

# The Impact of Artificial Intelligence on Teaching and Learning – A Look into ChatGPT and the Future of Sustainable Assessments in Industrial Engineering



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## ABSTRACT

The advances in artificial intelligence (AI) have drawn more attention to its imminent influence on teaching and learning in higher education institutions. However, ChatGPT has the potential to generate incorrect information, can be biased and is characterised by ethical concerns, such as dishonest use by scholars can potentially lose employment due to the technology. It is against the backdrop of these challenges that this paper aimed to investigate the use of ChatGPT in educational settings and to illustrate AI's potential benefits and challenges by the generation of a marking memorandum using ChatGPT. The IDEE theoretical framework was used for identifying the expected outcomes, determining the appropriate level of automation, ensuring that ethical issues are taken into consideration, and evaluating the effectiveness of ChatGPT in accomplishing the anticipated outcomes. A marking memorandum for two assessments was generated using ChatGPT and the AI software passed the Principles of Management module from a University of Technology in South Africa, but failed some sections of the Production Engineering module. The findings of the study revealed that ChatGPT can positively impact lecturers and students by establishing the originality of their ideas and building upon existing ideas more efficiently. It was recommended that the University of Technology establishes standards and policies that embrace AI and involve all staff in the adoption of AI technologies. This paper advocates the adoption of human-AI tool augmentation. Future research direction should encompass the social and ethical implications of deploying AI in engineering education.

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## INTRODUCTION

To keep up with the fast-evolving technological developments, engineering education should change to meet the evolving needs of the engineering industry.<sup>1</sup> One recent development in the field of engineering education is the adoption of generative Artificial Intelligence (AI) technology, such as ChatGPT, a state-of-the-art natural language processing technology that deploys algorithms that mimic human beings to generate new text. Coupled with the development and ease of access to the Internet, the technological

<sup>1</sup> Kehdinga George Fomunyam, "Education and the Fourth Industrial Revolution: Challenges and Possibilities for Engineering Education," *International Journal of Mechanical Engineering and Technology* 10, no. 8 (2019): 271–84.

improvement of computer hardware capabilities has reduced the computational cost of artificial intelligence. Artificial intelligence has gained significant attention from the higher education sector in recent years, with more educational institutions attempting to gain insight into the possible benefits of AI-driven models.<sup>2</sup>

The advances in AI have drawn more attention to its imminent influence on teaching and learning in higher-education institutions. Artificial intelligence models have the ability of generating assessment tasks, automating outmoded assessment practices, seeking suitable peers to grade assessments, and tests and assignments can be automatically scored.<sup>3</sup> ChatGPT can potentially provide lecturers with better solutions while concurrently providing students with effective, personalised learning experiences through customised explanations and feedback. However, ChatGPT has the potential to generate incorrect information, can be biased and is characterised by ethical concerns, such as dishonest use by scholars. Also, humans can lose employment due to the technology.

The UoT under study has an assessment policy which is underpinned by the notions of student autonomy, self-directed learning, and critical self-reflection. Furthermore, the policy aims at stimulating and shaping practice through the provision of assessment strategies that necessitate critical thinking about academic problems and matters and to explore diverse approaches to problem-solving in discipline-specific scenarios.<sup>4</sup> The policy takes into consideration the increasing role of technology in the three delicately entwined processes of teaching, learning and assessment. The implementation of e-learning platforms for assessment purposes is considered a fundamentally student-centred approach to teaching and learning, chiefly due to how independent and self-regulated learning is promoted. In this context, technology is referred to as the use of e-learning platforms and is devoid of the impact of generative artificial intelligence technologies.

The UoT under study has a plagiarism policy that provides a strategic framework for specific disciplines and faculties to protect and promote the academic integrity of learning, teaching and research matters. Self-plagiarism and plagiarism are considered to be academic misconduct, and the policy stipulates the principles and processes that apply when self-plagiarism or plagiarism is detected, with the view to fostering the value system of an ethically responsible institution. However, the plagiarism policy is characterised by inaccurate or a lack of acknowledgement of ChatGPT or equivalent references. In addition, the institution's referencing style is not configured to references from ChatGPT or other AI generative models.

Against the backdrop of these challenges, questions are raised about whether ChatGPT would have a negative or positive impact on scholarship for industrial engineers. This paper aims: (1) to explore the use of ChatGPT at a UoT to enhance student learning regarding the role of Industrial Engineering in the age of artificial intelligence and (2) to improve lecturers' efficiency by demonstrating AI's potential limitations and strengths through the generation of a marking memorandum using ChatGPT. Recommendations are also offered for future policy, research, and practice, to guide the UoT in adopting AI in engineering education.

## LITERATURE REVIEW

The need for physical distancing between individuals due to the COVID-19 pandemic prompted universities across the world to adopt online learning, teaching, and assessment.<sup>5</sup> Dewa conducted a study on the deployment of the DMAIC methodology to improve online delivery and assessment beyond the COVID-19 pandemic and the results demonstrated that the online teaching and learning environment could be improved, resulting in reliable assessments and true reflection of students' academic performance.<sup>6</sup> Artificial intelligence can enhance personalised support for academic staff by providing

<sup>2</sup> André Renz and Gergana Vladova, "Reinvigorating the Discourse on Human-Centered Artificial Intelligence in Educational Technologies," *Technology Innovation Management Review* 11, no. 5 (June 1, 2021): 5–16, <https://doi.org/10.22215/timreview/1438>.

<sup>3</sup> Víctor González-Calatayud, Paz Prendes-Espinosa, and Rosabel Roig-Vila, "Artificial Intelligence for Student Assessment: A Systematic Review," *Applied Sciences* 11, no. 12 (2021): 5467.

