



JOURNAL OF SCIENCE, TECHNOLOGY AND EDUCATION (JSTE)



**A PUBLICATION OF THE
DEPARTMENT OF SCIENCE,
TECHNOLOGY AND MATHEMATICS
EDUCATION (STME),
NASARAWA STATE UNIVERSITY, KEFFI, NIGERIA**



VOLUME 10

ISSN: 2651-5539

EFFECT OF INTEGRATING MOTIVATION INTO CLASSROOM INSTRUCTION ON STUDENTS' ACHIEVEMENT IN GENETICS IN KEFFI EDUCATION ZONE, NASARAWA STATE, NIGERIA

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Citation: Shafa, H., M., Tanko, J. A., & Uzoechi, B., C. (2026). Effect of integrating motivation into classroom instruction on students' achievement in genetics in Keffi Education Zone, Nasarawa State, Nigeria. *Journal of Science, Technology, and Education (JSTE)*; www.nsukjste.com/. 10(44), 614-626.

Abstract

The study determined the effect of integrating motivation into classroom instruction on students' achievement in genetics in Keffi Education Zone, Nasarawa State, Nigeria. The study adopted a quasi-experimental, pre-test, post-test, non-randomised control group design. The target population comprised all 1,519 Senior Secondary Three (SS3) Biology students (779 male and 740 female) in the six co-educational public secondary schools in Keffi Local Government Area of Nasarawa State during the 2024/2025 academic session. A sample of 133 SS3 students, drawn as intact classes from two randomly selected schools, took part in the study. Two objectives, two research questions and two null hypotheses guided the study, and the hypotheses were tested at the 0.05 level of significance. Data were collected with the Genetics Achievement Test (GAT), which had a reliability index of 0.93. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the null hypotheses.

The findings revealed that students taught with motivation-integrated instruction achieved significantly higher post-test scores in genetics than those taught with the conventional method ($F(1, 130) = 94.781, p < 0.05$), and that there was no significant difference between the achievement of male and female students taught with motivation ($F(1, 68) = 0.077, p > 0.05$). The study recommended that Biology teachers should integrate motivational strategies such as praise, rewards, goal-setting and real-life examples into genetics instruction; that government and school administrators should provide adequate instructional materials to support motivational teaching; and that school administrators should periodically organise seminars and workshops to train in-service and pre-service teachers in the use of motivational strategies.

Keywords: Motivation, Classroom Instruction, Achievement, Gender, Genetics

Introduction

Science education was recognised as central to national development, and biology was one of its foundational subjects. Within biology, genetics was widely regarded as one

of the most difficult topics for secondary school students (Bahar et al., 1999; Çimer, 2012), largely because it relied on abstract concepts such as genes, chromosomes, inheritance patterns and probability, none of

which could be observed directly (Lewis & Wood-Robinson, 2000). Teachers often relied on lecture-based methods, which left many students passive, disengaged and struggling to grasp the content (Abimbola & Bello, 2024). This was a serious limitation, since a meta-analysis of 225 studies showed that students in traditional lecture classes were 1.5 times more likely to fail than those taught through active learning (Freeman et al., 2014). Persistently poor performance in genetics had been a recurring concern in biology examinations in Nigeria (West African Examinations Council [WAEC], 2019; Abimbola & Bello, 2024).

Motivation was identified as one of the key factors that shaped how students learned (Ryan & Deci, 2000a; Schunk et al., 2014). Motivated students tended to pay closer attention, participate actively, persist through difficult content and develop a genuine interest in the subject (Glynn et al., 2011). Miao et al. (2020) described motivation as the force that drove people to achieve high levels of performance and to overcome barriers to change. Where instruction did not stimulate curiosity or connect content to students' lives, interest declined, and achievement suffered (Niemic & Ryan, 2009). Integrating motivational strategies into classroom instruction, such as relating genetics to real-life situations, using hands-on activities, giving feedback and encouragement (Hattie & Timperley, 2007),

and setting achievable goals (Locke & Latham, 2002), was therefore expected to make learning more engaging and effective. Meta-analytic evidence supported this expectation: intrinsic motivation predicted school achievement over time (Taylor et al., 2014) and remained a medium-to-strong predictor of performance even when extrinsic incentives were present (Cerasoli et al., 2014).

