ŌTAUTAHI CHRISTCHURCH AOTEAROA NEW ZEALAND
35TH AUSTRALASIAN ASSOCIATION FOR ENGINEERING EDUCATION ANNUAL CONFERENCE
8-11 DEC 2024
THE ENGINEER AND THE WORLD

Analysing ChatGPT's Role in Enhancing Quality and Standards in Cyber Education

Bhavani Sridharan[a]; Kamanashis Biswas[a], Jade McKay[a], and Mohammad Jabed Morshed Chowdhury[b].
Australian Catholic University[a], La Trobe University[b]
Corresponding Author Email: Kamanashis.biswas@acu.edu.au

ABSTRACT

CONTEXT

The integration of Artificial Intelligence (AI) tools like ChatGPT, Copilot, and Gemini into education prompts a re-evaluation of traditional methods. This research investigated how ChatGPT can enhance critical thinking, problem-solving, and information verification, and assessed students' abilities to apply AI to both theoretical and technical challenges.

PURPOSE OR GOAL

Despite ChatGPT's popularity across domain and sectors, the research points to a raft of limitations and the need for rigorous critical scrutiny. Therefore, this research aimed to address the following research questions: Is there a difference in university students' levels of achievement scores based on whether AI-Generated solutions are provided, considering the different components of learning (e.g., Theory and Technical) and gender (Male and Female)?

APPROACH

This research involved designing an assessment comprising two parts. In Part I, students were given theoretical and technical problems to solve using any tools, including ChatGPT. In Part II, students were provided with both theoretical and technical problems and ChatGPT-generated answers, which they had to evaluate for correctness and provide justifications. Data from their responses were collected and analysed to assess their performance in both parts. The analysis aimed to identify how effectively students solved the problems and evaluated ChatGPT's answers.

OUTCOMES

The results indicated that integrating ChatGPT in assessment and higher education was effective in developing students critical thinking and problem-solving skills, particularly in supporting technical skill development compared to the theory component. In addition, significant positive differences in mean scores without and without using Generative AI (Gen AI) for theory demonstrated the power of ChatGPT in uplifting the quality of higher education.

CONCLUSIONS

The integration of ChatGPT provided valuable insights into its potential and limitations as an educational tool. While ChatGPT assisted in solving theoretical and technical problems, it is crucial to develop students' critical thinking and problem-solving skills to verify and contextualise AI-generated information.

KEYWORDS

ChatGPT, Critical thinking, Problem solving, Correctness

Introduction

The integration of advanced natural language processing tools such as ChatGPT, Copilot, and Gemini into various domains, including education, has prompted a re-evaluation of traditional teaching methods. ChatGPT's potential to enhance critical thinking and problem-solving skills while highlighting the importance of information verification aligns with the educational objective of preparing students for real-world challenges. This study examines the use of ChatGPT in an educational setting, specifically within a cyber security unit taught at Australian Catholic University. By employing a tailored assessment, the research aims to evaluate how well students can utilise ChatGPT to answer both theoretical and technical questions. The objective is to understand the practical implications of integrating such AI tools in enhancing students' proficiency in addressing complex problems, ultimately assessing whether these tools can significantly contribute to achieving educational goals in the context of cybersecurity.

Literature Review

The versatility and advanced natural language processing capabilities of ChatGPT have positioned it as an invaluable tool spanning diverse domains including healthcare and medicine (Cascella et al., 2023; Dave et al., 2023), business and finance (Chuma & De Oliviera, 2023), law and legal services (Biswas, 2023), and education and training (Grassini, 2023; Ngo, 2023). Within two months of its launch in November 2022, the ChatGPT tool had reached 100 million users worldwide (Halaweh, 2023), with countries like the US, UK, Australia, Canada, the UAE and China leading the way in their adoption of AI technologies for learning and teaching, integrating AI into educational tools and platforms in order to personalise the learning experience and enhance teaching and learning as well as engagement and outcomes (Rasul et al., 2023; Wang et al., 2023). These countries are not only using AI tools for educational purposes but are also investing in research and development to further integrate AI into their education systems (Grassini, 2023).

