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IMPACT OF GENERATIVE AI ON STUDENT LEARNING OUTCOMES

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ABSTRACT

This study explores how generative artificial intelligence tools—such as ChatGPT, Bard, Claude, and Copilot—shape various aspects of student development, including academic performance, cognitive growth, creativity, and ethical conduct. The research aims to determine the extent to which these tools contribute to or hinder student learning. To address this inquiry, a mixed-methods framework was adopted. Data were collected through an online survey completed by 55 students from multiple academic fields, followed by qualitative thematic analysis to interpret emerging patterns.

Keywords: Generative AI, Student Learning, Academic Achievement, Cognitive Development, Ethical Use, AI Tools, Mixed-Methods Design.

I. INTRODUCTION

The digital revolution has continuously reshaped the landscape of education, and in the current era, Generative Artificial Intelligence (AI) represents one of the most transformative technological innovations in the modern educational setting. These sophisticated tools, which include models like ChatGPT, Google's Gemini, Claude, and Copilot, are causing a profound paradigm shift in how students and educators approach learning, research, and creative endeavors. Generative AI systems are capable of producing outputs that closely resemble human creation, such as text, images, code, and novel ideas, which offers the significant potential to enhance learning efficiency, improve understanding, and foster critical thinking skills among students. The adoption of generative AI is particularly visible and accelerating in higher education. Students are integrating these tools into various facets of their academic life, using them for purposes ranging from writing assistance and idea generation to personalized tutoring, coding help, and guidance on complex

projects. This integration promises a more accessible, personalized, and efficient learning experience. For instance, AI chatbots have been observed to improve comprehension through interactive explanations and instant feedback, and AI tools can offer personalized assistance that enhances self-paced learning. Similarly, the broader application of AI technologies in education is known to support adaptive learning, assessment, and data-driven teaching methodologies. However, the rapid influx and integration of generative AI into academic environments is not without its complications and challenges. A substantial debate has emerged surrounding its potential negative consequences, particularly concerning academic integrity, student dependency, and the possible erosion of fundamental cognitive skills. While these tools offer promising opportunities for customized learning and accessibility, there is a growing and valid concern that students may develop an over-reliance on them for completing assignments, developing critical thinking, and engaging in genuine problem-solving. Excessive reliance on AI, for example, has been argued to potentially hinder students' analytical skills and stifle originality. Furthermore, research has emphasized the serious ethical implications of using AI in academic writing, raising issues around plagiarism, intellectual honesty, and the ambiguity of authorship.

The focus of this research is to systematically analyze the dual impact of generative AI on the learning outcomes of college and university students. It seeks to explore the full spectrum of effects, investigating both the potential benefits and the drawbacks that manifest within academic contexts. The study recognizes that educational institutions are currently in the process of developing appropriate frameworks for the responsible and effective integration of these powerful tools. Therefore, a study of their actual influence on learner performance and engagement is essential for guiding future policy and pedagogical practice .

II. REVIEW OF LITERATURE

1.

Authors: Meryem Seda Gunsaldi; Elif Gamze Güner; Musa Uçkan; Kaan Batı.
Affiliation: Kaan Batı is associated with Hacettepe University.
Published in: Journal of Education in Science, Environment and Health (JESEH), Volume 11, Issue 3, 2025.
This systematic review explores how generative artificial intelligence (GenAI) tools affect middle school students' learning outcomes in science education. The authors selected twelve empirical studies (via databases like Web of Science, Scopus, ERIC, and TrDizin), following the PRISMA protocol to ensure rigor.
Key findings reveal that GenAI applications positively influence multiple dimensions of learning: Academic Achievement: AI-supported environments contributed to higher test scores and better concept mastery.
Conceptual Understanding: Students showed deeper understanding of scientific concepts, often correcting misconceptions more effectively than traditional methods.
Scientific & Digital Literacy: Use of GenAI enhanced students' literacy around science topics and digital competencies.
Personalized Learning: These tools enabled adaptive and individualized learning paths, allowing students to progress at their own pace.
Affective Outcomes: There were improvements in motivation, engagement, self-efficacy, and even emotional outcomes linked to GenAI-integrated learning. The authors emphasize that while GenAI is transformative, its integration must be pedagogically sound and ethically grounded. They recommend increasing AI literacy among teachers, embedding ethical awareness in curricula, and designing culturally sensitive, interdisciplinary learning practices. Overall, the review argues that GenAI has strong potential to boost quality, accessibility, and inclusivity in science education but that its adoption should be thoughtful, guided, and equitable.

