

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

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### **ABSTRACT**

*The study investigated the effects of artificial intelligence (AI) on senior secondary two (SS II) Civic Education students' achievement in Jos-North Local Government Area, Plateau State, Nigeria. The study was guided by two objectives, two research questions and two hypotheses. Quasi-experimental pre-test-post-test non-equivalent control group research design was employed. The sample was 75 students drawn from two schools out of a population of 1,779 SS II students. Data collection instruments was the Civic Education Achievement Test (CEAT). The instrument was structured on the five-point Likert scale. Mean and standard deviation were used to answer the research questions. The hypotheses were tested using ANCOVA at 0.05 level of significance. The study found that in the experimental group, the achievement of SS II students in civic education was better than that of the control group. The study also found that female students showed slightly better achievement than male students in civic education when taught using artificial intelligence. However, that did not indicate any significant disparity. On the whole, the study found that there was a significant effect of artificial intelligence on SS II students' achievement in civic education. The study recommended among others, that AI systems should be designed to cater to the unique learning needs of both male and female students, and that AI developers and educators should collaborate to create inclusive and gender-sensitive algorithms and interfaces that recognize and accommodate different learning styles in Jos-North LGA, Plateau State, Nigeria*

**Key words: Achievement Artificial intelligence Gender**

### **INTRODUCTION**

Artificial intelligence (AI) refers to the emulation of human intelligence through software-coded heuristics, representing a rapidly advancing technology aimed at replicating human cognitive functions such as learning, reasoning, and perception. This multifaceted field encompasses various subfields, including machine learning (ML) and deep learning, where ML allows automated learning from new data without explicit programming and deep learning enables the automatic absorption of vast amounts of unstructured data. AI has found widespread applications across industries, including healthcare for diagnostics and patient classification, finance for detecting unusual activity and enhancing trading, and manufacturing for predictive maintenance and supply chain management.

AI is becoming increasingly prominent across various facets of society, and education is a notable arena of application. In recent years, AI has gained substantial attention for its potential to enhance teaching and learning experiences. A specific focus is placed on its role in civic education, a critical component of secondary school curricula designed to educate students about their civic rights, responsibilities, and active participation in society. The integration of AI into civic education holds the promise of creating innovative and interactive learning environments tailored to the unique needs of students (Chen, Chen, & Lin, 2020).

Gender roles, ingrained in individuals through childhood socialization, peer influences, and societal expectations, play a pivotal role in shaping beliefs, behaviours, and opportunities. These roles categorize individuals into male and female, establishing distinctions that significantly impact various aspects of life, including education. The influence of gender roles on students'

achievement is profound, as it shapes their perceptions of subjects and professions Fatokun & Idagboyi (2016). The categorization of certain subjects as 'masculine' or 'feminine' can influence students' self-perception and expectations. For instance, the perception of science and mathematics as masculine and home economics as feminine can impact students' confidence and interest in pursuing specific academic paths. This stereotyping can create barriers that affect not only motivation but also academic achievement. The pressure to conform to gender norms may discourage students from exploring subjects perceived as outside their prescribed gender roles. This influence can limit students' exposure to diverse educational experiences and opportunities, hindering their ability to explore their full potential.

The senior secondary level of education in Nigeria is a crucial three-year phase for students aged 15 to 18, during which they prepare for examinations like 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). 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).

Achievement is defined as 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. 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 lecture method appears to be untenable nowadays in enhancing students' achievement in civic education. This is shown by the fact that the students' achievement in national examinations has not been encouraging. In spite of efforts by stake holders, the achievement of the students has not improved. There is therefore the need to introduce another teaching strategy such as artificial intelligence to teach civic education which is likely to lead to an improvement in achievement of SS II students in Jos-North Local Government Area, Plateau State, Nigeria.

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

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

1. find the pre-test and post-test achievement scores of SS II civic education students in the experimental and control groups.
2. determine the post-test achievement scores of SS II civic education students in the experimental group based on gender.

### **RESEARCH QUESTIONS**

The following research questions guide the study:

1. What are the pre-test and post-test achievement scores of SS II civic education students in the experimental and control groups?

2. What are the post-test achievement scores of SS II civic education students in the experimental group based on gender?

### **HYPOTHESES**

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

1. There is no significant difference in the pre-test and post-test mean achievement scores of SS II civic education students in the experimental and control groups
2. There is no significant difference in the post-test mean achievement scores of SS II civic education students in the experimental group based on gender.

