JOURNAL OF SCIENCE TECHNOLOGY AND EDUCATION 12(4), DECEMBER, 2024
ISSN: 2277-0011; Journal homepage: www.atbuftejoste.com.ng

Impact of the Station-Rotation Blended Learning Design on Motivation and Educational Attainment in Genetics at Secondary level Slow Learners in Zaria, Nigeria

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ABSTRACT

The present study explored the Impact of the Station-Rotation Mixed-Mode Learning on Motivation and Genetics achievement of School Slow Learners in Zaria, Nigeria. The study adopted a quasi-experimental and control group design. The study's population comprises of 8,439 (4853 males and 3586 females in 29 schools. The sample of the study comprised of two intact classes of 61 slow learners (20 students from experimental group and 31students from the control group). The experimental group was taught utilising the Station-Rotation Blended Learning instruction, whereas the control group was instructed utilising the conventional teaching method. Two instruments were used for data collection, they were Genetics Performance Test (GPT) and Genetics Concept Motivation Questionnaire (GCMQ). The two instruments were validated by three experts in Science Education and Psychology. The reliability tests for GPT were obtained using a test-retest procedure while the coefficients were established using Pearson's Product- Moment Correlation Coefficient (PPMCC) which was found to be 0.74. Cronbach's alpha statistic was used to compute the reliability coefficients of GCMQ and GPT which were found to be 0.83 and 0.76 respectively. The research questions were addressed using Mean and Standard Deviation, as well as Mean Rank and Sum of Mean Ranks, while the null hypotheses were tested using the t-test and the Mann-Whitney H-test at a significance level of $p < 0.05$. Among the findings, it was established that there is a substantial disparity in the academic performance mean scores of students taught genetics utilizing the Station-Rotation Blended Instruction compared to those taught utilising the conventional method. Consequently, it is recommended that biology teachers adopt the Station-Rotation Blended Learning strategy for teaching genetics.

ARTICLE INFO
Article History
Received: July, 2024
Received in revised form: September, 2024
Accepted: November, 2024
Published online: December, 2024

KEYWORDS
Station-Rotation, blended learning, genetics, academic performance and slow learners

INTRODUCTION

Science education is essential in managing natural resources sustainably ensuring ecological balance and addressing environmental issues (Srinivas & Vedavathi, 2024). In developing countries like Nigeria, advancements in science and technology education are crucial for improving security capabilities and mitigating threats (Adah, 2023). The historical development of science is interwined with societal needs, influencing how knowledge is perceived and utilized (Chakraborty, 2021).

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Teaching biology is crucial for fostering scientific literacy and understanding the complexities of life and the environment. Biology education develops students' scientific literacy, enabling them to understand and engage with biological concepts and issues in their daily lives ((Tzovla & Kedraka, 2020). It equips learners with essential life skills, including analytical skills and decision making, which are vital for achieving personal and professional success (Mahmudova, 2024).

These among others according to Iksan and Daniel (2019) include appropriate use of wait-time appropriate methods of teaching such as inquiry, guided discovery, project laboratory, field trip/excursion and cooperative instruction. Since Biology is considered fundamental subject for science students at the high school levels in Nigerian educational system.

Station-Rotation Blended learning is an educational approach that combines online learning with traditional face-to-face instruction allowing students some control over their learning environment. Violetta et al. (2024) defined Station-Rotation Blended Learning as an instructional approach where students engage in learning in conjunction with e-learning platforms, allowing them a degree of control over aspects such as time, location, learning path, or pace, while being supervised in a setting outside their home.

According to Mikawati and Susianna (2024), Station-Rotation learning normally occurs in structured setting often within a classroom ensuring guidance from education. Each Station-Station normally target different skills such as reading, listening promoting a comprehensive understanding of the subject matter (Khalmatova & Ektĭ, 2023). It was opined by Lee and Cheon (2024) that slow learners are often associated with borderline intellectual functioning (BIF), which lacks a consensus definition and specific diagnostic criteria (Lee & Cheon, 2024). Research has identified slow learners as a distinct group differentiating them from those with intellectual disabilities and learning disabilities, leading to classification based on academic and cognitive characteristics (Kim et al., 2022). According to Tri et al. (2023) slow learners can be identified through IQ tests, teacher observations and analysis of academic performance. In rural settings where IQ testing resources are limited focusing on motivation, self-confidence and consistent support from teachers and parents (Anggi, 2022).

