Artificial Inteligence I Based Learning,Academic Self Concept and Cognitive Engegment

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ABSTRACT

Artificial Intelligence (AI) has increasingly been integrated into educational settings; however, its psychological impact on learners remains underexamined, particularly in Indian secondary schools. This study investigated the effects of AI-based learning tools on academic self-concept and cognitive engagement among secondary school students in Patna, Bihar. A quantitative, comparative, cross-sectional design was adopted with a sample of 400 students, equally divided into an AI-Integrated Learning Group (n = 200) and a Traditional Learning Group (n = 200). Data were collected using the Self-Description Questionnaire–II and a Cognitive Engagement Scale and analyzed using independent-samples t tests. The results revealed no significant differences between AI users and non-users in academic self-concept or cognitive engagement.The findings indicate that AI use alone does not necessarily produce psychological or cognitive benefits without pedagogically guided integration.

Keywords: ***Artificial intelligence, Academic self-concept; Cognitive Engagement; Students***

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Introduction

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines, enabling learning, reasoning, problem-solving, and adaptive decision-making (Russell & Norvig, 2021). Since its conceptual foundations were laid by Turing (1950) and McCarthy and colleagues (1956), AI has evolved from symbolic, rule-based systems to data-driven, adaptive algorithms. In contemporary education, AI-based tools are increasingly embedded within instructional practices, promising personalized learning experiences and enhanced learner outcomes.

Beyond technological advancement, AI represents a significant psychological and pedagogical shift. Learning environments mediated by AI can influence how students perceive their academic abilities and how deeply they engage cognitively with learning tasks. Academic self-concept and cognitive engagement are central psychological constructs that shape learning quality, motivation, and persistence. Understanding how AI-based learning tools influence these constructs is therefore essential for evaluating their educational effectiveness.

Artificial Intelligence in Education:

AI-based educational systems—including intelligent tutoring systems, adaptive learning platforms, and learning analytics tools—are designed to tailor instruction to learners' individual needs, pace, and performance (Luckin et al., 2016; VanLehn, 2011). Such systems are theoretically aligned with constructivist and socio-cognitive perspectives, emphasizing active learning, timely feedback, and self-regulation (Piaget, 1970; Vygotsky, 1978).

Empirical research suggests that adaptive AI environments can support conceptual understanding and sustained intellectual involvement by offering immediate feedback and calibrated challenges. However, the psychological outcomes of AI integration depend not only on technological sophistication but also on pedagogical alignment, instructional intent, and learner engagement.

In India, AI-based learning tools are increasingly accessed through platforms such as BYJU's, Embibe, DIKSHA, Google Classroom, and Coursera. National initiatives including the National Education Policy (NEP) 2020, the National Digital Education Architecture (NDEAR), and *AI for All* have further accelerated AI adoption within the education sector.

These platforms provide adaptive assessments, progress visualization, and personalized learning pathways. Nevertheless, their educational effectiveness must be evaluated not merely in terms of technological exposure or access, but in relation to how they shape learners' academic self-concept and cognitive engagement.

Psychological Relevance of AI-Based Learning

From an educational psychology perspective, AI-mediated environments can influence students' self-evaluation, metacognitive awareness, and strategic learning behaviors. Personalized feedback and mastery visualization have the potential to strengthen academic self-concept by reinforcing perceptions of competence and achievement (Marsh & Shavelson, 1985; Chassignol et al., 2018).

AI systems may also influence cognitive engagement by encouraging sustained attention, strategic thinking, and self-regulated learning. However, excessive automation or uncritical reliance on AI may reduce productive struggle and deep engagement, thereby limiting higher-order cognitive processing (Selwyn, 2019).

Academic Self-Concept;

Academic self-concept refers to students' perceptions of their academic competence and their beliefs about their ability to succeed in learning tasks (Marsh & Shavelson, 1985). It is a multidimensional construct that significantly influences motivation, persistence, and academic achievement.

AI-based learning tools may enhance academic self-concept by providing individualized feedback, visual indicators of progress, and scaffolded learning experiences. However, the durability and depth of such effects depend on meaningful engagement, reflective learning opportunities, and instructional mediation.

Cognitive Engagement

Cognitive engagement involves the degree of mental effort, strategic thinking, persistence, and self-regulation that learners invest in academic tasks (Fredricks et al., 2004). AI-based environments may promote cognitive engagement through adaptive difficulty levels, reflective prompts, and feedback-driven learning cycles. Nonetheless, the quality of engagement depends largely on pedagogical design rather than automation alone.

Research Gap

Despite the rapid adoption of AI in Indian secondary education, empirical research examining its psychological impact—particularly on academic self-concept and cognitive engagement—remains limited. Studies focusing on Hindi-speaking regions such as Bihar are especially scarce. Moreover, socio-economic and infrastructural disparities necessitate region-specific investigations to understand the contextual realities of AI integration.

Significance of the Study;

The present study contributes empirical evidence on the psychological implications of AI-based learning tools in secondary education. Its findings offer valuable insights for educators, policymakers, and curriculum designers seeking to implement balanced, psychologically informed AI integration strategies.

