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IMPACT OF TEAM-GAME-TOURNAMENT INSTRUCTION ON PERFORMANCE IN GENETICS CONCEPT AMONG SECONDARY SCHOOL STUDENTS IN ILORIN, KWARA STATE, NIGERIA

BY

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Abstract
This study investigated the impact of Team-Game-Tournament Instruction (TGTI) on performance in genetics concept among secondary school students in Ilorin, Kwara State, Nigeria. The study adopted quasi-experimental research design involving pretest and post-test. The study comprised of two groups (experimental and control). The experimental group was taught using TGTI, while the control group was taught using lecture method. A total of 2723 SS II students constituted the target population out of which 100 students were randomly selected and used as sample for the study. Genetics Performance Test (GPT) was used as instrument for data collection. GPT was duly validated, piloted and the reliability coefficient was found to be 0.84. The research questions were answered using mean and standard deviation while the research hypotheses were tested using independent t-test at P≤ 0.05 level of significance. The findings of the study showed that students in the experimental group performed significantly better than those in control group. The results also revealed no significant difference in performance of male and female students. It was concluded that TGTI is effective in the teaching and learning of genetics and it is gendering friendly approach. Based on the findings of the study, it was recommended among others that Biology teachers should employ the TGTI in the teaching of genetics in senior secondary schools to enhance students' performance.

Keywords: *Team-Game-Tournament Instruction, Impact, Performance and Genetics*

Introduction

Science and technology are powerful drivers of social and economic change. They influence every aspect of modern life, from healthcare and communication to industry and education. Recognizing their transformative potential, many governments prioritize investment in scientific research and technological innovation as pathways to progress. Many view science as a crucial tool for effective development. Supporting this, the United Nations Economic Commission for Africa (2023) emphasizes that science, technology, and innovation (STI) are

key enablers for economic growth, climate resilience, and sustainable development across the continent. The importance of Science, Technology, and Mathematical Education (STME) in nation-building cannot be overstated. STME serves as a vital instrument for reducing illiteracy and poverty. Moreover, it fosters the development of culturally and socially tolerant individuals who uphold ethical and moral values in local, national, and international contexts. Additionally, STME plays a key role in economic growth, contributes significantly to personal and community health, and has been described as the foundation for building a country's knowledge economy.

Science education focuses on preparing individuals with the necessary skills, abilities, and competencies both mentally and physically to live productively and contribute to societal development. The growing importance of science education has significantly reshaped educational objectives in many countries, including Nigeria. Recent research emphasizes the need to produce knowledge and deepen understanding that directly supports the advancement of Science, Technology, Engineering, and Mathematics (STEM) education (OECD, 2021). In Nigeria, considerable emphasis is placed on science as a core subject at all levels of education, extending to tertiary institutions. Reflecting this, the Federal Government of Nigeria stresses the importance of teaching science and technology across all educational levels, as outlined in the National Policy on Education (FRN, 2013). However, this focus sometimes contrasts with global reform initiatives aimed at enhancing both science and mathematics curricula and classroom practices. For example, recent reform frameworks in the United States, such as the Next Generation Science Standards (NGSS, 2013) and reports by the National Academies of Sciences, Engineering, and Medicine (NASEM, 2018), emphasize developing students' scientific literacy, conceptual understanding, and skills acquisition principles that are also applied in teaching foundational sciences like Chemistry, Physics, and Biology. Therefore, Biology remains an integral component of Science, Technology, Engineering, and Mathematics (STEM) education.

Biology is a branch of science that deals with the systematic study of life (Michael, 2018). Sarojini (2018) defines Biology as a life science that involves the study of plants and animals. Its content ranges from microscopic organisms to the biosphere, encompassing the earth's surface and all living things. Some branches of Biology include botany, zoology, anatomy, morphology, cytology, genetics, entomology, parasitology, and others. The teaching and learning of Biology is crucial to the development of any nation. Nation-building involves preparing the population for important careers in medical and paramedical fields, agriculture, industry, population management, wildlife control, and environmental management, among

others. Biology has universal applications in agriculture, human and veterinary medicine, and the development of vaccines and drugs for disease prevention and treatment. It is closely connected to agriculture, which is a biological production system dependent on the growth and development of plants and animals within a given environment (Okwo & Tartiyus, 2016). According to Oyarole (2016), some Biology concepts can be difficult, particularly when they involve abstract ideas that students may not fully comprehend at first. The WAEC Chief Examiner's Report (WAEC, 2024) revealed that students' academic performance in Biology is often poor, especially in topics such as evolution, ecology and genetics. Genetics is considered abstract and challenging, contributing significantly to students' difficulties and poor performance in secondary school Biology examinations.