### **LITERATURE REVIEW**

#### **Citizenship Education**

The term "Civic Education" deals with the kind of education that prepares citizens for citizenship, equipping them with whatever is needed to be good and responsible citizens and contribute to good governance. A formative endeavour inculcates in citizens the skill, knowledge, and consciousness needed to exhibit positive and participatory behaviours in their country (Nwana & Odoh, 2013). 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 and contributes to disorder and anarchy. Hobbes in Dumas and Anderson (2014) canvassed and advocated for the transition to a civil state and for civil science, without which political stability becomes impossible. When people are not properly educated about civics, that is, their real rights, roles, and responsibilities to their nation, unfortunately, they will become unconsciously ignorant. Dumas and Anderson regarded this as a dangerous position where one sees the right way of doing something yet cannot do it, sees the wrong way as the right way, at times does not know what one should know, etc. The manifestation of such ignorance is abysmal and destructive. This is absolutely the root of the instability in different dimensions.

There are many different concepts of civic education, as there are many scholars in the field of civic education. Scholars have conceptualised civic education in different ways. Civic education has been most often considered a special school subject; in which case it includes several lessons taught by a teacher. However, it can also be a group of activities that students experience or a government policy (Kennedy & Archambault, 2012). Education embodies certain aspects of civics, which include the impartation of knowledge and values, which often leads to the inculcation of certain attributes (Cohen, 2014). Based on the type of behaviour that the products of an educational system imbibe, there are two types of citizens: individualistic and communal. However, having individualistic or communal citizens depends on the kind of knowledge and values inculcated in the citizens and the educational policies of the concerned state.

#### **Concept of Artificial Intelligence**

Artificial intelligence (AI) is increasingly becoming an integral part of instructional materials, revolutionizing teaching and learning. AI deals with systems engaging in human-like processes, including learning, adaptation, and complex data processing. AI-driven tools and platforms offer personalized learning experiences, adapt to individual student needs, and provide real-time feedback, enhancing student engagement and achievement Ucoglu (2020). Examples include AI-powered tutoring systems, virtual reality simulations, and adaptive learning platforms. Instructional materials can be classified based on their nature and form. Abifarin (2021),

categorizes them into printed, audio, visual, audio-visual, and electronic resources. . Printed materials include textbooks and reference books, while audio resources encompass podcasts and microphones. Visual resources consist of posters and charts, while audio-visual resources include videos and motion pictures. Electronic resources range from internet resources to e-books and e-databases. The integration of AI in instructional materials is transforming education. AI enhances teaching methodologies and tools, such as adaptive teaching strategies and personalized learning, benefiting students in various learning environments Timms (2020). AI's potential in offering tailored instruction and enhancing classroom experiences remains promising.

### **Concept of Achievement**

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).

The impact of academic achievement extends deeply into the lives of students, shaping their future educational trajectories significantly. Metrics like grade point average (GPA) or standardised tests like the Scholastic Assessment Test (SAT) play a pivotal role in determining access to higher education, acting as gatekeepers for further learning (Awodun, 2021). They delineate individuals' eligibility for pursuing advanced education, thereby establishing a critical link to higher learning opportunities. Evaluation methods for academic achievement primarily align with the outcomes attained at the culmination of an educational journey. Ensuring the reliability and validation of assessments is paramount, especially with standardised tests that must adhere to national norms to ensure fairness and consistency over time (Ingersoll & Wainer, 2014). The evaluation of an educational system's efficacy often hinges on assessing students' achievements, aiming to gauge the extent to which educational objectives are met and identify areas requiring remedial action. Importantly, academic achievement reflects more than cognitive prowess; it encompasses attitudes and values shaped by the educational system's mission and goals, showcasing a broader impact beyond cognitive development (Ingersoll & Wainer, 2014).

### **METHODOLOGY**

Quasi-experimental design, specifically the non-randomized pre-test post-test non-equivalent control group model was adopted for the study. This type of design aims 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 research focused on 1,779 SS II students, consisting of 879 males and 900 females, who enrolled in Civic Education during the 2022-2023 academic year across 24 government senior secondary schools in Jos North Local Government Area. The sample was 75 students, made up of 40 students from Federal Government College (27 males, 13 females) which formed the experimental group, and 35 students from Government College, Jos (20 males, 15 females), which formed the control group. Purposive sampling technique was used to sample the two co-educational, government-owned schools. An instrument tagged "Civic Education Achievement Test (CEAT)", validated by relevant experts, was used for data collection. The instrument was rated on a five-point Likert scale. The research questions were addressed using mean scores and standard deviation. Hypotheses were tested at 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.