Studies exploring student perceptions of ChatGPT have found them to be moderately positive in their attitudes and views of the individualised educational opportunities afforded by the technology (Huallpa et al., 2023). Students have indicated a need for institutional standards being made explicit, particularly in relation to privacy and data security (Huallpa et al., 2023), as well as the ethical considerations of fairness and non-discrimination and transparency in the use of ChatGPT (Mhlanga, 2023). Halaweh (2023) suggests there are some serious ethical concerns with regards to the use of this technology in education, including potential bias and discrimination due to its reliance on natural language processing, privacy concerns around search data being saved and used for unintended purposes, concerns about lack of critical thinking, as well as plagiarism.

Research suggests that ChatGPT has shown effectiveness in assisting students with both theoretical and technical problems to a notable extent (Rasul et al., 2023; Zhang & Tur, 2024). In more theoretical disciplines such as mathematics, science, and humanities, ChatGPT can assist in clarifying concepts, offering examples, and unpacking abstract ideas (Kolade et al., 2024). For more technical subjects like programming or engineering, ChatGPT can provide guidance on syntax, algorithms, and problem-solving strategies (Tsai et al., 2023). However, its effectiveness is said to vary depending on the complexity of the problem and the quality of its training data. While ChatGPT can significantly aid students by providing instant access to information and explanations (Javaid et al., 2023), it is not a substitute for personalised teaching or deep domain expertise in certain niche areas where contextual understanding is critical (Kalla et al., 2023). Its role is most effective when used as a supplementary tool alongside traditional educational methods and expert guidance (Gill, 2024).

The integration of ChatGPT in the higher education context has shown promising potential in fostering critical thinking and problem-solving skills among students (Buselic, 2023). Studies suggest that by engaging with ChatGPT, students are encouraged to formulate clear and structured inquiries, which in turn prompt them to think critically about the information they seek

and receive (Katavic et al., 2023). ChatGPT has been found to provide diverse perspectives and information which encourages students to evaluate and synthesise knowledge from various sources, thereby enhancing their analytical abilities (Guo & Lee, 2023). Moreover, ChatGPT can potentially simulate real-world problem-solving scenarios by offering suggestions and guiding students through complex issues, promoting strategic thinking and decision-making skills (Kohler, 2024; Kurban & Sahin, 2024). However, the effectiveness ultimately hinges on how educators integrate ChatGPT into curricula (Wu, 2024), ensuring it complements and enhances existing teaching and learning methods while fostering a supportive learning environment that encourages experimentation and reflection (Wu, 2024). It is argued that continued research and refinement of these educational approaches is critical in order to fully realise the potential of ChatGPT in developing students' critical thinking and problem-solving capabilities (Rasul et al., 2023).

Research on ChatGPT highlights several limitations in providing accurate and contextually relevant answers. Firstly, these models rely heavily on the data they were trained on, which may not always encompass the breadth and depth of specific educational curricula or nuanced academic contexts (Grassini, 2023). As a result, ChatGPT may struggle with domain-specific jargon (Einarsson et al. 2024), complex theoretical concepts (Ali et al., 2023), or specialised technical details that go beyond its training data (Ray, 2023). Furthermore, while it excels at generating text based on patterns in data (Azaria et al., 2024), it may lack the ability to deeply understand the underlying meaning or context of questions (Javaid et al., 2023), leading to occasional misinterpretations or incomplete responses (Azaria et al., 2024). Moreover, ChatGPT's responses are generated probabilistically, meaning they can sometimes be inaccurate or misleading, especially when faced with complex or vague queries (Huang & Huang, 2024). Lastly, its inability to learn from interactions in real-time can limit its adaptability and improvement over time compared to human tutors who can dynamically adjust instructions and explanations based on student feedback and understanding (Graefen & Fazal, 2024). Therefore, while ChatGPT offers valuable support, its limitations underscore the need for caution and complementary educational strategies in ensuring accurate and contextually relevant assistance (Graefen & Fazal, 2024; Kurban & Sahin, 2024; Zhang & Tur, 2024).

