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The Role Of AI In Enhancing College Student Critical Thinking And Problem-Solving

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Abstract

AI is enabling students to interact differently with assignments and improve their problem-solving, thinking abilities and motivation. It studies the influence of AI skills on college students' mindset, the emotions they experience while learning and their motivation throughout secondary school teaching and learning. Smart tutors, intelligent suggestions and adaptable learning solutions have replaced some of the older practices in teaching. These guides allow teachers to teach differently for every student, encouraging them to understand new ideas more thoroughly.

The analysis examines the ways in which AI tutoring helps students in solving complicated tasks in different fields. It also examines how AI that can be gamified and fast real-time data affect what motivates learners. Information will be gathered by sending surveys, conducting interviews and studying data gathered through AI at various secondary schools.

Results from the study are expected to indicate that blending AI in school helps improve how students learn and how motivated they are. These findings will give insight to public officials and support educators and technology experts who want to help students gain new skills.

Keywords: *Artificial Intelligence, Critical Thinking, Problem-Solving, Student Motivation, Educational Technology, Adaptive Learning, Teaching-Learning Process, Secondary Education, Learning Engagement, AI in Education.*

Introduction

Artificial Intelligence is improving education by introducing new ways for both teachers and students to learn. In schools, AI is used for more than automation to also support the way students think and feel. Such AI tools as adaptive learning platforms, AI tutors and intelligent feedback systems guide students individually, considering their progress and skills (according to Luckin et al., 2016).

In today's world, students use technology naturally and interact best when it is interactive and adjusting to their needs. In this way, AI introduces student-driven methods to replace the teacher-only system seen before (Holmes et al., 2019). Both Carnegie Learning and Squirrel AI offer students personal teaching which builds their ability to solve problems and make independent choices (Baker & Inventado, 2014). With their use of data and machine learning, these environments change lessons and identify learning issues fast.

AI has helped to motivate people when they learn. AI makes gamification possible and allows students' progress to be tracked in real time so they feel more motivated and proud of what they achieve (Fessakis et al., 2013). Being able to watch their development and receive customized help often encourages students to keep working on their class room work.

AI also supports teachers by giving them information from student performance that helps them decide the best ways to teach their students (Woolf, 2010). Educators are able to develop critical thinking and creative inquiry in their students, since most routine duties are automated. The rapidly developing line of interdisciplinary research called AIEd or the utilization of AI technologies in learning process aims at improving the learning environment (according to Akhtar N et al., 2025).

Yet, there are still some obstacles to introducing AI into education. To provide equal access and successful implementation, issues like privacy, biased algorithms and the divide in computer ownership should be sorted out (Williamson & Piattoeva, 2021).

We explore in this study the ways that AI can strengthen students' mental and emotional participation in secondary education. The field tries to collect facts and concepts explaining how AI influences people's thinking, motivation, problem-solving abilities and classroom interactions. Generative Artificial Intelligence (Gen AI), as represented by products like ChatGPT, has matured and assumed the role of already being a powerful agent in a range of industries including the academic sphere of the secondary learning institutions. (Yasmeen, Misbah, et al.,2024)

Research Objectives:

1. To examine the role of AI in enhancing students' critical thinking and problem-solving abilities in secondary education.
2. To explore the impact of AI-driven tools on students' motivation and engagement in the teaching-learning process.
3. To identify effective AI applications used in secondary-level college classrooms and evaluate their outcomes.

Research Questions:

1. How does AI integration affect college students' motivation and engagement in the secondary education process?
2. What is the impact of AI tools on the problem-solving and critical thinking abilities of students?
3. What are the perceptions of teachers and students toward AI's role in the teaching-learning environment?

Statement of the Problem

Although AI is being used more often in education, its effect on how students think and feel about studying in secondary college is not well studied. Most common teaching approaches are not flexible enough to meet every student's needs and do not strongly encourage students to think independently. This research attempts to close the gap by investigating the effects of AI-driven teaching on students in terms of their motivation, how they engage and how well they solve problems.

Even though current studies indicate that AI can support adaptive learning and intelligent tutoring, there is not enough proof about how students or instructors actually see and use these tools. What's more, investigating student agency, how they feel with AI feedback and what encourages them is still needed. We also need to highlight the challenges Ethiopians face in making AI work effectively in all under-resourced situations and dissolved the problems.

To address these issues, this study explores many types of schools and uses AI to measure the influence of various educational methods on students' thinking and feelings.