<sup>4</sup> DUT, *Plagiarism Policy. Research, Innovation & Engagement*. (Durban University of technology, 2020).

<sup>5</sup> Olasile Babatunde Adedoyin and Emrah Soykan, "Covid-19 Pandemic and Online Learning: The Challenges and Opportunities," *Interactive Learning Environments* 31, no. 2 (2023): 863–75.

<sup>6</sup> Mendon Dewa, "Use of DMAIC Methodology to Enhance Online Delivery and Assessment during and beyond the COVID-19 Pandemic," *Scholarship of Teaching and Learning in the South (SOTL) in the South* 6, no. 2 (2022): 100–116.

opportunities to support the lecturers as they simulate students to be independent learners. It is also capable of providing real-time feedback and suggestions to educators on what questions to ask the students in class.<sup>7</sup> In addition, AI is capable of producing post-teaching feedback, such as post-lesson reports that can summarise classroom dynamics. Typical metrics on post-teaching feedback would include identifying key questions that would have triggered more student engagement or a student speaking time since when students engage or talk more, their learning is enhanced.<sup>8</sup> Additionally, AI could aid lecturers to keep abreast with the latest trends in their field of expertise.

Generative AI has been demonstrated to be a game-changer for reformation in education and, hence, rather than being shunned, should be embraced in the future of education.<sup>9</sup> Some compelling questions include whether generative AI can be compared to a calculator in the classroom and whether it is a more detrimental tool, given that a calculator is ubiquitous, enabling students to swiftly solve complex problems and perform speedy computations without the removal of basic mathematical computations from education curricula. Some scholars argue that AI may raise the bar, allowing students to edit and curate, forcing them to engage deeper and be able to pursue more creative and ambitious research avenues.<sup>10</sup>

Artificial intelligence can enable learning without fear of being judged and thus has the potential to support learners' self-confidence.<sup>11</sup> Students who are scared of being judged by their peers hold back from fully engaging in classroom contexts. However, interfaces that leverage AI can offer constructive feedback that does not cause the same self-consciousness as a human's response and students are therefore more willing to take risks, engage, and be vulnerable.

One AI software application in education is ChatGPT, which is a language model that employs deep learning techniques to analyse and generate human-like text.<sup>12</sup> It is based on a huge quantity of text data and is trained to execute diverse language tasks such as writing stories, answering questions, generating essays and code generation. ChatGPT operates by deploying a deep learning algorithm called a transformer to synthesise natural language inputs and produce human-like responses through pre-processing, encoding, decoding and postprocessing. ChatGPT is an AI language model that has numerous limitations, such as a lack of common sense, limited consideration of context, data bias, absence of emotional intelligence, failure to perform physical tasks, and vulnerability to adversarial attacks.<sup>13</sup>

Chat GPT can be quite beneficial to the attainment of sustainable assessments. The purposes of assessment should be extended to embrace the groundwork of preparing students for sustainable assessment or the mandatory abilities for undertaking activities that essentially characterise learning throughout life in formal or informal environments.<sup>14</sup> Sustainable assessment is perceived as a notion that focuses on the influence of assessment on education and knowledge beyond the time scale of a given learning module. It is perceived as an assessment that meets the present needs of formative and summative assessment, while concurrently preparing the students to meet their individual future learning requirements.<sup>15</sup>

Chung and Choi conducted a study on the development of sustainable assessment to examine the satisfaction levels of instructors and students regarding the evolving forms of English language

<sup>7</sup> Uttam Sharma et al., "Artificial Intelligence and Its Implications in Education," in *Impact of AI Technologies on Teaching, Learning, and Research in Higher Education* (IGI Global, 2021), 222–35.

<sup>8</sup> Terry Hyland, "Educational Responses to Artificial Intelligence (AI) Applications: Problems and Promise," n.d.

<sup>9</sup> Weng Marc Lim et al., "Generative AI and the Future of Education: Ragnarök or Reformation? A Paradoxical Perspective from Management Educators," *The International Journal of Management Education* 21, no. 2 (2023): 100790.

<sup>10</sup> Aras Bozkurt et al., "Speculative Futures on ChatGPT and Generative Artificial Intelligence (AI): A Collective Reflection from the Educational Landscape," *Asian Journal of Distance Education* 18, no. 1 (2023): 53–130.

<sup>11</sup> Cherie Lucas et al., "Implementing a Novel Software Program to Support Pharmacy Students' Reflective Practice in Scientific Research," *American Journal of Pharmaceutical Education* 85, no. 10 (2021): 8320.

<sup>12</sup> Malak Abdullah, Alia Madain, and Yaser Jararweh, "ChatGPT: Fundamentals, Applications and Social Impacts," in *2022 Ninth International Conference on Social Networks Analysis, Management and Security (SNAMS)* (Ieee, 2022), 1–8.

<sup>13</sup> Partha Pratim Ray, "ChatGPT: A Comprehensive Review on Background, Applications, Key Challenges, Bias, Ethics, Limitations and Future Scope," *Internet of Things and Cyber-Physical Systems* 3 (2023): 121–54.

<sup>14</sup> Donna Pendergast, Katherine Main, and Nan Bahr, *Teaching Middle Years: Rethinking Curriculum, Pedagogy, and Assessment* (Taylor & Francis, 2024).

