RESEARCH ARTICLE

Assessing the impact of AI on the academic learning of agricultural students

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Abstract

Generative Pre-trained Transformers (GPTs) are transforming agricultural science education by enhancing students' critical thinking, creativity and decision-making skills. However, concerns exist regarding over-reliance and diminished independent analytical thinking. This study investigated the impact of GPT usage among undergraduate and postgraduate students at Tamil Nadu Agricultural University. A structured questionnaire was employed to collect primary data from 164 students (122 GPT users and 42 non-users). The research adopts a descriptive design and utilizes statistical tools such as percentage analysis, Garrett ranking, Relative Importance Index (RII) and exploratory factor analysis to assess the influence of GPTs on cognitive skills. The findings indicate that the GPTs enhance efficiency, creativity and problem-solving, they additionally possess the risk of overreliance, reducing independent analytical thinking. Factor analysis revealed key dimensions, including decision-making enhancement, overreliance on AI and the impact on problem solving of agricultural science students. The study concludes that balanced AI integration is essential for maximizing GPT's advantages while minimizing dependency. Agricultural institutions should promote critical engagement strategies to ensure responsible AI use and foster an optimal AI-human synergy in the academic learning process of agricultural students.

Keywords: academic learning; AI in education; agricultural students; critical thinking; Generative Pre-trained Transformers (GPTs); problem-solving skills

Introduction

GPTs

GPTs are a class of deep learning models designed for Natural Language Processing (NLP) tasks, such as text generation, translation, summarization, question answering and more. The term "Generative" refers to the model's ability to create new text based on patterns learned from training data, rather than merely retrieving existing information. "Pre-trained" indicates that the model is initially trained on a vast corpus of text before being fine-tuned for specific tasks, enabling it to understand language structures and semantics effectively. The "Transformer" architecture, which underlies GPTs, utilizes a self-attention mechanism to efficiently process and generate sequences of data, making it highly suitable for complex language tasks.

Use in education

Artificial Intelligence (AI) has developed rapidly in recent years, leading to various applications in different disciplines, such as healthcare and education. Developed by OpenAI, these foundation models power ChatGPT and other generative AI applications capable of simulating human-created output. AI applications have also been utilised in education to enhance administrative services and academic support. ChatGPT is used to

assess inputs and take action in a variety of academic and non-academic sectors. For example, it can give real-time information by analysing data from sensors or other monitoring equipment.

It has been observed that AI is progressively moving from an algorithm-based intelligence model to a language-based one in the modern period, demonstrating its enormous potential to reach the level of human intelligence. The modern AI chatbot, ChatGPT, was created by the private business OpenAI and is based on extensive language models (1). It builds the complicated information required during user interactions and offers associated services using NLP technology. Neural networks based on deep learning were used to train a machine learning platform.

Challenges

One of the primary concerns surrounding the use of GPTs in education is their influence on students' cognitive abilities. Traditional education provides analytical reasoning, originality and self-directed learning. However, AI-AI-generated content may lead to passive consumption rather than active engagement with knowledge. Research suggests that when students depend on AI-AI-generated outputs, they may struggle to evaluate the validity of information, weakening their critical thinking skills (2, 3). While GPTs can support brainstorming and idea generation, there is a

risk that their outputs may reinforce existing biases or limit truly original thinking (4).

Benefits

GPTs also have the potential to enhance learning experiences by exposing students to diverse perspectives, encouraging curiosity and interdisciplinary exploration. GPTs can act as cognitive catalysts, stimulating creative thinking rather than replacing it. In problem-solving contexts, GPTs can aid students in breaking down complex problems, guiding them through logical reasoning steps and supporting decision-making in data-driven scenarios (5).

Research gap

This study aims to evaluate the impact of GPTs on academic learning by analyzing their influence on students' ability to think critically, generate innovative ideas and solve problems independently. By comparing students who frequently engage with AI-assisted learning environments with those who rely on traditional study methods, the research will assess whether AI tools serve as enhancers or inhibitors of intellectual growth. The findings will contribute to a deeper understanding of AI's role in shaping the future of education and inform strategies for its responsible integration into academic settings.

