



Effect of Whot-Game on Algebra Anxiety among Senior Secondary School Students in Zamfara State, Nigeria

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Abstract

This study examined the effect of the Whot-Game on algebra anxiety among senior secondary school students in Zamfara State, Nigeria. A pretest-posttest nonequivalent quasi-experimental design was adopted. The population comprised of all SSII students in Kaura-Namoda Educational Zone (N = 5225) during the 2023/2024 session. Using purposive sampling, 109 students from two schools were selected and randomly assigned to experimental (52) and control (57) groups. Data were collected using the Algebra Anxiety Questionnaire (AAQ) with a reliability coefficient of 0.89 using the Chronbach's Alpha reliability test. Mean and standard deviation were to answer the research questions, while independent samples t-test ANCOVA tested the hypotheses at a 0.05 significance level. Findings revealed there was a significant reduction in algebra anxiety among students taught with the Algebra Whot-Game compared to those taught through the conventional method, it was also found that there was no disparity between male and female students algebra anxiety reduction. The study concludes that there was an effect of whot-game on algebra anxiety among senior secondary school students in Zamfara. The study recommends the integration of algebra whot game into the teaching of algebraic concepts by mathematics teachers in Zamfara State.

Keywords: Algebra Anxiety, Anxiety, Kaura-Namoda Educational Zone (KNEZ), Whot-Game (algebra whot-game),

Introduction

Quality mathematics education is fundamental to national scientific and technological development, particularly in science- and technology-driven disciplines where credit-level passes in mathematics are required for progression. Algebra is a core component of secondary school mathematics and serves as a foundation for advanced mathematical thinking and problem solving (Iroko & Olaoye, 2021). However, its abstract nature of algebra characterized by the use of letters and symbols, makes it one of the most difficult areas of mathematics for many learners (Ekpenyong & Raymond, 2024; Ibok & Unoh, 2019).

The abstractness of algebra often leads to negative emotional responses, commonly referred to as algebra anxiety or algebraphobia (Ihekweba et al., 2020). Anxiety toward mathematics may be socially learned through observation and communication, such as hearing peers or siblings describe mathematics as

difficult (Ekeh & Onuiké, 2025). Persistent weaknesses in algebraic operations, including fractions and linear equations, have been reported by WAEC Chief Examiners (WAEC, 2021), suggesting the need for innovative instructional strategies.

Instructional methods play a critical role in shaping students' emotional and cognitive learning outcomes (Atoyebi & Atoyebi, 2022). Game-based learning has gained prominence as an innovative instructional approach that promotes engagement, enjoyment, and reduced anxiety (Plass & Pawar, 2020). One such strategy is the Algebra Whot-Game (AWG), developed by the National Mathematical Centre (2002), which provides a playful and interactive means of learning algebraic concepts. Despite its potential, AWG is rarely used in secondary schools in Zamfara State. Hence, this study investigated the effect of the Whot-Game on algebra



anxiety among secondary school students in Kaura-Namoda Educational Zone (KNEZ), Zamfara State, Nigeria.

Literature Review

The Algebra Whot-Game is one of several mathematics games developed to enhance conceptual understanding and reduce learning difficulties (National Mathematical Centre, 2002). Studies on mathematics games have shown positive effects on students' achievement and engagement (Okpube & Anugwo, 2016; Ochulor, 2022). However, empirical studies focusing specifically on algebra anxiety remain limited.

Mathematics anxiety has been shown to negatively influence students' engagement and career choices (Garba & Ismail, 2020). It manifests as fear and tension that interfere with problem-solving processes (Adeniyi et al., 2021; Pizzie & Kraemer, 2017). Algebra anxiety, as a domain-specific form of mathematics anxiety, similarly affects students' emotional responses and learning outcomes.

Social Cognitive Theory explains mathematics anxiety as an interaction among personal factors, behavior, and environmental influences. Deficit Theory suggests that poor achievement leads to anxiety (Sorvo et al., 2019), while the Debilitating Anxiety Model posits that anxiety disrupts cognitive functioning (Carey et al., 2016). The Reciprocal Theory integrates both perspectives, indicating that anxiety and poor performance reinforce each other over time (Brewster & Miller, 2020).