Despite its importance, motivation received little deliberate attention during instruction in many Nigerian classrooms. In the Keffi Education Zone of Nasarawa State, students' performance in biology, particularly in genetics, remained a concern, and there was limited empirical evidence on whether motivation-integrated teaching could improve learning outcomes. Nigerian studies had linked motivation to achievement in biology (Ozioko, 2019; Olosunde & Babatunde, 2025), but these were correlational and did not test motivation as a deliberate instructional intervention in genetics. This study therefore investigated the effect of integrating motivation into classroom instruction on students' achievement in genetics in the Keffi Education Zone. Its findings were intended to help teachers, curriculum planners and other education stakeholders improve the teaching and learning of genetics.

Nitko (2021) described academic achievement as the level of success and

progress made towards educational goals, typically measured through grades, standardised tests and the completion of assignments and projects. The construct encompassed proficiency in reading, mathematics, science, and social studies and reflected the knowledge, skills, and competencies students acquired in their academic pursuits. It was usually assessed through tests, examinations, assignments, projects and other evaluations. Onyekwere, Okoro and Eugene (2018), Zaccane and Pedrini (2019), Darman (2023), Udegbonam (2024a, 2024b) and Ali and Talib (2025) found that motivation improved students' achievement and attentiveness, encouraged them to become active learners, and provided meaningful feedback to both students and teachers.

This study was anchored on Cognitive Evaluation Theory (CET), propounded by Deci and Ryan (1985) as a sub-theory of Self-Determination Theory. CET explained the factors that influenced intrinsic motivation, namely the natural human tendency to engage in an activity out of interest and inherent satisfaction rather than for external rewards or pressures (Ryan & Deci, 2000a). The theory addressed the mechanism through which integrating motivation into classroom instruction was expected to influence students' achievement in genetics. Students often perceived genetics as abstract and difficult, and conventional teaching

approaches such as lecturing and rote memorisation tended to be controlling rather than need-supportive (Reeve, 2009), which might explain the persistently low achievement in the topic. By integrating motivational strategies into instruction, such as giving students choice in learning activities, offering informative rather than judgemental feedback (Deci et al., 1999), and setting collaborative, relevant and appropriately challenging genetics tasks, teachers could satisfy students' needs for competence and autonomy (Niemic & Ryan, 2009; Ryan & Deci, 2000b).

Following the logic of CET, satisfying these needs was expected to heighten students' intrinsic motivation to learn genetics. Heightened motivation would, in turn, translate into greater engagement, effort and persistence, and ultimately into improved academic achievement (Taylor et al., 2014). CET therefore provided the theoretical basis for the study's central hypothesis: students exposed to motivation-integrated instruction would achieve significantly higher scores in genetics than those taught through conventional methods, because the former approach more effectively satisfied the psychological needs that CET identified as the foundation of intrinsic motivation.

Gender was considered a possible influence on students' experiences, interests and learning outcomes. Kimmel and Aronson (2021) defined gender as "the social and

cultural meanings that societies assign to the biological differences between sexes,” a definition that encompasses the roles, behaviours, identities and expectations constructed around individuals based on their perceived sex. Some earlier studies reported that males tended to show more interest in mathematics and science, while females showed greater interest in language arts and the social sciences. These differences, however, varied widely among individuals, and a broad range of interests existed within each gender. Hyde (2005), in a review of 46 meta-analyses, found that most psychological gender differences, including most of those in mathematics, were small or close to zero. Nigerian studies on biology and genetics instruction have likewise reported no significant difference in achievement between male and female students (Alabi & Abimbola, 2019; Ahmed et al., 2021).

Gender equity in education sought to ensure that all students, regardless of gender, had equal opportunities to succeed academically, and inclusive teaching practices were regarded as one way of narrowing potential gender gaps in achievement. On this basis, the study also examined whether the effect of motivation-integrated instruction on achievement in genetics differed between male and female students in the Keffi Education Zone, Nasarawa State.

