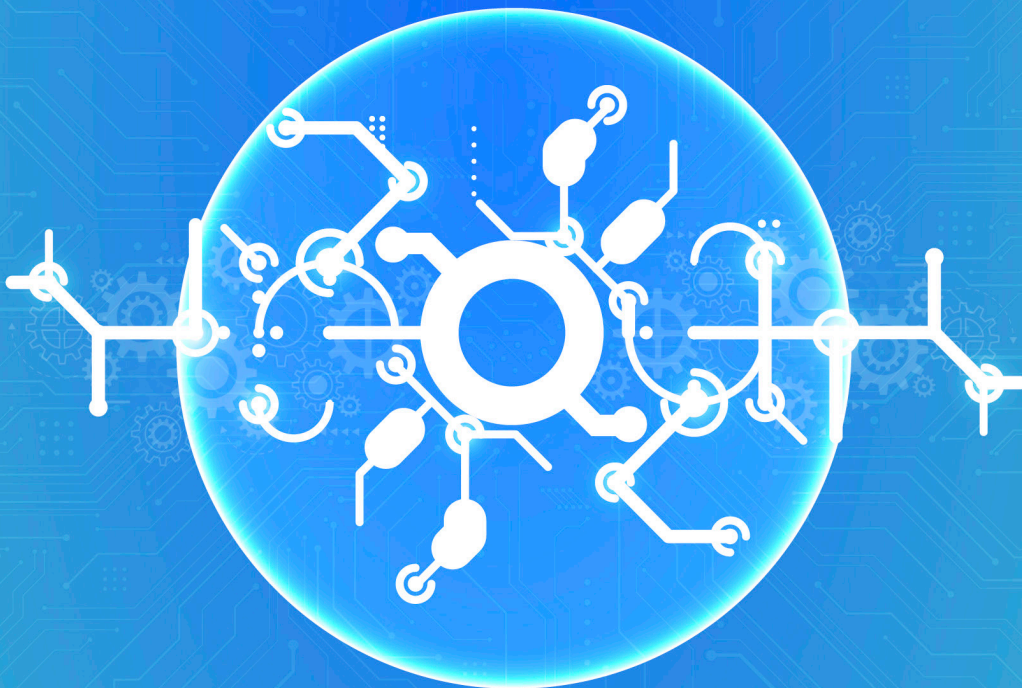




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Artificial Intelligence Dependency as a Correlate of Critical Thinking, Problem-Solving, and Ethical Learning Practices among Secondary School Students in South-West Nigeria

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ABSTRACT

The growing deployment of Artificial Intelligence (AI) tools in secondary education provides students with new methods to find information, to acquire explanations, and to seek for help with their academic work. At the same time, there are fears that students might become dependence on AI, and what this means for autonomous thinking and responsible learning. The study examined the use and dependency of AI tools by senior secondary school students in Southwest Nigeria and examined its relationship with critical thinking, problem-solving skills and ethical learning practices. A correlational survey design was utilised. The survey was conducted among 7,200 students from SS1 to SS3 in 60 secondary schools in the six states of Southwest Nigeria. Data were obtained by structured questionnaire and analysed using descriptive statistics, Pearson Product-Moment Correlation, independent-samples t-test and one-way analysis of variance. The results suggest that the level of AI tool utilisation was high ($M = 3.73$, $SD = 1.04$) and the level of AI dependency was moderate to high ($M = 3.53$, $SD = 1.11$). AI reliance was adversely and strongly correlated with critical thinking ($r(7198) = -.46$, $p < .001$) and problem-solving skills ($r(7198) = -.41$, $p < .001$). The use of AI tools was positively associated with ethical learning practices ($r(7198) = .34$, $p < .001$). There was no gender difference in AI reliance ($t(7198) = -1.85$, $p = .064$), however there was a significant difference in ethical learning practices across SS1, SS2 and SS3 students ($F(2, 7197) = 6.85$, $p = .001$) with SS3 students having the highest mean. The results show that students are using AI tools extensively in their academic work, although the more use of such tools is related to poorer levels of critical thinking and problem solving. Thus, the study emphasises the importance of directed use of AI to help students' learning, without eliminating their own reasoning or accountability for academic work.

INTRODUCTION

Students are increasingly using Artificial Intelligence (AI) to find information, get explanations, and do their academic assignments. Tools such as ChatGPT and Google Gemini, which are generative AI, can answer questions, explain concepts, give examples and help with many kinds of school work. For students, these skills can offer additional learning opportunities outside the regular classroom engagement. But the value of such help is largely dependent on how students engage with the information and responses supplied by artificial intelligence (AI) systems. When students require more explanations, examples, feedback, or access to learning resources, artificial intelligence can be helpful. Holmes *et al.* (2019) noted the potential of AI to support learning through systems that respond to the demands of learners while Luckin (2018) highlighted the role of AI as a support for teaching and learning. Generative artificial intelligence can also help pupils by providing instant feedback and other explanations. These possibilities make AI relevant to contemporary schooling, and especially so as pupils have more ready access to AI applications through internet-

enabled gadgets.

These tools are becoming more available, and this raises problems about how students use them. The study defines AI dependency as an overreliance on artificial intelligence systems to do academic work at the detriment of independent reasoning, reflection, and problem-solving. AI is able to give a learner an explanation, and the student can then explore, question, or use that explanation. Another student may take the answer without understanding the procedure and utilise the answer to finish the task. The two methods of use are extremely different in terms of student engagement. The difference is crucial because for learning pupils need to be engaged in cognitive activity. Critical thinking entails analysing information, assessing alternatives, making decisions, and justifying those judgements. Problem solving necessitates learners to understand a problem, examine various strategies, work through challenges, and assess answers. If students regularly move these work to artificial intelligence (AI) systems, opportunities to practise the relevant cognitive processes may be lost. This has been associated with cognitive offloading, a phenomenon in which some mental

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activities are outsourced to external technology systems (Grassini, 2023; Zhang *et al.*, 2024).

However, the association between AI use and learning is not necessarily negative. Artificial intelligence can also be an effective tool provided students remain actively involved in the learning process. The question is therefore not just whether students utilise AI but how they use it and to what extent. This dichotomy is crucial to note in relation to students' critical thinking and problem-solving skills, as suitable use of AI help can foster these skills, while overdependence may limit the chances for individual involvement. There is also an ethical dimension to the usage of AI. Students may face issues around plagiarism, originality of their work, correct citation of AI usage and accuracy of AI outputs. UNESCO (2021) refers to human agency and responsible use in its ethical framework for AI. Responsible use isn't simply the technical competence to run an AI program, but also the judgement of when it's suitable to get AI assistance, and the ability to assess the information provided by the system.

The issue is becoming more pertinent in Nigeria as students are increasingly exposed to digital and AI-enabled devices. Evidence of this development is beginning to be documented from southwest Nigeria. For example, Adegoke *et al.* (2026) observed good sentiments about generative AI for academic learning among students in Osun State, while highlighting the significance of responsible and guided use. Akinbuwa (2025) similarly observed that AI technologies were perceived as valuable for academic support by instructors and students in Ondo State, while suggesting organised adoption. These advances provide an important research question. Students may be using AI more often but more use does not equal to establishing suitable habits of engagement with the technology. Therefore, it is necessary to investigate if students' reliance on AI is associated with significant cognitive outcomes and ethical learning practices. Existing research have investigated several elements of AI adoption and perspectives. But, there is limited information on the link between AI dependency, critical thinking, problem-solving, and ethical learning practices among secondary school students in Southwest Nigeria. This study was designed to give empirical evidence for these links.

Statement of the Problem

The emergence of Artificial Intelligence (AI) tools has altered the way secondary school pupils search for information and accomplish academic activities. Generative AI programs can answer questions, produce replies, help with assignments and present viable answers to academic challenges. These qualities can be valuable to students, especially when AI is employed as an adjunct to classroom learning. But such ready access to help also easily raises worries about how much students depend on AI to do work that normally requires autonomous thinking and problem-solving. The worry isn't that pupils are using AI. The more immediate question is at what point such use becomes dependence. Students who utilise AI to clarify a subject,

compare different answers, or gain feedback may still be fully engaged in the learning task. By contrast, students who rely on AI to create answers or do hard work for them may have fewer chances to work through challenges on their own. This distinction is significant because activities in which students review information, make judgements, evaluate alternatives, defend conclusions and persist when answers are not immediately evident foster critical thinking and problem-solving.