Research indicates that students' abilities to verify and correct ChatGPT-generated responses can significantly contribute to their learning outcomes in several ways (Javaid et al., 2023). By engaging in the process of verifying information and correcting inaccuracies, students develop critical thinking skills and a deeper understanding of the subject matter (Guo & Lee, 2023). This active participation fosters a more reflective approach to learning, encouraging students to question and evaluate the information presented to them (Rasul et al., 2023). When students identify errors or inconsistencies in ChatGPT's responses, they are prompted to seek additional resources or consult with peers and teachers, which enhances their overall comprehension and retention of the material (Javaid et al., 2023; Ngo, 2023). Furthermore, the act of correcting inaccuracies can reinforce conceptual understanding, leading to more robust learning outcomes (Rahul et al., 2023).

Drawing upon the above literature, we identified several burning questions which require further investigation. For example, how effective is ChatGPT in assisting students with theoretical and technical problems? Can the use of ChatGPT enhance critical thinking and problem-solving skills among students? What are the limitations of ChatGPT in providing accurate and contextually relevant answers? How do students' abilities to verify and correct ChatGPT-generated responses contribute to their learning outcomes?

Research Question, Conceptual Model and Hypotheses

In trying to find answers to above questions, the following is the overarching research question for this study.

> *Is there a difference in university students' levels of achievement scores based on whether AI-Generated solutions are provided, considering the different components of learning (e.g., Theory and Technical) and gender (Male and Female)?*

Based on the literature reviewed, we also developed the conceptual model followed by framing of hypothesis for both with and without providing AI-Generated solutions.

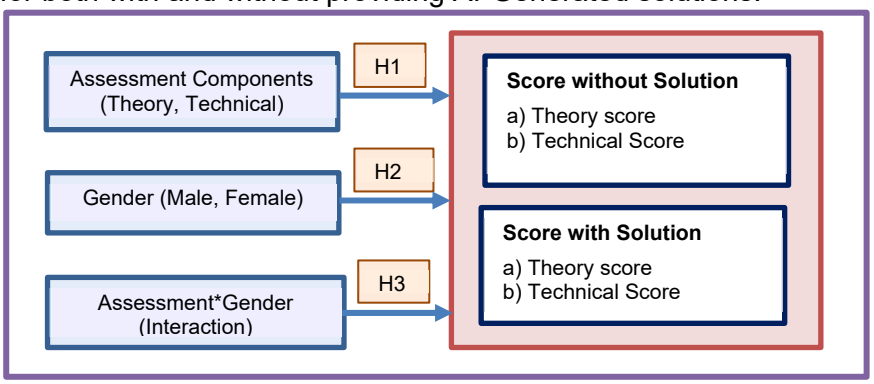

Figure 1. Conceptual Model and Hypotheses

Accordingly, three hypotheses include:

H1 (a&b): Different assessment components will affect the performance scores for theory (a) and technical (b) components.

H2 (a&b): Differences in gender will affect the performance scores for theory (a) and technical (b) components.

H3 (a&b) Interdependency between assessment component and gender will influence the performance scores for theory (a) and technical (b) components.

Methodology

Study design entails analysis of students' performance data collected from 30 students enrolled in the Network Security unit at Australian Catholic University over one semester. Students completed the two assessment components namely Part A and Part B. In Part A, students were given theoretical and technical problems to solve using any tools, including ChatGPT. In Part B, students were provided with both theoretical and technical problems and ChatGPT-generated solutions, which they had to evaluate for correctness and provide justifications. Students' performance in both parts was analysed to understand the effectiveness of ChatGPT in enhancing learning outcomes and critical thinking skills. 73% of students were male and 27% of students are female.