Empirical findings on gender differences are inconsistent. While some studies report no significant gender differences in mathematics anxiety (Muhammad, 2017; Akbayır, 2019), others report higher anxiety levels among female students (Garba et al., 2021; AbdulRahaman et al., 2023). These inconsistencies underscore the need for context-specific studies such as the present research.

Research Question

1. What is the mean difference between the pretest and posttest algebra anxiety scores of students taught algebra using algebra whot game and those taught using the conventional method?
2. What is the mean difference between the pretest and posttest algebra anxiety scores of male and female students exposed to algebra whot game?

Research Hypothesis

1. There is no significant difference between the mean algebra anxiety scores of students taught algebra using AWG and those taught using the conventional method.
2. There is no significant difference between the mean algebra anxiety scores of male and female students exposed to algebra whot game.

Methodology

The study adopted a pretest–posttest quasi-experimental non-equivalent control group design. The population comprised all 5,225 SSII students in Kaura-Namoda Educational Zone (2023–2024 academic session) as obtained from the Education Quality Assurance Authority. Due to insecurity, schools were selected purposively, while simple random sampling was used to assign them to experimental (52) and control (57) groups. The whot-game used in this study was adopted from National Mathematical Centre (2002). The Algebra Anxiety Questionnaire (AAQ) with a reliability coefficient of 0.89 (Cronbach's Alpha), was used for data collection. The experimental group was exposed to the algebra whot-game intervention for a period of three weeks, the conventional teaching method was employed for the control group. Descriptive statistics (mean and SD) answered the research question, while ANCOVA tested the hypothesis at a 0.05 significance level. The hypotheses was tested at $p \leq 0.05$. It is retained when greater or equal to 0.05, otherwise rejected. The instrument was administered before and after the intervention to both groups.

The Algebra Whot Game was strategically used as a treatment in the experimental group to help students learn and develop skills in solving algebraic concepts. The game cards were developed locally using low-cost materials, preferably cardboard sheets, each measuring 9 cm x 12 cm. The cards covered key algebraic topics in the SS II curriculum. The game involves competition and adherence to its rules. It can be played by two, four to eight players, with a teacher or an appointed student serving as the judge. The player who retains the highest number of cards is declared the winner. Mathematics teachers in the research population do not use games in teaching mathematics. This create a window of opportunity to strategically adopt the whot game in the current study to examine it effect on students' anxiety in algebra.



The algebra anxiety questionnaire was adapted from May's (2009) Mathematics Self-efficacy and Anxiety Questionnaire and used to measure the students' anxiety in algebra. The original 15-item Likert-type scale was expanded to 20 items in this study to better capture students' anxiety response towards algebra. The response options are: Never Worried = 1 point; A Little Worried = 2 points; Sometimes Worried = 3 points; Frequently Worried = 4 points; and Always Worried = 5 points. The minimum score is 20 and the maximum obtainable score is 100.

The algebra anxiety questionnaire was validated by three experts in the field of Educational Psychology from a Federal University and Federal College of Education with a PhD, and not lower than Senior lecturer in the university and Chief lecturer in Federal College of Education. They confirmed both face and content validity and certified that the questionnaire was adequate for eliciting relevant responses for the study's objectives. They therefore recommended the instrument to be used for the study.

Results

Table 1 shows the Means (M), Standard Deviations (SD), and Standard Errors of Means (SEM) of the pretest and posttest scores of the algebra anxiety of students in the AWG and Control groups.

Table 1: Mean Gain Difference in Algebra Anxiety Scores between Pretest and Posttest of Groups

Group	N	Pretest			Posttest			Mean Gain	Mean Gain Difference
		Mean	SD	SEM	Mean	SD	SEM		
AWG	52	61.31	9.93	1.38	50.63	9.20	1.28	-10.68	-13.20
CON	57	52.37	8.84	1.17	54.89	7.15	0.95	2.52	

As revealed on Table 1, for the AWG group, a mean gain of 10.68 points reduction in algebra anxiety was found between the pretest ($M = 61.31$, $SD = 9.92$) and posttest ($M = 50.63$, $SD = 9.20$), in favour of the posttest scores. The negative sign indicates a reduction in algebra anxiety. Also, for the control group, a mean gain of 2.52 points increase in

algebra anxiety was found between the pretest ($M = 52.37$, $SD = 8.84$) and posttest ($M = 54.89$, $SD = 7.15$), in favour of the pretest scores. This indicates no reduction of algebra anxiety in the control group. A mean gain difference of 13.20 points reduction in algebra anxiety was found between the AWG and control group in favour of the AWG group.