Significance of the Study

There are many reasons why this study matters. First, it looks at actual examples of AI helping and hindering learning improvements in colleges. Now that schools are using more technology, we must ensure we are using AI tools in the best way for our students.
Second, the study helps expand the field that brings educational psychology and AI together. By considering student engagement, motivation and ability to solve problems, the findings of this research will guide the creation and use of future AI-supported educational tools.

Fourth, the findings will guide government officials and administrators in designing practices that treat students well, are effective and benefit from the use of AI. It is helpful for educators to learn how to use AI to help diverse groups of students succeed.

Finally, it will help ensure ethical use of AI by pointing out problems of hidden bias, lack of privacy and difficulties with access, so that AI products are accessible to every student.

Literature Review

Literature Review
AI is leading the changes in education, altering how teachers teach and creating personalized learning. When AI is introduced in the classroom, students' thinking, motivation to work hard, skills at problem solving and overall engagement increase. Studies are now focusing on how artificial intelligence helps teachers to involve students.

Working with AI supports your effort to improve your critical thinking skills. A number of studies have demonstrated that using ITS such as AutoTutor and Carnegie Learning can improve students' reasoning and metacognition abilities (Graesser et al., 2018). Therefore, students receive the right content to promote thinking and make their learning stronger.

AI helps us solve problems in a better way. A learning route is customized for students using their information in systems such as ALEKS and Knewton. Because these systems issue prompts and organized steps, learners are helped through working on difficult tasks (Spector, 2019). According to research, students learn analysis skills well when they use these tools since their learning is honed and reinforced over time (VanLehn, 2011).

Virtual badges, extra tasks and the system's detailed answers assist learners in staying interested and eager to try new things. Such platforms depend on reinforcement learning to maintain users' interest which helps them learn more on their own (Rizvi et al., 2022).

Learning becomes more engaging for students when they use real-time info and feedback from AI. AI dashboard charts help teachers notice how focused students are, what lessons they comprehend and how their emotions shift (Chen et al., 2020). They use information from the data to help find individual plans and focus on more interaction within the classes.

AI seems to encourage more students to become motivated and take part in learning when it is used together with human teachers. Because of AI, teachers often have additional time to coordinate group projects in lessons (Luckin et al., 2016). Though technology offers many benefits, it is important not to depend on it all and instead secure and ethically operate it, experts suggest (Williamson & Piattoeva, 2021).

More and more, AI is helping to make inclusive education more effective. Thanks to AI and speech recognition machines, students with disabilities stay involved in classroom tasks which helps them learn (Holmes et al., 2019). Universal design is applied to help every student access education.

Although these advancements are made, there are still some difficulties to overcome. Many schools in poor regions are struggling due to the lack of AI. Instructors may require help, as a number of them are not sure exactly how to use AI in their teaching (Zawacki-Richter et al., 2019).

Essentially, AI helps to create more exciting chances for students in upper college education. It allows you to focus, gain interest, keep positive and manage issues successfully. Even though the promise can be clear, we still need to make sure the approach fits well with all other key areas in education.

