

**INTERACTION EFFECTS OF ARTIFICIAL INTELLIGENCE AND GENDER ON SENIOR SECONDARY TWO CIVIC EDUCATION STUDENTS' MOTIVATION AND ACHIEVEMENT IN JOS-NORTH LOCAL GOVERNMENT AREA, PLATEAU STATE, NIGERIA**

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**ABSTRACT**

*The study examined the interaction effects of artificial intelligence (AI) and gender on senior secondary two (SS II) civic education students' motivation and achievement in Jos-North Local Government Area, Plateau State, Nigeria. The study identified two objectives, answered two research questions and tested two hypotheses. The population of the study was 1,779 SS II students, drawn from 24 public senior secondary schools, out of which a sample of 75 students was drawn from two schools. Two instruments were used for the study, namely, the Civic Education Motivation Questionnaire (CEMQ), and the Civic Education Achievement Test (CEAT), both of which were developed by the researchers. Findings showed that there was no interaction effect of treatment and gender on the motivation and achievement of senior secondary two (SS II) students in civic education in Plateau State. Findings also showed that the combined effect of treatment and gender on SS II students' motivation and achievement in civic education was not significant. The study recommended the incorporation of AI into civic education to increase engagement and performance, along with teacher training for effective AI integration.*

**Key words: Achievement    Artificial intelligence    Gender    Interaction effect    Motivation**

**INTRODUCTION**

In Nigeria, the senior secondary level of education is fundamentally a crucial three-year phase for students from ages 15 to 18. It is during this period that the students prepare for examinations such as the West African Senior School Certificate Examination (WASSCE) conducted by the West African Examination Council (WAEC) and the Senior Secondary Certificate Examination (SSCE) often administered by the National Examination Council (NECO). This phase covers a wide range of subjects, including English Language, Mathematics, Sciences (Physics, Chemistry, Biology), Social Sciences (Geography, Economics, Government), Languages (English and indigenous languages), Arts and Humanities (History, Literature in English, Religious Studies), and Vocational Subjects (Agriculture, Home Economics, Technical Drawing).

Over time, and recent examinations, such as the West African Senior School Certificate Examination (WASSCE) by the West African Examination Council (WAEC) and the Senior Secondary Certificate Examination (SSCE) by the National Examination Council (NECO), have revealed that students' achievement in civic education falls below expectations. This poor achievement can be attributed to a lack of effective teaching methods, limited access to instructional materials, and the absence of innovative approaches to enhance student engagement. The consequence of this downward trend is a potential continuation of civic knowledge gaps among Nigerian youth in Jos North.

Students may lack the necessary understanding of democratic principles, civic responsibilities, and the importance of active citizenship. This deficiency could hinder their ability to participate effectively in democratic processes and contribute positively to their communities.

Achievement of students refers to the successful accomplishment of a goal, task, or objective, often resulting from effort, skill, or perseverance. It is a measurable result or outcome that reflects the individual's or group's ability to overcome challenges and reach a desired level of performance or success. Achievements can be related to various aspects of life, including education, career, sports, personal development, and more. They are often seen as milestones or markers of progress and are a source of pride and satisfaction for individuals or communities. Achievement in civic education encompasses students' mastery of knowledge, skills, and values related to citizenship, government, and social issues.

Poor achievement of students in civic education at the senior secondary school may not be unconnected with the students' level of motivation. Motivation is a multifaceted psychological concept referring to the internal or external factors that drive individuals to initiate, sustain, and direct their behaviour toward specific goals or outcomes. It involves the forces that energize human behaviour, influencing choices, effort, and persistence in goal achievement. Motivation can stem from personal needs, desires, values, external rewards, or societal expectations.

Gender may also be a factor in students' achievement in civic education. Gender categorizes individuals into male and female, establishing distinctions that significantly impact various aspects of life, including education. The influence of gender roles on students' motivation and achievement is profound, as it shapes their perceptions of subjects and professions (Fatokun & Idagboyi, 2016). Consequently, the categorization of certain subjects as 'masculine' or 'feminine' can influence students' self-perception, expectations and achievement. In other words, the discourse on gender as regards students' academic achievement is ongoing. While certain studies found that male students achieved more in school subjects than girls, other studies found that female students achieved more in the subjects than their male counterparts (Klapproth & Schaltz, 2013; Hadjar & Buchmann, 2016; Agasisti & Zoido, 2019). This indicates that relating to achievement between male and female students, the discourse is inconclusive, and hence the need for further studies.

