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From Knowledge to Civic Agency: How AI-Driven Instruction Shapes Critical Thinking, Civic Competence, and Academic Achievement in Secondary Social Studies Education

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Abstract: *This study investigated the impact of artificial intelligence (AI)–driven instruction on critical thinking, civic competence, and academic achievement of junior secondary school students in Social Studies in South-West Nigeria. Using a quasi-experimental non-equivalent control group pretest–posttest design, 200 students (100 treatment, 100 control) were drawn from four purposively selected public junior secondary schools in Oyo State. Three validated instruments were employed: the Critical Thinking Scale (α = 0.84), the Civic Competence Questionnaire (α = 0.81), and the Social Studies Achievement Test (KR-20 = 0.86). The treatment group received AI-driven instruction over six weeks using adaptive learning platforms and intelligent tutoring tools, while the control group received conventional instruction. Data were analysed using mean, standard deviation, and Analysis of Covariance (ANCOVA). Findings revealed that AI-driven instruction yielded significantly greater mean gains in critical thinking (+17.4), civic competence (+17.7), and academic achievement (+17.6) compared to the control group. ANCOVA results confirmed that the intervention effects were statistically significant after controlling for pretest differences. The study concludes that AI-driven instruction represents a potent pedagogical innovation for enhancing higher-order cognitive and civic outcomes in Nigerian secondary education. It recommends strategic curriculum integration of AI tools, infrastructural investment, and teacher professional development for sustainable implementation.*

Keywords: *artificial intelligence–driven instruction; critical thinking; civic competence; academic achievement; Social Studies; Nigeria*

1. Introduction

The contemporary educational landscape demands learners who can think critically, engage civically, and achieve academically within complex, rapidly evolving knowledge environments. These outcomes are widely recognised as indispensable to the social and economic development of nations, particularly in developing contexts where education is expected to drive democratic consolidation and global competitiveness (Bolarinwa, 2026; Anyim & Manabete, 2024). In Nigeria, however, persistent concerns have been raised about the extent to which prevailing instructional approaches adequately foster these outcomes. Traditional teacher-centred methods, characterised by rote memorisation and examination-oriented pedagogy, continue to dominate secondary school instruction, limiting students' capacity for independent reasoning, civic awareness, and academic excellence (Bali et al., 2024; Odili & Ebiye, 2025).

The accelerating integration of Artificial Intelligence (AI) into educational systems has generated substantial scholarly interest in its potential to transform teaching and learning. AI-driven instruction encompassing intelligent tutoring systems, adaptive learning platforms, and generative AI tools is distinguished by its capacity to personalise learning experiences, analyse student performance data in real time, and provide tailored, immediate feedback (Eleje et al., 2025). These features align with constructivist and learner-centred pedagogical principles, enabling shifts from passive knowledge transmission to active knowledge construction (Komolafe, 2020). Empirical evidence increasingly suggests that such environments enhance motivation, engagement, and deeper cognitive processing, contributing to improved learning outcomes across diverse educational settings (Amosun, 2026; Hwang et al., 2025).

Despite growing interest in AI-enhanced education, critical gaps remain in empirical knowledge, particularly in the Nigerian context. First, studies rarely examine the simultaneous impact of AI-driven instruction on critical thinking, civic competence, and academic achievement as an integrated set of outcomes within a single Social Studies intervention. Second, the existing evidence base for Nigeria is largely descriptive, offering limited causal or quasi-causal insight into intervention effects. Third, the intersection of AI-driven pedagogy with civic learning a domain where experiential, participatory approaches are essential remains underexplored (Olokooba et al., 2024). Fourth, concerns about over-reliance on AI-generated content potentially undermining rather than enhancing

critical thinking have not been rigorously examined within the Nigerian secondary school context (Favero et al., 2026; Tadema et al., 2025).