The variables used in this study design are two independent variables: type of assessment (theory and technical) and gender (Male and Female) and two dependent variables: performance score for the two components of assessment namely theory and technical and the two assessment regimes- one without solution and the other with AI-generated solution.

Analysis methods used for this study include t-test followed by two-way ANOVA (Analysis of Variance) for the performance data generated from the two assessment regimes. Prior to conducting the analysis, the data was tested for non-violation of assumptions such as normal distribution of data and homogeneity of variances. Normality assumption was tested using skewness and kurtosis threshold values of +or- 3 (Gravetter & Wallnau, 2005). Levene's homogeneity of variance tests was used with both standard threshold value of 0.05 and a more stringent value of 0.001 along with Bonferroni adjustments was used to reduce the chances of obtaining false positive results (Tabachnick et al., 2001). The effect size ($\eta 2$) was also used to measure the magnitude of the difference between groups, following the standard rules: 0.01 – small; 0.06 – medium, 0.14 – large (Cohen, 1988).

Results

Table 1 presents the basic measures of the performance data considering two types of assessment regimes, two types of assessment components and gender. The data had normal distribution with acceptable levels of skewness and Kurtosis value ranges. The sample size for each iteration was 30. The results indicate that students had higher mean scores for without

solutions compared to with solutions. Male students scored higher in theory and technical parts without solutions. However, the trend reversed for the assessment regime with solution as female mean score was higher than male score for both theory and technical components.

Table 1. Descriptive statistics

Assess Code			Mean	Std. Deviation	N
Score without solution	Theory	Male	8.95	1.527	22
		Female	8.50	3.817	8
		Total	8.83	2.291	30
	Technical	Male	8.55	2.874	22
		Female	8.50	4.175	8
		Total	8.53	3.192	30
	Total	Male	8.75	2.284	44
		Female	8.50	3.864	16
		Total	**8.68**	**2.759**	**60**
Score with Solution	Theory	Male	5.68	2.626	22
		Female	5.63	1.408	8
		Total	5.67	2.339	30
	Technical	Male	7.68	2.801	22
		Female	8.38	1.996	8
		Total	7.87	2.596	30
	Total	Male	6.68	2.867	44
		Female	7.00	2.191	16
		Total	**6.77**	**2.689**	**60**

Table 2 presents bivariate correlation results for all four variables. The results suggest significant positive correlation between score without and with solution, score with solution and assessment component code, and no correlation was found for gender variable.

Table 2. Bivariate correlation Matrix

Variable	1	2	3	4
1. Score without solution	1	.307*	-0.055	-0.040
2. Score with Solution	.307*	1	.412**	0.053
3. Assess code	-0.055	.412**	1	0.000
4. Gender code	-0.040	0.053	0.000	1
* Significant difference; ** Correlation is significant at the 0.01 level (2-tailed).				

A paired *t-test* analysis was conducted as shown in table 3(a) and 3(b) to determine any difference in results based on the type of assessment and gender variables. The results indicate a significant difference in mean scores between with and without solutions for the theory component compared to technical component, i.e., students scored higher scores in theory without solutions compared to ChatGPT generated solutions. Similarly, a significant difference in mean scores between with and without solutions for male students, i.e., male students' mean score for without solutions was significantly higher than with solutions.