Poor achievement of students in civic education may also not be unconnected with the method of teaching employed by teachers. More often than not, the lecture method is employed by teachers. This method, though saves time and space, possesses several disadvantages such as making the lesson bored, making students to lose interest in the lesson, and lack of a close interaction between the teacher and students. In essence, the lecture method is teacher-centred. In order to arouse students' interest in civic education which will ultimately motivate them and consequently improve their achievement, a new teaching strategy is required. The study focuses on artificial intelligence (AI). AI technologies offer the potential to provide tailored learning experiences that cater to students' individual learning styles and needs. These technologies include interactive simulations, personalised learning platforms, and real-time feedback systems. Investigating the impact of AI on students' achievement in civic education can provide insights into its effectiveness as a pedagogical tool (Chen et al., 2020). The need to employ AI in teaching civic education in Jos-North Local Government Area of Plateau State became obvious.

## **AIM AND OBJECTIVES OF THE STUDY**

The aim of the study is to determine the interaction effects of artificial intelligence and gender on senior secondary two civic education students' motivation and achievement in Jos-North Local Government Area, Plateau State, Nigeria. The objectives of the study are to:

1. find out the interaction effect of treatment and gender on the motivation of SS II students in civic education
2. determine the interaction effect of treatment and gender on the achievement of SS II students in civic education.

## **RESEARCH QUESTIONS**

The following research questions guide the study.

1. What is the interaction effect of treatment and gender on the motivation of SS II students in civic education?
2. What is the interaction effect of treatment and gender on the achievement of SS II student in civic education?

## **HYPOTHESES**

The following hypotheses are stated and shall be tested at 0.05 level of significance:

1. There is no significant difference in the mean scores of the interaction effect of treatment and gender on SS II students' motivation in civic education.
2. There is no significant difference in the mean scores of the interaction effect of treatment and gender on SS II students' achievement in civic education.

## **LITERATURE REVIEW**

### **Artificial Intelligence and Civic Education**

Popenici and Kerr (2017) define AI as computing systems mirroring human learning, adaptation, and data processing. Its application in education focuses on personalized guidance and feedback (Fahimirad, & Kotamjani, 2018). This integration spans robotics, e-learning, virtual reality, and on-line self-learning platforms (Petko, Prasse, & Cantieni, 2018; Pyörälä, Mäenpää, Heinonen, Folger, Masalin, & Hervonen, 2019), aiming to revolutionize learning, teaching, and problem-solving across educational contexts (Baker, Ferszt, & Breines, 2019).

Civic Education refers to the type of education that prepares citizens for citizenship, equipping them with whatever is needed to be good and responsible citizens who would contribute to good governance. The knowledge of one's rights, roles, and responsibilities and consciousness of both the good and bad in one's environment as a citizen of a country guarantees good and honourable behaviour. Without such disposition, society is prone to slip back into the state of nature - a state without a government, a state of war of all against all, a state of anarchy and doom, a state of brutality and inhumanity. It is also the mission of education to enlighten and liberate citizens from such a state. As civic education contributes to political stability, a lack of proper education is equal to deformation which contributes to disorder and anarchy.

Artificial Intelligence (AI) integration into civic education represents a transformative avenue, offering substantial promise in shaping engaged and knowledgeable citizens. Within this domain, plays multifaceted roles, presenting various opportunities and considerations. Primarily, AI augments civic education by providing tailored and diverse

information. It delivers a spectrum of perspectives on governance, societal structures, and civic responsibilities. Through unbiased and comprehensive data, it facilitates a deeper understanding of historical events, government functions, and global issues, empowering individuals with a holistic view. Moreover, AI driven tools in civic education foster critical thinking skills. These tools encourage the analysis, evaluation, and interpretation of information, enabling users to dissect news sources, recognize biases, and comprehend the implications of policies. By nurturing critical thinking, AI aids in shaping individuals capable of making informed decisions.