2.

First author: Daniel A. Lee.
Other co-authors: Matthew Arnold, Amit Srivastava, Katrina Plastow, Peter Strelan, Florian Ploeckl, Dimitra Lekkas, Edward Palmer.
Affiliation: University of Adelaide, North Terrace, Adelaide, South Australia, Australia Published in: Computers & Education: Artificial Intelligence (Elsevier) in 2024.
The study examines how generative artificial intelligence (GenAI) tools such as ChatGPT are reshaping higher education from the viewpoints of educators. Through surveys and interviews with university teaching

staff, the research reveals a deeply ambivalent and heterogeneous set of attitudes toward AI, rather than a unified consensus.
One of the central concerns raised by educators pertains to academic integrity. Many fear that students might misuse AI to shortcut learning, produce work that is not genuinely their own, or overly depend on AI-generated content. Interestingly, the authors argue that these concerns may be somewhat overstated: although risk exists, not all educators experienced rampant misuse. At the same time, the study notes that almost half of participating staff have already begun integrating AI in their teaching practices, particularly through assessment redesign. Rather than banning AI outright, educators are adapting: modifying assignment structures, introducing more process-oriented tasks, and emphasizing student use of AI in reflective or scaffolded ways. However, institutional support is lagging: fewer than a quarter of the educators felt that their university had adequately prepared them to engage with GenAI. Over three-quarters expressed a desire for more training, policies, and guidance to align AI use with pedagogical goals
Underlying the ambivalence is a sense of future optimism all respondents agreed that AI is not a passing fad and is likely to improve over time. Educators stressed that while GenAI can enhance efficiency, creativity, and personalization, it cannot replace the human aspects of teaching: mentorship, emotional support, and adaptive feedback.
Overall, the literature suggests that higher education institutions must stay proactive: fostering ongoing dialogue, conducting research, and co-developing ethical and pedagogical frameworks. As GenAI continues to evolve, universities have a responsibility not just to regulate it, but to harness it in ways that preserve academic rigor and support genuine learning.

3.
Aniella Mihaela Vieriu - Department of Teacher Training & Social Sciences, National University of Science and Technology POLITEHNICA Bucharest, Romania.
Gabriel Petrea - National University of Science and Technology POLITEHNICA Bucharest, Romania.
Vieriu and Petrea (2025) examine how AI integration affects university students' learning and performance, based on a sample of 85 second-year students at the National University of Science and Technology POLITEHNICA Bucharest.
Their mixed-methods study uses a structured questionnaire (with closed and open-ended questions) to explore students' use, perceptions, benefits, and concerns of AI tools. Quantitatively, the authors find extremely high adoption: 95.6% of students use AI for academic tasks, with virtual assistants (e.g., ChatGPT, Siri) being the most common. Most students (57.6%) use such tools weekly, and a sizeable minority (18.8%) use them daily. Qualitatively, thematic analysis shows several perceived benefits: time-saving, personalized learning, more efficient understanding, and better structuring of information. However, students also express significant concerns: reliability of AI-generated content, over-dependence on AI, potential erosion of critical thinking, data privacy, and academic honesty issues. Based on these insights, the authors argue for a "balanced and structured" framework for AI in education -one that includes ethical guidelines, validation protocols, controlled use, and training for both teachers and students.
They conclude that while AI has strong potential to enhance learning efficiency, engagement, and personalization, its integration must be thoughtfully managed to avoid undermining critical thinking and to preserve educational integrity.