Table 3(a). Difference between Means scores without and with solution based on Assessment Type Variable

Variables	Mean Difference	t-Value	p Value
Theory	3.16	5.97	0
Technical	0.67	1.2	0.24

Table 3(b). Difference between Means scores without and with solution based on Gender Variable

Variables	Mean Difference	t-Value	p Value
Male	2.07	4.76	0
Female	1.5	1.48	0.16

Findings from two-way ANOVA Results

The effectiveness of using ChatGPT in cybersecurity education was evaluated by comparison of performance scores based on assessment component types, gender variable for both assessment regimes using the two-way ANOVA method. The results indicate no significant main effect of both dependent variables and interactions effects on the performance scores for without a solution assessment regime as shown in table 4. However, significant difference was found for main effect of assessment component type on performance score with large effect size (16%) for with solution assessment regime. However, there was no significant main effect results for gender or interaction effect for the second assessment regime.

Table 4. Performance Score Results by main and interactive effects

Variables	**Without Solution**						**With Solution**			
Effect	SS	DF	F	P	Effect Size	SS	DF	F	P	Effect Size
Assessment component Type (Main Effect)	0.49	1	0.06	0.80	0.00	66.18	1	10.55	0.00	0.16
Gender (Main Effect)	0.73	1	0.09	0.76	0.00	1.19	1	0.19	0.67	0.00
Assessment Type*Gender (Interaction effect)	0.49	1	0.06	0.80	0.00	1.65	1	0.26	0.61	0.00
Note: SS (Sum Squared), DF (Degrees of Freedom), F (F-Statistics Value), P (P-Value)										

Even though insignificant results were indicated above for all but one, a further comparison analysis was conducted to better understand the sign and direction of the results. Table 5 provides the comparison results with significant difference in mean scores between theory and technical components for with solution assessment regime. However, mean score sign is negative, suggesting that students scored higher in technical components compared to theory. This is the reverse of results for without solution assessment regime. The positive sign for without solution (even though not significant) indicates students scored higher for the theory component compared to the technical component.

Table 5. Comparison results for assessment type and gender variable

Comparisons	**Without Solution**					**With Solution**				
	Mean Difference	**Standard Error**	**Sig**	**Lower Boundary**	**Upper Boundary**	**Mean Difference**	**Standard Error**	**Sig**	**Lower Boundary**	**Upper Boundary**
Theory Vs Technical	0.20	0.82	0.80	-1.45	1.86	-2.375*	0.73	0.00	-3.84	-0.91
Male Vs Female	0.25	0.82	0.76	-1.40	1.90	-0.32	0.73	0.67	-1.78	1.15
* Significant difference										

Table 6 summarises the results of the hypothesis proposed in this study. As noted, H1 – differences in assessment component influencing the performance score with provision of solution is the only hypotheses that had significant results and all other hypotheses were rejected.

Table 6. Hypothesis Results

Hypothesis	Without Solution	With Solution
H1 (a&b): Different assessment components will affect the performance scores for theory (a) and technical (b) components	Reject	*Accept*
H2 (a&b): Differences in gender will affect the performance scores for theory (a) and technical (b) components	Reject	Reject
H3 (a&b) Interdependency between assessment component and gender will influence the performance scores for theory (a) and technical (b) components	Reject	Reject

Discussion

The findings of this study provide some interesting results indicating some contradictions and tensions surrounding assessment regimes considering the components and gender differences. Even though the interaction effect was not significant, further analysis was conducted to understand the direction of performance scores considering both dependent variables.

Without Solution

Results for this regime indicate that male students scored high for theory and low for technical component of assessment. This contrasts with the common belief that male students are more oriented towards techniques than theory. This makes us question the underlying issues male students' inability to apply theory into practice or if there has been a breach of academic integrity with respect to theory component for male students. Female students scored below male students for both components, however, their scored remained at the same level for both theory and technical.