Over-reliance on AI and its relation to autonomous reasoning and cognitive engagement have generated concerns in prior work. Grassini (2023), Kasneci *et al.* (2023) and Zhang *et al.* (2024) reported concerns on the use of AI tools by students while Adegoke *et al.* (2026) reported the increasing use of generative AI among secondary school students in Osun State and emphasised the need for guided and responsible use. Simultaneously, artificial intelligence can function as a beneficial learning assistance, provided that students stay fully engaged with the work. The available evidence consequently does not support the idea that AI use is either positive or negative in its totality, but rather that the amount and nature of students' dependence on AI needs to be considered further. Another worry is the ethical usage of AI for academic work. The rising availability of AI tools raises problems regarding academic integrity, the authenticity of students' work, ethical use of technology, and students' responsibility for information generated by artificial intelligence (AI) systems. UNESCO (2021) stresses the need for human-centered and responsible approaches to AI. These are especially pertinent to children in secondary school, who should know that responsible use involves a level of discretion, rather than unthinking acceptance or reproduction of AI-generated material.

In Nigeria, evidence shows that pupils and teachers are increasingly exposed to generative AI. Research in Osun and Ondo States have depicted positive impressions of AI as an academic assistance tool but highlighted the necessity for controlled and responsible use. However, such developments have not provided enough empirical evidence on the association between students' AI dependency and their cognitive and ethical learning results. Specifically, research on the relationship between AI reliance and students' critical thinking and problem-solving skills among secondary school students in Southwest Nigeria is scant in the specific context. There is also a dearth of research about the ethical engagement of students with AI and the degree to which patterns of AI use are related with such behaviours. Without this proof it is hard to understand the connection between increased access to AI and students' autonomous cognitive involvement and ethical academic usage of the technology. Hence, this study aims to fill the gap of empirical knowledge on the relationship between students' dependency on AI technologies, critical thinking, problem-solving skills and ethical learning practices in Southwest Nigeria. Examining such correlations may offer evidence to encourage teachers, schools, curriculum developers and policymakers

to promote the use of AI that complements, rather than substitutes, students' own engagement in learning.

Purpose of the Study

The main purpose of this study was to examine the relationship between students' dependency on Artificial Intelligence (AI) tools and their critical thinking, problem-solving skills, and ethical learning practices among senior secondary school students in South-West Nigeria. Specifically, the study sought to:

1. Assess the extent of AI tool usage among students in South-West Nigeria;
2. Determine the level of students' dependency on AI technologies for academic tasks;
3. Examine the relationship between AI dependency and students' critical thinking skills;
4. Examine the relationship between AI dependency and students' problem-solving skills;
5. Examine the relationship between AI usage and students' ethical learning practices;
6. Determine whether students' AI dependency differs by gender; and
7. Determine whether students' ethical learning practices differ across educational levels (SS1, SS2, and SS3).

Research Questions

The following research questions guided the study:

1. What is the extent of AI tool usage among students in South-West Nigeria?
2. What is the level of students' dependency on AI technologies for academic tasks?
3. What relationship exists between AI dependency and students' critical thinking skills?
4. What relationship exists between AI dependency and students' problem-solving skills?
5. What relationship exists between AI usage and students' ethical learning practices?
6. Does gender influence students' level of AI dependency?
7. Does educational level influence students' perception of ethical learning practices related to AI use?

Null Hypotheses

The following null hypotheses were tested at the 0.05 level of significance:

- H₀₁:** There is no significant relationship between students' AI dependency and their critical thinking skills.
- H₀₂:** There is no significant relationship between students' AI dependency and their problem-solving skills.
- H₀₃:** There is no significant relationship between AI usage and students' ethical learning practices.
- H₀₄:** There is no significant difference in students' AI dependency based on gender.
- H₀₅:** There is no significant difference in students' ethical learning practices across educational levels (SS1, SS2, and SS3).

Significance of the Study

The results of this study could be valuable for instructors,

students, policy makers, curriculum developers, researchers and educational technology developers. The results on AI dependency and its relevance to students' cognitive and ethical learning outcomes should give more informed recommendations to these stakeholders about the role of AI in secondary education.

Teachers

The findings should assist teachers comprehend the connection between students' use of AI and their critical thinking and problem-solving skills. Such understanding may help shape the design of classroom activities in which AI is employed as a learning aid, but students are still required to analyse information, work through challenges and explain their reasoning.

Students

The study may assist students to distinguish between utilising AI for support in learning and using AI to fulfil academic tasks. Increased understanding of this divide may help to motivate students to utilise AI more intentionally, while still remaining engaged in thinking, problem-solving, and responsible academic work.

Policymakers and curriculum designers.

The findings may provide empirical evidence to guide the responsible incorporation of AI in secondary education. Such coaching should include acceptable student use of AI, academic integrity and the significance of preserving possibilities for individual thinking and problem solving. The findings could also feed into ongoing conversations around ethical and human-centred approaches to AI in education.

Researchers said the study provides actual evidence of AI dependency among secondary school pupils in Nigeria, especially in Southwest Nigeria. It can serve as a launchpad for future study on AI usage, cognitive abilities, and ethical learning strategies across various educational contexts and student groups.

Educational Technology Developers

The results may be helpful in understanding how AI-powered educational tools might aid, but not promote over-reliance. Such evidence can be used by developers to design features that enable students to engage with explanations, assess their responses, and actively participate in learning, rather than merely accepting finished answers.

Delimitations of Study

The study was geographically delimited to the six states of Southwest Nigeria, which are Lagos, Ogun, Oyo, Osun, Ondo and Ekiti States. The study focused on the demographic of senior secondary school pupils in SS1, SS2 and SS3 who utilise AI tools for academic purposes. The study focused on students' use of AI tools, dependency on artificial intelligence (AI) tools, critical thinking skills, problem-solving skills, and ethical learning

practices. The ethical learning practices discussed in the study refer to the appropriate academic use of AI, including challenges surrounding academic integrity and students' responsible use of AI-generated knowledge. This study was conducted in the academic year of 2025/2026, which represents the time frame of the investigation and the increasing availability of generative AI tools such as ChatGPT.

Theoretical Background

This work is informed by Cognitive Load Theory, Constructivist Learning Theory and ethical views of Artificial Intelligence in education. Each perspective considers a different area of the topic. Cognitive Load Theory can be used to understand the cognitive implications of offloading certain thinking tasks to standard artificial intelligence systems. Constructivist Learning Theory focuses on students' active involvement in learning, and the ethical aspect offers a foundation for reflection on responsible AI usage and students' accountability for their academic work.

The Cognitive Load Theory

The Cognitive Load Theory (CLT) (Sweller, 1988) is based on the notion that working memory has a finite capacity. Learning can be inhibited when learners are required to process more information or conduct more mental operations than their working memory can support. Instructional assistance is therefore effective if it allows learners to cope with unwarranted demands and to concentrate their attention on material important to learning. This is crucial to students' use of AI since artificial intelligence systems can take on some of the mental work involved in an academic endeavour. Students can use an AI application to ask for an explanation of a difficult idea or to create an example or solution. This kind of aid can decrease the immediate cognitive load of the task. The danger is when help becomes a replacement for the student's own thinking, rather than a way of supporting it.

This is usually considered in terms of cognitive offloading, in which people employ external technologies to execute or augment cognitive tasks that could otherwise be carried out internally. Offloading isn't inherently a bad thing in an educational context. Students commonly use calculators, textbooks, notes and other materials to facilitate learning. The question for the present study is if persistent reliance on AI diminishes the chances for students to participate in the reasoning and problem-solving processes by which cognitive skills are built. Concerns concerning over-reliance on AI and students' autonomous reasoning and critical thinking were raised by Grassini (2023), Kasneci *et al.* (2023), and Zhang *et al.* (2024). The study also refers to Adegoke *et al.* (2026) who observed that there is growing adoption of generative AI among secondary school students in Osun State with the requirement for guided and responsible use.

Therefore, CLT is applicable to the current study as

it gives a way of explaining why the degree of AI dependency may be related to students' critical thinking and problem-solving skills. The idea does not state that using AI is necessarily bad. Rather, it is concerned with how the transfer of cognitive tasks to technology may change the extent to which learners engage in those tasks themselves.

Constructivist Learning Theory

Constructivist Learning Theory describes learning as an active process in which learners construct knowledge through interaction with information, experience, reflection and problem-solving. Learners are expected to relate new knowledge to their previous knowledge, and not passively receive knowledge. This view is particularly applicable in critical thinking and problem solving. Both demand active engagement with learning task. This view of learning can be accommodated by the usage of AI tools. For example, students could employ an AI system to offer an alternate explanation, create questions to investigate further, or compare different potential approaches to a problem. In many cases, the technology can be a resource in the learning process, but the student remains responsible for analysing and assessing the information.

