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Developing higher-order thinking skills among graduate students using Artificial Intelligence

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Abstract

A mixed-method study was designed to develop higher order thinking skills among graduate students at college level. The study investigated the perceptions, benefits, teaching strategies and challenges associated with AI implementation in academic settings to enhance critical thinking skill among graduate students. For quantitative data, a sample size of 120 students were selected through random sampling for college students. For qualitative data, a sample size of 20 teachers were selected for interviews. The findings revealed that while AI holds significant potential to enhance critical thinking, problem-solving, and personalized learning, and it also presented challenges such as technical complexities, unequal access, and concerns over privacy and over-reliance on technology. The study also emphasizes the necessity of addressing the ethical and practical challenges that arise from the use of AI in education, particularly in ensuring equitable access and maintaining the balance between technology and human interaction. The research concludes that with appropriate strategies and support, AI can significantly contribute to the development of higher order thinking skills, preparing students for the complexities of the modern workforce and developing comprehensive frameworks for training educators in AI utilization.

Keywords: Higher order thinking skills, Artificial Intelligence, Graduate students, Teachers.



Introduction

Artificial intelligence (AI) involves performing tasks like inference, deduction, and perception that require highly developed human intelligence is known as artificial intelligence (AI) (Aldosari, 2020). AI, according to Luckin (2017), is the capacity of computer systems to behave in ways that are comprehensible to humans. The present study examines the noteworthy advancements from the inception of artificial intelligence (AI) to the forefront of education in recent years. Artificial intelligence (AI) technology, which is typified by machine learning algorithms, natural language processing, and artificial intelligence, has the potential to improve conventional learning and encourage self-directed learning. Both new prospective needs and personal needs arise. In both academic and professional contexts, higher-order skills like critical thinking, problem-solving, creativity, and metacognition are lacking in the capacity to resolve challenging issues. The study investigated how graduate students' higher order thinking skills could be developed by artificial intelligence (AI) in higher education. To improve students' critical thinking abilities, it investigated the attitudes, advantages, instructional methods, and difficulties related to the use of AI in classrooms. A subfield of machine learning called "deep learning" uses artificial intelligence to teach (Janiesch et al., 2021).

Statement of the problem

This study addresses the need to foster higher order thinking skills among graduate students through the integration of artificial intelligence in higher education.

Purpose of the study

The purpose of this study is to examine the factors that influence the acceptance and use of AI in higher education and to identify the barriers and enablers affecting both students' interaction with AI and educators' instructional practices. Additionally, the study aims to propose AI-based communication models that enhance learning and skill development through targeted interventions and data-informed evaluation.

Objectives of the study

1. To examine the impact of AI on students' problem-solving abilities and development of higher order thinking skills.
2. To identify the challenges faced by students and teachers in implementing AI within higher education settings.

Research Questions

1. What are students' perceptions of AI in fostering higher order thinking skills?
2. What strategies do teachers use to promote critical thinking using AI?
3. What barriers do students and teachers face when using AI in the classroom?

Literature Review

The term "students facing AI" describes the software that students utilize to study subjects. AI-trained teachers can conduct activities like administration, evaluation, feedback, and plagiarism detection, helping teachers and lightening their workload by offering insights into students' development. Administrators and leaders can access up-to-date information from systems-oriented AI (Zawacki et al., 2019). Higher education institutions can create digital transformation strategies by following the practical instructions provided by the Microsoft Higher Education Transformation Framework (ETF) (Papaspriidis, 2020). Digital assistants and chatbots are related technologies that are utilized in tandem (Janiesch, 2021). Chatbots and digital assistants are virtual teaching assistants that may respond to inquiries from students without the need for human assistance (Popenici and Kerr, 2017).

A virtual learning environment that adjusts instruction and resources to students' needs and skills is known as adaptive learning, or smart tutoring (ITS) (Luckin et al., 2016). By determining each student's skill level and offering pertinent assignments and tests, adaptive learning offers individualized instruction (Baker, 2021). A computerized paper scoring AI system used in extensive summative evaluation programs was illustrated by Gardner et al. (2021). Automatic rating and feedback systems driven by AI offer real-time, data-based assessments of student achievement, guaranteeing impartial and reliable evaluation. By providing individualized feedback, recognizing students' strengths and shortcomings, and providing real-time guidance toward growth, these systems boost learning (Brennan, 2023).

The way higher education has historically functioned could be altered by intelligence-supporting systems and technologies (Baker, 2021). The "US Education Sector Report" by Dhawan and Batra (2021) projects that the use of AI in the US education sector would grow by 48% between 2018 and 2022. AIED (page 11). Software that students utilize to learn specific courses is referred to as student-facing AI. AI-powered teacher training can handle administrative, evaluation, feedback, and plagiarism detection duties, helping educators and lightening their workload by giving them information about students' progress. Administrators and leaders can access university information through systems-oriented AI (Richter et al., 2019).

Significance of the study

This study is significant in demonstrating how AI technologies can enhance critical thinking, creativity, and problem-solving among graduate students. By offering adaptive assessments, real-time feedback, and engaging simulations, AI enables students to participate in cognitively demanding tasks. It also supports diverse learning styles, encourages reflective reasoning, and facilitates exploration of real-world issues through data-driven scenarios. As AI automates routine functions, students can devote greater attention to higher-order cognitive processes.