Additionally, AI facilitates active civic participation. Through interactive platforms, it encourages engagement in debates, discussions, and community initiatives. This engagement not only amplifies civic awareness but also highlights the significance of individual contributions to decision-making processes. Furthermore, AI in civic education delves into ethical considerations concerning technological advancements. It addresses concerns such as biases in AI, privacy issues, surveillance, and their impacts on civil liberties and societal norms. This exploration encourages ethical reasoning and a deeper understanding of the ethical implications of technology in civic life. However, the integration of AI into civic education demands vigilant attention to potential challenges. AI susceptibility to biases and misinformation poses a risk to accurate information dissemination, emphasizing the need for critical evaluation and bias recognition. Moreover, considerations around privacy and surveillance must be addressed to navigate the balance between technology-driven civic engagement and individual privacy rights. Bridging the digital divide ensures equitable access to AI driven civic education tools, preventing further societal disparities.

### **Motivation and Achievement**

The term motivation is often considered to serve as a catalyst, driving students to focus on goals and fostering resilience, initiative, and curiosity (Yarborough & Fedesco, 2020). High motivation is associated with sustained attention and is vital for prolonged learning periods, showcasing the ability to navigate the learning journey autonomously. This force, inherent in human behaviour, is multifaceted, encompassing intrinsic and extrinsic motivations. Intrinsic motivations arise from personal satisfaction, while extrinsic motivations emanate from external stimuli like rewards or recognition (Lin, Chai, Jong, Dai, Guo, & Jian-jun, 2021). The authors added that in order to initiate, direct, and maintain goal-oriented behaviours across several dimensions, these motivations converge, requiring activation, persistence, and intensity to meet desired outcomes.

Achievement serves as a crucial benchmark within education, encapsulating the realisation of both short-term and long-term educational objectives (Ingersoll & Wainer, 2014). It stands as a cornerstone, often evaluated through assessments or examinations, providing a fundamental measure to assess the success of students, educators, and educational institutions. Tangible markers of academic achievement, such as secondary school certificates or bachelor's degrees, underscore the fulfilment of these educational milestones amidst ongoing debates about evaluation methods and the varying significance of different knowledge domains, from procedural skills to factual knowledge (Ingersoll & Wainer, 2014).

## **Academic Achievement and Gender**

Gender roles, primarily shaped through childhood socialisation, peer influences, and stereotyped work expectations, categorise individuals into male and female categories. This categorization significantly impacts societal beliefs, behaviours, and opportunities, aligning certain subjects and professions as 'masculine' or 'feminine.' Fatokun and Idagboyi (2016) highlighted the suppression of women's roles in societal development efforts. Certain fields, like science and mathematics, are often perceived as masculine, while others, such as home economics, are considered feminine, further perpetuating gender-based distinctions.

Studies by United Nations Women (2016) revealed disparities in knowledge between male and female teachers, emphasising male teachers' depth in certain subjects like environmental education. The UN underscored the prevalence of patriarchal values that reinforce the notion of male superiority, leading to power imbalances favouring men. Moreover, UN Women (2016) noted gender imbalances in fields like science, technology, engineering, and mathematics (STEM), labelling them as predominantly masculine subjects. This societal perception significantly affects career choices and opportunities for individuals based on their gender.

The impact of gender roles on academic achievement is evident across different stages of education. Early childhood patterns exhibit gender-typical behaviours influenced by societal norms. Primary education sees varying competencies, with girls excelling in language subjects while boys outperform in mathematics and sciences (Hadjar & Buchmann, 2016). In highly stratified educational systems, boys are more likely to be placed in lower secondary school tracks, affecting their future prospects and careers (Klapproth & Schaltz, 2013). However, the authors posited that when academic performance is considered, the differences in educational tracking decisions diminish, indicating that gender isn't the sole determining factor.

Despite these disparities, studies such as PISA (Programme for International Student Assessment) consistently show girls outperforming boys in language subjects, but boys demonstrating superiority in mathematics (Agasisti & Zoido, 2019). Moreover, as Agasisti and Zoido indicated, while more women are enrolling in higher education institutions, the transition rates into higher education remain higher for men, reflecting societal biases in educational opportunities. This societal outlook contributes to the perception of girls as the 'weaker sex' in some communities, influencing their educational experiences from an early age, particularly in countries like Nigeria.