It's a different story, however, when students turn to AI for work that they could otherwise try themselves. If an AI system regularly offers explanations, answers, or written responses without having students analyse how those responses were generated, students might have less opportunity to build and test their own understanding. This distinction is relevant to the present study. The question is not whether students are using AI, but if their pattern of use allows enough space for independent reasoning and active engagement in learning. Hence, Constructivist Learning Theory helps to explain the relevance of AI reliance to the development of critical thinking and problem-solving skills.

Ethics Frameworks for Artificial Intelligence in Education

The third perspective is the ethical aspect of utilising AI in education. The use of AI in academic work raises problems concerning student accountability for their work, academic integrity, acceptable use of technology, and the dependability of information supplied by AI. UNESCO's ethical framework for Artificial Intelligence offers an appropriate base to reflect on these challenges. Use responsibly means students should exercise their discretion in the use of artificial intelligence technology. An AI-generated response may be informative, but students are still responsible for judging whether the material is true, acceptable and suited for the academic goal. Similarly, students should not be absolved of accountability for their work by the use of AI tools. These challenges are particularly pertinent as students increasingly rely on AI apps for academic purposes. The article addresses ethical considerations about the use of

AI in education, such as academic honesty, the authenticity of student work, the ethical use of technology, and intellectual independence.

The ethical perspective thus forms the framework for the research of ethical learning practices in the present study. It changes the conversation from whether students are using AI to how they are using it responsibly and how they're owning their academic choices and their academic work.

Relationship among Theoretical Perspectives

The three points of view fit together. Cognitive Load Theory, which highlights the potential consequences of delegating cognitive activities to an outside system. The primary tenet of the Constructivist Learning Theory is that students need to be fully engaged in the course of knowledge construction. The ethical lens raises the topic of the responsible use of AI and if students are still responsible for their academic work. The viewpoints together give a framework for analysing the dependence on AI in terms of cognition and ethics. They also assist distinguish between AI use as a learning support and AI dependence as a reliance behaviour. This distinction is important for the current study as it is concerned with AI dependency in relation to critical thinking, problem-solving skills, and ethical learning practices and not all use of AI as harmful.

Conceptual Framework

The conceptual framework of this study is a combination of the study variables on the students' use of Artificial Intelligence (AI) for academic reasons. The concept emphasises the use and dependence of AI and their interaction with critical thinking, problem solving skills and ethical learning practices. AI utilisation refers to the use of AI tools by students in completing academic activities, whereas AI reliance is the amount to which students rely on such tools when carrying out academic duties. The cognitive outcomes explored in the study are critical thinking and problem-solving abilities. Ethical learning practices are about how students responsibly use AI in their academic work, which includes responsible use and academic integrity.

The concept is based on an assumption that access or frequency of use cannot explain educational relevance of AI use. Of equal importance is the degree to which pupils depend on AI. A learner might utilise an AI tool sometimes for clarification or feedback without becoming overly reliant on it. Another student could be using AI on a regular basis to get answers or do school work. The patterns of use are the basis for studying the relationship between dependency on AI and the cognitive factors of the study. This paradigm also acknowledges the link between AI utilisation and ethical learning practices. The use of AI by students for academic purposes raises problems of how they treat AI-generated knowledge, maintain accountability for their work, and observe relevant academic standards. Ethical learning practices

are consequently seen as a key characteristic of students' interaction with AI.

Variables of the Study

The major variables represented in the framework are:

AI-related variables

- AI tool usage
- AI dependency

Cognitive variables

- Critical thinking skills
- Problem-solving skills

Ethical variable

- Ethical learning practices

Conceptual Relationships

The study examines the following relationships:

- AI dependency and critical thinking skills:

The study examines whether students' level of dependency on AI is related to their critical thinking skills.

- AI dependency and problem-solving skills:

The study examines whether students' level of dependency on AI is related to their problem-solving skills.

- AI usage and ethical learning practices:

The study examines whether students' use of AI tools is related to their ethical learning practices.

- AI dependency and gender:

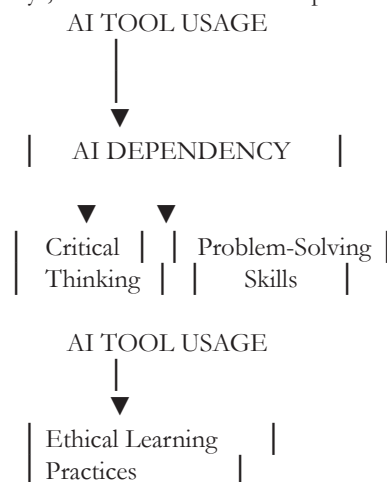
The study also examines whether students' level of AI dependency differs according to gender.

- Ethical learning practices and educational level:

The study further examines whether ethical learning practices differ among SS1, SS2, and SS3 students.

Conceptual Model

Rather than presenting the relationships as definite causal pathways, the framework can be represented as follows:



The framework is intended to show the relationships examined in the study, rather than to assert that one variable causes another.

Concept of Artificial Intelligence in Education

Artificial Intelligence (AI) is computer-based systems that can accomplish tasks that often require human intelligence such as learning, reasoning, problem-solving,

and decision-making. Russell and Norvig (2021) define AI as intelligent beings that observe their environment, learn from experience, reason, and act to achieve defined goals. In education, these capabilities have been utilised to carry out tasks like as content creation, delivering feedback, decision-making assistance, and the customisation of learning resources to the needs of learners. The expanding importance of AI-supported technologies for teaching and learning has been underlined by UNESCO (2021) and OECD (2023). With the introduction of generative AI, many applications are now more attainable for students. Tools like ChatGTP and Google Gemini can provide explanations, answer queries, give examples and help with academic work. These applications can expand the learning materials available to students, and help them beyond the traditional classroom engagement. The instructional value of these tools, however, depends on the way they are included in the learning process.

It has already been shown in prior study that the way that the technology is used for instruction affects the efficacy of AI in education. Zawacki-Richter *et al.* (2019) revealed that AI apps can support learning when they are integrated to proper pedagogical procedures rather than being considered as separate technology. More recent study, particularly Kasneci *et al.* (2023), has also shown how uncritical usage of generative AI could impair students' cognitive involvement. This distinction between AI as a learning resource versus AI as a replacement for students' own work is particularly relevant in the present investigation. AI could provide helpful explanations, feedback, and support but excessive use of generated responses might alter the level of students' involvement in academic work independently. In this study we look at the concept of AI in education not only from the perspective of the possibilities of the technology, but also from the perspective of how students utilise it and how much they rely on it.

The Concept of Student AI Dependence

Student AI dependence is the degree to which students use artificial intelligence systems to complete academic assignments. Dependency in this study environment is more than standard application of AI. That's a trend of students using AI more and more to get answers, explanations, solutions, or any kind of academic help instead of doing the work on their own.

AI reliance is part of a larger concept of cognitive offloading, in which humans utilise external resources to assist or execute cognitive tasks. Offloading can be helpful, Students frequently employ calculators, textbooks, notes, and other devices to minimise the effort needed for certain activities. The educational difficulty arises when students rely so heavily on an AI system that they have fewer opportunity to practise the reasoning, evaluation and problem solving processes that are necessary for learning. There is evidence cited in the draft that speaks to this worry. Students with more dependence on artificial intelligence showed weaker self-regulated learning and

critical thinking engagement (Zhang *et al.*, 2024). Similarly, Grassini (2023) associated regular use of AI chatbots with surface-level processing and fears of deep learning. Kasneci *et al.* (2023) have identified that generative artificial intelligence can contribute to circumstances where pupils show understanding without conceptual mastery. The study further connects this concern to the OECD's (2023) notion of "false mastery" related to dependence on automated systems. This does not mean that dependency is to be equated with all forms of AI use. AI is able to provide scaffolding, hints, explanations and feedback that can aid learning if students are actively involved in the work. The crucial contrast is between utilising AI to augment your own learning, and using AI to replace large parts of your own academic endeavour. This distinction serves as the basis for analysing AI reliance in connection to students' critical thinking and problem-solving skills in the current study.

The Idea of Critical Thinking

Critical thinking is a higher-order cognitive skill that enables learners to analyse information, assess evidence, make reasoned decisions and determine what to believe or do. Ennis (1985) defined critical thinking as reasonable reflective thinking that is focused on deciding what to believe or do. Facione (1990) also described it as an intentional, self-regulatory process of interpretation, analysis, evaluation, inference, explanation, and self-regulation. These descriptions focus evaluation, reflection and judgement in critical thinking. Critical thinking is especially important for learning in a setting where kids have access to enormous volumes of digital information. Learners should be able to assess the credibility and relevance of material, discern between supported and unsupported arguments, and draw conclusions based on evidence. Similarly, Zohar and Dori (2023) highlighted interpretation, analysis, evaluation and inference as crucial components of critical thinking. Another aspect of this process is the expanding use of AI. Artificial intelligence systems can provide students with explanations, alternate perspectives, examples, and feedback that they might employ in their academic endeavours. Such support can provide opportunity for students to compare material, to explore other techniques, and to reflect on possible answers. But the educational effectiveness of these experiences relies on the students' active evaluation and engagement with the information presented.