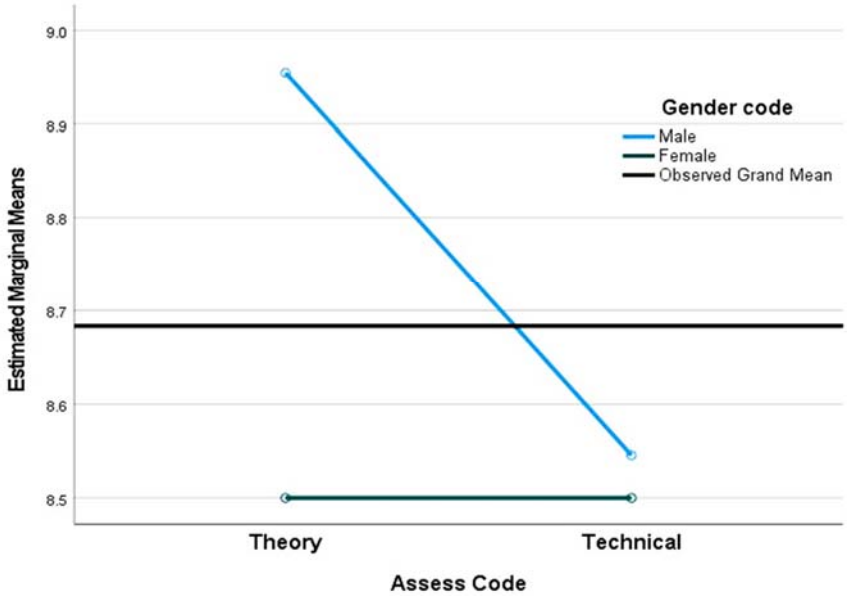

Figure 2. Estimated marginal means of score without solution

With Solution

Results for this regime show both male and female students scored below the grand mean for theory component and above for technical component. It is interesting to note that female

students mean score was higher than male students for technical component of the assessment. This indicates female students are better at effectively evaluating and identifying errors found from the AI generated solutions compared to male counterparts. One of the key limitations of this study was non-generalisability due to small sample size. We plan to collect more data to enhance the validity and reliability of these results.

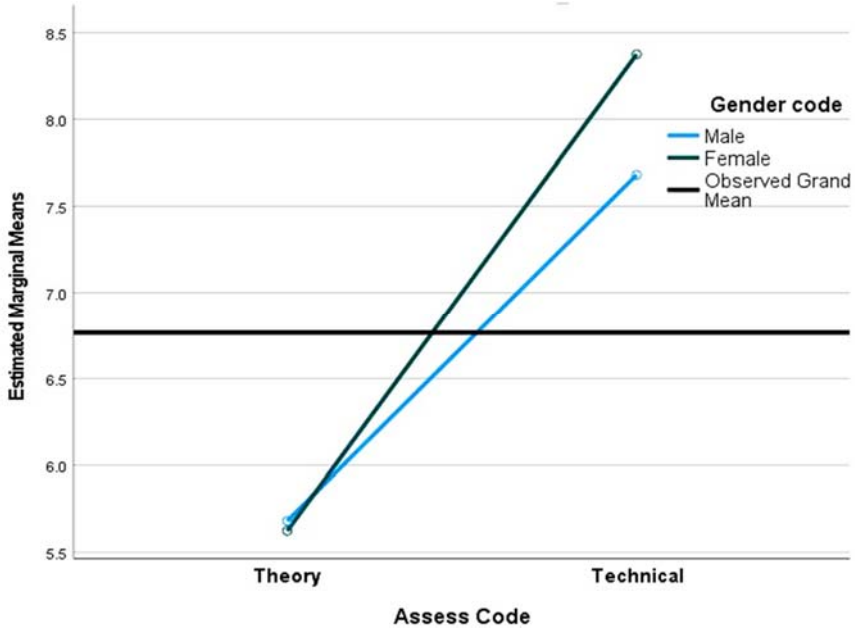

Figure 3. Estimated marginal means of score with solution

Conclusion

The study evaluated the effect of using ChatGPT in cybersecurity education. The results indicate that integrating ChatGPT in assessment and higher education is effective in developing students critical thinking and problem-solving skills, particularly in supporting technical skill development compared to the theory component. In addition, significant positive differences in mean scores without and without using Gen AI for theory indicates the power of ChatGPT in uplifting the quality of higher education.