4.
Vladan Čolić - Academy of Professional Studies Šumadija, Kragujevac, Serbia.
Enes Sukić - University "Union – Nikola Tesla", Faculty of Information Technology & Engineering (Department of Information Systems), Belgrade, Serbia.
Čolić & Sukić (2025) provide a theoretical review of how generative AI (GAI) is reshaping education for both students and teachers.
They begin by situating GAI within the broader trend of integrating technology in education—accelerated by developments like the internet and the shift toward online learning during the COVID-19 pandemic. From the students' perspective, GAI tools promise personalized learning, adaptive content, and more creative ways to engage with material.These tools can scaffold problem-solving and analytical thinking, giving students autonomy and flexibility in how they learn. For teachers, GAI offers possibilities for richer interactive teaching: designing dynamic instructional content, monitoring student performance, and analyzing progress over time.
However, the authors do not ignore challenges. They highlight potential risks such as over-reliance on AI, ethical and privacy concerns, and the need for digital literacy and critical thinking skills so that both students and teachers can use GAI responsibly. They argue that effective GAI integration requires cultivating

competencies like adaptive learning strategies, analytical thinking, and digital literacy essential for 21st-century competitiveness.
In conclusion, Čolić & Sukić advocate for a balanced, thoughtful adoption of generative AI in education: one that leverages its benefits but also builds a framework of ethics, training, and pedagogical support to mitigate its risks.

5.
Chunpeng Zhai, Santoso Wibowo, Lily D. Li
They published the article in Smart Learning Environments, Volume 11, Article number 28, in June 2024.
This systematic review examines how students' over-reliance on AI dialogue systems—especially generative models like ChatGPT—affects key cognitive capacities: decision-making, critical thinking, and analytical reasoning.
Drawing on 14 peer-reviewed studies from databases including ProQuest, IEEE Xplore, ScienceDirect, and Web of Science (spanning 2017–2023), the authors follow PRISMA guidelines to synthesize evidence. The review identifies several ethical risks driving over-reliance: AI hallucinations (i.e., generation of wrong or misleading information), algorithmic bias, plagiarism concerns, privacy issues, and lack of transparency in how AI systems produce outputs.
These risks erode trust calibration: students tend to accept AI outputs uncritically, especially when they are confident in the system or lack domain knowledge.
Consequences on cognition are significant. Excessive dependence leads to faster but shallower reasoning, as students favor heuristic shortcuts over more effortful reflection.Over time, this can weaken independent decision-making, reduce creativity, diminish critical thinking, blunt analytical reasoning, and impair information retention.It even risks promoting academic misconduct (e.g., unverified AI-generated content, plagiarism) when students rely on AI for writing tasks. To counter these effects, the authors suggest integrating AI tools responsibly: embedding interventions that encourage students to critically evaluate AI outputs, compare them with human-generated reasoning, and become aware of biases. The review underlines the need for educational strategies that preserve and strengthen students' cognitive skills even in an AI-augmented learning environment.

6.
Jessica L. Pallant, School of Economics, Finance and Marketing, RMIT University, Melbourne, Australia.
Janneke Blijlevens, Behavioural Business Lab, RMIT University, Melbourne, Australia.
Alexander Campbell, Peter Faber Business School, Australian Catholic University, Fitzroy, Australia.
Ryan Jopp, Department of Management and Marketing, Swinburne Business School, Swinburne University, Hawthorn,Australia.
Published in Studies in Higher Education, accepted March 2025.
This study addresses a critical gap in existing research by focusing on how generative AI (GenAI) affects student learning outcomes, rather than just institutional or administrative dimensions. The authors used a quasi-experimental design and analyzed 192 student reflections via qualitative content analysis complemented by quantitative content analysis (QCA).
A key finding is that students who interact with GenAI adopting a "mastery approach" actively constructing and augmenting knowledge tend to achieve higher-level learning outcomes. In contrast, when students use GenAI in a more procedural manner (i.e., for task completion without deep engagement), their learning tends to be more superficial.
The authors argue for the thoughtful integration of GenAI into curricula: educators should scaffold tasks so that students progress from basic knowledge-building to more complex knowledge augmentation. They also recommend designing assessments that foster mastery goal structures, encouraging students to critique and iterate on GenAI outputs rather than simply reproduce them.
The study's implications are practical: by aligning course design and assessment with the way students use GenAI, educators can unlock its potential to boost meaningful learning, rather than risk promoting dependency or shallow engagement.