The reverse pattern is feasible as well. Students who accept AI-generated responses at face value without critically scrutinising the reasons behind those responses might have less opportunity to develop analysis, assessment and independent judgement. This is in keeping with the distinction between use and dependence on artificial intelligence highlighted in the present study. Relying on an AI tool as one source of help does not necessarily mean reliance. Reliance becomes more relevant when students habitually offload substantial elements of the thought process to the technology. The empirical evidence

referenced in the study reflects both options. Zohar and Dori (2023) found that when embedded in instructional activities that encourage active learning and guided inquiry, digital technologies can support critical thinking. Conversely, Zhang *et al.* (2024) observed that overuse of AI tools without sufficient control was related with a decreased level of participation in critical thinking, as students tended to rely on AI-generated responses instead of reasoning independently.

Thus, in this study, critical thinking is addressed in connection to the degree of students' dependence on AI. The issue is not whether students have access to AI or utilise it at all. Rather, the issue is whether higher reliance on AI is related with disparities in their involvement in critical thinking processes.

Concept of Problem-Solving Skills

Problem-solving skills are the talents to recognise an issue, determine what information is relevant, develop feasible solutions, analyse the alternatives, and choose a course of action. This talent is extremely useful in mathematics, physics, and many everyday situations where solutions cannot easily be recalled and applied. To solve problems effectively we need to reason, decide, persevere and be able to change our strategy if the first attempt fails. There are various ways AI tools can help solve problems. They might walk you through it step-by-step, brainstorm possible techniques, give you examples, or provide feedback right away. Such help can be valuable if students use it to get a clearer understanding or to explore different ways of solving an issue. The fear is that students may use AI-generated solutions to solve problems rather than try to solve them. In certain cases, the student may arrive at a correct-looking response but not have gone through the thinking and tenacity it took to get to the solution. The frequent use of ready-made AI solutions may therefore limit the opportunity for pupils to practise independent problem solving.

The use of AI tools in learning has generated both opportunities and concerns regarding students' problem-solving and critical-thinking engagement. Barana *et al.* (2023) demonstrated that students using ChatGPT to support mathematical problem-solving still needed to engage in problem-solving and critical-thinking processes to accomplish the tasks. Similarly, Ubowska and Królikowski (2023) noted concerns that the use of ChatGPT could limit students' problem-solving skills and creative thinking. These findings suggest that although AI tools can support learning, their educational value may depend on students' continued active engagement in problem-solving and critical-thinking activities.

Kasneci *et al.* (2023) have warned that generative AI may lower students' motivation to persevere in the face of a difficult challenge when answers may be found from an AI system. The relevance of problem-solving to the present investigation is the contrast between AI-supported problem-solving and AI-dependent problem-solving. Artificial intelligence can be a resource for advice

or feedback, but students need opportunities to grasp challenges, develop strategies, test solutions, and learn from failing attempts. Accordingly, the study explores if the students' level of AI dependence is associated with their problem-solving abilities.

Ethical Learning Practices

Ethical learning practices are about the proper use of technology by students in the conduct of academic activities. These include academic integrity, appropriate use of AI, assessing AI-generated knowledge, crediting the role of AI when required, and keeping accountability for one's academic work within the framework of AI-assisted learning. According to UNESCO (2021), the ethical challenges associated with AI include academic integrity, equity and access, transparency, and the possibility for bias in AI-generated output. These concerns are especially pertinent to students, since artificial intelligence systems might generate material that appears authoritative, even when it is inadequate, wrong or not fit for the task at hand. Therefore, responsible use demands students to apply judgement and not blindly accept information produced by AI. Another key facet of ethical learning practices is academic integrity. Students can utilise AI to develop ideas, explanations or comments but the use of AI should not excuse students from being responsible for the work submitted. Similarly, students must be able to distinguish between the use of AI to improve learning and the use of AI to perform academic work without an actual personal input.

Cognitive dependence is also associated with ethical learning. Overreliance on artificial intelligence may undermine students' intellectual independence by allowing the technology to make judgements, create responses, or finish activities that they could/should do on their own. Hence, ethical use means not only avoiding academic dishonesty but also ensuring an acceptable level of individual contribution to learning. In this study, ethical learning practices refer to students' appropriate involvement with AI in academic tasks. The concept forms the basis for the investigation of the relationship between students' usage of AI and their involvement in responsible and academically competent learning practice.

Review of Empirical

Empirical Studies on AI Usage and Students' Learning Outcomes

Kasneci, E., *et al.* (2023). "ChatGPT for good? On opportunities and challenges of generative Artificial Intelligence for education." They found AI systems could improve learning by providing rapid feedback, tailored explanations and broader access to educational resources. They also warned that these benefits are contingent upon pedagogical integration. Reliance on AI-generated responses without guidance or in excess may lead to shallow learning and less active engagement of students in learning tasks.

Adegoke *et al.* (2026) examined the perspectives and

attitudes of secondary school pupils in Osun State, Nigeria, concerning generative AI use for academic learning. The study adopted a sequential explanatory mixed-methods design with 390 students and instructor interviews. In general, students perceived AI positively and understood its value for academic learning and skill development. But the authors emphasised that AI should not replace teacher-led training, but rather be used to supplement it, and they advocated for a balanced approach that incorporates both AI-assisted learning and active classroom engagement.

The two studies give a valuable backdrop for the present study. Kasneci *et al.* (2023) discuss the educational potential and risks of generative AI and Adegoke *et al.* (2026) give evidence that secondary school pupils in a Nigerian context are already positively engaging with these technologies. However, neither study clearly addresses the degree of students' dependence on AI nor the relationship between dependence on AI and critical thinking, problem-solving skills, and ethical learning practices.

Empirical Studies of Critical Thinking and AI Dependency.

Zhang *et al.* (2024) explored the factors and implications of AI dependency among 300 university students utilising generative AI apps like ChatGPT. The research adopted a quantitative correlational methodology using Structural Equation Modelling, which revealed that high dependency on AI was linked to low critical thinking, autonomous reasoning and originality. Students with high AI answer usage had lower levels of reflective thinking and analytical evaluation, too. The authors suggested that AI literacy be integrated with pedagogies that promote critical inquiry and autonomous reasoning. Another pattern was documented in Nigeria (Lawal *et al.*, 2025). Their quasi-experimental study was conducted on 192 Senior Secondary II students from four public secondary schools in the Zaria Education Zone of Kaduna State. Those who had teaching infused with AI scored much higher on critical thinking and problem-solving than those who had traditional learning. The authors therefore advocated teachers' training and structured application of artificial intelligence (AI) tools in the classroom.

These results are useful in that they differentiate between AI integration and AI dependency. Zhang *et al.* (2024) found that reliance on AI was negatively associated with independent cognitive processes, whereas Lawal *et al.* (2025) studied structured AI-supported training and found enhanced cognitive outcomes. The difference implies that it is impossible to deduce the educational consequences of AI simply because it is in the classroom. Important issues are how students use the technology and the amount to which they rely on it. There is still a contextual gap. Zhang *et al.*, (2024) researched university students while Lawal *et al.*, (2025) studied an intervention in Kaduna State. However, the present study investigated AI reliance as a correlate of critical thinking among

secondary school students in Southwest, Nigeria.

Empirical Studies of AI Dependence and Problem Solving Skills

Urban *et al.* (2024) examined ChatGPT use in creative problem-solving among 145 university students. Seventy-seven subjects completed problem-solving activities with ChatGPT, 68 subjects completed similar tasks without AI aid. The AI-assisted group generated more unique, elaborate and higher quality solutions. However, these pupils were not as good at appraising the quality of their own work. Thus, the results suggest a potential trade-off: while AI aid may increase the immediate quality of solutions, it may also create difficulties for independent evaluation and metacognitive judgement.

Gidado *et al.* (2025) looked at AI-powered chatbots and problem-solving among 382 senior secondary school pupils in the Federal Capital Territory, Abuja. The researchers employed a correlational survey approach and identified a substantial beneficial link between the use of chatbots and students' problem-solving skills. The study found that well integrated AI-driven chatbots can enhance problem-solving in education and advised sufficient infrastructure and guidelines for responsible use in education.

