# IMPACT OF ARTIFICIAL INTELLIGENCE (AI) USAGE ON THE COGNITIVE SKILLS OF SCHOOL STUDENTS

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**ABSTRACT**

*The integration of Artificial Intelligence (AI) in education has transformed learning environments by offering adaptive, personalized, and feedback-rich instruction. However, the influence of AI on students' cognitive development remains a matter of academic concern. This study investigates the impact of AI usage on the cognitive skills of school students, specifically focusing on critical thinking, problem-solving, creativity, attention span, and memory retention. A mixed-method approach was employed using a quasiexperimental design. The findings revealed that moderate and guided use of AI tools enhanced cognitive engagement and conceptual understanding, whereas excessive or unguided dependence on AI reduced independent reasoning and originality. The results emphasize the importance of structured pedagogical frameworks to balance AI assistance and human cognition for sustainable learning outcomes.*

***Keywords:*** *Artificial Intelligence, Cognitive Skills, Critical Thinking, Educational Technology, Metacognition*

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## INTRODUCTION

Artificial Intelligence (AI) is rapidly reshaping educational practices across the world. In classrooms, AI technologies—such as adaptive learning systems, intelligent tutoring platforms, and generative AI chatbots—offer customized instruction and real-time feedback. While such integration enhances access and engagement, questions arise about its effect on core cognitive skills, including critical thinking, reasoning, memory, and problem-solving.

Cognitive skills are the foundation of learning. They enable students to process information, make decisions, and apply knowledge creatively. AI's capacity to automate thinking tasks may either scaffold or suppress these skills depending on how it is used.

Thus, this study explores: "What is the impact of AI usage on the cognitive skills of school students?"

## REVIEW OF LITERATURE

Studies on AI in education present a dual narrative. Intelligent Tutoring Systems (ITS) have been shown to enhance conceptual mastery and problem-solving (Kulik, 2016). Similarly, adaptive learning platforms improve retention through personalized feedback (Wang et al., 2024). However, recent research warns that constant reliance on AIgenerated answers can lead to cognitive offloading, lowering critical thinking and metacognitive awareness (Hasanein et al., 2023; Létourneau et al., 2025).Neurosciencebased studies (Kosmyna et al., 2025) indicate that excessive AI dependence may reduce neural engagement during complex reasoning tasks. Hence, a nuanced understanding is required: AI can serve as a cognitive enhancer when used to support thinking, but as a cognitive substitute when used to replace it.

## OBJECTIVES OF THE STUDY

1. To examine the overall impact of AI usage on students' cognitive skills.
2. To analyze the relationship between the level of AI dependence and critical thinking ability.
3. To compare cognitive performance of students using AI tools versus those using traditional learning methods.
4. To identify teachers' and students' perceptions regarding AI's influence on creativity and reasoning.

## HYPOTHESES

1. There is no significant difference in cognitive skill scores between AI-using and nonAI-using students.
2. Over-reliance on AI negatively correlates with students' independent reasoning and problem-solving ability.
3. Moderate use of AI tools enhances metacognitive awareness and creativity.

## METHODOLOGY

To strengthen methodological rigor, the study ensured that experimental and control groups were identified through structured class section allocation. Teachers of the experimental group exclusively implemented AI integrated lessons, while control group teachers continued traditional instruction. Students were instructed not to exchange AI generated content, and AI tool access for the control group was restricted during the study period, thus minimizing contamination.

## RESEARCH DESIGN

The study followed a quasi-experimental design with a mixed-method approach combining quantitative assessment and qualitative feedback. Two groups of students—experimental (AI-integrated learning) and control (traditional learning)—were compared over an 8-week instructional period.

## SAMPLE

The sample comprised 120 students from Classes VIII and IX of three urban schools in Chandigarh, India.

- Experimental Group:60 students used AI-based learning platforms (ChatGPT, Khanmigo, and Mindspark).
- Control Group: 60 students followed regular instruction without AI support.
- Equal representation was maintained across gender and school type.