Statement of the Problem

Genetics was a core area of the senior secondary biology curriculum, yet students consistently performed poorly in it. Chief examiners’ reports of the West African Examinations Council (WAEC) and the National Examinations Council (NECO) repeatedly pointed to weak understanding of inheritance, genetic crosses and related concepts (WAEC, 2019; Abimbola & Bello, 2024). The topic was abstract and vocabulary-heavy (Bahar et al., 1999; Çimer, 2012), and it demanded reasoning and problem-solving skills that many students found difficult to develop.

A major contributing factor was the way genetics was taught. Instruction in many classrooms was teacher-centred and lecture-based, with little attention to the factors that drive students to learn (Ahmed et al., 2021; Abimbola & Bello, 2024). Students were often passive listeners, saw little link between genetics and their daily lives, and received limited encouragement or meaningful feedback. Consequently, interest in the topic was low, and that low interest led to poor achievement.

Although motivation was widely recognised as a key determinant of learning (Schunk et al., 2014), it was seldom built deliberately into lesson delivery. Existing studies on motivation in science education had largely focused on other regions, other subjects or general academic performance, and few had examined its effect on achievement in

genetics specifically. In the Keffi Education Zone of Nasarawa State, little empirical evidence existed on whether motivation-integrated instruction could address the persistent difficulties students faced in this topic.

The problem of this study, therefore, was to determine the effect of integrating motivation into classroom instruction on students' achievement in genetics in the Keffi Education Zone.

Objectives of the Study

The main aim of the study was to determine the effect of integrating motivation into classroom instruction on secondary school students' achievement in genetics in the Keffi Education Zone, Nasarawa State. Specifically, the objectives were to:

1. determine the effect of motivation on students' achievement in genetics in the Keffi Education Zone, Nasarawa State; and
2. determine the effect of motivation on the achievement of male and female students in genetics.

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of students taught genetics using motivation and those taught using the conventional method?

2. What are the mean achievement scores of male and female students taught genetics using motivation?

Null Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

H₀₁: There was no significant difference in the mean achievement scores of secondary school students taught genetics using motivation and those taught using the conventional method.

H₀₂: There was no significant difference in the mean achievement scores of male and female students taught genetics using motivation.

Methodology

The study adopted a quasi-experimental design with a pre-test, post-test, non-randomised control group. The design was considered appropriate because intact classes were used (Shadish et al., 2002; Creswell, 2014). Two intact classes were randomly assigned to the experimental and control groups. The experimental group was taught genetics with motivation integrated into instruction, while the control group was taught genetics using the conventional teaching method (demonstration method).

The population of the study consisted of all SS3 students offering Biology in the Keffi Area Educational Quality Evaluation Office

(AEQEO). The target population comprised all 1,519 SS3 students (779 male and 740 female) in six public co-educational schools during the 2025/2026 academic session. SS3 was chosen because genetics was taught at that level of the curriculum and because students at that stage were considered cognitively mature enough to learn the topic through motivation-integrated instruction. A sample of 133 SS3 students (70 male and 63 female) was used for the study. Simple random sampling was used to select the schools. First, two schools were randomly selected from the Keffi AEQEO by balloting. Second, one intact SS3 class was randomly sampled in each school. Third, one intact class was randomly assigned to the experimental group and the other to the control group. The number of students in each class was confirmed by a physical head count. Because gender was a moderator variable, students in the sampled classes were classified by gender. Random selection gave every school and class an equal chance of being chosen, reducing selection bias that might otherwise have threatened the study's validity and reliability. The Genetics Achievement Test (GAT), developed by the researcher, was used to collect pre-test and post-test achievement data. The GAT was a

30-item multiple-choice objective test based on the genetics content of the SS3 Biology curriculum, covering the transmission and expression of characters in organisms, genetic terms and heredity concepts. Items were constructed according to the revised Bloom's taxonomy of the cognitive domain (Anderson & Krathwohl, 2001). Item weighting reflected the proportion of lower-order objectives (Remember, Understand and Apply) and higher-order objectives (Analyse, Evaluate and Create) in the unit, as set out in the table of specification. Three experts validated the instrument for face and content validity and found it valid. To assess its reliability, the GAT was pilot tested with a small, comparable group of SS3 students who were not part of the sample. The Kuder-Richardson 21 (KR-21) formula (Kuder & Richardson, 1937) was used to estimate the internal consistency of the GAT, which yielded a reliability coefficient of 0.92. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at the 0.05 level of significance, with pre-test scores as the covariate to adjust for initial differences between the intact groups (Shadish et al., 2002).