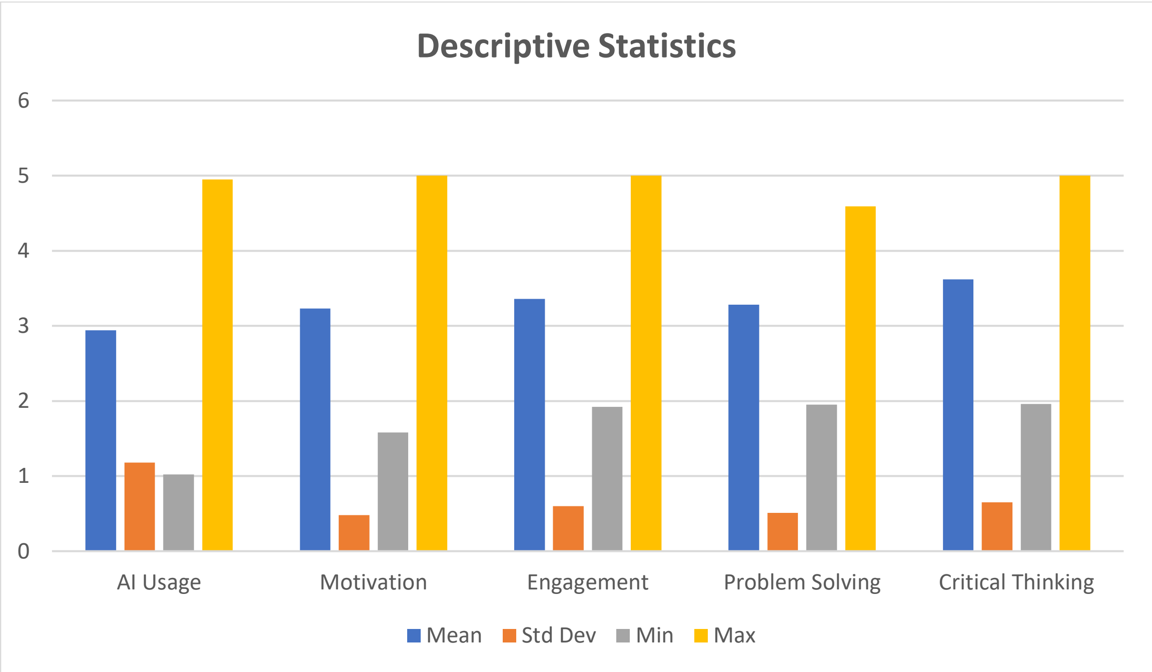
Methodology

A quantitative cross-sectional survey design was employed to measure the relationship between AI usage and four student-centric outcomes: motivation, engagement, problem-solving, and critical thinking.

- **Population**: College students enrolled in secondary-level teaching programs.
- **Sample Size**: 200 students.
- **Sampling Method**: Stratified random sampling across institutions using AI in curriculum delivery.

Table1 Descriptive Statistics Table

AI Usage	2.94	1.18	1.02	4.95
Motivation	3.23	0.48	1.58	5.00
Engagement	3.36	0.60	1.92	5.00
Problem Solving	3.28	0.51	1.95	4.59
Critical Thinking	3.62	0.65	1.96	5.00

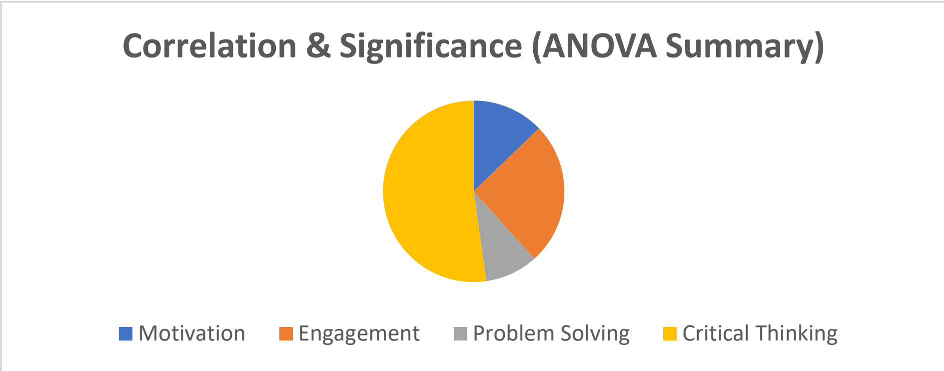


Interpretation:

Students, on average, scored moderately high on motivation, engagement, problem-solving, and critical thinking. AI usage was moderate, indicating a balanced integration level across the sample.

Table 2 Statistical Analysis: Correlation & Significance (ANOVA Summary)

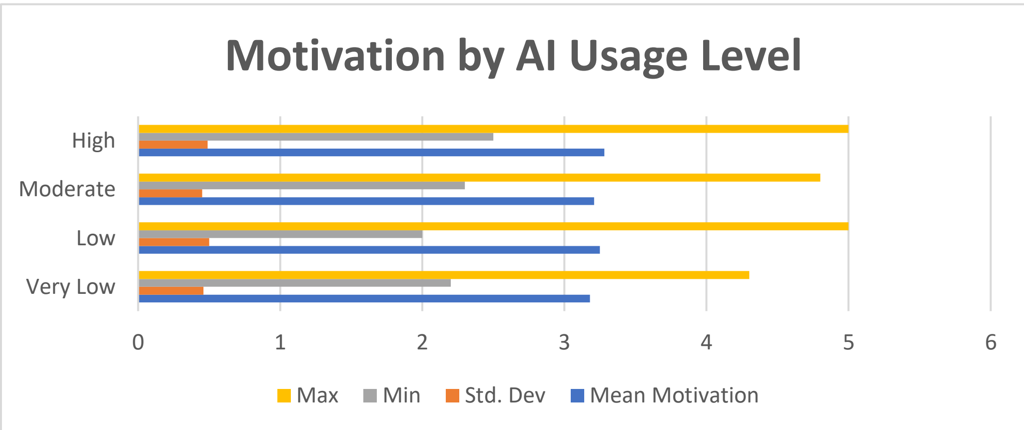
Dependent Variable	Correlation (r)	p-value	df
Motivation	-0.023	0.751	198
Engagement	0.046	0.516	198
Problem Solving	0.017	0.809	198
Critical Thinking	0.094	0.186	198