Literature review

ChatGPT enhances student learning by providing instant academic support, facilitating homework completion and improving exam preparation. However, concerns arise regarding overreliance, reduced critical thinking and inaccurate information. The balance between leveraging ChatGPT's benefits and mitigating its drawbacks remains crucial in shaping effective educational strategies (6). ChatGPT transforms education by enhancing personalized learning and supporting faculty and students with real-time assistance. Nevertheless, issues such as plagiarism and the spread of misinformation emphasize the necessity for ethical guidelines, AI-detection tools and innovative assignment designs to ensure their responsible and effective use in academic settings (7).

ChatGPT contributes to increased student engagement by offering instant feedback and personalized academic support. While this can enhance the learning experience, studies caution that excessive reliance on such tools may impede the development of independent critical thinking skills. In introductory chemistry courses, ChatGPT has been used to enhance students' critical abilities. In one staged activity, students demonstrated increased confidence in evaluating information, analyzing complex topics and formulating insightful questions. However, challenges like low-quality comments and difficulties in validating sources were noted. (8) ChatGPT has significantly influenced student behaviour in the UAE, particularly in academic and learning contexts. Studies reveal that its use enhances critical thinking, creativity and personalized learning, offering immediate assistance and diverse perspectives. However, overreliance on ChatGPT may diminish independent problem-solving skills, posing a challenge to traditional education methods. The balance between leveraging AI for academic growth and ensuring authentic learning experiences remains a key focus in understanding its impact (9).

ChatGPT influences student learning, focusing on cognitive skills such as critical thinking, problem-solving and creativity. Findings indicate a positive correlation between ChatGPT interaction and cognitive skill enhancement, though concerns about overreliance persist. The study highlights the need for responsible AI integration in education, emphasizing guidance over direct solutions. ChatGPT's impact on critical, creative and reflective thinking skills among university students. Findings indicate that ChatGPT enhances engagement and cognitive skills but raises concerns about over-reliance and misinformation. The balance between AI-assisted learning and traditional educational methods is essential for effective skill development (10).

ChatGPT plays a growing role in education by fostering personalized learning, enhancing critical thinking and promoting interactive engagement. While these AI tools contribute positively to cognitive development, persistent concerns related to data privacy, algorithmic bias and excessive dependence on AI must be addressed to ensure ethical and effective integration in academic environments (11). In academic learning contexts, ChatGPT offers notable benefits such as personalized feedback, increased engagement and support for critical thinking development. However, ethical concerns such as academic integrity, data privacy and potential bias in AI-generated content pose challenges to its effective implementation. The study emphasizes the importance of responsible AI integration to maximize benefits while maintaining educational fairness (12).

In undergraduate education, ChatGPT demonstrates the potential to enhance student engagement, strengthen problem-solving abilities and improve writing skills. However, the presence of AI-generated biases, the risk of plagiarism and the lack of adequate faculty training highlight the need for responsible integration and informed integration of AI tools into the curriculum (13). ChatGPT enhances students' critical thinking skills by encouraging analysis, evaluation and paraphrasing of AI-generated content. Findings suggest that while ChatGPT aids academic work, excessive reliance may hinder independent thought. The research emphasizes the importance of guided AI usage to maximize learning benefits while maintaining originality (14).

The literature shows a positive view of digital learning tools, highlighting their potential to personalize learning, boost engagement and improve results in various settings. However, it also notes concerns such as dependency on technology, ethical issues and declining independent thinking. Most studies agree that technology should be integrated responsibly. Future research should find ways to use these tools to enrich learning while maintaining critical thinking, creativity and integrity.

Statement of the problem

The increasing integration of GPTs in academic environments raises concerns about their impact on students' cognitive development. While these AI tools enhance efficiency, creativity and access to diverse information, they may unintentionally lead to overreliance, reduced capacity for critical thinking and independent problem-solving. Traditional education emphasizes active engagement and analytical reasoning, but AI-generated responses may discourage students from deeply evaluating content or generating original ideas. This study addresses a key gap in empirical research by exploring the influence of GPTs on students' intellectual development, particularly in essential academic skills such as critical thinking, creativity and decision-making.

Need for the study

Despite the growing body of research on artificial intelligence in education, few studies have specifically examined the cognitive implications of GPT usage among students. Most of the existing research focuses on the functional or supportive role of AI tools, without deeply analysing their influence on learners' ability to think critically, creatively and independently. Given the widespread adoption of GPTs, particularly among undergraduate and postgraduate students, there is an urgent need to investigate both their benefits and drawbacks. The study aims to fill the gap by providing quantitative insights into the cognitive effects of GPTs, thereby guiding educators to promote responsible AI integration in academic learning.