<sup>15</sup> David Boud and Rebeca Soler, "Sustainable Assessment Revisited," *Assessment & Evaluation in Higher Education* 41, no. 3 (2016): 400–413.

teaching and assessment practices.<sup>16</sup> The results showed that multimodal projects can be used to promote sustainable assessments, where target language forms and structures are actively utilised by students. Maki highlighted some recent effective sustainable assessment practices that include peer assessment, self-awareness, self-assessment, and assessment for learning.<sup>17</sup> Coupled with self-directed learning, peer assessment would enhance the development of students' independent learning abilities and improve their capacity to critically analyse and reflect on their learning performance.<sup>18</sup>

Through carefully planned and structured self-assessment activities, self-awareness and self-assessment would nurture the development of self-directed learning skills and self-assessment. It is imperative for an educational institution to make provision for a conducive learning environment in which students can continuously monitor their progress and performance while getting adequate instructional support and feedback to pursue their studies.<sup>19</sup> Assessment for learning should be perceived as integral to learning processes, as opposed to being deployed as an instructional tool for gauging the abilities or performance of the students. Sustainable assessment is inherently aligned with teaching and assessment practices, which enable students to enhance their capability to be sustainable appraisers of their individual long-standing learning skills.<sup>20</sup>

## THEORETICAL FRAMEWORK

The Identify Determine Ensure Evaluate (IDEE) framework was used to identify the expected outcomes, determine the appropriate level of automation, ensure that ethical issues are taken into consideration, and evaluate the effectiveness of ChatGPT in accomplishing the anticipated outcomes.<sup>21</sup> The first step, "I", was to identify two desired outcomes. This was to investigate the use of ChatGPT in educational settings to enhance learning by students on the role of Industrial Engineering in the age of artificial intelligence. The second outcome was to illustrate AI's potential benefits and challenges by generating of marking memorandum using ChatGPT.

The second step, "D", was to determine whether to use AI as a supplement to traditional learning approaches or to completely automate the learning experience using educative AI. The third step, "E", ensured that ethical, including the impact of potential biases on the lecturer and students were embraced. In addition, the deployment of ChatGPT should not substitute for the critical role that is played by the lecturer in providing guidance and support to the student. The fourth step, "E", focused on evaluating the effectiveness of educative AI in achieving the anticipated outcomes. The effectiveness of ChatGPT in educational settings was investigated to help enhance learning by students on the role of Industrial Engineering. Additionally, the effectiveness of ChatGPT was investigated in terms of the generation of marking memorandum for two tests from two modules, that is, Principles of Management and Production Engineering, which are second-year modules.

## METHODOLOGY

### Research Design

This study employed a descriptive cross-sectional research design to provide a detailed view of the use of ChatGPT by second-year students and lecturers in the Department of Industrial Engineering. The design was chosen to capture a snapshot of the use of AI and qualitative data were collected to ensure a

<sup>16</sup> Sun-Joo Chung and Lee-Jin Choi, "The Development of Sustainable Assessment during the COVID-19 Pandemic: The Case of the English Language Program in South Korea," *Sustainability* 13, no. 8 (2021): 4499.

<sup>17</sup> Peggy L. Maki, *Assessing for Learning: Building a Sustainable Commitment across the Institution* (Routledge, 2023).

<sup>18</sup> Hongli Li et al., "Does Peer Assessment Promote Student Learning? A Meta-Analysis," *Assessment & Evaluation in Higher Education* 45, no. 2 (2020): 193–211.

<sup>19</sup> Kesavan Vadakalur Elumalai et al., "Factors Affecting the Quality of E-Learning during the COVID-19 Pandemic from the Perspective of Higher Education Students," *COVID-19 and Education: Learning and Teaching in a Pandemic-Constrained Environment* 189, no. 3 (2021): 169.

<sup>20</sup> Marco Ferreira, Baiba Martinsone, and Sanela Talić, "Promoting Sustainable Social Emotional Learning at School through Relationship-Centered Learning Environment, Teaching Methods and Formative Assessment," *Journal of Teacher Education for Sustainability* 22, no. 1 (2020): 21–36.

<sup>21</sup> Jiahong Su and Weipeng Yang, "Unlocking the Power of ChatGPT: A Framework for Applying Generative AI in Education," *ECNU Review of Education* 6, no. 3 (2023): 355–66.

comprehensive understanding of the use of ChatGPT in researching the role of Industrial Engineering in the age of artificial intelligence.

### **Study Sample and Population**

The population for this study was all undergraduate and postgraduate students, as well as academic staff, in the Department of Industrial Engineering characterised at the UoT. A sample of 30 second-year students and 1 lecturer was selected, and to ensure that participants had prior exposure to the use of ChatGPT, a purposive sampling technique was used for the study.

### **Data Collection and Analysis**

Data were collected through semi-structured interviews on the Moodle platform to provide deeper insights into individual students' use of ChatGPT in researching the role of Industrial Engineering. The qualitative data from interviews were analysed through the use of the Moodle gradebook and attitudes regarding the use of ChatGPT in teaching and learning.

### **Ethical Considerations**

According to the university's research ethics policy, the study fell under ethics category one, an indication that the study was a straightforward research without ethical problems. Therefore, it was exempted from the Ethics and Biosafety Research Committee Review. Participation was voluntary and the students were informed about the purpose of the study and they gave their consent before undertaking the study. However, since the students used the Moodle learning management system used by the university, and purposive sampling was used, anonymity could not be assured while confidentiality was assured through restricted access and use of a password to store data, and respondents could withdraw at any time without any consequences.