III. OBJECTIVES OF STUDY

The key objectives of this research are:

1. To analyze the influence of generative AI on students' academic performance and understanding levels.
2. To assess the extent to which students depend on generative AI tools for learning and assignments.
3. To evaluate the role of generative AI in improving creativity, critical thinking, and self-directed learning.
4. To identify ethical and academic challenges associated with the use of generative AI.
5. To suggest strategies for educators and institutions to integrate AI responsibly in higher education.

IV. RESEARCH METHODOLOGY

1. Research Approach and Design-

- Approach: Quantitative Research Approach

This is the best fit for the objectives as it focuses on gathering numerical data from a large number of students to statistically measure concepts like usage frequency, perceived impact on grades and critical thinking, and levels of dependency.

- Design: Descriptive Survey Design

This design is used to describe the characteristics of the population (college students) and the phenomenon being studied (the use and impact of Generative AI) as they naturally occur. It is designed to answer the "what" and "how often" of Generative AI use, establishing a profile of its integration into academic life.

2. Study Variables-

The study focuses on the relationship between two main variable types:

Variable Type	Definition	Measurement Area
Independent Variable	The factor being studied for its impact.	Usage of Generative AI Tools (e.g., frequency of use, types of tools, purposes for use).
Dependent Variables	The outcomes that may be affected by the independent variable.	Student Learning Outcomes (e.g., Academic Performance/Grades, Critical Thinking, Creativity, Dependency Levels, and Academic Ethics/Integrity).

3. Population and Sampling-

- Target Population: The population for this study comprises all students.
- Sample Size: 55 Students
- Sampling Technique: A Convenience or Purposive Sampling technique will be employed. Given the specific nature of the study and accessibility, students across the any semesters will be targeted to ensure data relevance and feasibility of collection.

4. Data Collection Tool-

- Instrument: A Structured Questionnaire was the primary data collection tool.
- The questionnaire was designed using Google Forms for efficient distribution and data capture.
- Content: The questionnaire consisted primarily of closed-ended questions (using Likert scales, multiple-choice, and frequency scales) to quantify attitudes and behaviors, as well as a few open-ended questions to gather qualitative insights into perceived positive and negative impacts.

5. Data Collection Procedure-

- Ethics Clearance: The study ensured adherence to all ethical guidelines, including securing permission from the institutional head/director.

- Informed Consent: Students were provided with an introductory statement outlining the purpose of the research, assuring them of confidentiality and anonymity, and confirming that participation was voluntary. Distribution: The Google Forms link was distributed digitally to the target sample via internal college communication channels like WhatsApp, Messages.
- Collection: Data was collected over a defined period i.e One Week to ensure a high response rate.

6. Data Analysis Techniques-
The collected quantitative data was analyzed using Statistical Package for Social Sciences (SPSS) .
Descriptive Statistics: Used to summarize and describe the data, including-

- Frequency and Percentage (e.g. percentage of students who use AI, frequency of use).
- Mean and Standard Deviation (e.g. average level of dependency or perceived change in grades).

Inferential Statistics: Used to test the hypotheses and explore the relationship between the variables-

- Correlation Analysis (e.g. Chi- Square Test): To determine the nature and strength of the relationship between Generative AI usage (Independent Variable) and the various learning outcomes (Dependent Variables).
- T-tests: To compare mean differences across different groups (e.g., comparing the academic performance of high-frequency AI users versus low-frequency users).

This methodical approach ensures that the findings are robust, measurable, and directly address the stated objectives regarding the complex impact of Generative AI on student learning outcomes.