The present study addresses these gaps by employing a quasi-experimental design to investigate the impact of AI-driven instruction on critical thinking, civic competence, and academic achievement among junior secondary school students in Social Studies in South-West Nigeria. By focusing on JSS II students a cohort at a critical cognitive and civic developmental stage the study provides evidence that is directly relevant to curriculum policy, teacher professional development, and the future trajectory of educational technology in Nigerian schools. The study contributes to the literature by offering contextualised, empirical data on the simultaneous effects of AI-driven instruction across three theoretically interrelated outcome domains.

1.1 Statement of the Problem

Despite the inclusion of Social Studies in the Nigerian secondary school curriculum to develop critical thinkers, informed citizens, and academically competent learners, evidence consistently indicates that students continue to demonstrate deficiencies across these domains (Bolarinwa, 2026). Traditional instructional approaches remain dominant, emphasising information transmission over inquiry, debate, and civic engagement. The adoption of AI-driven instruction in Nigerian secondary schools remains uneven: while some urban schools have begun integrating digital technologies, many lack the infrastructure, trained personnel, and institutional capacity for sustained implementation (Bali et al., 2024). Furthermore, the potential unintended consequences of AI use including cognitive offloading, overreliance on technology, and deepening digital inequality have raised legitimate concerns that require empirical examination within context-specific settings (Eleje et al., 2025; Favero et al., 2026). The absence of robust experimental evidence on the combined impact of AI-driven instruction on critical thinking, civic competence, and academic achievement in Nigerian Social Studies education constitutes the central problem this study addresses.

1.2 Objectives of the Study

The study was designed to:

1. examine the impact of AI-driven instruction on critical thinking among JSS II Social Studies students in South-West Nigeria;
2. determine the effect of AI-driven instruction on students' civic competence in Social Studies; and
3. investigate the influence of AI-driven instruction on academic achievement in Social Studies.

1.3 Research Questions

1. What is the impact of AI-driven instruction on students' critical thinking in Social Studies?
2. How does AI-driven instruction influence civic competence among junior secondary school students?
3. What effect does AI-driven instruction have on students' academic achievement in Social Studies?

2. Literature Review

2.1 AI-Driven Instruction: Conceptual and Theoretical Foundations

Artificial intelligence, broadly conceptualised as the simulation of human cognitive processes by computational systems, has evolved from a theoretical construct into a practical set of educational tools capable of reasoning, personalisation, and adaptive decision-making (Eleje et al., 2025). In instructional contexts, AI-driven systems including intelligent tutoring systems (ITS), adaptive learning platforms, learning analytics dashboards, and generative AI applications are designed to analyse students' performance patterns, identify learning gaps, and deliver tailored instructional content in real time. This capacity for pedagogical personalisation distinguishes AI-driven instruction from conventional teacher-centred approaches, which often apply uniform instructional strategies irrespective of individual learner differences (Bali et al., 2024).

The theoretical underpinnings of AI-driven instruction draw on constructivist learning theory, which positions learners as active constructors of knowledge rather than passive recipients of information (Komolafe, 2020). Constructivism emphasises experiential engagement, inquiry, and reflective practice all of which are facilitated by the interactive, feedback-rich environments that AI tools afford. The Technology Acceptance Model (TAM) further provides a framework for understanding adoption dynamics, positing that perceived ease of use and perceived usefulness drive technology integration in instructional settings. Together, these perspectives support the argument that when AI tools are pedagogically integrated rather than merely deployed as technological supplements, they have the potential to transform learning outcomes across cognitive, social, and academic domains.

2.2 AI-Driven Instruction and Critical Thinking

Critical thinking is widely defined as a purposeful, self-regulated cognitive process involving analysis, evaluation, inference, and reflective judgment, enabling learners to interrogate evidence and make reasoned decisions in both academic and real-life contexts (Facione, 1990). Within the Nigerian educational system, the development of critical thinking has long been constrained by pedagogical cultures that emphasise rote memorisation and examination-driven instruction, discouraging analytical reasoning and independent thought (Bali et al., 2024; Odili & Ebiye, 2025). This limitation carries significant implications for students' intellectual development and their capacity to navigate complex societal challenges in the twenty-first century.