**PRESENTATION OF RESULTS****Research Question One**

What are the pre-test and post-test achievement mean scores of SS II civic education students in the experimental and control groups?

This research question is treated using the data presented in Table 2

**Table 1****Pre-test and Post-test Achievement Mean Scores of SS II Students in the Experimental and Control Groups**

Group	N	Pre-test		Post-test		$\bar{x}G$	$\bar{x}G$ - difference
		Mean	SD	Mean	SD		
Experimental	40	40.25	7.91	79.10	6.71	38.85	34.88
Control	35	40.03	7.28	44.00	8.94	3.97	

In Table 1, pre-test mean scores of the experimental and control groups are 40.25 and 40.03, with standard deviation scores of 7.91 and 7.28 respectively. At post-test, the experimental group has a mean score of 79.10 with a standard deviation score of 6.71. The control group, on the other hand, has a mean score of 44.00 with standard deviation of 8.94 at post-test. There is a gain mean score of 38.85 in experimental group, and a gain mean score of 3.97 in the control, both between pre-test and post-test. On the whole, there is a gain mean difference of 34.88 in favour of the experimental group. This result shows that in the experimental group the achievement of SS II students in civic education is better.

**Research Question Two**

What are the post-test achievement mean scores of SS II students in civic education in the experimental group based on gender?

Research Question Two was treated using the data in Table 2

**Table 2****Post-test Achievement Mean Scores of SS II Students in Civic Education in the Experimental group**

Group	Gender	N	$\bar{x}$	SD	$\bar{x}$ - difference
Experimental	Male	13	78.38	7.14	1.06
	Female	27	79.44	6.60	

Table 2 displays the outcomes of post-test mean scores for male and female students in civic education within the experimental group. The data reveal a post-test mean score of 78.38 with a standard deviation of 7.14 for male students. For the female students, a slightly higher post-test mean score of 79.44 with a standard deviation of 6.60 has been recorded. This results in a mean difference of 1.06 in favour of female students. This result indicates that female students show slightly better achievement than male students in civic education when taught using artificial intelligence.

**Hypothesis One**

There is no significant difference in the pre-test and post-test mean achievement scores of SS II civic education students in the experimental and control groups

Table 3 shows the results that were obtained when Hypothesis One was tested.

**Table 3: ANCOVA Results of Pre-test and Post-test Mean Achievement Scores of SS II Civic Education Students in Experimental and Control Groups**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	23165.903 <sup>a</sup>	2	11582.952	193.892	.000	.843	
Intercept	7290.750	1	7290.750	122.043	.000	.629	
Covariate	168.383	1	168.383	2.819	.098	.038	
Group	22934.786	1	22934.786	383.916	.000	.842	
Error	4301.217	72	59.739				
Total	322502.000	75					
Corrected Total	27467.120	74					

a. R Squared = .843(Adjusted R Squared = .839)

In Table 3 are presented analysis of covariance (ANCOVA) results of pre-test and post-test achievement mean scores SS II civic education students; mean achievement scores in the experimental and control groups. The table shows that  $F(1,72) = 383.92$ ,  $p < 0.05$ , since the p-value of 0.000 is less than 0.05 level of significance, the null hypothesis is rejected, indicating that there is a significant difference in the pre-test and post-test mean achievement scores of SS II civic education students in the experimental and control groups. The result further reveals an adjusted R squared value of .839 which means that 83.9 percent of the variation in the dependent variable which is students' achievement is explained by variation in treatment, while the remaining is due to other factors not included in the study. This indicates that artificial intelligence does improve students' achievement in Civic Education.

### Hypothesis Two

There is no significant difference in the post-test mean achievement scores of SS II civic education students in the experimental group based on gender.

In Table 4 is presented ANCOVA results in respect of Hypothesis Two.

**Table 4: ANCOVA Results on Post-test Achievement Mean Scores of SS II Civic Education Students in the Experimental Group based on Gender**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	30.467 <sup>a</sup>	2	15.234	.327	.723	.017	
Intercept	7366.711	1	7366.711	158.182	.000	.810	
Pre-motivation	20.611	1	20.611	.443	.510	.012	
Gender	17.469	1	17.469	.375	.544	.010	
Error	1723.133	37	46.571				
<b>Total</b>	<b>252026.000</b>	<b>40</b>					
<b>Corrected Total</b>	<b>1753.600</b>	<b>39</b>					

a. R Squared = .017 (Adjusted R Squared = -.036)

In Table 4, the analysis of students' achievement scores in civic education revealed no statistically significant difference between genders. Specifically, a one-way analysis of covariance (ANCOVA) was conducted, considering male and female students as two gender levels. Table 4 displays the results, indicating that gender did not have a significant effect at the 0.05 significance level. The main effect of gender resulted in an F-value of 0.375 with a corresponding p-value greater than 0.05 (0.544). This suggests that the mean achievement score of male students is not

significantly different from that of female students in civic education. Therefore, based on these finding, there is no notable disparity in achievement between male and female students in civic education.