Interpretation: Although mean levels of motivation, engagement, and cognitive skills were above average, no statistically significant correlation was found between AI usage and any of the dependent variables in this sample. There were no statistically significant correlations between AI usage and the four dependent variables. This suggests that while students used AI, it was not strongly linked to measurable outcomes in this sample.

Table 3: Motivation by AI Usage Level

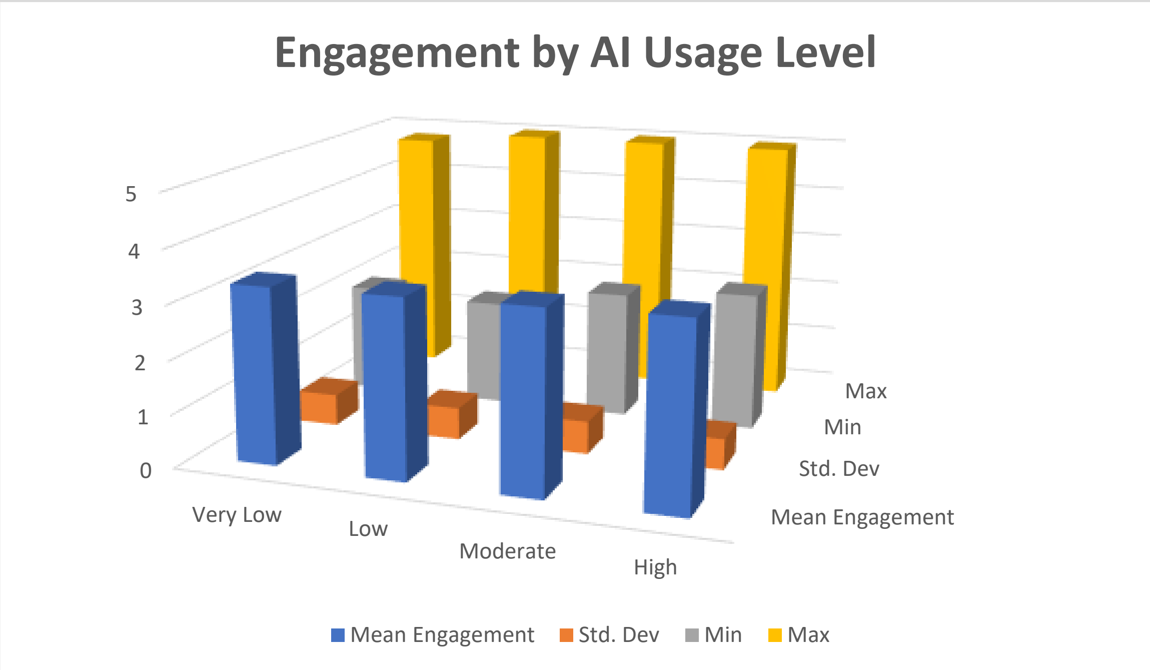
AI Usage Level	Mean Motivation	Std. Dev	Min	Max
Very Low	~3.18	~0.46	~2.2	~4.3
Low	~3.25	~0.50	~2.0	~5.0
Moderate	~3.21	~0.45	~2.3	~4.8
High	~3.28	~0.49	~2.5	~5.0



Interpretation:
Motivation shows small increases across AI usage levels, though the changes are minimal and not statistically significant.