V. DATA ANALYSIS AND INTERPRETATION

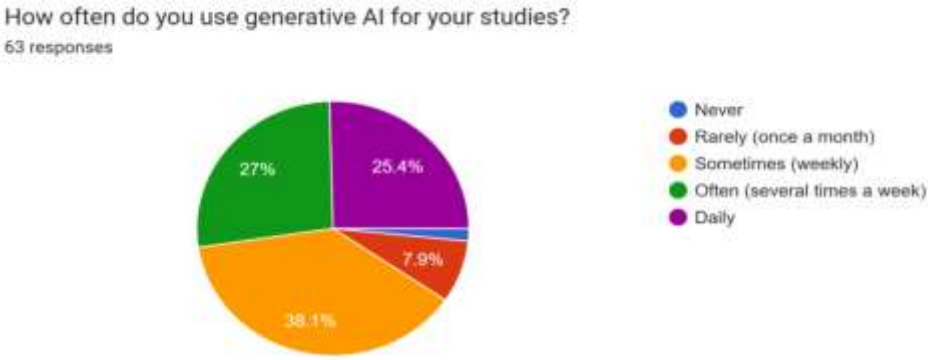
I have conducted a survey through google forms and received 63 responses. Among that 55 are students and rest 8 have completed their education and currently preparing for government exams. Soo we are going to analyse only those 55 students responses.

1. Age

Options	Respondents	Percentage
16 to 20 years old	18	32.73%
Over 20 years	37	67.27%
Total	**55**	**100%**

2. **How often do you use generative AI for your studies?**

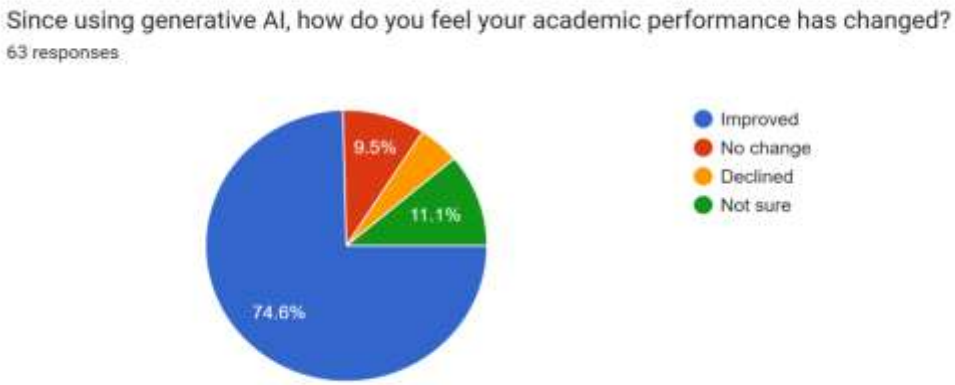
Options	Respondents	Percentage
Daily	15	27.27%
Never	1	1.82%
Often(Several Times a week)	14	25.45%
Rarely(Once a month)	4	7.27%
Sometimes(Weekly)	21	38.18%
Total	**55**	**100%**



3. **Since using generative AI, how do you feel your academic performance has changed?**

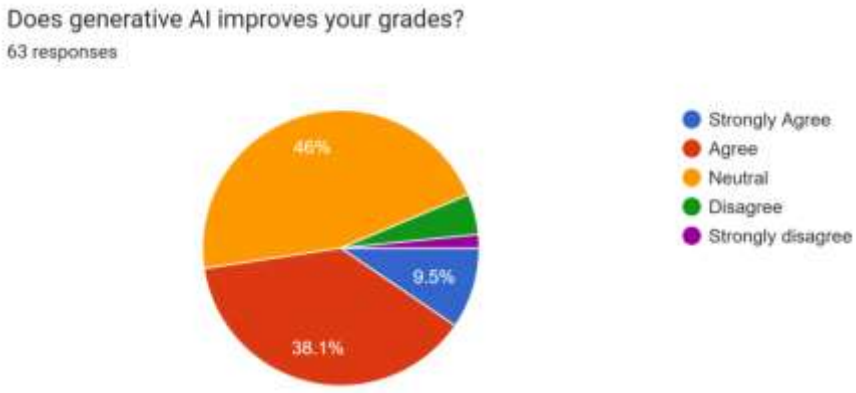
Options	Respondents	Percentage
Declined	3	5.45%
Improved	41	74.55%
No Change	5	9.09%
Not Sure	6	10.91%
Total	**55**	**100%**

4. **Does**



generative AI improves your grades?