## **PRESENTATION OF FINDINGS**

### **Role of Industrial Engineering in the age of artificial intelligence**

The first objective of the study was to investigate the use of ChatGPT in educational settings to enhance learning by students on the role of Industrial Engineering in the age of artificial intelligence. The lecturer tasked 30 second-year students to use ChatGPT to conduct research on the role of Industrial Engineering in the age of artificial intelligence. The responses received from the students indicated that Industrial Engineering (IE) plays a significant role in the age of artificial intelligence and these include:

- **Process Optimization:** Industrial engineers are skilled in analyzing and optimizing complex systems. With the integration of AI, they can leverage machine learning algorithms and big data analytics to enhance productivity and efficiency. By utilizing AI technologies, IE professionals can identify patterns, predict outcomes, and make data-driven decisions for process improvement.
- **Robust System Design:** Industrial engineers are responsible for designing systems that encompass people, processes, and technology. With the integration of AI, they need to consider the capabilities and limitations of AI technologies while designing robust systems. IE professionals can explore applications of AI in areas like predictive maintenance, supply chain optimization, quality control, and resource allocation, enabling optimal system design.
- **Data-driven Decision Making:** AI generates massive amounts of data, making it challenging to extract meaningful insights. Industrial engineers have expertise in data analytics and statistical modeling, allowing them to harness AI-generated data for decision-making purposes. They can develop algorithms that leverage machine learning techniques to analyze vast datasets, optimize processes, and achieve operational excellence.
- **Human-AI Collaboration:** As AI technologies automate tasks, industrial engineers are essential in creating seamless human-AI collaboration. They can assess the capabilities of both humans and machines, identify areas where AI can augment human abilities, and design workflows that maximize the strengths of both. IE professionals bridge the gap between technology and human factors, ensuring the effective utilization of AI systems in industrial settings.

- **Workforce Reskilling:** The rise of AI impacts the skill requirements for the workforce. Industrial engineers can assess the impact of AI on jobs, identify skill gaps, and develop training programs to enable workers to adapt to new roles and responsibilities. They play a crucial role in managing the transition of the workforce in an AI-driven world, ensuring that employees are equipped with the right knowledge and skills.

It was established that the field of Industrial Engineering will remain relevant in the age of AI since it blends the technical skills of AI with the knowledge of systems, processes, and human factors. It was noted that industrial engineers can optimise the potential of AI in diverse industries, resulting in enhanced efficiency, productivity and innovation. The issue of empowering students with skills for response use of ChatGPT assures sustainable assessment is inherently aligned with teaching and assessment practices, which enable students to enhance their capability to be sustainable appraisers of their individual long-standing learning skills.<sup>22</sup>

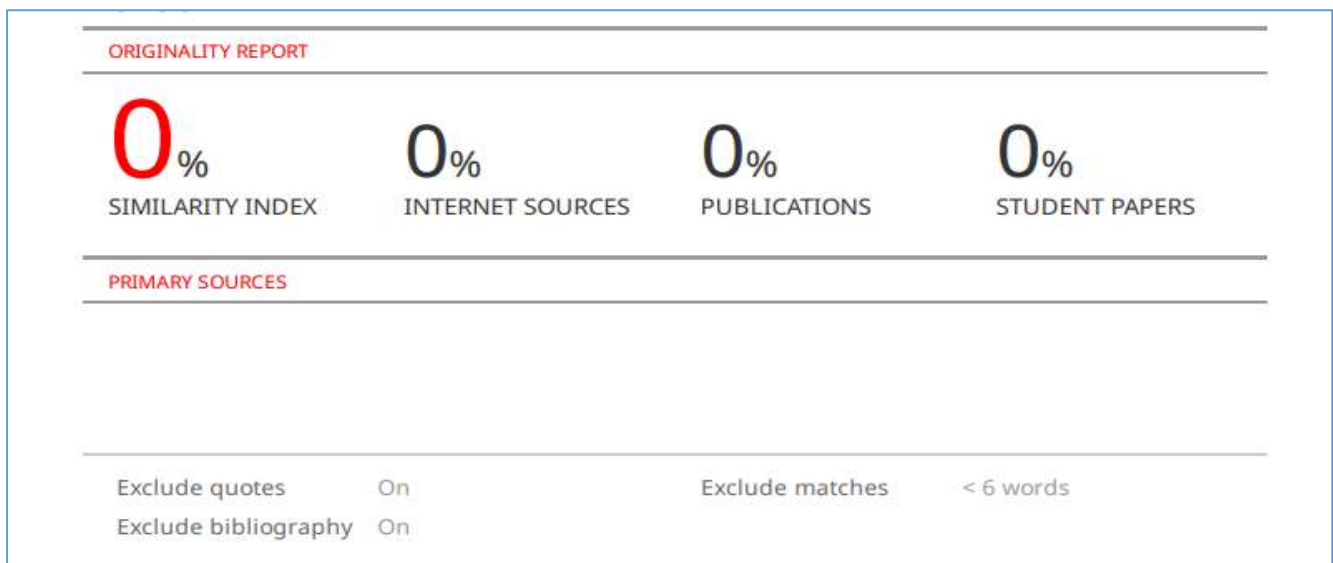


Figure 1: Similarity report from Turnitin

The results of the similarity report from Turnitin, shown in Figure 1, show a similarity index of 0%. This is an indicator of the capability of AI technologies to generate text that cannot be detected by plagiarism software.

### Generation of marking memorandum using ChatGPT

The second objective of the study was to illustrate AI’s potential benefits and challenges by generating a marking memorandum using ChatGPT. The lecturer manually prepared a marking memo for two tests from two different modules. Thereafter, two tests from the two modules, namely Principles of Management and Production Engineering generated assessments marking memorandum, using ChatGPT. The rationale behind using ChatGPT to generate the marking memorandum was to identify strengths and pitfalls of the technology so that the lecturer would establish where, in future, to use the technology in generating questions and solutions for tests and examinations. Table 1 shows examples of the responses from ChatGPT regarding the Principles of Management module.