Results

Research Question One

What are the mean achievement scores of students taught genetics using motivation and those taught using the conventional method?

Table 1. Mean Achievement Scores and Standard Deviations of Students Taught Genetics Using Motivation and Those Taught Using the Conventional Method

Teaching strategy	Type of test	No of students	Mean score	Std Dev.
Experimental	Pre-test	71	10.25	2.459
	Post-test	71	24.03	3.299
Control	Pre-test	62	9.56	1.989
	Post-test	62	18.89	2.483

Table 1 showed that the pre-test and post-test mean achievement scores and standard deviations of students taught genetics using motivation were ($\bar{x} = 10.25, \sigma = 2.459$) and ($\bar{x} = 24.03, \sigma = 3.299$) respectively. The corresponding pre-test and post-test mean achievement scores and standard deviations

of students in the conventional group were ($\bar{x} = 9.56, \sigma = 1.989$) and ($\bar{x} = 18.89, \sigma = 2.483$) respectively. Both groups therefore started from similar baselines, but the experimental group gained 13.78 marks from pre-test to post-test, compared with 9.33 marks for the control group.

Null Hypothesis One

There was no significant difference in the mean achievement scores of students taught genetics using motivation and those taught using the conventional method. The data used to test this hypothesis were presented in Table 2.

Table 2. Results of Analysis of Covariance on the Achievement Scores of Students Taught Genetics Using Motivation and Those Taught Using the Conventional Method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	895.194 ^a	2	447.597	52.058	0.000
Intercept	2504.845	1	2504.845	291.325	0.000
Pretest	20.400	1	20.400	2.373	0.126
Group	814.934	1	814.934	94.781	0.000
Error	1117.753	130	8.598		
Total	64247.000	133			
Corrected Total	2012.947	132			

Table 2 showed $F_{(1, 130)} = 94.781$ with an associated probability value of 0.000, which was less than the α (alpha) value of 0.05 ($F = 94.781, p = 0.000 < \alpha = 0.05$). This indicated that there was motivation, and those taught using the conventional method were in favour of the motivation group. The null hypothesis was therefore rejected.

Research Question Two

What are the mean achievement scores of male and female students taught genetics using motivation?

Table 3. Mean Achievement Scores and Standard Deviations of Male and Female Students Taught Genetics Using Motivation

Gender	Type of test	No of students	Mean score	Std Dev.
Male	Pre-test	37	10.05	2.415
	Post-test	37	23.86	3.497
Female	Pre-test	34	10.47	2.525
	Post-test	34	24.21	3.112

Table 3 showed that the pre-test and post-test mean achievement scores and standard deviations of male students taught genetics using motivation were ($\bar{x} = 10.05, \sigma = 2.415$) and ($\bar{x} = 23.86, \sigma = 3.497$) respectively, while the corresponding pre-test and post-test mean achievement scores

Motivation-integrated instruction had a significant and large effect on students' post-test achievement in genetics after controlling for pre-test scores (partial $\eta^2 = 0.42$, a large effect by the benchmarks of Cohen, 1988), whereas the pre-test covariate was not a significant predictor of post-test scores ($F = 2.373, p = 0.126$).

and standard deviations of female students taught genetics using motivation were ($\bar{x} = 10.47, \sigma = 2.525$) and ($\bar{x} = 24.21, \sigma = 3.112$) respectively. Male students gained 13.81 marks and female students gained 13.74 marks, a difference of less than one tenth of a mark.

Null Hypothesis Two

There was no significant difference in the mean achievement scores of male and female students taught genetics using motivation. The data used to test this hypothesis were presented in Table 4.