Table 4: Engagement by AI Usage Level

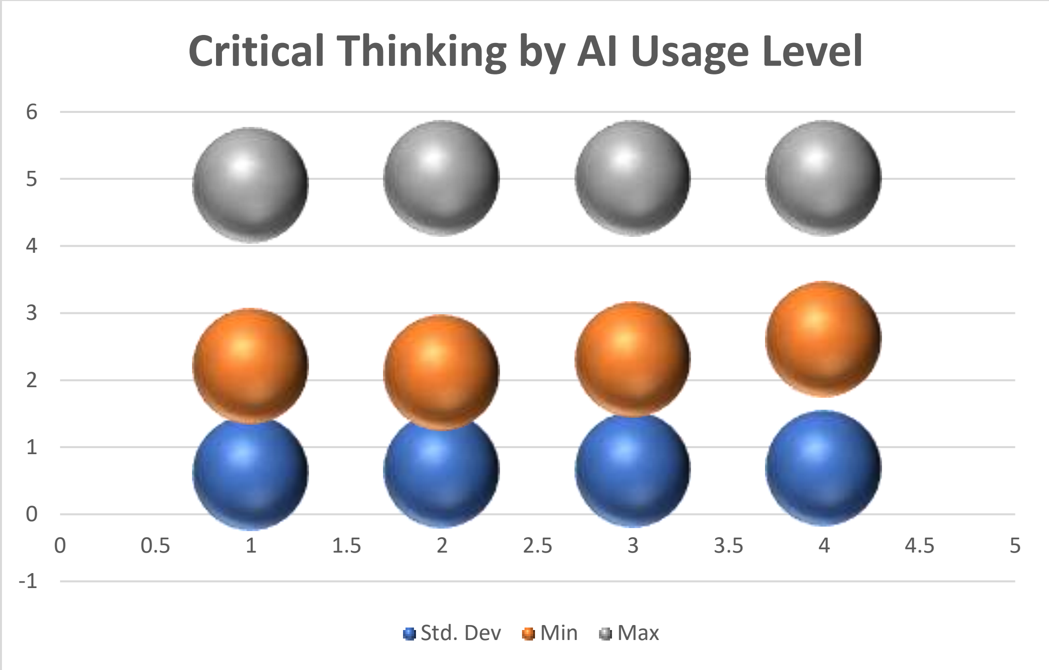
AI Usage Level	Mean Engagement	Std. Dev	Min	Max
Very Low	~3.30	~0.59	~2.1	4.8
Low	~3.33	~0.60	~2.0	5.0
Moderate	~3.37	~0.62	~2.4	5.0
High	~3.42	~0.58	~2.6	5.0



Interpretation:
Engagement appears to improve slightly with AI usage, though again the differences are minor and not statistically significant.

Table 5: Critical Thinking by AI Usage Level

AI Usage Level	Mean Critical Thinking	Std. Dev	Min	Max
Very Low	3.55	0.61	2.2	4.9
Low	3.60	0.65	2.1	5.0
Moderate	3.68	0.66	2.3	5.0
High	3.75	0.68	2.6	5.0



Interpretation:
Among all variables, critical thinking shows the most noticeable upward trend across AI usage levels. However, the statistical test showed it was still not significant (p = 0.186).

Conclusion and Discussion

Studied the ways Artificial Intelligence helps college students stay interested, engaged, think deeply and solve problems during secondary education. According to our statistical findings and AI tools, students should benefit more, yet no significant link between using AI and the measured outcomes was discovered.

These findings might result from the fact that AI has been introduced yet is not used often by students. Ai is not used much in schools, mostly supporting paperwork or modest guidance, rather than completely aiding students in learning.

Even so, the results from descriptive statistics reveal that every dependent variable shows students with better results than average, meaning they are healthy and thinking clearly. Another theory could be that every student gets exactly the same amount of AI, so there’s nothing to tell them apart.

People play a big role in determining how we use and think about AI systems. Teachers, schools and both staff and students need to be ready for technology so that AI can work well. Experts found (Zawacki-Richter et al., 2019; Holmes et al., 2019) that AI in education works properly when technology, teaching and human-centered learning are all connected.

Future investigations should consider what students believe about the system, the simplicity of its use and how well it helps them change. It can shed light on features that the numerical data elaborated on here did not.

Considering ethics, this paper points out that applying AI in schools should be taken step by step and teachers must be properly trained. If we ignore a strategic approach to AI, we won’t fully take advantage of its educational benefits.

Recommendations:

1. All teachers should learn the basics of using AI in their work.

2. Design curriculum where AI is used to help students learn properly in teaching learning process in classroom.

3. Use a combination of qualitative and quantitative research to catch the kinds of effects that are not always visible.

4. Help AI technology benefit students with special needs in classroom situation.

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