Table 1: Questions and ChatGPT Responses

Question	ChatGPT Response
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<sup>22</sup> Ferreira, Martinsone, and Talić, “Promoting Sustainable Social Emotional Learning at School through Relationship-Centered Learning Environment, Teaching Methods and Formative Assessment.”

<p>Explain any two characteristics of the environment in which engineers work, citing relevant examples.</p>	<p>1) Technological advancements: The environment in which engineers work is constantly evolving due to rapid technological advancements. For example, automotive engineers need to adapt to the rise of electric vehicles by developing new battery technologies and charging infrastructures.</p> <p>2) Collaborative work: Engineers often work in teams and collaborate with colleagues from various disciplines to solve complex problems. For instance, civil engineers working on large infrastructure projects such as bridges or skyscrapers need to coordinate with architects, environmental experts, and construction managers to ensure the project's success.</p>
<p>Explain the role of the control function and cite two examples of mechanisms or tools used in accomplishing this.</p>	<p>The control function in management refers to the process of monitoring and evaluating activities to ensure that they are in line with organizational goals and objectives. The control function helps in detecting and rectifying deviations from plans and ensures that the organization is moving towards its desired outcomes.</p> <p>Two examples of mechanisms or tools used in accomplishing the control function are:</p> <p>1) Budgeting: Budgeting is a commonly used tool for controlling financial activities within an organization. By comparing actual financial performance with the budgeted figures, managers can identify any variances and take appropriate actions to control costs or reallocate resources. For example, a project manager may regularly review the project's budgeted expenses against the actual expenses to ensure that it is on track and take corrective actions if there are any deviations.</p> <p>2) Key Performance Indicators (KPIs): KPIs are metrics or measures that are used to track and evaluate performance in areas critical to the organization's success. They are specific to each department or function and are aligned with organizational goals. For instance, in a manufacturing plant, KPIs may include measures such as production output, quality defects, and on-time delivery.</p>
<p>Explain any two basic types of conflict and cite an example for each.</p>	<p>Two basic types of conflict are interpersonal conflict and intrapersonal conflict.</p> <p>1) Interpersonal conflict: This type of conflict occurs between individuals or groups in an organization. It arises when there are differences in opinions, goals, or interests, leading to friction and tension. An example of interpersonal conflict is a disagreement between team members in a project regarding the best approach to solve a problem. One team member may believe in a certain methodology, while another may have a different perspective.</p> <p>2) Intrapersonal conflict: Intrapersonal conflict is an internal conflict that takes place within an individual. It arises when an individual experiences conflicting goals, values, or emotions. An example of intrapersonal conflict is when an engineering manager needs to decide whether to prioritize cost efficiency or quality in a product design.</p>

Additionally, ChatGPT was found to be able to generate responses to multiple-choice questions in both modules. Figure 2 shows the responses to multiple-choice questions in the Principles of Management module.