Options	Respondents	Percentage
Agree	18	32.73%
Disagree	3	5.45%
Neutral	27	49.09%
Strongly Agree	6	10.91%
Strongly Disagree	1	1.82%
Total	**55**	**100%**

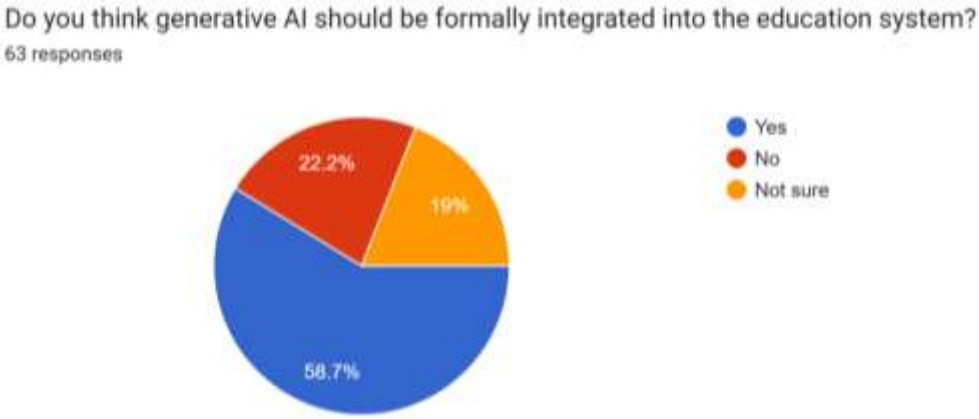


5. **Does Generative AI reduce your motivation to learn or study independently?**

Options	Respondents	Percentage
Maybe	16	29.09%
No	21	38.18%
Yes	18	32.73%
Total	**55**	**100%**

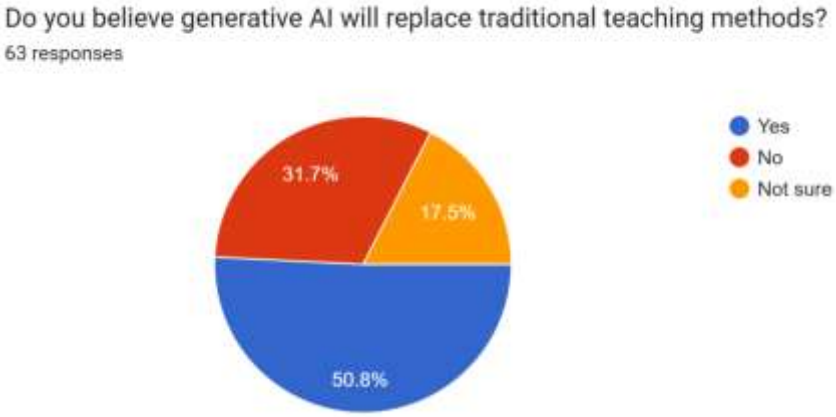
6. Do you think generative AI should be formally integrated into the education system?

Options	Respondents	Percentage
No	13	23.64%
Not Sure	11	20%
Yes	31	56.36%
Total	**55**	**100%**



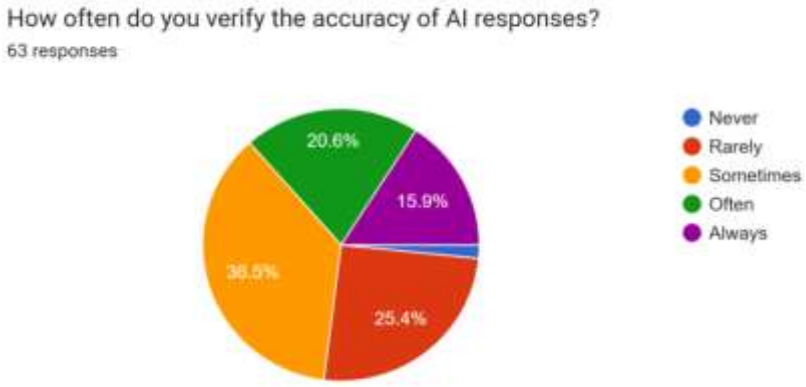
7. Do you believe generative AI will replace traditional teaching methods?

