rather than learning. We develop a fully functional speech recognition and language processing system without exposure to large amounts of data and drilled training (Dupoux, 2018). Our findings are an anecdote to the concerns raised in academia concerning the misuse of Chat GPT in writing. The creativity and style of language show remarkable differences when closely read. We can distinguish the writings by looking at the patterns, originality of ideas, and connection to the experience. Even though we could find a difference, our study is limited.

One limitation is that Chat GPT can generate many responses from the same prompt. We considered only the first generated responses. It can be justified by the fact that the participants were also given only one chance, just free writing with minimal time and the paper was considered for analysis. Also, if given an identity, Chat GPT can create responses assuming the essence, which we didn't do as the same probe was given to the participants without any difference. Creative prompting can generate innovative and desirable answers from the Chatbot. If we need more specific writing, it can be done by writing effective prompts. For example, "Answer the following assuming the personality of an Indian ESL student with a technical background" would have given a different, creative answer. Despite its limitations, the study certainly adds to our understanding of the differences in the language written by Chat GPT and humans. Even though there is some similarity in the architecture of Chat GPT and the human brain, more is required to call the text generated by GPT "human-like".

## The Authors

*Ambily John* is pursuing doctoral study at the Department of Humanities and Social Sciences, National Institute of Technology, Tiruchirappalli, India. Her research interests include creativity, education, second language acquisition, teaching, and biolinguistics.

Department of Humanities and Social Sciences  
National Institute of Technology, Tiruchirappalli  
Tamil Nadu, 620015, India  
Mobile: +91 9400687879  
Email: smartambily@gmail.com

*Dr. R. Joseph Ponniah* (corresponding author) is a Professor of English in the Department of Humanities and Social Sciences at the National Institute of Technology, Tiruchirappalli, India. His current research and teaching interests include biolinguistics, memory studies, reading, and second language acquisition. He has co-edited a book titled: *The Idea and Practice of Reading* published in 2018 by Springer.

Department of Humanities and Social Sciences  
National Institute of Technology, Tiruchirappalli  
Tamil Nadu, 620015, India  
Tel: +91-431-250 3695  
Mobile: +91 - 9487368155  
Email: joseph@nitt.edu

## References

- Alser, M., & Waisberg, E. (2023). Concerns with the usage of CHATGPT in academia and medicine: A viewpoint. *American Journal of Medicine Open*, 9, 100036. <https://doi.org/10.1016/j.ajmo.2023.100036>
- Bender, E. M., Gebru, T., McMillan–Major, A., & Shmitchell, S. (2021, March). On the dangers of stochastic parrots: Can language models be too big? *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency* (pp. 610-623). <https://doi.org/10.1145/3442188.3445922>
- Bender, E. M., & Koller, A. (2020, July). Climbing towards NLU: On meaning, form, and understanding in the age of data. *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics* (pp. 5185-5198). <http://dx.doi.org/10.18653/v1/2020.acl-main.463>
- Biswas S. S. (2023). Potential use of Chat GPT in global warming. *Annals of Biomedical Engineering*, 51(6), 1126–1127. <https://doi.org/10.1007/s10439-023-03171-8>
- Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9(2), 27–40. <https://doi.org/10.3316/qj0902027>
- Brown, T.B., Mann, B., Ryder, N., Subbiah, M., Kaplan, J., Dhariwal, P., Neelakantan, A., Shyam, P., Sastry, G., Askell, A., Agarwal, S., Herbert-Voss, A., Krueger, G., Henighan, T.J., Child, R., Ramesh, A., Ziegler, D.M., Wu, J., Winter, C., ... Amodei, D. (2020). Language models are few-shot learners. *Proceedings of the 34<sup>th</sup> International Conference on Neural Information Processing System* (pp. 1877–1901).
- Buccino, G., Colage, I., Gobbi, N., & Bonaccorso, G. (2016). Grounding meaning in experience: A broad perspective on embodied language. *Neuroscience and Biobehavioral Reviews*, 69, 69–78. <https://doi.org/10.1016/j.neubiorev.2016.07.033>
- Choi, R. Y., Coyner, A. S., Kalpathy-Cramer, J., Chiang, M. F., & Peter Campbell, J. (2020). Introduction to machine learning, neural networks, and deep learning. *Translational Vision Science and Technology*, 9(2). <https://doi.org/10.1167/tvst.9.2.14>
- Crossley, S. A., Muldner, K., & McNamara, D. S. (2016). Idea generation in student writing. *Written Communication*, 33(3), 328–354. <https://doi.org/10.1177/0741088316650178>
- Dupoux, E. (2018). Cognitive science in the era of artificial intelligence: A roadmap for reverse-engineering the infant language-learner. *Cognition*, 173, 43–59. <https://doi.org/10.1016/j.cognition.2017.11.008>
- Elkins, K., & Chun, J. (2020). Can GPT-3 Pass a Writer’s Turing Test? *Journal of Cultural Analytics*, 5(2). <https://doi.org/10.22148/001C.17212>
- Firat, M. (2023). *How chat GPT can transform autodidactic experiences and open education*. OSF Preprints. <https://doi.org/10.31219/osf.io/9ge8m>
- Guilford, J. P. (1967). Creativity: Yesterday, today and tomorrow. *The Journal of Creative Behavior*, 1(1), 3–14. <https://doi.org/10.1002/j.2162-6057.1967.tb00002.x>
- Hassabis, D., Kumaran, D., Summerfield, C., & Botvinick, M. (2017). Neuroscience-inspired artificial intelligence. *Neuron*, 95(2), 245–258. <https://doi.org/10.1016/j.neuron.2017.06.011>
- Herrera Ortiz, A. F. (2023). Commentary to the article “A CHAT(GPT) about the future of scientific publishing.” *Brain, Behavior, and Immunity*, 111, 124. <https://doi.org/10.1016/j.bbi.2023.04.004>