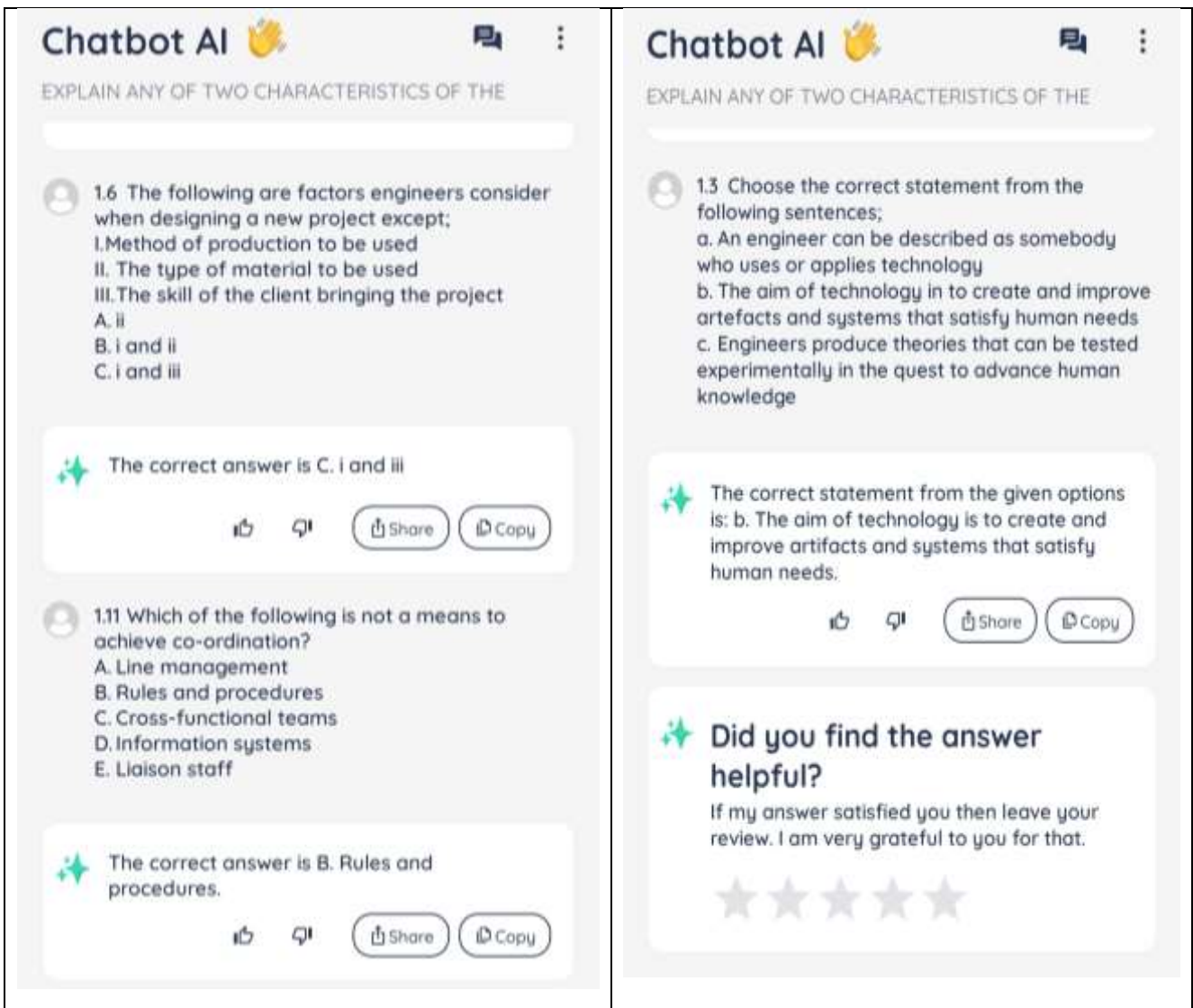


Figure 2: Responses to multiple choice questions on the Principles of Management Module

Figure 3 shows a sample of the responses to 20 multiple-choice questions in the Production Engineering module. It is worth noting that most of the responses from ChatGPT were positive. When questioned on the examples of appropriate applications of additive manufacturing in the actual production of parts or products, ChatGPT was able to state clearly that customised one-of-a-kind parts, parts with complex geometries and plastic parts in small batch sizes were the correct answers.

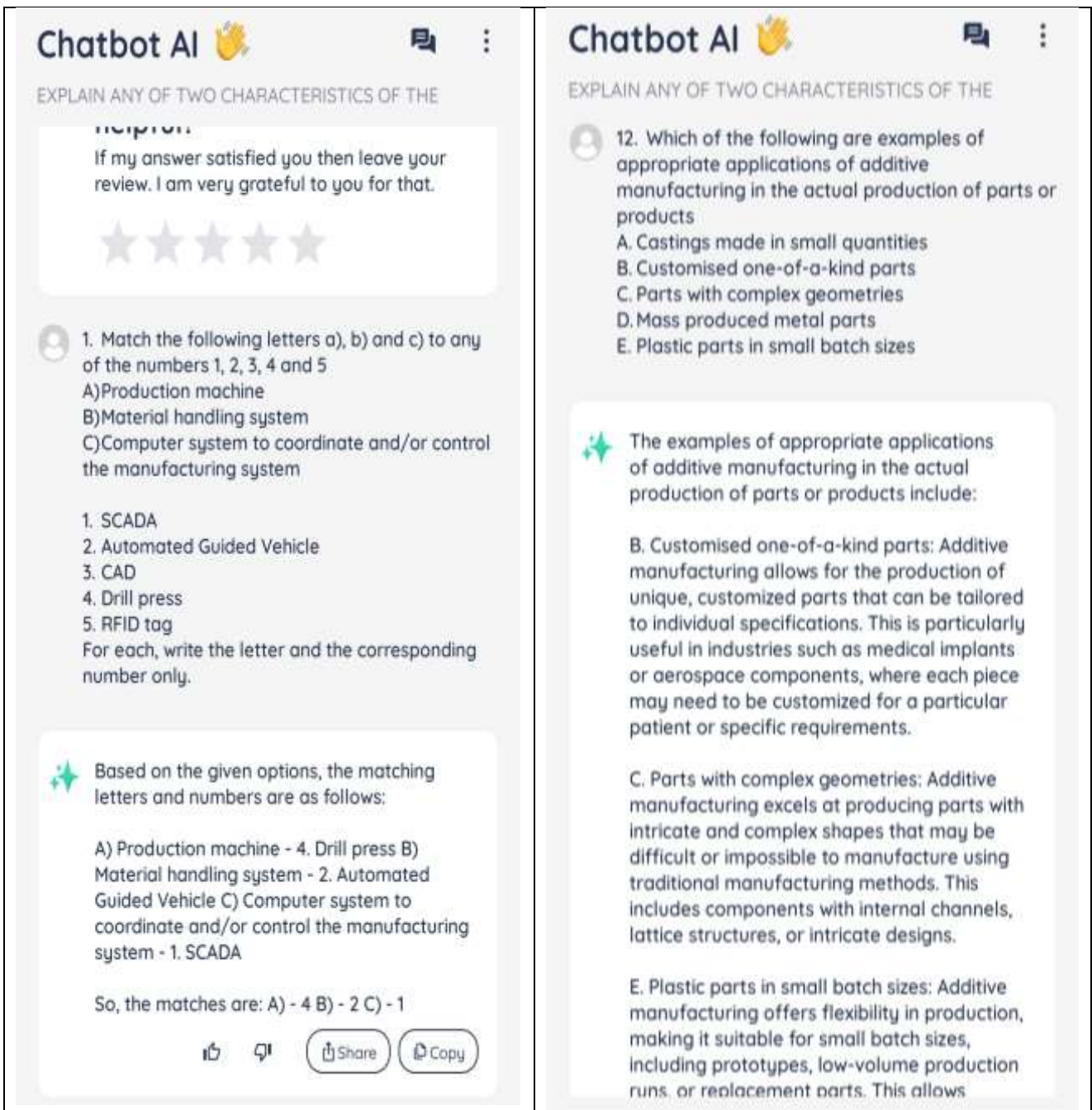


Figure 3: Responses to multiple-choice questions on the Production Engineering module

However, when questioned to compute an estimated time required to build the part using an additive manufacturing technique, as shown in Figure 4, ChatGPT was unable to comprehend the volumetric shape of the cone and compute the average volume per layer, average area per layer and then average time per layer. Instead of getting 7.82 hours as the estimate for the time required to build the part, ChatGPT found the answer to be 2 hours 30 minutes.