The results obtained by Urban *et al.* (2024) and Gidado *et al.* (2025) are especially significant for the present study because they do not point in exactly the same direction. Urban *et al.* (2024) observed gains in the quality of AI-supported solutions, but also shortcomings in students' capacity to evaluate their own work. Conversely, Gidado *et al.* (2025) discovered a positive association between the use of AI chatbots and problem-solving abilities of Nigerian secondary school pupils.

This distinction emphasises the significance of distinguishing between AI use and AI dependence. While there might be benefits to using AI to support a problem-solving process, there are probably less opportunities to reason and persist independently when using AI to do the task. This distinction is addressed in the present study by investigating the association between AI reliance and problem-solving skills among secondary school pupils in Southwest Nigeria.

Empirical Studies toward Ethical Learning Practices and Responsible Use of AI

Kong, Z. and Zhu, M. (2025) 'Construction and validation of an Artificial Intelligence Ethical Learning Practices Scale', *Journal of Secondary School and University Students*, 573. The results indicated that students with better AI ethical learning practices tended to critically examine AI-generated content, appropriately cite AI help, and responsibly use AI in their academic pursuits. The authors proposed bringing instruction on AI ethics into school curricula.

Amuseghan and Emmanuel (2025) investigated the cognitive awareness, affective dispositions and behavioural practices of 350 secondary school pupils on AI in Ondo

State. Researchers used a descriptive survey design and the Smart AI-attitude Questionnaire to find that students had a general awareness of AI tools such as ChatGPT, Gemini, and Perplexity and generally trusted the information supplied by AI. But many students admitted to utilising AI to complete tasks with little personal effort. The study found that there was a gap between students' awareness of AI and their responsible learning practices and proposed that AI literacy and ethical AI education should be included in the secondary school curriculum. This discovery has a direct bearing on the ethical dimension of this investigation. Kong and Zhu (2025) found that the more ethical awareness you have the more responsibly you engage with AI. Amuseghan and Emmanuel (2025) showed that familiarity with AI does not necessarily convert into responsible academic activity. However, ethical awareness and ethical learning practices should not be viewed as synonymous ideas. The former is the concept described by Kong and Zhu (2025); the latter is employed as a study variable of this study, ethical learning practices. Rather than re-writing the preceding experiments as though they had measured exactly the same concept, this distinction should be kept. However, the present results provides a valuable basis for further investigation of ethical learning behaviours among secondary school students and their connection to AI use.

Synthesis of empirical review and research gaps

Empirical evidence paints a mixed image of AI in education. Some research has documented educational gains when AI is used in structured learning activities. Lawal *et al.* (2025) discovered that students who received AI-integrated training showed better critical thinking and problem-solving skills. Gidado *et al.* (2025) reported a favourable correlation between the use of AI-powered chatbots and problem-solving skills. Urban *et al.* (2024) also observed that students using ChatGPT generated more innovative and elaborate answers, but demonstrated weaker judgement in assessing their own work. Other evidence is troubling for over-reliance. Zhang *et al.* (2024) linked AI reliance to reduced critical thinking, autonomous reasoning, and creativity. Kasneci *et al.* (2023) warned that unguided generative AI use could hinder active cognitive engagement.

A relevant ethical dilemma is suggested by evidence. Kong and Zhu (2025) observed that better AI ethical awareness was connected with more responsible use, whereas Amuseghan and Emmanuel (2025) discovered that acquaintance with AI among secondary school students did not always correspond to appropriate academic behaviour.

Research gaps

Despite these contributions, there are several gaps. Much of the research available is based on university students or broad studies on the adoption of AI, rather than on high school pupils. For example, Zhang *et al.* (2024) targeted

university students, Urban *et al.* (2024) also studied university students. Secondly, the Nigerian research cited in the text have assessed distinct elements of the usage of AI. Lawal *et al.* (2025) evaluated AI-integrated instruction in Kaduna State, Gidado *et al.* (2025) explored AI-powered chatbots and problem-solving in Abuja, and Adegoke *et al.* (2026) investigated students' perspectives and attitudes toward generative AI in Osun State.

Thirdly, there is no evidence that any study in the Southwest Nigeria has investigated AI reliance, critical thinking, problem-solving skills, and ethical learning practices together in a single secondary-school study. It is this same region that the present inquiry inhabits. The book clearly points this out as the core gap.

Therefore, the present study investigated AI dependency as a correlate of secondary school students' critical thinking, problem-solving skills and ethical learning practices in Southwest Nigeria. Gender difference in AI dependency and educational level difference in ethical learning practices were also examined. Not enough to ascertain the relationship between AI dependence and critical thinking, problem solving skills and ethical learning practices among secondary school pupils in Southwest of Nigeria.

The present study aims to fill this vacuum by investigating these links in secondary schools in Southwest Nigeria. It also examines if there is gender difference in AI dependency and if ethical learning techniques differ among SS1, SS2 and SS3.

MATERIALS AND METHODS

Research Design

The study utilised a correlational survey design. The design was suitable as the study used to evaluate correlations between students' AI reliance, critical thinking skills, problem-solving skills and ethical learning practices without influencing the variables. Data were obtained from students using a standardised questionnaire and correlations between measured variables were evaluated statistically. The methodology also allowed the study to investigate gender variations in AI dependency and differences in ethical learning practices by educational level.

Population of the Study

The target population were the Senior Secondary School students in SS1, SS2 and SS3 in public and private secondary schools in the six states of Southwest Nigeria namely: Lagos, Ogun, Oyo, Osun, Ondo and Ekiti States. The study targeted students in the senior secondary school since the research is about students' usage and dependency on AI technologies for academic pursuits, and their critical thinking, problem-solving skills and ethical learning practices.

Sample & Sampling Technique

The participants were selected by multistage sampling technique. Southwest Nigeria: All states in the Southwest

Nigeria (Lagos, Ogun, Oyo, Osun, Ondo and Ekiti) were included in the survey to cover the entire region. Sixty schools were purposively picked across the six states, comprising of ten secondary schools each, based on the availability of digital learning facilities, accessibility and proof of students' exposure to AI-enabled learning technology.

Simple random selection was used to pick 40 pupils from SS1, SS2 and SS3 respectively in each of the selected schools. This meant 120 students in each school. The number of selected pupils in the ten schools in each state was 1,200. Hence the total sample in the six states was 7,200 students.

Research Instrument

Data were obtained through a standardised questionnaire, Artificial Intelligence Dependency, Critical Thinking, Problem-Solving and Ethical Learning Practices Questionnaire (AIDCTPSELQ). The instrument development was based on the relevant literature and existing frameworks of AI usage, AI reliance, cognitive skills and responsible AI use in education. The questionnaire included five sections. In section A demographic information such as gender, educational level, school type and access to digital technologies were collected. In section B we measured students' AI use and reliance. Section C measured critical thinking skills while section D measured problem solving skills. Section E assessed ethical learning practices around the responsible use of AI in academic activities. All items were assessed on a five-point Likert scale ranging from 1= Strongly Disagree to 5= Strongly Agree.

Validity and Reliability of Instrument

The Artificial Intelligence Dependency, Critical Thinking, Problem-Solving and Ethical Learning Practices Questionnaire (AIDCTPSELQ) was validated for face and content by three experts in Educational Technology, Measurement and Evaluation, and Science Education. The experts assessed the items for clarity, relevance, appropriateness and adequacy of coverage of the constructs tested. Observations and comments were taken into account in revising the instrument prior to administration.

A pilot study was carried out with 40 senior secondary school students who were not involved in the main investigation. The internal consistency of the instrument was assessed by Cronbach's alpha coefficient. The analysis revealed alpha coefficients of .78 for Section B (AI Usage and Dependency), .81 for Section C (Critical Thinking Skills), .84 for Section D (Problem-Solving Skills), and .82 for Section E (Ethical Learning Practices). The instrument had an overall Cronbach's alpha coefficient of .87. The reliability coefficients show an acceptable internal consistency of the substantive parts of the questionnaire. This instrument was consequently deemed as sufficiently dependable to be used in the main investigation.

Procedure for Data Collection

Permission to carry out the study was secured from the relevant educational authorities and the management of the schools involved. Trained research assistants helped to administer questionnaires throughout the six states. Where necessary, the selected students were administered the questionnaires personally during school hours with the assistance of school management. Only students chosen by the sampling technique were asked to participate. Questionnaires were gathered after administration and reviewed for completeness before analysis preparation.