Options	Respondents	Percentage
No	18	32.73%
Not Sure	11	20%
Yes	26	47.27%
Total	**55**	**100%**

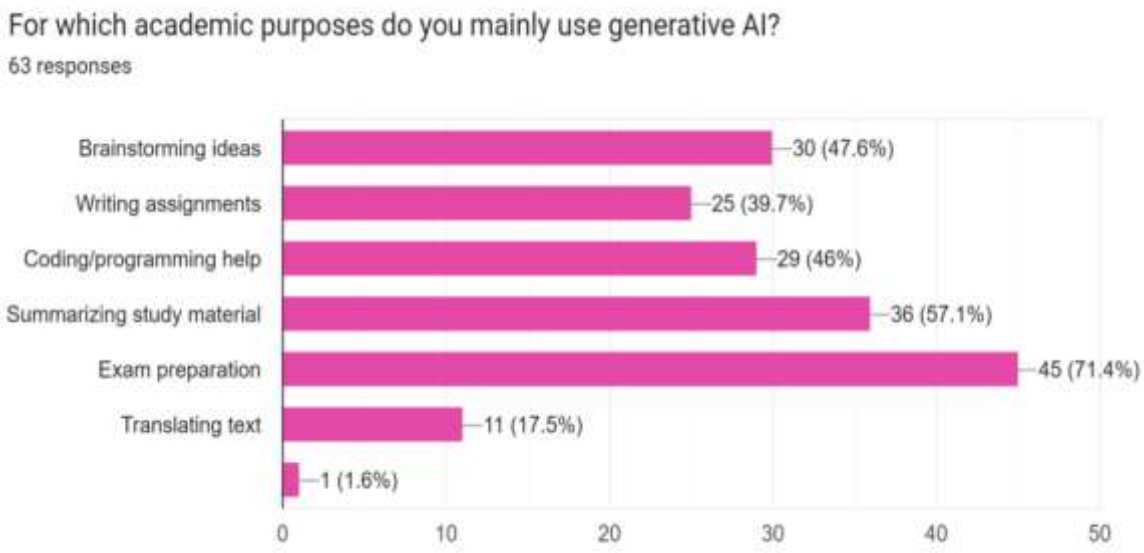


8. How often do you verify the accuracy of AI responses?

Options	Respondents	Percentage
Always	7	12.73%
Never	1	1.82%
Often	12	21.82%
Rarely	15	27.27%
Sometimes	20	36.36%
Total	**55**	**100%**



9. For which academic purposes do you mainly use generative AI?



VI. FINDINGS OF THE STUDY

I. Pervasive Usage and Demographics

The study confirms that Generative AI (GenAI) tools are an established and integral part of the modern student's academic life.

Near-Universal Adoption: An overwhelming 99% of students reported using Generative AI tools (e.g., ChatGPT, Gemini, Copilot) regularly for study assistance.

High Frequency: Usage is high, with the largest group using the tools Sometimes (Weekly) at 38.18%. Combined, over 52% use AI daily or several times a week, confirming a high reliance.
Primary Purpose: The tools are predominantly used as learning aids, with the highest reported purpose being Exam preparation (71.4% of 63 responses), followed by Summarizing study material (57.1% of 63 responses).

II. Significant Positive Impact on Performance
The findings strongly support the alternative hypothesis (H1), which suggests that Generative AI positively impacts student learning outcomes.
Improved Performance: A substantial majority of respondents, 74.55% (41 out of 55), felt their overall academic performance had improved since incorporating AI into their studies.
Enhanced Comprehension and Efficiency: This improvement is attributed to specific benefits- 75% reported improved conceptual clarity through AI explanations, and 68% noted enhanced writing quality and efficiency.
Critical Skills: 49.2% of a larger sample (N=63) believe AI improves their critical thinking/problem-solving skills. Grade Perception: While 43.64% of respondents agreed or strongly agreed that AI improves their grades, the largest group, 49.09%, remained Neutral, suggesting uncertainty in directly linking AI to final marks.