Objectives of the study

The study aims to achieve the following three objectives,

1. To assess the impact of GPTs on students' critical thinking, analytical abilities and decision-making processes.

2. To explore how GPTs influence creativity and the generation of new ideas in academic and research contexts

3. To evaluate whether reliance on GPTs affects students' capacity to think independently and solve problems effectively.

Collectively, these objectives aim to determine whether GPT tools serve as enhancers or inhibitors of intellectual and cognitive development in academic settings.

Methodology

The study was conducted at Tamil Nadu Agricultural University, involving both undergraduate and postgraduate agricultural students. Primary data were collected using structured questionnaires designed to capture students' engagement with GPTs and the factors influencing their usage. The questionnaire focused on students' experiences, frequency of use, perceived benefits and concerns related to GPTs in academic contexts.

A quantitative research approach was adopted for this study, using a structured survey administered to students. The methodology encompasses the following components:

Research design

A descriptive research design was adopted to analyse students' perspectives on GPTs' impact on critical thinking, creativity and independent problem solving. The study utilized a structured questionnaire as the primary data collection instrument.

Sampling technique and sample size

A stratified random sampling technique was employed to ensure diversity in student representation across different academic backgrounds (undergraduate, postgraduate). The sample size was determined in a survey of 164 students from various institutions in Tamil Nadu Agricultural University and their affiliated colleges.

Data collection

Primary data was collected through an online questionnaire in google forms designed to capture students' perceptions of GPTs' influence on their learning process. The questionnaire included Likert-scale questions (ranging from strongly agree to strongly disagree), ranking questions to facilitate analysis.

Data analysis tools

The collected data from the students were analysed using statistical techniques. Percentage analysis is a fundamental statistical tool used in this study to analyse the demographic characteristics of the respondents. Garrett ranking technique was applied to study the factors influencing creativity and idea generation in the usage of the GPTs. Relative importance index analysis was significant to this study because its result indicated the ranked degree of relevance to calculate factors influencing critical thinking and analytical skills. Factor analysis is a dimensionality reduction technique used to identify the underlying relationship between observed variables and the factors influencing the usage of the GPTs in the academic learning of the students.

Results and Discussion

Percentage analysis

Fig. 1 shows that 74.39 % of students (122 respondents) use GPT-based tools, while 25.60 % (42 respondents) do not use GPTs. This indicates a strong reliance on AI tools in academic learning. GPTs can enhance creative thinking by generating new ideas, improving access to diverse perspectives and brainstorming ideas. They support problem-solving by providing quick solutions. Non-GPT users might develop stronger independent thinking skills through traditional learning methods. These
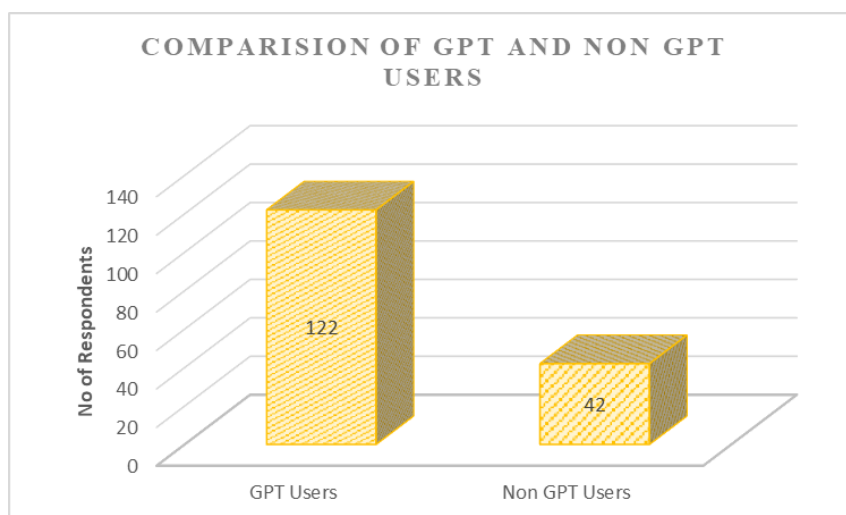

Fig. 1. Comparison of GPTs and Non GPT Users.

findings suggest that although GPTs boost efficiency and creativity, excessive dependence on them may reduce students' capacity for self-directed critical thinking.