## **METHODOLOGY**

The study adopted a quasi-experimental design, specifically a non-randomized pretest-posttest non-equivalent control group model. Quasi-experiments aim to assess the causal effect of an intervention on a target group without using random assignment. This design involves gathering data both before and after the intervention (DeRue, Nahrgang, Hollenbeck & Workman, 2012). The population of the study was 1,779 senior secondary II (SS II) students in Jos North Local Government Area, drawn from 24 public secondary schools. The population was made up of 879 males and 900 females who enrolled in Civic Education during the 2022-2023 academic year. The sample was made up of 75 students: 40 from Federal Government College (27 males, 13 females) which formed the Experimental Group and 35 from Government College, Jos (20 males, 15 females) which formed the Control Group. A multistage sampling technique was used: Simple random sampling selected the educational area office in Jos North, Plateau State, while purposive sampling

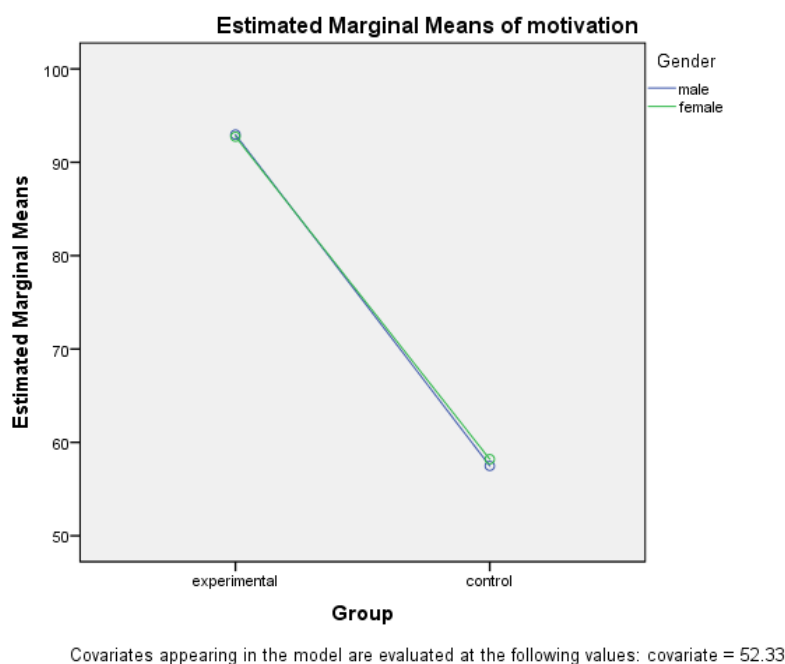
identified two co-educational, government-owned schools based on certain vital criteria. Two instruments were used for data collection, namely, the Civic Education Achievement Test (CEAT), and the Civic Education Motivation Questionnaire (CEMQ). CEMQ was structured on a four-point scale. The research questions were addressed using mean scores and standard deviations. The hypotheses were tested at a 0.05 significance level using Analysis of Covariance (ANCOVA). The decision rule for ANCOVA was that if  $p > 0.05$ , the null hypothesis was retained; if  $p < 0.05$ , it was rejected. For the research questions, mean scores of 2.50 or higher were considered "agree," while scores below 2.50 were deemed "disagree."

### Research Question One

What is the interaction effect of treatment and gender on the motivation of SS II students in civic education students?

Research Question One is answered using the data in Figure 1.