Objectives and Hypotheses:

The study aimed to examine differences in academic self-concept and cognitive engagement between students using AI-based learning tools and those using traditional learning methods. Accordingly, null hypotheses were formulated.

Methodology:

Research Design

A quantitative, comparative, cross-sectional research design was adopted.

Sample: The sample comprised 400 secondary school students (Classes IX–XII), equally divided into the AI-Integrated Learning Group (AILG; n = 200) and the Traditional Learning Group (TLG; n = 200).

Sampling Technique:

A purposive–stratified sampling technique was employed to ensure representation, school type, location, and class level.

Tools : • Demographic and AI Usage Proforma

- Self-Description Questionnaire–II (Marsh, 1990)
- Cognitive Engagement Scale (Fredricks et al., 2004; AI-adapted)

Procedure

Data were collected in classroom settings after obtaining informed consent and providing standardized instructions to participants

Statistical Analysis:

Descriptive statistics (mean and standard deviation), independent-samples *t* tests were computed using SPSS.

Results:

Table - 1

Comparison of Academic Self-Concept between AI-Integrated Learning Group and Traditional Learning Group

Variable	Group	N	Mean	SD	*t*	*p*
Academic	AI-based learning (Study Group)	200	91.22	7.58	0.410	0.682
Self-Concept	Traditional learning (Control Group)	200	90.88	9.14		

Table 1 indicates that although the AI-based learning group obtained a marginally higher mean academic self-concept score than the traditional learning group, the difference was not statistically significant, suggesting that AI-based learning tools did not significantly enhance students' academic self-concept.

Table 2:

Comparison of Cognitive Engagement between AI-Integrated Learning Group and Traditional Learning Group

Variable	Group	N	Mean	SD	*t*	*p*
Cognitive	AI-based learning (Study Group)	200	107.85	9.09	1.122	0.263
Engagement	Traditional learning (Control Group)	200	106.78	9.94		

Table 2 shows that the AI-based learning group demonstrated slightly higher cognitive engagement scores; however, the difference was not statistically significant, indicating that AI usage alone did not substantially influence cognitive engagement.

Discussion:

The present study examined the impact of AI-based learning tools on academic self-concept and cognitive engagement among secondary school students. Although students exposed to AI-based learning tools obtained marginally higher mean scores on both variables, these differences were not statistically significant. Consequently, all null hypotheses formulated for the study were retained.

The absence of significant differences in academic self-concept suggests that students' perceptions of their academic competence are not easily altered through technological interventions alone. Academic self-concept is a relatively stable, multidimensional construct shaped by prolonged academic experiences, teacher feedback, peer comparison,and achievement-related reinforcement (Marsh & Shavelson, 1985). While AI-based tools offer personalized feedback and performance visualization, such features may not be sufficiently internalized to influence students' self-evaluative beliefs, particularly when AI functions as a supplementary resource rather than a core instructional strategy.

These findings are consistent with earlier research indicating that technology-enhanced

learning environments do not automatically improve self-related psychological constructs unless accompanied by reflective pedagogy and sustained instructional support (Chassignol et al., 2018; Selwyn, 2019). In the present context, AI-based tools were primarily used for practice, assessment, or content delivery, with limited emphasis on mastery-oriented feedback or metacognitive reflection.

Similarly, no statistically significant difference was observed in cognitive engagement between AI-user and non-user groups. Cognitive engagement involves deep mental effort, strategic learning, persistence, and self-regulation (Fredricks et al., 2004). Although AI systems are theoretically designed to promote adaptive learning, the findings suggest that such outcomes are not guaranteed in real-world classroom contexts. Excessive automation or solution-oriented AI systems may reduce productive struggle and deeper cognitive processing if not pedagogically moderated. Students with access to AI-based learning tools were more likely to belong to urban and higher socio-economic backgrounds. However, these structural advantages did not translate into measurable psychological gains, underscoring the distinction between access to technology and its effective pedagogical use.

Conclusion:

The study concludes that AI-based learning tools do not exert a statistically significant impact on academic self-concept or cognitive engagement among secondary school students. Although AI-integrated environments provide personalization, adaptive feedback, and technological efficiency, these features alone are insufficient to produce meaningful changes in students' academic self-perceptions or depth of cognitive involvement.

Academic self-concept and cognitive engagement are complex psychological constructs that develop through sustained instructional interaction, teacher guidance, learner motivation, and reflective learning experiences (Marsh & Shavelson, 1985; Fredricks et al., 2004). The findings suggest that AI-based tools, when used in isolation or as supplementary resources.

From an educational and policy perspective, the results highlight the need for pedagogically grounded AI integration. Teachers play a central role in mediating AI-based learning experiences, fostering metacognitive reflection, and encouraging mastery-oriented engagement. AI should therefore be viewed not as a replacement for instructional interaction, but as a supportive cognitive scaffold whose educational value depends on thoughtful design, teacher facilitation, and psychological sensitivity. Future research should adopt longitudinal and mixed-method approaches to examine how sustained and pedagogically guided AI integration influences students' self-concept and cognitive engagement over time.

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