Table 1 shows the Means (M), Standard Deviations (SD), and Standard Errors of Means (SEM) of the pretest and posttest scores of the algebra anxiety of male and female students in the AWG group.

Table 2: Mean Gain Difference in Algebra Anxiety Scores between Pretest and Posttest of Male and Female Students in Experimental Groups

Group	Gender	N	Pretest			Posttest			Mean Gain	Mean Gain Difference
			Mean	SD	SEM	Mean	SD	SEM		
AWG	Male	37	61.27	11.09	1.82	50.92	9.60	1.58	-10.35	1.12
	Female	15	61.40	6.58	1.70	49.93	8.41	2.17	-11.47	

The results revealed in Table 2 shows a mean gain of 10.35 was found between the pretest ($M = 61.27$, $SD = 11.09$) and posttest ($M = 50.92$, $SD = 9.60$) for the male students in AWG group. The negative mean gain indicates a reduction in algebra anxiety for the male students. Similarly, a gain of 11.47 was found

for the female students between the pretest ($M = 61.40$, $SD = 6.58$) and posttest ($M = 49.93$, $SD = 8.41$). The negative mean gain indicates a reduction in algebra anxiety for the female students. Between the male and female students, a mean gain difference of 1.12 was found in favour of the female students.

Research Hypotheses

Table 3 shows the Analysis of Covariance (ANCOVA) result of students exposed to the AWG and their counterpart not exposed to it in the control group.

Table 3: ANCOVA Summary of Algebra Anxiety Posttest Scores of Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	528.042 ^a	2	264.021	3.914	.023	.069
Intercept	6901.173	1	6901.173	102.298	.000	.491
ANXIETY_PRETEST	34.533	1	34.533	.512	.476	.005
GROUP	509.335	1	509.335	7.550	.007	.066
Error	7150.893	106	67.461			
Total	312272.000	109				
Corrected Total	7678.936	108				

a. R Squared = .069 (Adjusted R Squared = .051)

As shown in Table 3, the results indicated a statistical effect of group on post-anxiety scores after adjusting for pretest scores, $F(1, 106) = 7.75, p < 0.05$, partial $\eta^2 = .066$. Hypothesis one was rejected since $p < 0.05$. Thus, there is a significant difference between the mean algebra anxiety scores of students

taught algebra using AWG and those taught using the conventional method. The partial eta squared ($\eta^2 = .066$) indicates that approximately 6.6% of the variance in posttest scores can be attributed to the group differences. The mean difference was in favour of the AWG group, as revealed in the post-hoc test.

Table 3 shows the Analysis of Covariance (ANCOVA) result of students exposed to the AWG and their counterpart not exposed to it in the control group.

Table 4: Independent Samples T-Test of Algebra Anxiety Posttest Scores by Gender in the Experimental Groups.

Variable	Gender	N	Mean	SD	T	df	Sig	Decision
Anxiety	M	37	50.92	9.60	.347	50	.730	NS
	F	15	49.93	8.40				

NS = Not Significant

Table 4 show that no significant difference existed in algebra anxiety between male ($M = 50.92, SD = 9.60$) and female ($M = 49.93, SD = 8.40$) students ($t(50) = .35, p = .73$), in the AWG group. Thus, hypothesis two was retained, indicating no gender disparity on the level of algebra anxiety for both male and female students.

Discussion of the Finding

The finding of this study provide valuable insights into the effect of AWG on algebra anxiety among secondary students in Zamfara State. These findings align with findings from some previous studies while contradicting others, thus contributing to ongoing discourse in the field.

The result showed significant reduction in anxiety for the AWG group, this suggests the instructional effectiveness of educational games like AWG. The finding align with some previous studies.

The findings of (Wangid & Rudyanto, 2020; Ihendinihu (2020), Suryani & Hidayat, 2022; Omurtak & Zeybek, 2022; Sari et al., 2023) supported positive effects of instructional strategies on anxiety reduction. Wangid and Rudyanto (2020) researched the use of AR-assisted storybooks to reduce mathematical anxiety in elementary school students. Their findings reported that AR-assisted storybooks significantly reduced mathematics anxiety among elementary students, supported by a p-value of less than .05.