Table 4. Results of Analysis of Covariance on the Achievement Scores of Male and Female Students Taught Genetics Using Motivation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	39.814 ^a	2	19.907	1.875	0.161
Intercept	1660.034	1	1660.034	156.319	0.000
Pretest	37.753	1	37.753	3.555	0.064
Gender	0.822	1	0.822	0.077	0.782
Error	722.130	68	10.620		
Total	41754.000	71			
Corrected Total	761.944	70			

Table 4 showed $F_{(1, 68)} = 0.077$ with an associated probability value of 0.782, which was greater than the α (alpha) value of 0.05 ($F = 0.077$, $p = 0.782 > \alpha = 0.05$). This indicated that there was no significant difference in the mean achievement scores of male and female students taught genetics

using motivation. The null hypothesis was therefore not rejected. The effect of motivation-integrated instruction on achievement in genetics did not differ significantly by gender, and the effect size for gender was negligible (partial $\eta^2 = 0.001$; Cohen, 1988).

Discussion of Findings

This study examined the effect of integrating motivation into classroom instruction on achievement in genetics among senior secondary school students in the Keffi Education Zone, Nasarawa State. Data collected with the GAT were analysed using mean, standard deviation and ANCOVA, and the findings were interpreted as follows.

The findings showed a significant difference in the mean achievement scores of students taught genetics using motivation and those taught using the conventional method. Students exposed to motivation-integrated

instruction understood genetics better than their counterparts in the control group, and the large effect size indicated that the difference was of practical as well as statistical importance. This finding agreed with those of Onyekwere, Okoro and Eugene (2018), Zacccone and Pedrini (2019), Darman (2023), Udegbonam (2024a, 2024b) and Ali and Talib (2025), who found that motivation improved students' achievement and attentiveness, encouraged active learning and provided meaningful feedback to both students and teachers. It also mirrored Nigerian studies in which learner-centred strategies outperformed conventional

teaching in biology and genetics (Ahmed et al., 2021; Abimbola & Bello, 2024). The results also showed that motivation-integrated instruction was gender-neutral, as it benefited male and female students alike. The mean achievement scores of male and female participants did not differ significantly, and both groups recorded almost identical gains from pre-test to post-test. This result was consistent with Alabi and Abimbola (2019) and Ahmed et al. (2021), who found no significant gender difference in achievement when senior secondary students were taught biology with alternative instructional strategies, and with Hyde's (2005) conclusion that gender differences in most cognitive outcomes were small.

The improved achievement of the treatment group could be explained by Cognitive Evaluation Theory (Deci & Ryan, 1985), which held that social and environmental factors such as rewards, feedback and supervision affected individuals' intrinsic motivation (Ryan & Deci, 2000b). According to the theory, rewards, praise and control could either strengthen or weaken a student's natural interest in learning, depending on whether the student experienced them as informative or controlling (Deci et al., 1999). The motivational strategies used in this study were informative and supportive, and their appropriate use appeared to have enhanced students' engagement with, and achievement in, genetics. They were also consistent with

evidence that specific, task-focused feedback (Hattie & Timperley, 2007) and clear, achievable goals (Locke & Latham, 2002) improved performance.

Motivation-integrated instruction therefore appeared to be a useful means of reducing the apprehension that students commonly showed towards genetics lessons. The activities it promoted, including goal-setting, feedback and the use of real-life examples, probably sustained students' attention and mental effort, and so facilitated the acquisition of the knowledge and skills needed to solve problems in genetics.

Conclusion

The study concluded that integrating motivation into classroom instruction significantly improved senior secondary school students' achievement in genetics in the Keffi Education Zone, and that male and female students benefited from it to the same degree. Motivation-integrated instruction was therefore an effective and gender-neutral approach to teaching genetics.

Recommendations

The following recommendations were made based on the findings of the study:

1. Integration of motivational strategies in teaching: Biology teachers in the Keffi Education Zone, and in Nigeria at large, should integrate motivational strategies such as praise, rewards, goal-setting and real-life examples into genetics instruction to enhance

students' competence and achievement.

2. Provision of instructional materials: Government and school administrators should provide adequate instructional materials, such as charts, models, videos and rewards like stickers, to support motivational teaching, especially for abstract topics such as genetics.
3. Teacher training: School administrators should periodically organise seminars and workshops to train in-service and pre-service Biology teachers in the use of motivational strategies for teaching genetics and other biology concepts, since teachers could be helped to adopt a more autonomy-supportive motivating style

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