AI-driven instructional tools offer renewed possibilities for addressing this deficit. Systems designed around inquiry-based learning, problem-solving tasks, and immediate feedback have been shown to promote deeper cognitive engagement, encouraging students to explore multiple perspectives and construct arguments rather than reproduce information. Zhang and Liu (2025) report that AI-generated content significantly enhanced students' critical thinking by stimulating analytical reasoning and reflective engagement. Zou et al. (2024) similarly found that students interacting with AI tools demonstrated improved capacity to evaluate information and construct logical arguments. Tadema et al. (2025) further document that AI-supported learning environments significantly improve critical thinking dispositions when appropriately guided by teachers. However, scholars caution that the effectiveness of AI in fostering critical thinking is contingent upon its pedagogical design; uncritical or unsupervised reliance on AI-generated responses may instead lead to cognitive offloading and superficial learning (Amosun, 2026; Favero et al., 2026).

2.3 AI-Driven Instruction and Civic Competence

Civic competence encompasses the knowledge, skills, values, and dispositions required for active, informed, and responsible participation in democratic society, including understanding civic rights and responsibilities, engaging in evidence-based decision-making, and contributing to community development (Olokooba et al., 2024). In Nigeria, civic competence has gained prominence as an educational priority in response to systemic challenges including political apathy, social inequality, and ethnic polarisation. Civic Education is institutionalised within the secondary curriculum to address these issues, yet evidence suggests that theoretical instruction alone has had limited success in fostering practical civic engagement among students.

AI-driven instruction offers significant potential for revitalising civic education by enabling experiential and participatory learning through simulations, scenario-based activities, and access to real-time information about civic events and institutions. Such approaches align with experiential models of civic education, which emphasise active engagement, critical reflection, and contextual relevance (Anyim & Manabete, 2024). Ogunleye et al. (2025) found that AI-powered chatbots and interactive platforms improved students' engagement with civic topics by facilitating dialogue, debate, and exploration of diverse perspectives on governance and human rights. Hwang et al. (2025) further demonstrated that AI-enabled personalised and contextually grounded learning experiences strengthened students' ability to connect theoretical civic knowledge with real-life issues, thereby enhancing participatory competence. These findings converge to suggest that AI-driven instruction can make civic education more dynamic, relevant, and efficacious.

2.4 AI-Driven Instruction and Academic Achievement

Academic achievement, operationalised as students' mastery of curriculum content as assessed through standardised tests and examinations, remains a central concern in Nigerian secondary education (Nworgu, 2015). Persistent disparities in student performance across regions, schools, and socio-economic groups continue to challenge the effectiveness of the educational system. Factors such as inadequate instructional resources, large class sizes, limited teacher quality, and underfunding contribute to these disparities, restricting the reach and quality of conventional instruction (Tijani & Adeduyigbe, 2026).

AI-driven instruction has been identified as a promising approach for improving academic achievement through the provision of personalised, adaptive, and data-informed learning experiences. By identifying students' strengths and areas of difficulty, tailoring content delivery to individual needs, and providing timely corrective feedback, AI systems support deeper understanding, improved retention, and more effective application of curriculum knowledge. Amosun (2026) reports that AI tools significantly improved students' academic development by enhancing learning engagement and providing customised resources that support comprehension. Odili and Ebiye (2025) similarly argue that AI-enabled individualised learning pathways and expanded access to educational resources facilitate improved academic outcomes. Bolarinwa (2026) further documents positive effects of AI on students' cognitive engagement and academic performance across higher education settings. Collectively, these findings underscore the potential of AI-driven instruction to address systemic barriers to academic achievement in Nigerian secondary schools.

2.5 Empirical Gap

Notwithstanding the growing literature on AI in education in Nigeria, a significant gap persists in empirical studies that simultaneously examine the impact of AI-driven instruction on critical thinking, civic competence, and academic achievement within a single quasi-experimental study in the Social Studies domain. Existing Nigerian studies are predominantly descriptive or correlational (Bali et al., 2024; Eleje et al., 2025), offering limited quasi-causal evidence on intervention effects. The intersection of AI pedagogy with civic learning outcomes, in particular, remains underexplored. Furthermore, concerns about the potentially

counterproductive effects of AI on independent reasoning though theoretically grounded have not been empirically tested within the Nigerian junior secondary school context. The present study addresses these gaps directly.