**Figure 1:** Interaction Effect of Treatment and Gender on Students' Motivation in Civic Education



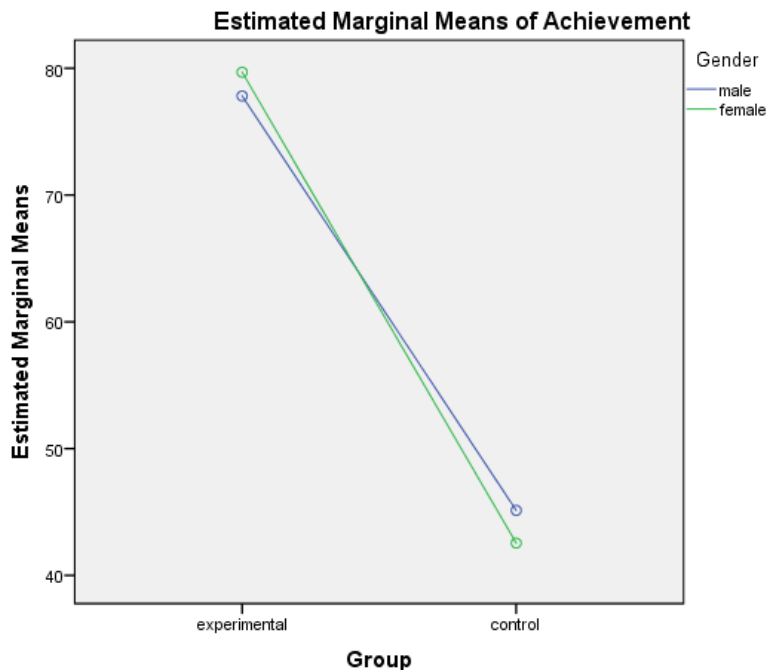
In Figure 1 is presented the profile plot of the interaction effect of treatment and gender on motivation of students in civic education. The interactive pattern shows that the plots for male and female students did not intercept, since the two lines are not crossed between groups but more of parallel and within group, there is no likelihood of an interaction effect between treatment and gender on the motivation of students in civic education. It further shows that the plot is extrapolated. Consequently, the intersection could not hold; which means that the interaction effect between treatment and gender on the motivation of students was not attainable. Therefore, there is no interaction effect of treatment and gender on the motivation of senior secondary two (SS II) students in civic education in Plateau State.

### Research Question Two

What is the interaction effect of treatment and gender on the achievement of SS II students in civic education?

Research Question Two is answered using Figure 2 data.  
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Covariates appearing in the model are evaluated at the following values: Covariate = 40.15

**Figure 2:** Interaction Effect of Treatment and Gender on Students' Achievement in Civic Education  
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In Figure 2, the profile plot illustrates the interaction effect of treatment and gender on students' achievement in civic education. The plot indicates that the lines representing male and female students do not intersect, suggesting that there is no interaction effect between treatment and gender on students' achievement. The pattern observed is more within-group, indicating that the differences in achievement are not influenced by the interaction of treatment and gender. Additionally, the plot is extrapolated, indicating that the intersection of the lines is not feasible. This further supports the fact that there is no interaction effect of treatment and gender on the achievement of senior secondary two (SS II) students in civic education in Plateau State.

### Hypothesis One

There is no significant difference in the mean scores of the interaction effect of treatment and gender on SS II students' motivation in civic education.

The data in Table 1 were used to test Hypothesis One.

### Table 1

**ANCOVA Result of Interaction Effect of Treatment and Gender on Motivation of Students in Civic Education**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	23325.395 <sup>a</sup>	4	5831.349	112.041	.000	.865	
Intercept	3667.627	1	3667.627	70.468	.000	.502	
Covariate	97.057	1	97.057	1.865	.176	.026	
Treatment	20646.918	1	20646.918	396.700	.000	.850	
Gender	1.032	1	1.032	.020	.888	.000	
Treatment* Gender	3.819	1	3.819	.073	.787	.001	
Error	3643.272	70	52.047				
Total	465505.000	75					
Corrected Total	26968.667	74					

a. R Squared = .865(Adjusted R Squared =.857)

Table 1 presents ANCOVA result of the interaction effect of treatment and gender on SS II students' motivation in civic education. The main effect of treatment on the experimental group ( $F(1,70) = 396.70, p < 0.05$ ) indicated a significant impact of treatment, specifically the use of artificial intelligence, on students' motivation in civic education, as the p-value was less than 0.05, leading to the rejection of the null hypothesis. In contrast, the main effect of gender ( $F(1,70) = 0.020, p > 0.05$ ) showed no significant influence on students' achievement in civic education, with a p-value greater than 0.05, leading to the retention of the null hypothesis. Furthermore, the interaction effect of treatment and gender ( $F(1, 70) = 0.073, p > 0.05$ ) was not statistically significant, with a p-value greater than 0.05, suggesting no significant combined effect of treatment and gender on students' motivation in civic education. This indicates that the use of artificial intelligence did not interact differently with gender in influencing students' motivation.

**Hypothesis Two**

There is no significant difference in the mean scores of the interaction effect of treatment and gender on SS II students' achievement in civic education.

Hypothesis Two is tested using the data in Table 2.