## TOOLS USED

1. Cognitive Skills Assessment Battery (CSAB) – a standardized test measuring memory, reasoning, and creativity.

2. Critical Thinking Inventory (CTI) – adapted from Ennis-Weir Critical Thinking Essay Test.

3. AI Usage Scale (AUS) – developed by the researchers to measure frequency, purpose, and depth of AI use.

4. Teacher Observation Schedule – to qualitatively assess engagement, attention, and participation.

## PROCEDURE

- Pre-tests on cognitive and critical thinking skills were administered to both groups.
- The experimental group used AI tools in selected subjects (Science and English) for 45 minutes daily.
- Teachers guided students on responsible AI use, prompting reflection and verification of AI outputs.
- After 8 weeks, post-tests were conducted on both groups.
- Semi-structured interviews were conducted with 10 teachers and 15 students for qualitative insights.

## STATISTICAL TECHNIQUES

- Descriptive statistics (Mean, SD)
- Inferential statistics: *t-test* for group comparison and *Pearson's correlation* for AI usage and cognitive skill relation.
- Thematic analysis for qualitative responses.

## DATA ANALYSIS AND RESULTS

| Variable | Group | Mean (Pre-test) | Mean (Post-test) | Mean Gain | t-value | Significance |
|---|---|---|---|---|---|---|
| Cognitive Skill Score | Experimental | 58.2 | 74.6 | +16.4 | 5.42 | $p < 0.01$ |
| Cognitive Skill Score | Control | 57.9 | 64.3 | +6.4 | -- | -- |
| Critical Thinking Score | Experimental | 55.6 | 70.1 | +14.5 | 4.98 | $p < 0.01$ |
| Critical Thinking Score | Control | 56.2 | 61.7 | +5.5 | _ | _ |

Correlation between AI Usage and Cognitive Scores (Experimental Group):

*$r = 0.48$, $p < 0.05$* → moderate positive correlation between guided AI usage and improved cognitive scores.

## QUALITATIVE FINDINGS

The focus group of 15 students was chosen through purposive sampling, ensuring representation of different performance levels and learning styles. Although modest in size, the group allowed for in-depth discussion within the study's scope. Students were selected from both experimental and control groups to capture varied experiences.

- Teachers observed higher engagement and curiosity when AI tools were used for exploration and concept visualization.
- Students reported greater ease in understanding difficult topics but admitted "sometimes just copying answers from AI" without reflection.

- Teachers expressed concern about students' reduced persistence on challenging problems.

## DISCUSSION

The results reveal that structured and guided AI use significantly improved cognitive skills, particularly critical thinking and problem-solving abilities. Students who interacted with AI tools demonstrated better comprehension and could articulate reasoning processes more clearly than those in the control group.

However, qualitative feedback highlighted the risk of cognitive dependency. Students tended to use AI for quick answers rather than reasoning independently when guidance was minimal. This aligns with earlier findings by Hasanein et al. (2023) that unregulated AI use fosters surface learning rather than deep learning.

The positive correlation ($r = 0.48$)between AI usage and cognitive skills suggests that when AI is integrated under teacher supervision, it acts as a cognitive amplifier. Conversely, without pedagogical control, it can become a cognitive crutch—reducing creative exploration and effortful retrieval.

These findings support the "cognitive scaffolding" theory, which posits that technology enhances cognition when it supports but does not replace internal thinking processes.

## IMPLICATIONS OF THE STUDY

Despite limitations, the study provides meaningful insights for practical application. Teachers can incorporate AI as a tool for reflective questioning to enhance reasoning skills. Curriculum planners may embed AI-literacy components to help students critically assess AI outputs. Policymakers may develop structured guidelines ensuring balanced AI use to support cognitive development across diverse educational settings.

- For Educators:Incorporate AI as a reflective learning partner, not as an answer machine.
- For Curriculum Planners:Embed AI literacy and critical evaluation modules in school curricula.
- For Policymakers: Frame guidelines on ethical and developmental use of AI tools in education.
- For Researchers:Conduct longitudinal studies on how prolonged AI exposure shapes neural and cognitive development in children.

## LIMITATIONS

1. The study's duration (8 weeks) may not capture long-term cognitive changes.
2. Self-reported AI usage may include bias.
3. The sample was limited to urban schools; rural and low-resource contexts need exploration.

## CONCLUSION

The study concludes that AI usage can both enhance and hinder cognitive skills depending on its pedagogical application. When used purposefully—with teacher guidance, reflective questioning, and verification—AI can stimulate critical thinking, creativity, and metacognition. Conversely, unguided or excessive reliance may lead to cognitive laziness and reduced originality. Future research should focus on developing frameworks for balanced AI integration that promote independent reasoning and lifelong learning.

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