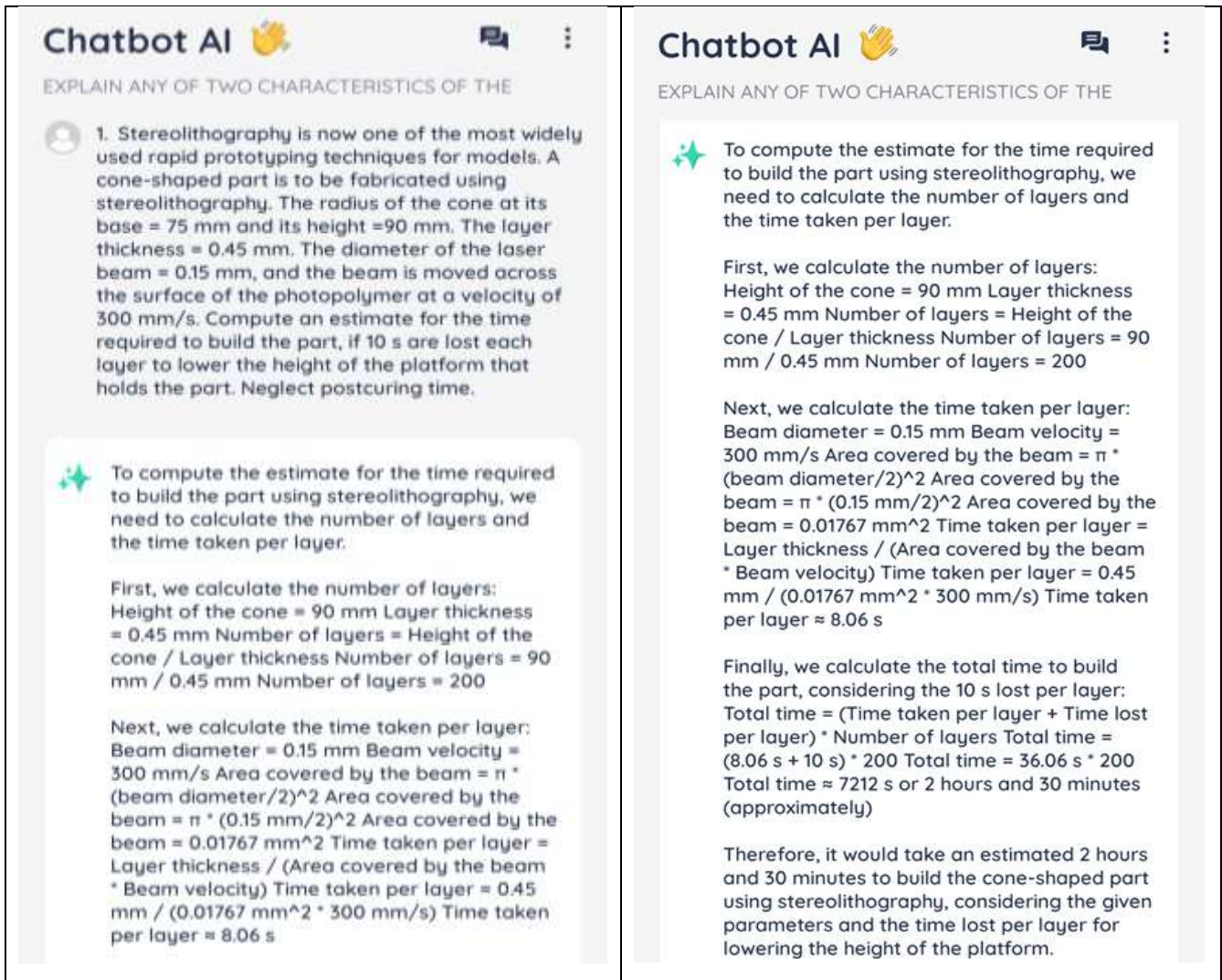


Figure 4: Responses to a complex question on the Production Engineering module

The results from the study demonstrated that ChatGPT would perform well on multiple-choice questions and match questions, but caution should be taken in the future when using ChatGPT to generate solutions that involve computations. Hence, in the future, when using ChatGPT to generate questions and solutions that involve complex computations, it will be imperative for the lecturer to cross-check the solution manually.

## DISCUSSION

Management in educational institutions have expressed several concerns about the integration of ChatGPT into educational settings ever since its launch for public use, citing that originality of ideas and critical thinking are indispensable elements of genuine research or learning.<sup>23</sup> Plagiarism is considered using another individual's ideas or work and presenting them as one's own, without acknowledging the original source or author. Since ChatGPT does not provide the details of the original source, in the paper, the source was acknowledged as ChatGPT. It is worth noting that researchers or students can still plagiarise work without using ChatGPT, but when using AI, the process is quicker. If a researcher or student used ChatGPT to generate an essay and, thereafter, through reverse searching, provided proper referencing for the ideas sourced, this would not be detected or regarded as plagiarism. Hence, there is no excuse to avoid using ChatGPT; it narrows down to the strategies that are employed by the academic staff, students or researchers. Therefore, it becomes imperative that the users of

<sup>23</sup> Halaweh, M. (2023). ChatGPT in education: Strategies for responsible implementation. *Contemporary Educational Technology*, 15(2), ep421. <https://doi.org/10.30935/cedtech/13036>

generative AI technologies be properly informed and educated so that they are able to use them responsibly.