- Hill-Yardin, E. L., Hutchinson, M. R., Laycock, R., & Spencer, S. J. (2023). A Chat (GPT) about the future of scientific publishing. *Brain, Behavior, and Immunity*, *110*, 152–154. <https://doi.org/10.1016/j.bbi.2023.02.022>
- Hoff, E. (2006). How social contexts support and shape language development. *Developmental Review*, *26*(1), 55–88. <https://doi.org/10.1016/j.dr.2005.11.002>
- Huang, J., & Yau, H. T. (Eds.). (2019). Dynamics of deep neural networks and neural tangent hierarchy. *Proceedings of the 37th International Conference on Machine Learning* (pp. 4542–4551).
- Johnson, D., Goodman, R., Patrinely, J., Stone, C., Zimmerman, E., Donald, R., Chang, S., Berkowitz, S., Finn, A., Jahangir, E., Scoville, E., Reese, T., Friedman, D., Bastarache, J., van der Heijden, Y., Wright, J., Carter, N., Alexander, M., Choe, J., ... & Wheless, L. (2023). *Assessing the accuracy and reliability of AI-generated medical responses: An evaluation of the Chat-GPT model*. Research Square. <https://doi.org/10.21203/rs.3.rs-2566942/v1>
- Kalla, D., & Smith, N. (2023). Study and analysis of Chat GPT and its impact on different fields of study. *International Journal of Innovative Science and Research Technology*, *8*(3), 827–833. <https://doi.org/10.5281/zenodo.7767675>
- Kasneji, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., ... Kasneji, 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>
- Liu, A., Zhu, H., Liu, E., Bisk, Y., & Neubig, G. (2023). *Computational language acquisition with theory of mind* [Conference presentation]. The Eleventh International Conference on Learning Representations, Kigali, Rwanda.
- Marblestone, A. H., Wayne, G., & Kording, K. P. (2016). Toward an integration of deep learning and neuroscience. *Frontiers in Computational Neuroscience*, *10*, 1–60. <https://doi.org/10.3389/fncom.2016.00094>
- McGee, R. W. (2023). Is chat GPT biased against conservatives? An empirical study. *Fayetteville State University*. <https://doi.org/10.2139/ssrn.4359405>
- Mearian, L. (2023, April 25). *Schools look to ban CHATGPT, students use it anyway*. Computerworld. <https://www.computerworld.com/article/3694195/schools-look-to-ban-chatgpt-students-use-it-anyway.html>
- Mirolli, M., & Parisi, D. (2009). Language as a cognitive tool. *Minds and Machines*, *19*(4), 517–528. <https://doi.org/10.1007/s11023-009-9174-2>
- O’Neill, S. (2012). Teaching and assessment of persuasive writing: Juggling the language features and grasping the metalanguage. *International Journal of Pedagogies and Learning*, *7*(1), 84–98. <https://doi.org/10.5172/ijpl.2012.7.1.84>
- Ouyang, L., Wu, J., Jiang, X., Almeida, D., Wainwright, C. L., Mishkin, P., Zhang, C., Agarwal, S., Slama, K., Ray, A., Schulman, J., Hilton, J., Kelton, F., Miller, L.E., Simens, M., Askell, A., Welinder, P., Christiano, P. F., Leike, J., & Lowe, R. J. (2022). *Training language models to follow instructions with human feedback* [Conference presentation]. 36th Conference on Neural Information Processing Systems, New Orleans, LA, United States.
- Roberts, D. A., Yaida, S., & Hanin, B. (2022). *The principles of deep learning theory: An effective theory approach to understanding neural networks*. Cambridge University Press.
- Rospigliosi, P. A. (2023). Artificial intelligence in teaching and learning: what questions should we ask of ChatGPT? *Interactive Learning Environments*, *31*(1), 1–3. Routledge. <https://doi.org/10.1080/10494820.2023.2180191>
- Theocharopoulos, P. C., Anagnostou, P., Tsoukala, A., Georgakopoulos, S. V., Tasoulis, S. K., & Plagianakos, V. P. (2023, July). Detection of fake generated scientific abstracts. *Proceedings of the 2023 IEEE Ninth International Conference on Big Data Computing Service and Applications (BigDataService)* (pp. 33–39). IEEE.

- Torrance, E. P. (1967). The Minnesota studies of creative behavior: National and international extensions. *The Journal of Creative Behavior*, 1(2), 137–154. <https://doi.org/10.1002/j.2162-6057.1967.tb00021.x>
- Wang, X., Zhao, Y., & Pourpanah, F. (2020). Recent advances in deep learning. *International Journal of Machine Learning and Cybernetics*, 11(4), 747–750. <https://doi.org/10.1007/s13042-020-01096-5>
- Zhang, M., & Li, J. (2021). A commentary of GPT-3 in MIT technology review 2021. *Fundamental Research*, 1(6), 831–833. <https://doi.org/10.1016/j.fmre.2021.11.01>

(Received September 30, 2023; Revised January 30, 2024; Accepted March 10, 2024)