Table 1 presents a percentage analysis of respondents' education levels and their usage of GPT tools. Out of 164 respondents, 51.63 % were undergraduates and 48.36 % were postgraduates. Among undergraduates, 63 respondents are in usage of GPTs, while 32 did not, representing 76.19 % and 23.81 % of the undergraduate group, respectively. For postgraduates, 59 respondents used GPT tools and 10 did not, accounting for 48.36 % and 51.64 % of the postgraduate group, respectively. This analysis highlights that undergraduates are more likely to use GPT tools compares to postgraduates, most of the respondents are undergraduate students. The higher usage among undergraduates may reflect greater integration of AI tools into their academic routines, whereas lower usage among postgraduates could stem from differing academic needs, greater self-reliance, or lower familiarity with such technologies.

Table 1. Education level of the usage of the GPT users

Sl. No	Education level	Respondents (n=164)		Percentage	
		GPT	Non GPT	GPT	Non GPT
1	Undergraduate	63	32	51.63	76.19
2	Postgraduate	59	10	48.36	23.8

Table 2 shows that most of the respondents are in the age group of 21-24 age (121 individuals or 73.78 %), followed by age group of 17-20 age (34 individuals or 20.73 %) and only 9 individuals are from the age groups of 25-27 age group. The 21-24 age group suggest that GPT tools are most commonly used by their students in undergraduate or postgraduate. The findings suggest that younger students (17-20) are increasingly adapting to AI tools, while older students (25-27) may rely more on traditional learning methods or have already developed independent learning strategies.

Table 2. Age of the students in the usage of GPTs

Sl. No	Age	No of respondents	Percentage
1	17-20	34	20.73 %
2	21-24	121	73.78 %
3	25-27	9	5.48 %

Table 3 indicates that 59 % respondents are male, while 41 % were female. This suggests a higher engagement with GPT tools among male students. Studies have shown that gender differences AI adoption in education. Male students are more likely to explore and integrate AI tools into their learning process, while female students may exhibit a different approach, it emphasizes critical thinking and problem solving. GPT tools can enhance creativity and problem solving, but impact on usage of GPT may varies across gender due to differences in technology and usage pattern of GPTs (3). The participation of female students in this study highlights the growing adoption of AI tools among women, underlining the importance of inclusive AI education programs that foster diverse perspectives in AI-enhanced learning.

Table 3. Gender of the students in the usage of the GPTs

Sl. No	Gender	No of respondents	Percentage
1	Male	96	59 %
2	Female	68	41 %

Garret ranking

Table 4 highlights key factors influencing creativity and idea generation, Alignment with goals ranks highest (Mean = 43.72), indicating that creativity is most effective when ideas are aligned with specific objectives. Exposure to new ideas (Mean: 43.34) ranked second, gives importance of innovation in various perspectives. Collaborative creativity (Mean: 42.13) ranks lower, suggest that potential challenges such as coordination issues and group thinking. The research supports that goal oriented creativity leads to more practical ideas, while exposure to enhances originality (15). Collaboration may require structured facilitation to maximum innovation. Effective collaboration may require structured facilitation to maximize innovation. Overall, these results suggest that balancing goal alignment, exposure to new ideas and well-managed collaboration is key to optimizing creative outcomes.

Table 4. Factors influencing creativity and idea generation in usage of the GPTs

Factors	Weighted sum (ΣW)	RII	Rank
Reduce use of critical thinking	445	0.72951	2
Decision-making	337	0.55246	5
Multi-perspective problem solving	456	0.74754	1
Trust over personal judgment	402	0.65902	4
Enhanced analytical skills	423	0.69344	3

Relative Importance Index (RII)

Table 5 presents RII for various factors influencing critical thinking and analytical skills. "Multi-perspective problem solving" ranks highest (RII = 0.74), emphasizing its crucial role for enhancing analytical skills (16). The "Reduction in critical thinking" factor ranks second (RII = 0.72), suggests concern over GPT reliance potentially diminishing cognitive engagement (17). "Enhanced analytical skills" (RII = 0.69) and "Trust in AI over personal judgement" (RII = 0.65) indicate the role of AI in improving independent reasoning. The lowest ranked factor, " Decision making (RII = 0.55) suggests that the AI's role in decision making remains constant, with implication for automation (18). These result align with broader concerns regarding AI's influence on human cognition and underscore the importance of balanced AI-human collaboration in educational contexts (19).