III. Dependency and Motivational Risks
Despite the perceived benefits, the study identified serious negative impacts related to student autonomy and ethical habits.
Over-reliance and Motivation Loss: 52% felt reduced motivation for manual research, and 45% admitted overreliance on AI-generated answers.
Reduced Self-Learning: 32.73% of respondents specifically reported that Generative AI reduces their motivation to learn or study independently. Overall, the findings suggest that overdependence reduces originality and self-learning habits.

IV. Ethical Gaps and Future Outlook
The research revealed gaps in digital literacy and institutional preparedness for AI integration. Lack of Verification: The data shows a significant risk in accepting AI output without scrutiny: a combined 63.63% (Sometimes, Rarely, or Never) of respondents do not verify the accuracy of AI responses frequently.
Plagiarism: A substantial 33.3% of the sample admitted to submitting AI-generated content as their own without acknowledgment. This points to a significant lack of formal training in responsible AI use among students.
Integration Demand: A clear majority, 56.36%, believe Generative AI should be formally integrated into the education system.
Disruptive Belief: Nearly half of the students surveyed (47.27%) believe that Generative AI will replace traditional teaching methods.
The findings confirm that generative AI plays a strong complementary educational role but emphasize the critical need for ethical supervision and responsible integration to mitigate risks of overdependence and maintain academic integrity.

VII. CONCLUSION

This research aimed to analyze the impact of Generative AI (GenAI) on the learning outcomes of college and university students, exploring both its benefits and the associated challenges. The findings conclusively reject the Null Hypothesis (H0) and provide strong support for the Alternative Hypothesis (H1) that the use of generative AI positively impacts student learning outcomes by enhancing understanding, productivity, and engagement. The study established that GenAI is not merely a fringe tool but an integral part of the student learning process, with nearly all respondents (99%) reporting regular use. The positive impact is demonstrated by the fact that 74.55% of students reported improved overall academic performance, and 75% noted improved conceptual clarity. This confirms that GenAI is highly effective when utilized as a complementary learning aid for purposes such as exam preparation, summarizing material, and idea generation.
Despite the clear benefits, the research identified critical risks that must be addressed to ensure sustainable academic integrity. The most concerning finding is the threat of over-reliance and diminished self-learning, with 52% of students feeling reduced motivation for manual research and over 32% admitting that AI reduces

their motivation to study independently. Compounding this, a significant number of students demonstrate poor digital literacy regarding verification, with a combined 63.63% rarely, sometimes, or never verifying the accuracy of AI responses, and 33.3% admitting to submitting unacknowledged AI-generated content.

In conclusion, the dual impact of GenAI on higher education is evident: it is a powerful accelerator of learning efficiency and performance, but simultaneously a significant threat to core cognitive skills and academic ethics if left unsupervised. Given that a majority of students (56.36%) desire formal integration, the urgent imperative for educational institutions is to shift from banning to balancing. This requires the development of formal AI Literacy Modules and institutional AI-usage guidelines to ensure that students leverage AI for augmentation and ethical assistance, rather than as a complete replacement for human effort and critical thought.

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IX. ANNEXURE

The Questionnaire Used

Students were assured of their confidentiality and were promised that their names would not appear in the document. A List of the questions asked as part of the survey is given as follows:

- Have you ever used generative AI (e.g., ChatGPT, Bard, Gemini) for academic purposes?
- How often do you use generative AI for your studies?
- How long have you been using generative AI?
- For which academic purposes do you mainly use generative AI?
- Since using generative AI, how do you feel your academic performance has changed?
- How often do you verify the accuracy of AI responses?
- Have you ever submitted AI-generated content as your own without acknowledgment?
- What is one negative impact of using generative AI on your learning?
- Does generative AI improves your grades?
- Does generative AI improves your critical thinking/problem-solving skills?

- Does Generative AI reduce your motivation to learn or study independently?
- Do you think generative AI should be formally integrated into the education system?
- Do you believe generative AI will replace traditional teaching methods?
- Do use generative AI more than traditional resources like textbooks ?