Genetics, which is the focus of this study, is a branch of biological science that examines the processes and mechanisms of heredity (National Human Genome Research Institute, 2020). According to Smith and Jones (2021), genetics involves the study of heredity and variation, which explain the diversity observed among living organisms. In essence, genetics explores how traits and characteristics are transmitted from one generation to the next. It serves as a central pillar in the development of modern biology. However, genetics can be challenging for both teachers and students because it involves understanding relationships across different levels of biological organization, from molecular to organismal scales (OECD, 2022). Moreover, genetics often deals with phenomena that are not directly observable, involving probabilities that occur at scales too fast, too slow, or too large to be seen in real time. The field focuses on establishing the scientific foundation for understanding how traits are inherited from parents to offspring across generations.

Despite the important role of Biology among science and related disciplines, students' performance has consistently fallen below expectations. The WAEC Chief Examiner' reports (WAEC, 2023, 2024) indicate particularly low student performance in genetics. Previous research, such as studies by Lawal (2011), Olaniyan and Ajayi Smith and Jones (2021), highlighted that students often experience difficulties and confusion with genetics, leading to dislike and poor understanding of topics within this concept. Consequently, this contributes to poor overall performance in Biology, especially at the senior secondary school (SSS) level. Johnson and Smith (2021) attributed students' poor performance in Biology to several factors, including a lack of qualified teachers, insufficient practical work, reliance on traditional teaching methods, and the highly conceptual nature of the subject. Students frequently demonstrate poor comprehension of exam demands, struggle with key genetic terms such as pure-breeding, nucleotide, hybrid, dominant, and recessive traits, perform poorly on genetics-related questions, and

have difficulty drawing genetic diagrams. Additionally, there is limited awareness of genetics' applications in areas like marriage counselling and agriculture.

Given the multidimensional nature of these challenges, various efforts have been made to address the persistent failure rates among Biology students. Research has particularly focused on improving instructional methods, recognizing the critical role that teaching strategies play in effective knowledge transfer. Conventional teaching methods have had a significant impact on the teaching and learning of genetics, often contributing to students' difficulties in understanding the subject. Abiodun, Jame and Ebiejemite (2023) reported that these methods fail to help students actively construct their own understanding. Consequently, this approach not only results in poor academic performance but also hinders the development of critical skills essential for creative thinking. Abiodun, Daodu, and Eniolorunda (2024) further noted that conventional methods often relying heavily on lectures and rote memorization do not adequately accommodate the abstract nature of genetics concepts. As a result, students frequently struggle to form meaningful connections in their learning. Abiodun, Idris, Ebiejemite, Chatta, and Eniolorunda (2023) have suggested new and innovative teaching strategies. Among these, the Team-Game-Tournament instructional method stands out as a promising approach to enhance student engagement and understanding.

Team-Game-Tournament Instruction (TGTI) is a model of cooperative learning in which students are organized into small, heterogeneous groups that work together over an extended period. According to modern educational research, TGTI combines elements of direct instruction, group study, and academic tournaments to reinforce learning (Gillies, 2019). It is an instructional approach that balances cooperation with structured competition, fostering an engaging classroom environment. TGTI is designed to promote student engagement, facilitate mastery of academic content, and support peer collaboration. Recent studies, such as those by Johnson, Johnson, and Holubec (2021), describe TGTI as a strategy that enhances both academic achievement and interpersonal skills through active student participation. The model encourages students to take responsibility for their learning and provides frequent, constructive feedback during team-based tournaments. TGTI also uses educational games, quizzes, and an incentive-based scoring system, where team representatives compete with members of other teams to reinforce content knowledge (Tran, 2022). This structure not only improves subject mastery but also builds self-esteem, fosters social integration, and supports diverse learners. Furthermore, TGTI has been shown to positively impact both male and female students' performance and attitudes toward academic subjects. Juwita, Sari, and Yurike (2017) found that TGTI improved students' performance. Considering these benefits, therefore, this study investigated the impact of Team-

Game-Tournament Instruction on students' performance in genetic concepts, with particular attention to gender differences. Gender is another important variable considered in this study. Gender refers to the socially and culturally constructed roles, behaviours, and attributes that a given society considers appropriate for males and females (UNESCO, 2021). It is often assumed to influence academic performance among students, as learning outcomes may vary based on gender-related factors. Research indicates that gender can affect how students engage with content, respond to instructional methods, and perform academically. For example, a recent study by Adebayo and Olatunji (2022) found that female students outperformed their male counterparts in science-related subjects under collaborative learning environments. Given this context, the present study investigates the impact of Team-Game Tournament Instruction on student performance in genetics, with particular attention to gender differences among secondary school students in Ilorin, Kwara State, Nigeria.