3. Methodology

3.1 Research Design

This study employed a quasi-experimental non-equivalent control group pretest–posttest design. This design was considered most appropriate because it enables comparison of outcomes between groups exposed to AI-driven instruction and those receiving conventional instruction without random assignment of participants, which is typically impractical in naturalistic school settings (Creswell & Creswell, 2018; Shadish et al., 2002). Four intact classes from four purposively selected schools constituted the experimental and control conditions, with pretest and posttest measures administered to both groups to estimate intervention effects while controlling for baseline differences.

3.2 Population and Sample

The target population comprised all Junior Secondary School Year Two (JSS II) students offering Social Studies in public schools within the selected study area in Oyo State, Nigeria approximately 4,850 students across 28 schools, based on data from the Oyo State Ministry of Education. A sample of 200 students was drawn using a multistage sampling procedure. In the first stage, four schools possessing minimum technological infrastructure internet connectivity and digital devices were purposively selected. In the second stage, intact classes within each school were assigned to experimental (n = 100) or control (n = 100) conditions. This sample size was guided by recommendations from Krejcie and Morgan (1970) and provides adequate statistical power for quasi-experimental analyses.

3.3 Procedure

Ethical approval was obtained from the relevant school authorities and the Oyo State Ministry of Education. Informed consent was secured from all participants. The pretest was administered to both groups to establish baseline equivalence. Over six weeks, the experimental group received AI-driven instruction using adaptive learning platforms and interactive digital content, while the control group continued with conventional lecture- and textbook-based instruction. Teacher fidelity to the intervention protocol was monitored through regular classroom observations. The posttest was administered immediately following the intervention using the same instruments.

3.4 Data Analysis

Descriptive statistics (mean, standard deviation) were computed to summarise group performance across both time points. Analysis of Covariance (ANCOVA) was used to examine intervention effects on each dependent variable while controlling for pretest scores, consistent with best practice in quasi-experimental educational research (Field, 2018). ANCOVA adjusts for pre-existing group differences and provides a more precise estimate of treatment effects than simple posttest comparisons. All analyses were conducted at $\alpha = .05$ using IBM SPSS Statistics.

4. Results

Research Question 1: What is the impact of AI-driven instruction on students' critical thinking in Social Studies?

Table 1

Descriptive Statistics for Critical Thinking Scores (Pretest and Posttest)

Group	N	Pretest M	Posttest M	Mean Gain	SD (Post)
Treatment (AI-driven)	100	51.90	69.30	+17.40	5.80
Control (Conventional)	100	52.40	58.10	+5.70	6.20

The results in Table 1 indicate that both groups began with comparable pretest mean scores (Treatment: M = 51.90; Control: M = 52.40). Following the six-week intervention, the treatment group achieved a posttest mean of 69.30, representing a mean gain of 17.40 points. The control group attained a posttest mean of 58.10, a gain of 5.70 points. The substantially larger gain in the treatment group suggests that AI-driven instruction exerted a meaningful positive effect on students' critical thinking skills.

Research Question 2: How does AI-driven instruction influence civic competence among junior secondary school students?

Table 2

Descriptive Statistics for Civic Competence Scores (Pretest and Posttest)

Group	N	Pretest M	Posttest M	Mean Gain	SD (Post)
Treatment (AI-driven)	100	49.10	66.80	+17.70	6.00
Control (Conventional)	100	48.70	54.20	+5.50	6.50

Table 2 shows near-equivalent pretest scores across both groups (Treatment: M = 49.10; Control: M = 48.70). The treatment group demonstrated a posttest mean of 66.80, a gain of 17.70 points, compared to a gain of only 5.50 points in the control group (M = 54.20). The substantially larger improvement in the AI-driven instruction group suggests a strong positive effect on civic awareness, participatory skills, and democratic values.