Ihendinihu (2020) reported improved student attitudes toward mathematics when games were incorporated into instruction. These studies suggest a more generalized effect of educational games on anxiety. Suryani and Hidayat (2022) conducted research on the psychology of learning in a geometry course with AR technology. The research concluded that pupils who apply AR show higher learning motivation than pupils who do not use AR, hence AR



on smartphones was effective in reducing mathematics anxiety. Omurtak and Zeybek (2022) investigated the effect of AR applications in biology lessons on academic achievement and motivation. A significant difference was found in favor of the experimental group in terms of the "anxiety in exams" dimension. Sari et al (2023) investigated infographic development through instagram to reduce mathematics anxiety and increase student learning outcomes. They reported that as many as 88% of students experienced an increase in learning outcomes after learning to use infographics through instagram, which indicated that the level of student anxiety in learning mathematics had decreased, aligning with the current study's reported 6.6% anxiety reduction.

In contrast, Omar et al. (2022) found that secondary students in Malaysia exhibited moderate mathematics anxiety, with no significant relationship between anxiety and achievement. Awofala et al. (2025) reported that smartphone-assisted jigsaw cooperative learning reduced students' mathematics anxiety. Mehmet and Yasemin (2021) showed that augmented reality-supported instruction enhanced academic achievement but did not significantly affect anxiety or motivation.

The second finding revealed no significant difference in algebra anxiety scores between male and female students. This indicates that both male and female students exhibited significant reductions in algebra anxiety equally when taught using AWG. This suggests that AWG is an inclusive instructional strategies that support consistent learning outcomes across genders.

The finding align with prior studies (Muhammad, 2017; Akbayır, 2019; Chukwuemeka et al., 2024; Abe & Gbenro, 2024) that reported no significant gender differences in mathematics anxiety. For instance, Muhammad (2017) examined gender differences in mathematics anxiety and performance among secondary school students and found a significant relationship between anxiety and performance, but not linked to gender. Akbayır (2019) explored mathematics anxiety levels among high school students based on gender. He found no significant differences in anxiety levels between male and female high school students. Similarly, Chukwuemeka et al. (2024) employed self-management techniques to reduce mathematics anxiety and improve academic achievement among pre-service ECCE teachers in Imo State. They reported that self-management techniques effectively reduced

mathematics anxiety and improved achievement regardless of gender.

Conversely, several studies contradict this finding (Justicia-Galiano et al., 2023; Garba, Aliyu, & Aliyu, 2021; AbdulRahaman et al., 2023). Justicia-Galiano et al. (2023) investigated gender stereotypes about mathematics anxiety, focusing on ability and emotional components. They found that female students were perceived as more prone to mathematics anxiety due to gender stereotypes related to ability and emotions. Garba, Aliyu, & Aliyu (2021) studied mathematics anxiety and its gender differences among secondary students in Sokoto State. They revealed a significant gender difference in mathematics anxiety among secondary school students in Sokoto State, Nigeria, thus contradicting the second finding of this study. AbdulRahaman et al. (2023) explored gender disparities in mathematics anxiety among senior high school students using an analytical cross-sectional design. They found that female students exhibited higher levels of mathematics anxiety than their male counterparts. Asikhia (2021) examined the effect of gender on mathematics anxiety among 270 SS II students in Ogun West Senatorial District. He reported higher mathematics anxiety scores for male students compared to females in the Ogun West Senatorial District.

Conclusion

This study examined the effect of the Whot-Game on algebra anxiety among SSII students in Kaura-Namoda Educational Zone, Zamfara State. The study concludes that there was an effect of whot game on algebra anxiety among senior secondary school students in Zamfara.

Recommendations

1. The study recommends the integration of algebra whot game into the teaching of algebraic concepts by mathematics teachers in Zamfara State.
2. Educational policymakers and curriculum planners should support continuous innovation testing and teacher training in the use of game based learning.
3. Zamfara state government should exposed mathematics teachers to workshop training on the effective implementation of mathematics game in teaching in secondary schools



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