Research Methodology

A mixed-method research design was selected for the study. First, a quantitative approach was taken, and the application of the Artificial intelligence technique was researched across disciplines and contexts. After gathering data from the survey instrument, qualitative methods were utilized to acquire in-depth information about how educators at the college level see various forms of artificial intelligence. All graduate level students were considered as the population of the study. By using a random sampling technique 120 students were selected for a survey method and 10 teachers and 10 students were selected for recorded interviews from 5 public colleges. A Semi-structured instrument was administered after pilot testing. Descriptive and inferential statistics were utilized to conclude if there was any existing statistically important variation for Artificial intelligence in various teaching experiences and developing higher order thinking skills among students. Interviews were transcribed and analyzed with 'open and axial coding' techniques.

Results of the Study

Students' Perception of AI

Sr. No	Statements	M	SD
01	AI tools are effective in developing higher order thinking skills in students.	2.59	1.134
02	AI can provide personalized learning experiences that enhance student engagement.	2.44	0.986
03	AI tools are too complex for students to use effectively.	2.40	0.956
05	AI-driven feedback helps students improve their critical thinking skills.	1.62	.597
06	Over-reliance on AI can negatively impact students' independent thinking abilities.	1.59	.667
07	AI can effectively identify students' strengths and weaknesses.	1.56	.696
08	Privacy concerns are a major barrier to the adoption of AI in education.	1.56	.591
09	AI can assist in designing effective strategies for diverse student needs.	1.53	.673
10	The use of AI in education is essential for preparing students for the future workforce.	2.32	1.053
11	AI tools are too complex for students to use effectively.	2.40	0.956
12	Access to AI technology should be equal for all students regardless of their background.	2.35	0.998
13	AI can help reduce the workload for students by automating routine tasks.	2.44	0.986
14	AI tools can enhance collaboration among students in group activities.	1.56	.591
15	The implementation of AI in education requires significant financial investment.	1.53	.673
16	Students are more engaged in learning when using AI-based educational tools.	1.56	.696
17	AI can help bridge the gap between high-achieving and low-achieving students.	2.40	0.956
18	Students feel confident in using AI tools in their classrooms.	2.32	1.053
19	AI can provide real-time feedback that helps students learn more effectively.	2.44	0.986
20	The integration of AI in education should be a priority for universities.	2.35	0.998

The table showed the students who responded to the most agreed statements of the questionnaire.

It seems that Students positively perceive Artificial Intelligence. The results indicated from 1-4 statements that all the statements responded by students fall in medium mean. The results indicated from 5- 9 statements that all the statements responded by Student fall in lowest mean. The results indicated from 10-13 statements that all the statements responded by students fall in medium mean. The results indicated 14-16 statements that all the statements responded by students fall in medium mean. The results indicated 17-20 statements that all the statements responded by students fall in medium mean. It means all the students frequently assess through Artificial Intelligence and are aware of its characteristics and importance. Therefore, the high means measure to be 2.8 and above, and low means are 1.92 or less, while medium means average measure between 1.93 and 2.79.

T-test for impact of gender on student's perception

Gender	N	M	SD	t	df	Sig. (2-tailed)	Difference
Male	60	50	5	2.31	118	0.022	M > F
Female	60	47	6				

An independent sample t- test was conducted to compare the Artificial Intelligence perceptions for male and female teachers. There were significant differences ($t=2.474$, $df=89.829$, Sig 2 Tailed =015), in mean score for Male ($M=1.94$, $SD=415$) and Female ($M=1.77$, $SD=304$), in students' perception on usefulness of Artificial Intelligence. The significance of Levine's test is (.001) p-value that is less than (0.05) alpha value that means equal variances not assumed. Hence, there were significant differences for male and female students in Student's perceptions.

Findings of Interviews by Students

Most of the students see AI as a valuable tool that enhances personalized and engaging learning experiences. Students appreciate how AI can adapt to their needs, offering extra support or challenges based on their performance. For instance, if a student struggles with a concept, AI can provide exercises or guidance to improve their understanding. This self-driven learning approach boosts confidence and fosters creativity. However, some students worry that excessive reliance on AI in the workplace may hinder their problem-solving and critical thinking skills. They fear AI might encourage overlearning, leading them to follow instructions without deeply engaging with the material. Additionally, some miss the human interaction of traditional teaching, valuing the insights and personal feedback from professors. Although they accept the advantages of AI, they think technology should enhance rather than replace teachers' roles in mentoring and instructing pupils.

Findings of Interviews by Teachers

Teachers use AI tools to tailor their teachings to the individual needs of each student. AI makes recommendations for specific exercises and materials to improve learning by evaluating student performance. For example, AI offers extra activities or explanations to help students who are having trouble understanding a certain subject. This individualized method facilitates better understanding of difficult ideas. Moreover, AI creates assessments, interactive games, and problem-solving exercises that motivate students to use their knowledge creatively as opposed to merely absorbing it. Students may quickly recognize errors and improve their thinking thanks to AI's instant assessments and feedback, which strengthens their problem-solving abilities. Furthermore, AI facilitates collaborative learning and teamwork by classifying students according to their strengths and shortcomings. Students improve their communication, critical thinking, and problem-solving skills by working on AI-driven projects and challenges, which guarantees they get the help and modifications they need for their academic development.

Conclusion

The study's findings demonstrated the application of AI in higher education, examining its advantages, difficulties, and effects on instruction and learning. In line with previous research that connects AI to enhanced critical thinking and problem-solving abilities, educators utilize AI to tailor lessons, offer immediate feedback, and encourage interactive learning. But issues like stress, an excessive dependence on technology, and the requirement for appropriate training also surfaced. Although they acknowledge the advantages of AI, such as greater motivation and engagement, students are concerned about their reliance on technology and the loss of in-person interactions with teachers. To guarantee successful learning while addressing its limits, the study placed a strong emphasis on striking a balance between AI and conventional instruction. This research offers a greater understanding of AI's function in education and its potential to improve students' higher order thinking skills by combining insights from both teachers and students.

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