The integration of ChatGPT into the unit assessment has provided valuable insights into its potential and limitations as an educational tool. While ChatGPT can assist in solving theoretical and technical problems, it is crucial to develop students' critical thinking and problem-solving skills to verify and contextualise AI-generated information. The project underscores the importance of fostering an environment where students actively question and validate the information, preparing them for real-world challenges. Future assessments should continue to emphasise these skills, ensuring that students become discerning consumers and effective users of AI technology.

The study contributes to the debate on whether or not to use Gen AI tools such as ChatGPT in higher education. The novel methodology used in this study unpacks various complexities of dilemmas. This study by evaluating interplay between theory and technical components with and without solutions generated by ChatGPT provides insights into effective use of such tools for enhancing the quality and standards of education and prepare students for the real world of work.

References

Ali, O., Murray, P., Momin, M., & Al-Anzi, F. S. (2023). The knowledge and innovation challenges of ChatGPT: A scoping review. *Technology in Society*, *75*,102402. https://doi.org/10.1016/j.techsoc.2023.102402

Azaria, A., Azoulay, R., & Reches, S. (2024). ChatGPT is a remarkable tool for experts. *Data Intelligence, 6*(1), 240-296.

Biswas, S. (2023). Role of chatGPT in Law: According to chatGPT. *Open Access Journal of Data Science & Artificial Intelligence, 1*(1). doi: 10.23880/oajda-16000103

Buselic, V. (2023). Teaching Information Literacy and Critical Thinking Skills in Chat GPT Time. Paper presented at the *International Conference on Computing, Networking, Telecommunications & Engineering Sciences Applications* (*CoNTESA*), Zagreb, Croatia, 14-20.

Cascella, M., Montomoli, J., Bellini, V., & Bignami, E. (2023). Evaluating the feasibility of ChatGPT in healthcare: an analysis of multiple clinical and research scenarios. *Journal of Medical Systems, 47*(1), 33.

Chuma, E. L., & De Oliveira, G. G. (2023). Generative AI for business decision-making: A case of ChatGPT. *Management Science and Business Decisions, 3*(1), 5-11.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences.* Hillsdale, NJ: Lawrence Earlbaum Associates.

Dave, T., Athaluri, S. A., & Singh, S. (2023). ChatGPT in medicine: an overview of its applications, advantages, limitations, future prospects, and ethical considerations. *Frontiers in Artificial Intelligence, 6*, 1169595.

Einarsson, H., Lund, S. H., & Jónsdóttir, A. H. (2024). Application of ChatGPT for automated problem reframing across academic domains. *Computers and Education: Artificial Intelligence, 6*, 100194.

Gill, S. S., Xu, M., Patros, P., Wu, H., Kaur, R., Kaur, K., ... & Buyya, R. (2024). Transformative effects of ChatGPT on modern education: Emerging Era of AI Chatbots. *Internet of Things and Cyber-Physical Systems, 4*, 19-23.

Graefen, B., & Fazal, N. (2024). From Chat bots to Virtual Tutors: An Overview of Chat GPT's Role in the Future of Education. *Archives of Pharmacy Practice, 15*(2-2024), 43-52.

Grassini, S. (2023). Shaping the future of education: exploring the potential and consequences of AI and ChatGPT in educational settings. *Education Sciences, 13*(7), 692.

Gravetter, F. J., & Wallnau, L. B. (2005). *Essentials of statistics for the behavioral sciences*. Belmont, CA: Thomson Learning Inc.

Guo, Y., & Lee, D. (2023). Leveraging chatgpt for enhancing critical thinking skills. *Journal of Chemical Education, 100*(12), 4876-4883.