Research Questions

The following research questions guided the study:

i. What is the difference between the mean performance scores of students taught genetic concepts using Team-Game Tournament Instruction and those taught using lecture methods?
ii. What is difference between the mean performance scores of male and female students taught genetic concepts using Team-Game Tournament Instruction?

Research Hypotheses

The following hypotheses were formulated and tested at $P \leq 0.05$ level of significance:

Ho_1: There is no significant difference between the mean performance scores of students taught genetic concepts using Team-Game Tournament Instruction and those taught using lecture method.

Ho_2: There is no significant difference between the mean performance scores of male and female students taught genetic concepts using Team-Game Tournament Instruction

Methodology

The research design adopted for this study was a quasi-experimental design involving a pretest and post-test. The study comprised two groups: an experimental group (EG) and a control group (CG). Both groups were pretested using the Genetic Concepts Performance Test (GCPT) before the treatment was administered. This was done to ensure uniformity and equivalence in performance levels at the outset. The experimental group was taught genetics using Team-Game Tournament Instruction (TGTI), while the control group was taught using the lecture method. The population of the study included all Senior Secondary School two (SS2) Biology students in the public secondary schools of Ilorin, Kwara State, Nigeria.

According to statistics from the State Ministry of Education, there are twenty-one (21) public schools with a total of two thousand seven hundred and twenty-three (2,723) Biology students, comprising one thousand one hundred and ninety-four (1,194) males and one thousand five hundred and twenty-nine (1,529) females. A simple random sampling technique by balloting was used to select two schools, which were then randomly assigned to the experimental and control groups. The total sample size for the two groups was one hundred (100) students. The study employed the Genetics Performance Test (GPT) as the instrument for data collection. The instrument consisted of 20 multiple-choice items, each with four options (A-D). The GPT was validated by experts in the field of Biology and pilot tested. The reliability coefficient, determined using the Pearson Product-Moment Correlation (PPMC), was found to be 0.84, indicating a high level of reliability. Therefore, the instrument is considered reliable for measuring the academic performance of the study participants.

Analysis

Research Question One: What is the difference between the mean performance scores of students taught genetic concepts using Team-Game Tournament Instruction and those taught using lecture method?

Descriptive statistics of mean and standard deviation was used to answer research questions. The summary of the analysis is presented in Table 1

Table 1

Summary of Mean Performance Scores between Experimental and Control Groups

Group	N	Mean	S.D.	Std. Error	Mean Diff
Experimental	60	77.63	8.75	0.82	29.73
Control	40	47.90	6.32	1.38	

Table 1 presents the summary of the mean performance scores for the experimental and control groups. The experimental group achieved a higher mean score of 77.63, while the control group recorded a mean score of 47.90. This resulted in a mean difference of 29.73 in favour of the experimental group. These results suggest a notable difference in performance between the two groups. To determine whether this difference is statistically significant, a t-test analysis was conducted on the scores.

Research Hypothesis One: There is no significant difference between the mean performance scores of students taught genetic concepts using Team-Game Tournament Instruction and those taught using lecture method.

To test this hypothesis, the mean scores obtained from the Genetic Concepts Performance Test (Table1) of the experimental and control groups were subjected to the independent t-test statistics at $P \leq 0.05$ as shown in Table 2.

Table 2:
Summary of the Independent T-test of Performance between Experimental and Control Groups

Group	N	Mean	SD.	Df	t-value	P-value	R
Experimental	60	77.63	6.32	98	19.7	0.001	S
Control	40	47.90	8.75				

Significant at P≤ 0.05

Table 2 presents the summary of the independent t-test comparing the experimental and control groups. A t-value of 19.7 with 98 degrees of freedom was obtained, and the corresponding p-value was 0.001. Since this p-value is less than the 0.05 alpha level of significance, it indicates a statistically significant difference between the experimental group, which was taught using the Team-Game Tournament Instruction, and the control group, which received the lecture method. Therefore, the null hypothesis that there is no significant difference between the mean performance scores of students taught genetics using Team-Game Tournament Instruction and those taught with the lecture method is rejected. These results demonstrate that the Team-Game Tournament Instruction is more effective in improving students' academic performance in genetics. This effectiveness is attributed to the student-centered nature of the Team-Game Tournament Instruction approach.

Research Question Two: What is difference between the mean performance scores of male and female students taught genetic concepts using Team-Game Tournament Instruction?

Descriptive statistics, including means and standard deviations, were used, and the results are presented in Table 3.