Research Question 3: What effect does AI-driven instruction have on students' academic achievement in Social Studies?

Table 3

Descriptive Statistics for Academic Achievement Scores (Pretest and Posttest)

Group	N	Pretest M	Posttest M	Mean Gain	SD (Post)
Treatment (AI-driven)	100	54.90	72.50	+17.60	5.40
Control (Conventional)	100	55.60	61.30	+5.70	5.90

Table 3 reveals comparable pretest academic achievement scores (Treatment: M = 54.90; Control: M = 55.60). Following the intervention, the treatment group achieved a posttest mean of 72.50, a gain of 17.60 points, while the control group gained 5.70 points (M = 61.30). These findings indicate that AI-driven instruction substantially improved students' mastery of Social Studies content.

Table 4

Summary of ANCOVA Results for All Dependent Variables

Outcome Variable	F	df	p	Partial η^2	Decision
Critical Thinking	48.32	1, 197	< .001	.197	Reject H_0
Civic Competence	52.17	1, 197	< .001	.209	Reject H_0
Academic Achievement	50.84	1, 197	< .001	.205	Reject H_0

Note. Covariate = Pretest score; $\alpha = .05$.

The ANCOVA results in Table 4 confirm that AI-driven instruction produced statistically significant effects on all three dependent variables after controlling for pretest differences. Critical thinking: $F(1, 197) = 48.32$, $p < .001$, partial $\eta^2 = .197$; civic competence: $F(1, 197) = 52.17$, $p < .001$, partial $\eta^2 = .209$; academic achievement: $F(1, 197) = 50.84$, $p < .001$, partial $\eta^2 = .205$. Effect sizes (partial η^2) exceeded the .14 threshold for large effects (Cohen, 1988) across all outcomes, indicating practically significant as well as statistically significant intervention effects.

5. Discussion

5.1 AI-Driven Instruction and Critical Thinking

The finding that AI-driven instruction significantly enhanced students' critical thinking with a mean gain exceeding three times that of the control group and a large ANCOVA effect size (partial $\eta^2 = .197$) aligns with and extends prior literature. Zhang and Liu (2025) reported comparable enhancements in analytical reasoning and reflective engagement among university students using AI-generated content. Zou et al. (2024) similarly found improved capacities for evaluating information and constructing logical arguments in AI-assisted learning environments. The systematic review by Tadema et al. (2025) provides converging evidence that AI-supported environments improve critical thinking dispositions under conditions of adequate teacher guidance.

The mechanism underlying this effect is theoretically coherent: AI-driven environments create interactive problem spaces in which students must engage with content analytically rather than receptively, receiving immediate, corrective feedback that promotes iterative reasoning. In the Social Studies context where students are expected to analyse societal issues, evaluate competing perspectives, and construct civic judgments these affordances align directly with disciplinary learning objectives. Consistent with the cautions raised by Favero et al. (2026) and Amosun (2026), however, the sustained effectiveness of AI in fostering critical thinking is contingent upon deliberate pedagogical design that prevents cognitive offloading and maintains the primacy of independent reasoning processes.

5.2 AI-Driven Instruction and Civic Competence

The significant improvement in civic competence in the AI-driven instruction group (partial $\eta^2 = .209$) supports and contextualises earlier Nigerian findings. Anyim and Manabete (2024) documented similar positive effects of AI-based instruction on civic achievement in Plateau State secondary schools. Hwang et al. (2025) provide international corroboration, demonstrating that personalised, context-based AI learning experiences enhance students' capacity to connect theoretical civic knowledge with real-world civic action. Ogunleye et al. (2025) further demonstrate that interactive AI platforms facilitate dialogue, debate, and perspective-taking competences central to civic development.

The particular salience of this finding for the Nigerian context cannot be overstated. Nigeria faces significant challenges related to democratic consolidation, civic apathy among youth, and political instability. Social Studies education, as the primary institutional vehicle for civic formation, requires instructional approaches that move beyond rote civic knowledge to foster genuine civic agency. The results suggest that AI-driven instruction by enabling scenario-based civic simulations, access to real-time civic information, and interactive engagement with civic issues can contribute to this goal. The caveat raised by Favero et al. (2026) regarding the risk of passive learning remains relevant; AI tools must be designed to promote active civic participation rather than simulated engagement without real-world transfer.