Halaweh, M. (2023). ChatGPT in education: Strategies for responsible implementation. *Contemporary Educational Technology, 15*(2). https://doi.org/10.30935/cedtech/13036

Huallpa, J. J. (2023). Exploring the ethical considerations of using Chat GPT in university education. *Periodicals of Engineering and Natural Sciences, 11*(4), 105-115.

Huang, Y., & Huang, J. X. (2024). Exploring ChatGPT for next-generation information retrieval: Opportunities and challenges. *Web Intelligence, 22*(1), 1-14.

Javaid, M., Haleem, A., Singh, R. P., Khan, S., & Khan, I. H. (2023). Unlocking the opportunities through ChatGPT Tool towards ameliorating the education system. *BenchCouncil Transactions on Benchmarks, Standards and Evaluations, 3*(2), 100115.

Kalla, D., Smith, N., Samaah, F., & Kuraku, S. (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), 827-830.

Katavic, R., Pahuja, A., & Syed, T. A. (2023). Navigating the Use of ChatGPT in Classrooms: A Study of Student Experiences. Paper presented at the *International Conference on Information Systems*, Hyderabad, India. https://aisel.aisnet.org/icis2023/learnandiscurricula/learnandiscurricula/15

Kohler, K. (2024). You only need to change your direction: A look at the potential impact of ChatGPT on education. *Technology in Language Teaching & Learning, 6*(1), 1-18.

Kolade, O., Owoseni, A., & Egbetokun, A. (2024). Is AI changing learning and assessment as we know it? Evidence from a ChatGPT experiment and a conceptual framework. *Heliyon, 10*(2024), e25953.

Kurban, C. F., & Şahin, M. (2024). Educational Implications. In C. F. Kurban & M. Shahin (Ed.), *The Impact of ChatGPT on Higher Education*. Emerald Publishing Limited.

Mhlanga, D. (2023). Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning. In *FinTech and artificial intelligence for sustainable development: The role of smart technologies in achieving development goals*. Cham: Springer Nature Switzerland.

Ngo, T. T. A. (2023). The perception by university students of the use of ChatGPT in education. International *Journal of Emerging Technologies in Learning (Online), 18*(17), 4.

Rasul, T., Nair, S., Kalendra, D., Robin, M., de Oliveira Santini, F., Ladeira, W. J., ... & Heathcote, L. (2023). The role of ChatGPT in higher education: Benefits, challenges, and future research directions. *Journal of Applied Learning and Teaching, 6*(1), 41-56.

Ray, P. P. (2023). ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope. *Internet of Things and Cyber-Physical Systems, 3*, 121-154.

Tabachnick, B. G., Fidell, L. S., & Osterlind, S. J. (2001). *Using multivariate statistics*. Boston, MA: Pearson Education, Inc.

Tsai, M. L., Ong, C. W., & Chen, C. L. (2023). Exploring the use of large language models (LLMs) in chemical engineering education: Building core course problem models with Chat-GPT. *Education for Chemical Engineers, 44*, 71-95.

Wang, Y., Pan, Y., Yan, M., Su, Z., & Luan, T. H. (2023). A survey on ChatGPT: AI-generated contents, challenges, and solutions. *IEEE Open Journal of the Computer Society, 4*, 280-302.

Wu, Y. (2024). Critical Thinking Pedagogics Design in an Era of ChatGPT and Other AI Tools—Shifting from Teaching “What” to Teaching “Why” and “How”. *Journal of Education and Development, 8*(1), 1-10.

Zhang, P., & Tur, G. (2024). A systematic review of ChatGPT use in K-12 education. *European Journal of Education, 59*(2), e12599.

Copyright statement

Copyright © B. Sridharan, K. Biswas, J. McKay, M. J. M. Chowdhury, 2024. The authors assign to the Australasian Association for Engineering Education (AAEE) and educational non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to AAEE to publish this document in full on the World Wide Web (prime sites and mirrors), on Memory Sticks, and in printed form within the AAEE 2024 proceedings. Any other usage is prohibited without the express permission of the authors.