Table 3:
Summary of Mean Performance Scores between Male and Female Students in the Experimental Group

Group	N	Mean	SD	Std. Error	Mean Diff
Male	31	75.81	6.62	1.19	3.50
Female	29	79.31	5.71	1.06	

Table 3 shows the summary of descriptive statistics for the mean performance scores of male and female students taught genetic concepts using Team-Game Tournament Instruction. The results indicate that male students had a mean score of 75.81, while their female counterparts scored a slightly higher mean of 79.31.

The corresponding standard deviations were 6.62 for males and 5.71 for females. A mean difference of 3.50 was recorded in favor of the female students. This implies that female students performed better than male students when taught genetic concepts through the Team-Game Tournament Instruction. To determine whether this difference is statistically significant, a t-test analysis was conducted on the scores.

Research Hypothesis two: There is no significant difference between the mean performance scores of male and female students taught genetic concepts using Team-Game Tournament Instruction.

To test this hypothesis, the mean scores obtained from the Genetic Concepts Performance Test (Table 4.3) of male and female were subjected to independent t-test statistic at P≤ 0.05 as presented in Table 4

Table 4:

Summary of Independent t-test for Performance between Male and Female Students in the Experimental Group

Group	N	Mean	SD	Df	t-value	P-value	R
Male	31	75.81	6.62				
				58	2.18	0.33	NS
Female	29	79.31	5.71				

Not Significant at P≤ 0.05

Table 4 presents the summary of the independent t-test comparing the performance of male and female students in the experimental group exposed to Team-Game Tournament Instruction. A t-value of 2.18 with 58 degrees of freedom was obtained, corresponding to a p-value of 0.33. Since this p-value is greater than the 0.05 level of significance, the difference in performance between male and female students is not statistically significant. This implies that there was no significant difference in the achievement of male and female students in genetic concepts when taught using the Team-Game Tournament Instruction. Therefore, the null hypothesis that there is no significant difference between the mean performance scores of male and female students taught genetics using this method is retained. The results indicate that Team-Game Tournament Instruction is a gender-friendly teaching approach.

Discussion of Results

This study investigated the impact of Team-Game Tournament Instruction on performance in genetics concept among secondary school in Ilorin, Kwara State, Nigeria. The students in both the experimental and the control groups used in the study had equivalent knowledge of genetics as determined by the result of the pretest administered before the treatment commenced. Therefore, the differences observed were due to treatment. The data collected from the posttest administered was analyzed using independent t-test statistic at P ≤ 0.05 levels of significance.

The findings of the results are discussed as follows: Findings from Tables 1 and 2 indicate a significant difference between students taught using Team-Game Tournament Instruction and those taught with the lecture method. This suggests that the use of Team-Game Tournament Instruction effectively improves students' academic performance in genetics. These results are aligned with the study by Juwita, Sari and Yurike (2017), which demonstrated that Team-Game Tournament Instruction significantly enhanced students' performance. Their study showed higher mean scores for students in the experimental groups compared to those taught using other learning methods, further supporting the effectiveness of this instructional approach. This highlights the potential of Team-Game Tournament Instruction to engage students more actively and improve learning outcomes.

Findings from Tables 3 and 4 indicate that there is no significant difference between the mean performance of male and female students when exposed to Team-Game Tournament Instruction (TGTI). This suggests that TGTI is a gender-friendly teaching method. This result aligns with the study by Juwita, Sari and Yurike (2017), who reported no significant gender difference in achievement among students exposed to Team-Game Tournament (TGT). Additionally, this study supports the findings of Lawal (2011) and Ibrahim (2015), who also found no significant difference in the performance of male and female students in genetic concepts. Such findings emphasize the potential of TGTI to create an inclusive learning environment that supports equitable student outcomes regardless of gender.

Conclusions

Based on the findings of the study, it was concluded that Team-Game-Tournament Instruction (TGTI) is more effective than the lecture method in improving secondary school students' performance in genetic concepts. The higher mean scores recorded by students exposed to TGTI demonstrate their positive impact on learning outcomes. Furthermore, the instruction method was found to be gender-neutral, as there was no significant difference in performance between male and female students. These results suggest that TGTI provides an inclusive and engaging learning environment that fosters better understanding and retention of genetic concepts.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Schools and educators should incorporate TGTI as a regular teaching strategy in genetics and other science subjects to enhance student engagement and improve academic performance.
2. Professional development programs should be organized to train teachers on the effective implementation of cooperative learning techniques like

TGTI, ensuring they have the skills to facilitate interactive and student-centered lessons.

3. Curriculum planners and policymakers should consider integrating cooperative learning models like TGTI into science curricula to foster deeper understanding and retention of complex scientific concepts.

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