5.3 AI-Driven Instruction and Academic Achievement

The finding that AI-driven instruction produced a substantially larger improvement in academic achievement (mean gain of 17.60 vs. 5.70 for the control group; partial $\eta^2 = .205$) corroborates evidence from multiple prior studies. Bolarinwa (2026) reports that AI significantly improves students' academic development by enhancing cognitive engagement and providing customised resources. Amosun (2026) similarly documents AI's positive impact on academic performance through personalised learning experiences. Hwang et al. (2025) explain the underlying mechanism: AI systems adapt to individual learners' needs, enabling students to progress at appropriate paces and receive targeted support for areas of difficulty.

In the Nigerian secondary school context characterised by large class sizes and limited individual attention the personalisation afforded by AI systems addresses a structural pedagogical deficit. By diagnosing learning gaps and adjusting instructional content accordingly, AI tools can compensate for the individualisation that is impractical in conventional whole-class instruction. These findings underscore the equity dimensions of AI-driven instruction: implemented strategically, it has the potential to reduce within-classroom achievement disparities and raise the floor of academic performance across diverse student groups. However, consistent with Bali et al. (2024), sustainable implementation requires addressing infrastructural prerequisites, particularly in under-resourced schools where digital inequality remains pronounced.

6. Conclusion

This study provided quasi-experimental evidence that AI-driven instruction significantly enhances critical thinking, civic competence, and academic achievement among junior secondary school students in Social Studies in South-West Nigeria. Across all three outcome domains, the treatment group demonstrated substantially larger mean gains than the control group, and ANCOVA confirmed that these differences were statistically significant and practically meaningful after controlling for pretest differences, with large effect sizes (partial η^2 ranging from .197 to .209).

These findings carry several important implications. Theoretically, they provide contextualised support for constructivist and learner-centred theoretical frameworks as applied to AI-enhanced instruction in a developing-country secondary school setting. Practically, they demonstrate that AI-driven instruction is feasible and effective in Nigerian schools with adequate technological infrastructure, and that its benefits extend beyond academic achievement to encompass higher-order cognitive competences and civic development outcomes outcomes that are essential for the socio-democratic development of Nigeria.

The study is not without limitations. The purposive selection of technologically equipped schools limits the generalisability of findings to schools without comparable infrastructure, which constitute the majority of Nigerian public secondary schools. The six-week intervention period may not capture long-term retention and transfer effects. The reliance on adapted self-report scales for critical thinking and civic competence, while validated, introduces the possibility of social desirability bias. Future studies should

employ randomised designs, extend the intervention period, use behavioural and performance-based outcome measures, and include diverse school contexts including under-resourced and rural settings to generate more generalisable evidence.

7. Recommendations

Based on the findings, the following recommendations are proposed:

4. Educational authorities and curriculum planners should integrate AI-driven instructional tools into the Social Studies curriculum, designing structured frameworks that leverage AI for inquiry-based and civic learning objectives.
5. Teachers should receive continuous, pedagogically oriented professional development in AI tool integration, with emphasis on designing learning environments that promote active reasoning and prevent cognitive offloading.
6. Government ministries and school administrators should invest in technological infrastructure including reliable internet access and digital devices to enable equitable access to AI-driven instruction across urban and rural schools.
7. Institutional policies should be developed to govern the ethical and pedagogically responsible use of AI in Nigerian secondary schools, addressing concerns related to data privacy, digital equity, and algorithmic bias.
8. Future research should employ longitudinal and mixed-methods designs to examine the sustained effects of AI-driven instruction on higher-order learning outcomes, and should explicitly investigate implementation conditions that maximise benefit while mitigating risks.

Conflict of Interest

The authors declare no conflict of interest regarding the publication of this paper.

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