AI has become a fundamental component of educational institutions and plays a crucial role in sustainable education, such that teachers and students would benefit from its applicability in education.<sup>24</sup> It was noted that the lecturers may have limitations about teaching and study resources; however, AI has the potential to resolve that dilemma by providing students with an environment that is conducive to sustainable education. Additionally, rather than sacrificing time to evaluate answer scripts, the lecturer can reorganise their workloads according to their priorities and deploy AI software to rate essays and answers from tests and assignments.

This paper advocates for the use of human-AI tool augmentation for the accomplishment of activities such as seeking information and ideas, text editing and refining written work in education settings. The combination of ChatGPT and human writers would generate synergy and a superior output in terms of originality, creativity and efficiency than operating in functional silos. Lack of originality and violation of academic integrity standards are the limitations of using AI-generated texts alone. On the other hand, the use of traditional human-authored texts and ideas is characterised by limited efficiency and originality. It is easier for human researchers to establish the originality of their ideas and build on existing ideas much faster by using ChatGPT since it stores information in databases, thereby aiding the identification of a multitude of ideas around one subject that were already published.<sup>25</sup>

## RECOMMENDATIONS

The UoT must commence to develop standards and policies that will optimise the curriculum system, develop innovative teaching and assessment methods, and adhere to evaluation criteria. The UoT should involve the academic staff and students when developing policies and processes for implementation to attain the positive benefits of generative AI in education. Another crucial issue in education is to consider personalised learning to customise learning for each student's strengths, skills, needs, and interests when using generative AI. However, it is also vital to note that implementing generative AI in education may amplify inequalities; hence, it becomes imperative to ensure that all scholars from diverse backgrounds benefit and gain access to the technology.

Furthermore, the use of AI in education generates academic performance data, personal information and learning preferences data on students. Hence, data privacy and security when deploying generative AI in the education sector must be ensured. Additionally, the UoT must take the issue of the ethical implications of using generative AI by the students and staff, especially with regard to bias, fairness, and accountability. It is also imperative to consider lecturers' roles and the skills that they need to be effective when executing their duties since generative AI can negatively influence some lecturers' effectiveness in terms of facilitating and enhancing teaching and learning.

Regarding lecturers' practices, there are several strategies they can employ to address the challenges associated with assessing student assignments written by ChatGPT. Lecturers can provide clear and detailed instructions to students about the expected structure of the assignment, and a rubric should be used to evaluate its quality. Furthermore, combining manual and automated assessment methods can help ensure an accurate measure of the student's true understanding.

The UoT and academic practice are commendable about educating students on plagiarism; the information on plagiarism is provided in the study guides of the modules and the consequences of plagiarism are also highlighted. However, there are no systems in place to avoid plagiarism when using ChatGPT or other AI models. An alternative is to request students to sign a declaration that states that the work is an individual contribution and that no AI language model was used to generate it. This approach can aid in holding students accountable for their actions and deter them from using ChatGPT or other AI models.

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<sup>24</sup> Darshana Devi and Aruna Dev Rroy, "Role of Artificial Intelligence (Ai) in Sustainable Education of Higher Education Institutions in Guwahati City: Teacher's Perception," *International Management Review* 19 (2023): 111–16.

<sup>25</sup> Dinesh Kalla et al., "Study and Analysis of Chat GPT and Its Impact on Different Fields of Study," *International Journal of Innovative Science and Research Technology* 8, no. 3 (2023).

A majority of the academic staff use Moodle, which is equipped with a SafeAssign feature to detect plagiarism, while a few are able to Turnitin. SafeAssign is primarily designed to maintain academic integrity by detecting instances of plagiarism in students' papers; however, it is not equipped with AI detection capabilities. Therefore, it was also recommended that UoT equip more academic staff on the use of Turnitin as a plagiarism detection tool since it can aid in detecting plagiarism in students' work.

## CONCLUSION

The study concludes that ChatGPT has the potential to provide students with effective, personalised learning experiences through timely feedback and customised explanations. The IDEE theoretical framework provided the groundwork for identifying the expected outcomes, determining the appropriate level of automation, ensuring ethical considerations, and evaluating the effectiveness of ChatGPT in accomplishing the desired outcomes. The results for generating the marking memorandum for the two tests from two modules demonstrated its potential strengths and weaknesses and the findings from the study revealed that ChatGPT has the potential to positively impact lecturers and students by establishing the originality of their ideas, building upon existing ideas more efficiently. It has been recommended that the UoT should involve the academic staff and students when developing policies and processes for implementation to attain the positive benefits of generative AI in education. Additionally, a hybrid of manual and automated assessment methods can be deployed to ensure that the student's true level of understanding is accurately assessed.

The UoT and academic practice with regard to educating students on plagiarism were found to be commendable. The information on plagiarism is provided in the study guides of the modules and the consequences of plagiarism are also highlighted. However, there are no systems in place to avoid plagiarism when using ChatGPT or other AI models. It has also been recommended that UoT equip more academic staff on the use of Turnitin as a plagiarism detection tool since it can aid in detecting plagiarism in students' work. Future research studies would embrace developing and evaluating AI-based educational tools, paying more detailed attention to ethical considerations. In addition, developments in AI-driven learning analytics will shed more light on student performance as machine learning algorithms identify correlations between student data and complex patterns, thereby allowing the academic staff to foresee learning challenges and proactively support the students.

## FUTURE RESEARCH DIRECTIONS

Future studies may embrace the development and evaluation of AI-based educational applications and exploration of the possible challenges and benefits of deploying the technology in diverse educational settings and contexts. In addition, it is imperative to investigate the effect of ChatGPT and other generative AI applications on the learning outcomes of the students, such as academic achievement, engagement and motivation. Moreover, it becomes imperative that future research encompasses the social and ethical implications of deploying AI in engineering education, its impact on human educators and the prerequisite environment characterised by proper policies and regulations.

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