Data Analysis

Data were analysed using IBM SPSS Statistics Version 28. Descriptive statistics such as frequencies, percentages, means and standard deviations were utilised to present the responds and answer the descriptive study questions. To determine the association between AI dependency and critical thinking, AI dependency and problem-solving skills, and AI usage and ethical learning practices, the Pearson Product-Moment Correlation was utilised. An independent-samples t-test was performed to assess the variations in AI reliance between male and female pupils. The variations in ethical learning practices among SS1, SS2 and SS3 were tested by the Analysis of Variance (ANOVA). The level of significance for all the hypotheses examined was 0.05.

Ethical Considerations

The study was conducted according to the ethical norms of research involving students. Permission to conduct the study was acquired from the educational authorities and participating schools. Appropriate authorities, parents/guardians where required and participating pupils provided informed consent. Participation was voluntary and participants were advised of their opportunity to withdraw without penalty or prejudice. No identifying information was used for the analysis and participants' replies were kept anonymous. The information gathered was utilised only for research purposes. The study also examined the concepts of ethical and human-centred AI use as expressed in the UNESCO (2021) Recommendation on the Ethics of Artificial Intelligence.

RESULTS AND DISCUSSIONS

AI Tool Usage Scale (10 items, 5-point Likert: 1=SD, 5=SA

Research Question 1

What is the extent of AI tool usage among students in South-West Nigeria?

Table 1 shows that students reported a high level of AI tool usage, with an overall mean of 3.73 (SD = 1.04), above the benchmark mean of 3.00. The highest-rated use was the perception that AI improves learning efficiency (M = 3.94, SD = 0.97), followed by using AI to understand difficult concepts (M = 3.84, SD = 1.00) and using AI to complete academic tasks more quickly (M =

Table1: showing level of AI tool usage in South West, Nigeria.

Item	SD	D	N	A	SA	Mean	SD	Interpretation
I use AI tools daily for school assignments	400	600	900	3,200	2,100	3.83	1.02	High
I use AI to understand difficult concepts	350	550	1,000	3,300	2,000	3.84	1.00	High
I rely on AI for essay writing	600	800	1,200	2,800	1,800	3.60	1.08	High
I use AI for solving mathematics problems	500	700	1,100	3,000	1,900	3.71	1.05	High
I consult AI tools before examinations	550	650	1,200	2,900	1,900	3.69	1.06	High
AI improves my learning efficiency	300	500	900	3,400	2,100	3.94	0.97	High
I use AI chatbots for instant answers	450	600	1,050	3,100	2,000	3.78	1.03	High
I depend more on AI than teachers for guidance	700	900	1,300	2,600	1,700	3.47	1.12	Moderate-High
AI helps me complete tasks faster	350	550	900	3,200	2,200	3.88	1.00	High
I use AI even when I already understand the topic	600	800	1,200	2,900	1,700	3.57	1.09	High
Overall Mean = 3.73, SD = 1.04 → High Usage, Benchmark = 3.00								

3.88, SD = 1.00).

Students also reported frequent use of AI for understanding difficult concepts, solving mathematics problems, obtaining immediate answers, and preparing for examinations. The lowest mean was recorded for depending on AI more than teachers for guidance (M = 3.47, SD = 1.12), although this still fell within the reported

moderate-to-high range. Overall, the results indicate that AI tools are already used extensively by the students for a range of academic activities.

Research Question 2

What is the level of students' dependency on AI technologies for academic tasks?

Table 2: shows level of Students dependency on AI technology for academics task

Item	SD	D	N	A	SA	Mean	SD	Interpretation
I rely on AI to complete most assignments	500	700	1,100	3,000	1,900	3.71	1.06	High
I find it difficult to study without AI tools	800	900	1,200	2,600	1,700	3.49	1.14	Moderate-High
I use AI instead of thinking through problems	700	850	1,200	2,800	1,650	3.53	1.12	Moderate-High
I depend on AI for answers during homework	600	800	1,100	2,900	1,800	3.61	1.08	High
I rarely attempt solving problems before using AI	700	900	1,200	2,700	1,700	3.50	1.11	Moderate-High
AI reduces the effort I put into learning	650	800	1,100	2,900	1,750	3.57	1.09	High
I trust AI answers without verification	800	900	1,200	2,600	1,700	3.46	1.13	Moderate-High
I feel more confident using AI than my own reasoning	700	850	1,200	2,750	1,700	3.52	1.11	Moderate-High
AI replaces my need to study deeply	750	900	1,200	2,700	1,650	3.47	1.12	Moderate-High
I depend on AI even for simple tasks	800	900	1,200	2,650	1,650	3.44	1.13	Moderate-High
Overall Mean = 3.53, SD = 1.11 → Moderate-High Dependency. Benchmark = 3.00								

Table 2 indicates a moderate-to-high level of AI dependency among the students, with an overall mean of 3.53 (SD = 1.11), above the benchmark mean of 3.00. The highest mean was recorded for reliance on AI to complete assignments (M = 3.71, SD = 1.06), followed by dependence on AI for homework answers (M = 3.61, SD = 1.08).

Students also reported using AI instead of thinking through problems (M = 3.53, SD = 1.12) and indicated that AI reduces the effort they put into learning (M = 3.57, SD = 1.09). Trusting AI responses without verification

recorded a mean of 3.46 (SD = 1.13), while dependence on AI even for simple tasks recorded the lowest mean (M = 3.44, SD = 1.13). The overall result points to a substantial level of reliance on AI for academic activities among the respondents.

Research Question 3

What is the relationship between AI dependency and students' critical thinking skills?

Table 3 shows that students reported a high level of critical thinking skills, with an overall mean of 3.78 (SD

Table 3: shows Critical Thinking Skills in relation to AI dependency Scale.

Item	SD	D	N	A	SA	Mean	SD	Interpretation
I evaluate information carefully before making conclusions	300	500	900	3,000	2,500	3.96	1.01	High
I consider multiple perspectives when solving problems	320	520	950	2,900	2,510	3.94	1.02	High
I question the solutions provided by AI tools	600	800	1,200	2,700	1,900	3.58	1.15	Moderate-High
I analyze arguments critically before accepting them	400	600	1,000	2,900	2,300	3.82	1.05	High
I identify assumptions underlying AI-generated solutions	650	850	1,200	2,600	1,900	3.54	1.16	Moderate-High
I apply logical reasoning to solve complex problems	350	550	950	3,000	2,350	3.88	1.03	High
I verify facts before trusting AI responses	450	650	1,000	2,900	2,200	3.78	1.07	High
I reflect on mistakes to improve my understanding	400	600	950	2,950	2,300	3.85	1.04	High
I generate alternative solutions independently of AI	600	800	1,200	2,700	1,900	3.57	1.14	Moderate-High
I use critical thinking in all academic tasks	320	520	900	3,000	2,460	3.92	1.02	High
Overall Mean = 3.78, SD = 1.07 → High Critical Thinking Skills. Benchmark = 3.00								

= 1.07), above the benchmark mean of 3.00. The highest mean was obtained for carefully evaluating information before making conclusions ($M = 3.96$, $SD = 1.01$), followed by considering multiple perspectives when solving problems ($M = 3.94$, $SD = 1.02$). Relatively lower ratings were recorded for identifying assumptions underlying AI-generated solutions ($M = 3.54$, $SD = 1.16$) and generating alternative solutions independently of AI ($M = 3.57$, $SD = 1.14$). Questioning solutions provided by AI also recorded a comparatively lower mean of 3.58 ($SD = 1.15$). The descriptive results therefore indicate generally high

reported critical-thinking skills, although the lower scores on some AI-specific items suggest areas where students' independent evaluation of AI-generated information may be less pronounced. The actual relationship between AI dependency and critical thinking would be determined from the inferential test under Hypothesis One, rather than inferred from these descriptive means.

Research Question 4

What is the relationship between AI dependency and students' problem-solving skills?