**Table 2  
ANCOVA Result of Interaction Effect of Treatment and Gender on Achievement of Students in Civic Education**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	23253.666 <sup>a</sup>	4	5813.417	96.581	.000	.847	
Intercept	6693.192	1	6693.192	111.197	.000	.614	
Covariate	148.173	1	148.173	2.462	.121	.034	
Treatment	20997.692	1	20997.692	348.844	.000	.833	
Gender	2.030	1	2.030	.034	.855	.000	
Treatment* Gender	86.009	1	86.009	1.429	.236	.020	
Error	4213.454	70	60.192				
Total	322502.000	75					
Corrected Total	27467.120	74					

a. R Squared = .847(Adjusted R Squared =.838)

Analysis of Covariance (ANCOVA) was used to explore the potential interaction effect of treatment and gender on students' achievement in civic education. Table 2 presents the finding, indicating a significant main effect of treatment for the experimental group ( $F(1,70) = 348.84, p < 0.05$ ). This result, with a p-value of 0.000, led to the rejection of the null hypothesis, suggesting that the treatment, particularly the use of artificial intelligence, significantly impacted students' achievement in civic education. Conversely, the main effect of gender ( $F(1,70) = 0.034, p > 0.05$ ) demonstrated no significant influence on students' achievement. The p-value of 0.855 led to the retention of the null hypothesis, indicating that gender did not have a notable effect on student achievement in civic education. Additionally, the interaction effect of treatment and gender ( $F(1, 70) = 1.43, p > 0.05$ ) was not statistically significant, with a p-value of 0.236. This result indicated that the combined effect of treatment and gender on students' achievement in civic education was not significant.

## FINDINGS

1. There is no interaction effect of treatment and gender on the motivation of senior secondary two (SS II) students in civic education in Plateau State
2. There is no interaction effect of treatment and gender on the achievement of SS II students in civic education in Plateau State.
3. There is no significant combined effect of treatment and gender on SS II students' motivation in civic education
4. The combined effect of treatment and gender on SS II students' achievement in civic education was not significant

## DISCUSSION

In Figure 1, interactive pattern indicates that the plots for male and female students did not intercept; the two lines are more parallel and within groups, suggesting no interaction effect between treatment and gender on students' motivation in civic education. The plot also appears extrapolated, indicating that the intersection could not hold, and thus, the interaction effect between treatment and gender on student motivation was not attainable. Consequently, there is no statistically significant interaction effect of treatment and gender on the motivation of senior secondary two (SS II) students in civic education in Plateau State. This finding is consistent with the research by Yunus, Setyosari, Utaya, and Kuswandi (2021).

In Figure 2, the absence of an intersection between the lines representing male and female students suggests that there is no significant interaction effect between treatment and gender on students' achievement. This finding indicates that the differences in achievement between male and female students are not influenced by the treatment administered. The observed pattern in the plot indicates that the variation in achievement levels is more attributed to factors within each gender group rather than the interaction of treatment and gender. Furthermore, the extrapolation of the plot suggests that the lines representing male and female students do not converge, reinforcing the notion that an interaction effect is not present. This implies that regardless of the treatment received, the achievement levels of male and female SS II students in civic education in Plateau State remain largely independent of their gender. These finding is in line with the work of Yilmaz and Yilmaz (2023)

Table 1 results showed a significant positive effect of the AI-based treatment on student motivation ( $p < 0.05$ ), suggesting it fostered a more engaging learning environment for civic education. This aligns with the potential of technology to enhance student engagement across disciplines interestingly, gender was not a significant factor in students' motivation ( $p > 0.05$ ). Table 2 addresses the interaction effect of treatment (use of artificial intelligence) and gender on student achievement in civic education. Consistent with prior research on instruction techniques and gender, the study found no significant interaction effect ( $p > 0.05$ ). This suggests that the impact of the AI-based treatment on student achievement was consistent for both male and female students.

## CONCLUSION

Based on the findings, the study concludes as follows: There is no interaction effect of treatment and gender on the motivation of senior secondary two (SS II) students in civic education in Plateau State; there is no interaction effect of treatment and gender on the achievement of SS II students in civic education in Plateau State; there is no significant combined effect of treatment and gender on SS II students' motivation in civic education; and the combined effect of treatment and gender on SS II students' achievement in civic education was not significant. The study therefore, recommends that there should be regular evaluation of the impact of AI on student motivation and achievement is essential to ensure its effective integration into the educational system. To achieve this, data-driven evaluation methods should be implemented

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