## **FINDINGS**

From the analysis of the data the following findings are recorded:

1. In the experimental group, the achievement of SS II students in civic education is better than that of the control group.
2. Female students show slightly better achievement than male students in civic education when taught using artificial intelligence
3. There is a significant difference in the pre-test and post-test mean achievement scores of SS II civic education students in the experimental and control groups, indicating that there is a significant effect of artificial intelligence on students' achievement.
4. No significant difference is found in the mean achievement scores of male and female students in civic education, indicating that disparity does not exist in the achievement of male and female students in civic education

## **DISCUSSION**

In Table 1, in the experimental group, the post-test mean gain score was higher than that of the pre-test mean score, indicating a gain mean difference of 34.88 in favour of the experimental group an improvement in students' achievement after the treatment. This finding is in line with that of Chiu, Moorhouse, Chai, and Ismailov (2023) which found the crucial role of teacher support in influencing student motivation and the need for tailored instructional designs to accommodate varying student needs and expertise levels in AI-driven learning. Additionally, the study found no significant difference between male and female students' motivation in Civic Education. There was no statistically significant interaction effect of treatment and gender on the motivation of students taught Civic Education using artificial intelligence.

From Table 2, it was found that female students showed slightly better achievement than male students in civic education when taught using artificial intelligence. This finding supports the broader research indicating the effectiveness of artificial intelligence in promoting students' learning outcomes. They are consistent with the works of Seo, Tang, Roll, Fels, and Yoon (2022), and Priyanga (2023), who explored the impact of artificial intelligence on learner-instructor interaction in online learning. Their research found that AI systems could enhance personalized interaction, although concerns about breaches of social boundaries, responsibility, agency, and surveillance were raised. Additionally, Mohamad and Khasawneh (2023) reported that students taught using artificial intelligence performed better in foreign language education than those exposed to a placebo.

In Table 3, the findings from the ANCOVA analysis indicate a significant effect of artificial intelligence on students' achievement in civic education. The F-statistic of 383.92 with a p-value of 0.000, which is less than the conventional significance level of 0.05, suggests that the null hypothesis can be rejected. This means that there is a statistically significant difference in achievement mean scores between the experimental and control groups, with the use of artificial intelligence contributing to this difference. The adjusted R-squared value of 0.839 indicates that 83.9 percent of the variation in students' achievement can be explained by the variation in treatment (use of artificial intelligence), while the remaining variation is due to other factors not considered in this study. This suggests that artificial intelligence plays a substantial role in improving students' achievement in Civic Education.

Table 4 displays the results, indicating that gender did not have a significant effect at the 0.05 significance level. The main effect of gender resulted in an F-value of 0.375 with a corresponding p-value greater than 0.05 (0.544). This suggests that the mean achievement score

of male students was not significantly different from that of female students in civic education. Therefore, based on these findings, there is no notable disparity in achievement between male and female students in civic education. However, studies by United Nations (UN) Women (2016) revealed disparities in knowledge between male and female teachers, emphasizing 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 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.

### **CONCLUSION AND RECOMMENDATIONS**

Based on the findings, the study concluded as follows: The achievement of SS II students in civic education in the experimental group is better than that of the control group; female students show slightly better achievement than male students in civic education when taught using artificial intelligence; there is a significant effect of artificial intelligence on students' achievement; and disparity does not exist in the achievement of male and female students in civic education. Based on these findings, the study recommends thus:

1. AI systems should be designed to cater to the unique learning needs of both male and female students.
2. AI developers and educators should collaborate to create inclusive and gender-sensitive algorithms and interfaces that recognize and accommodate different learning styles.
3. Workshops should be organized to gather input from diverse student groups, ensuring that the design of these AI tools reflects the varied perspectives and experiences of all learners. By doing so, these AI-driven platforms can provide personalized and effective civic education, fostering a deeper understanding of civic concepts and encouraging active participation from all students.

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