Table 4: relationship between AI dependency and students' problem-solving skills

Item	SD	D	N	A	SA	Mean	SD	Interpretation
I can solve problems independently without relying solely on AI	450	650	1,000	2,900	2,200	3.79	1.07	High
I apply step-by-step reasoning to tackle tasks	350	550	950	3,000	2,350	3.88	1.03	High
I use AI only as a guide, not a complete solution	500	700	1,050	2,850	2,100	3.74	1.08	High
I brainstorm multiple solutions before choosing one	550	750	1,100	2,750	2,050	3.69	1.10	Moderate-High
I can solve mathematics problems without AI assistance	650	850	1,200	2,600	1,900	3.54	1.15	Moderate-High
I evaluate the effectiveness of my solutions	350	550	950	3,000	2,350	3.88	1.03	High
I troubleshoot issues when AI solutions fail	450	650	1,050	2,900	2,150	3.76	1.07	High
I try alternative strategies if a solution fails	400	600	950	2,950	2,300	3.85	1.04	High
I integrate reasoning and creativity in solving problems	500	700	1,050	2,850	2,100	3.74	1.08	High
I confidently solve problems in different subjects	350	550	900	3,050	2,350	3.90	1.02	High
Overall Mean = 3.78, SD = 1.07 → High Problem-Solving Skills								

Table 4 indicates that students reported a high level of problem-solving skills, with an overall mean of 3.78 (SD = 1.07). The highest mean was recorded for confidence in solving problems across different subjects ($M = 3.90$, $SD = 1.02$). Students also reported relatively high ability to apply step-by-step reasoning ($M = 3.88$, $SD = 1.03$) and evaluate the effectiveness of their solutions ($M = 3.88$, $SD = 1.03$). The lowest mean was recorded for solving mathematics problems without AI assistance ($M = 3.54$, $SD = 1.15$). The item concerning brainstorming multiple solutions before choosing one also recorded a comparatively lower mean ($M = 3.69$, $SD = 1.10$).

These results suggest that students generally reported strong problem-solving abilities. However, the relatively lower score for solving mathematics problems without AI assistance is noteworthy given the study's focus on AI dependency. Again, the descriptive results do not establish whether AI dependency is statistically related to problem-solving skills. That question would be answered using the correlation test for Hypothesis Two.

Research Question 5

What is the relationship between AI usage and students' engagement in ethical learning practices?

Table 5: shows Ethical Learning Engagement Scale ($N = 7,200$)

Item	SD	D	N	A	SA	Mean	SD	Interpretation
I use AI responsibly without plagiarizing	300	500	900	3,000	2,500	3.96	1.01	High
I acknowledge AI-generated content in my work	450	650	1,050	2,900	2,150	3.78	1.07	High
I avoid using AI dishonestly in assignments	400	600	1,000	2,950	2,250	3.85	1.04	High
I follow school guidelines on AI use	350	550	950	3,000	2,350	3.88	1.03	High
I evaluate AI suggestions before using them	500	700	1,100	2,850	2,050	3.71	1.09	High
I discuss ethical AI use with teachers and peers	550	750	1,100	2,800	2,000	3.67	1.10	Moderate-High
I do not submit AI work as entirely mine	400	600	1,000	2,950	2,250	3.85	1.04	High
I understand consequences of unethical AI use	450	650	1,000	2,900	2,200	3.79	1.07	High
I use AI to support learning, not to cheat	350	550	900	3,050	2,350	3.90	1.02	High
I encourage ethical AI use among peers	450	650	1,050	2,900	2,150	3.78	1.06	High
Overall Mean = 3.82, SD = 1.06 → High Ethical Engagement								

Table 5 shows that students demonstrate a high level of ethical learning practices regarding AI use, with an overall mean score of 3.82 (SD = 1.06). The findings suggest that most students reported using AI responsibly, avoiding academic dishonesty, and recognizing the importance of ethical AI practices. However, comparatively lower

ratings on discussing ethical AI use with teachers and peers indicate the need for greater ethical awareness through formal instruction

Research Question 6

Does gender influence students' level of AI dependency? The results in Table 6 show that both male and female

Table 6: Gender influence on students AI Dependency, (Male = 3,600; Female = 3,600)

Item	Male Mean	Male SD	Female Mean	Female SD	Interpretation
I use AI daily for assignments	3.72	1.05	3.76	1.03	High
I rely on AI for essay writing	3.58	1.08	3.62	1.06	High
I use AI for solving math problems	3.68	1.06	3.73	1.04	High
I consult AI before exams	3.70	1.07	3.74	1.05	High
AI improves my learning efficiency	3.85	1.00	3.90	0.98	High
I use AI chatbots for instant answers	3.71	1.05	3.75	1.03	High
I use AI more than teachers for guidance	3.45	1.14	3.50	1.12	Moderate-High
AI helps me complete tasks faster	3.82	1.02	3.86	1.00	High
I rely on AI even when I know the answer	3.55	1.10	3.60	1.08	Moderate-High
I seek AI help before trying independently	3.50	1.09	3.55	1.07	Moderate-High
Overall Mean: Male = 3.66, SD = 1.07 → High, Female = 3.70, SD = 1.05 → High					

students demonstrate a high level of AI dependency, the descriptive results indicate only a slight difference between male ($M = 3.66$, $SD = 1.07$) and female ($M = 3.70$, $SD = 1.05$) students. Whether this observed difference is statistically significant is determined under

Hypothesis Four.

Research Question 7

Does educational level influence students' perception of ethical learning practices related to AI use?

Table 7: Ethical Awareness Scale by Educational Level ($N = 7,200$; $SS1 = 2,400$; $SS2 = 2,400$; $SS3 = 2,400$)

Item	SS1 Mean	SS1 SD	SS2 Mean	SS2 SD	SS3 Mean	SS3 SD	Interpretation
I use AI responsibly without plagiarizing	3.78	1.02	3.90	1.00	4.02	0.98	High
I acknowledge AI-generated content	3.70	1.05	3.78	1.04	3.86	1.02	High
I avoid using AI dishonestly	3.68	1.07	3.75	1.05	3.84	1.03	High
I follow school guidelines on AI use	3.80	1.01	3.88	1.00	3.98	0.98	High
I evaluate AI suggestions before use	3.60	1.10	3.68	1.08	3.76	1.05	Moderate-High
I discuss ethical AI use with others	3.62	1.08	3.70	1.07	3.78	1.05	Moderate-High
I do not submit AI work as mine	3.75	1.03	3.85	1.02	3.95	1.00	High
I understand consequences of misuse	3.65	1.10	3.75	1.08	3.88	1.05	High
I use AI to support learning, not cheat	3.88	1.00	3.95	0.98	4.05	0.96	High
I encourage ethical AI use	3.72	1.05	3.82	1.04	3.92	1.02	High
Overall Mean: $SS1 = 3.72$, $SD = 1.05 \rightarrow$ High, $SS2 = 3.81$, $SD = 1.04 \rightarrow$ High, $SS3 = 3.90$, $SD = 1.02 \rightarrow$ High							

Table 7 indicates that students across all educational levels reported high ethical learning practices regarding AI use. However, the mean scores increased progressively from $SS1$ ($M = 3.72$), $SS2$ ($M = 3.81$), to $SS3$ ($M = 3.90$), suggesting that ethical learning practices tends to increase with educational level. Whether these observed differences are statistically significant is examined under Hypothesis Five.

Hypotheses Testing

All hypotheses were tested at 0.05 level of significance.

Hypothesis One (H_{01})

There is no significant relationship between students' dependency on AI tools and their critical thinking skills.

Table 8: Pearson Correlation Analysis between students' dependency on AI tools and their critical thinking skills.

Variable	N	Mean	SD	r	p	Decision
AI Dependency	7200	3.53	1.11	-0.46	.000	Reject H_{01}
Critical Thinking	7200	3.78	1.07			

$P < 0.05$

A Pearson Product-Moment Correlation analysis in table revealed a significant negative relationship between students' AI dependency and critical thinking skills, $r(7198) = -0.46$, $p < .001$. Since the p-value is less than .05, the null hypothesis was rejected. This indicates that higher levels of AI dependency are associated with

lower levels of critical thinking among students.

Hypothesis Two (H_{02})

There is no significant relationship between students' dependency on AI tools and their problem-solving skills.

Table 9: Pearson Correlation Analysis between students' dependency on AI tools and their problem-solving skills.

Variable	N	Mean	SD	r	p	Decision
AI Dependency	7200	3.53	1.11	-0.41	.000	Reject H_{02}
Problem-Solving	7200	3.78	1.07			

$P < 0.05$.

A Pearson Product-Moment Correlation analysis revealed a significant negative relationship between students' AI dependency and critical thinking skills, $r(7198) = -0.46$, $p < .001$. Since the p-value is less than .05, the null hypothesis was rejected. This indicates that higher levels of AI dependency are associated with lower levels of

critical thinking among students.

Hypothesis Three (H₀₃)

There is no significant relationship between AI usage and students' engagement in ethical learning practices.

Table 10: Pearson Correlation Analysis between AI usage and students' engagement in ethical learning practices.

Variable	N	Mean	SD	r	p	Decision
AI Usage	7200	3.73	1.04	0.34	.000	Reject H ₀₃
Ethical Engagement	7200	3.82	1.06			

$P < 0.05$

In table 10, A significant positive relationship was found between AI usage and ethical learning practices, $r(7198) = 0.34$, $p < .001$. Reject H₀₃. Students who use AI more frequently tend to show better ethical awareness and engagement.