Table 5. RII for critical thinking and analytical skills

Sl.No	Factors	Mean value	Rank
1	Exposure to new ideas	43.34	II
2	Overcoming creative blocks	42.69	III
3	Alignment with goals	43.72	I
4	Efficiency in brainstroming	41.15	V
5	Collaborative creativity	42.13	IV

Factor analysis

Table 6 shows that the Kaiser-Meyer-Olkin (KMO) value of 0.859, confirming the sampling adequacy of the sample for factor analysis. The Bartlett test *(p < 0.05)* justifying the application factor analysis. The scree plot shows a sharp decline in eigenvalues for the first four components and a gradual levelling off, indicating that these four explain the majority variance. This aligns with the Kaiser criterion, suggesting components with eigenvalues greater than 1. The clear point in the fourth component supports the scree tests. These findings are consistent with existing studies on AI-assisted learning, where critical thinking, over-reliance on AI, problem-solving and analytical trust emerge as key factors [20]. The four components ensure a balance between interpretability and explanatory power in factor analysis.

The factor accounting highest variance in decision making (32.4 %) suggest that students utilize GPT to enhance their decision-making process and develop a dependency on AI-generated suggestions excessive reliance on GPTs may diminish critical thinking and independent judgement [21]. Overreliance on GPT (8.3 %) of variance, this highlights that excessive dependence on GPT can improve originality and cognitive engagement. Studies that have shown that overuse of AI tools may limit students' ability to think independently and critically [22]. Problem solving (6.8 %) of variance, this factor suggests that GPTs simplify complex tasks, it may reduce students' confidence in problem solving independently. Research on AI assisted learning suggests that students who frequently use AI tools may struggle in problem solving when AI is unavailable [20]. Analytical trust (5.4 %) of variance it reflects that student's tendency to trust GPT for analytical skills and tasks, which may reduce their own critical thinking abilities. Studies indicate that AI reliance can lead students to accept AI-generated insights without sufficient evaluation, affecting their analytical development [23].

Table 6. Factors influencing the usage of GPTs

Factors	Variables	Factor loadings	Variance
Decision making	Suggestion verification	0.61	32.4 %
	Decision enhancement	0.62	
	Decision dependency	0.58	
Overreliance on GPT	Over-reliance limitation	0.67	8.3 %
	Brainstroming efficiency	0.62	
	Orginality limitation	0.57	
Problem solving	Confidence decline	0.76	6.8 %
	Problem simplification	0.64	
Analytical trust	Argument support	0.71	5.4 %
	Traditional methods	0.70	
	Trust dependence	0.67	

Conclusion

The study highlights the advantages and impact of using GPTs and offers insightful information about how they affect analytical trust, critical thinking and decision making. Important features were found by the factor analysis such as improvements in decision making, the effectiveness of problem solving, over dependence on GPTs and shift in analytical trust. According to the study, GPTs help students to solve problems more quickly and make better decisions by providing a various viewpoint. However,

they also increases cognitive reliance by decreasing the ability to think critically and independently. The scree plot analysis also indicates the most changes in GPT reliance can be explained by a small number of significant components, which supports the idea that excessive use may impair one's capacity for problem-solving. Previous research has similarly highlighted the risk of automation bias, where users become overly dependent on AI-generated suggestions without sufficient critical evaluation. However, GPTs also serve as valuable cognitive tools when used appropriately, aiding in structuring arguments and simplifying complex problem-solving tasks. The findings indicate the balanced integration of GPTs in academic and professional settings, ensuring that they function as complementary aids rather than substitutes for independent reasoning. Future research should explore interventions that promote mindful GPT usage while mitigating the risk of overreliance.

The study concludes that GPTs should be integrated as assistive tools rather than replacements for independent cognitive processes. While AI enhances learning experiences by improving accessibility, creativity and efficiency, the risk of overreliance must be mitigated through educational interventions that encourage critical engagement with AI-generated content. They focus on strategies to mitigate dependency on AI and help students to build analytical trust not by accepting everything, but by learning to think critically about suggestions and ensure that students develop a balanced approach in AI and maintain their analytical and decision-making skills.

Authors' contributions

Conceptualization, data collection and methodology were done by JR and SS. Resources: [MD, DN, KM]; Investigation, formal analysis and writing original draft was performed by JR, SS and DN. Visualization done by JR, SS and KM. SS, MD, DN and KM supervised the whole work. All authors read and approved the final paper.

Compliance with ethical standards

Conflict of interest: The authors declare no Conflicts of interest.

Ethical issues: None

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