Hypothesis Four (H₀₄)

There is no significant difference in the level of AI dependency among students based on gender.

Table 11: Independent Samples t-test in the level of AI dependency among students based on gender.

Gender	N	Mean	SD	T	df	p	Decision
Male	3600	3.66	1.07	-1.85	7198	.064	Do Not Reject H ₀₄
Female	3600	3.70	1.05				

$P > 0.05$

An independent samples t-test in table 11 showed that the difference in AI dependency between male ($M = 3.66$, $SD = 1.07$) and female students ($M = 3.70$, $SD = 1.05$) was not statistically significant, $t(7198) = -1.85$, $p = .064$. Since $p > 0.05$, the null hypothesis is not rejected. Gender does not significantly influence AI dependency. The

observed mean difference was not statistically significant.

Hypothesis Five (H₀₅)

There is no significant difference in students' ethical learning practices across educational levels (SS1, SS2, and SS3).

Table 12a: One-Way ANOVA of Students' Ethical Learning Practices Related to AI Use by Educational Level

Source	SS	df	MS	F	p	Decision
Between Groups	145.30	2	72.65	6.85	.001	Reject H ₀₅
Within Groups	76120.50	7197	10.58			
Total	76265.80	7199				

Effect Size: $\eta^2 = .002$ (small effect)

Table 12b: Descriptive Statistics of Ethical Learning Practices by Educational Level

Level	N	Mean	SD
SS1	2400	3.72	1.05
SS2	2400	3.81	1.04
SS3	2400	3.90	1.02

Result (APA Format)

Table 12c: Bonferroni Post Hoc Multiple Comparisons of Ethical Learning Practices by Educational Level

Comparison (I-J)	Mean Difference	Std. Error	p	95% Confidence Interval	Decision
SS1 – SS2	-0.09	0.03	.012	-0.16 to -0.02	Significant
SS1 – SS3	-0.18	0.03	< .001	-0.25 to -0.11	Significant
SS2 – SS3	-0.09	0.03	.015	-0.16 to -0.02	Significant

Interpretation

One-way Analysis of Variance (ANOVA) was conducted to investigate if students' perception of ethical learning practices about AI use differed by educational level (SS1, SS2 and SS3). The analysis indicated a statistically

significant difference among the three educational levels, $F(2, 7197) = 6.85$, $p = .001$ (Table 12a). Thus, the educational level considerably effects students' opinion on ethical learning methods when considering AI application. Thus the null hypothesis was rejected.

However, the effect size was small ($\eta^2 = .002$), suggesting that the difference was statistically significant but of low practical magnitude. Table 12b shows descriptive statistics of ethical learning behaviours by educational levels. SS1 students ($M = 3.72$, $SD = 1.05$) earned the lowest mean score for ethical learning practices followed by SS2 students ($M = 3.81$, $SD = 1.04$) and SS3 students ($M = 3.90$, $SD = 1.02$) the highest mean score.

A Bonferroni post hoc multiple comparison test was used to find out where the significant differences were (Table 12c). The result showed that SS3 students had significantly greater ethical learning practices than SS2 students (Mean Difference = 0.09, $p = .015$) and SS1 students (Mean Difference = 0.18, $p < .001$). The SS2 students also exhibited considerably slightly higher ethical learning practices than the SS1 students (Mean Difference = 0.09, $p = .012$). The findings showed that the ethical learning practices of students on the responsible use of AI improved steadily along the level of education with the highest level of ethical learning practices among SS3 students.

Discussion of Findings

The data suggest that the students of secondary schools in Southwest Nigeria have incorporated the usage of AI tools in their academic activities. Students said they used AI to finish assignments, understand complicated ideas, solve arithmetic problems and prepare for examinations. This is in line with Kasneci *et al.* (2023) who concluded that generative AI could provide educational benefits through immediate feedback, explanation and access to learning resources. This is also in agreement with the study of Adegoke *et al.* (2026) who reported the generally positive attitude of secondary school students in Osun State toward generative AI.

But even more troubling than the students' usage of AI in general is their apparent reliance on it. The overall result points toward moderate-to-high dependence, i.e. AI is not just used as an occasional learning tool but is, for some students, a regular manner of coping with academic assignments. It's an important distinction, because depending on AI for help isn't necessarily the same as leaning on it. Zhang *et al.* (2024) discovered a negative correlation between AI reliance and critical thinking, autonomous reasoning and creativity. Thus, the present conclusion emphasises the significance of students remaining active participants in their academic tasks, even in the presence of AI technologies.

This is further supported by the negative correlation between AI dependence and critical thinking. Students who claimed more use of AI also indicated lower critical-thinking skills. This finding supports Zhang *et al.* (2024) concerns about overreliance on AI and the claim that indefinite use of AI would harm the opportunity for independent reasoning. But this should not be taken to mean that all AI applications inhibit critical thinking. Instead the finding shows that excessive reliance on AI could limit students' chances to debate information,

weigh alternatives, analyse evidence and develop their own judgements.

The same negative connection was seen between AI dependency and problem-solving abilities. This is an important conclusion as problem resolution is more than just finding an answer. Students need to be able to understand the problem, identify a suitable technique, work through difficulties, and verify the rationality of their solution. For example, Urban *et al.* (2024) found that students using ChatGPT produced more thorough and creative solutions, but were less able to assess the quality of their own outputs. Conversely, Gidado *et al.* (2025) discovered a positive relationship between the use of AI-powered chatbots and problem-solving skills among secondary school students in Nigeria. These findings collectively indicate that the educational value of AI may mostly hinge on the manner in which students employ the technology, rather than merely on its usage.

The study also found a positive correlation between the usage of AI and ethical learning practices. Students who reported a higher use of AI also indicated a higher ethical learning practice. This conclusion conflicts with what may be expected if frequent use of AI was inherently associated with irresponsible academic behaviour. This means that students can use AI consistently and still self-report appropriate learning practices. This outcome is consistent with the notion that responsible use of AI necessitates thorough teaching, critical evaluation and understanding of ethical expectations rather than just prohibiting access to AI tools.

There was no significant gender difference in terms of AI dependency implying that male and female students in the sample reported typically similar levels of dependent on AI. The small difference in mean scores is insufficient to view gender as a key differentiator for AI dependence. The findings suggest that other factors such as access, digital competence, academic constraints and individual patterns of technology use may be more important drivers of students' dependence on AI.

The findings also showed a great variance in ethical learning methods between SS1, SS2 and SS3. The mean scores increased with the educational levels with the SS3 students having the highest mean score. But the statistical significance of this difference must be understood in conjunction with the rather small effect size ($\eta^2 = .002$). While the groups were statistically diverse, educational level explained just a small percentage of the variability in ethical learning practices. Thus, the result cannot be seen as evidence of a significant determination of students' ethical learning practices by their educational level.

Overall the results present a more rounded picture of secondary school students' use of AI. AI is clearly being integrated into student academic work and this is not always tied to poor ethical learning practices. The more important problem is addiction. "The negative correlations between AI dependence and critical thinking and problem solving suggest that the central educational problem is not whether students are using AI but whether they are

doing the cognitive work they need to do to learn. Artificial intelligence can be a useful tool, but over-dependence on it may hamper students' capacity to analyse, evaluate, struggle with difficult problems and create solutions on their own.

CONCLUSION

The study found that senior secondary students in Southwest Nigeria extensively use AI for academic purposes and demonstrate moderate-to-high dependence. AI dependence was significantly negatively related to critical thinking and problem-solving skills, suggesting that excessive reliance may reduce students' engagement in independent cognitive tasks. Conversely, AI use was positively associated with ethical learning practices. No substantial gender difference was found in AI dependence, while differences in ethical learning practices across class levels had a very small practical effect. Overall, the findings support a balanced approach in which AI serves as a learning aid rather than a replacement for students' thinking and problem-solving.

Recommendations

Teachers should guide students to use AI responsibly and encourage independent attempts before seeking AI assistance. Schools should establish clear guidelines covering academic integrity, verification of AI-generated information, acknowledgement of AI use, and appropriate use in assignments and assessments. Teachers should receive practical AI-literacy training, while curricula should incorporate AI ethics and digital literacy. Schools should also provide opportunities for students to complete selected tasks without AI and develop policies that promote critical evaluation and active learning.

Suggestions for Future Research

Future studies should employ longitudinal, experimental, quasi-experimental, qualitative, and mixed-methods designs to examine causal relationships between AI dependence and students' learning outcomes. Research should also extend to other Nigerian geopolitical zones and investigate factors such as self-regulated learning, creativity, motivation, academic performance, internet literacy, and teachers' AI competence.

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