Motivation is a complex multidimensional construct that interacts with cognition to influence learning. According to Fernando et al. (2024) High motivation correlates with improved academic outcomes, as motivated students tend to be more diligent and persistent in their studies.

Problem Statement

Over the years, students' learning results in biology during public examinations has fluctuated significantly. Research highlights that qualified teachers and effective teaching strategies are essential for improving students' academic performance in biology (Fernando et al., 2024). Several interrelated factors have been identified as contributing to students' unsatisfactory progress in genetics, including misconceptions, inadequate facilities, teaching methods, and cognitive challenges.

Misconceptions about genetic concepts often arise from prior education and informal learning experiences. Additionally, ineffective teaching methods, such as fast-paced lessons and insufficient explanations, hinder students' understanding of genetics. The lack of laboratory facilities further impedes students' comprehension of genetics by depriving them of practical learning experiences. Consequently, many students resort to rote memorization of facts without a meaningful understanding of the concepts, which also negatively affects their retention levels. Despite efforts by educators to identify solutions to these challenges, students' performance in biology has continued to decline. Most teaching approaches and strategies appear to favor average learners rather than addressing the needs of slow learners. This lack of individualized attention and additional time for slow learners has been widely observed among secondary school teachers and has been linked to poor academic outcomes for this group.

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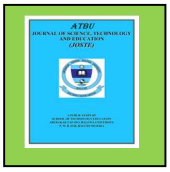

To enhance the academic performance of slow learners, student-centered teaching strategies have proven to be effective. One such approach is the station-rotation blended learning approach, which facilitates active participation and engagement. Motivation is a critical factor in academic success, and when appropriate teaching methods are employed, students are more likely to perform well. This study, therefore, investigates the impact of the Station-Rotation Blended Learning Strategy on the motivation and classroom accomplishment of slow learners in genetics in secondary education institutions in Zaria, Kaduna State, Nigeria.

Objectives of the Study

The present investigation was guided by the objectives outlined below:

1. To examine the impact of the Station-Rotation Blended Learning Strategy on the learning performance of slow learners in genetics.
2. To assess the impact of the Station-Rotation Blended Learning Strategy on the motivation levels of slow learners in genetics.

Research Questions

This investigation explored the following research questions:

1. How do the academic performance mean scores of slow learners taught genetics utilising the Station-Rotation Blended Learning Strategy compare to those taught the same concepts through the conventional method?
2. What are the differences in the motivation mean ranks of slow learners taught genetics through the Station-Rotation Blended Learning Strategy versus those taught utilising the conventional method?

Null Hypotheses:

This study is guided by the following null hypotheses:

1. There is no significant difference in the academic performance mean scores of students taught genetics through the Station-Rotation Blended educational tactic and those taught utilising the conventional method.
2. There is no significant disparity in the motivation mean ranks of slow learners taught genetics through the Station-Rotation Blended Learning Technique and those taught utilizing the conventional method.

METHODOLOGY

This investigation employed a pretest-posttest quasi-experimental control group design. This design facilitated a comparison between the intervention and control conditions to evaluate the outcome of the Station-Rotation Learning Strategy on slow learners' motivation and academic performance in genetics. The Experimental Group (EG) received instruction using the Station-Rotation Learning Model, while the Control Group (CG) was taught using the traditional lecture method. A pretest (O_1) was administered to both groups to assess students' baseline performance, and a posttest was conducted after the intervention to evaluate its impacts.

The target population for this study comprised all Senior Secondary 2 (SS2) biology students in public schools within the Zaria Education Zone of Kaduna State. As of the 2022 academic session, the population included 8,439 students: 4,853 males and 3,586 females across twenty-nine (29) schools (Zaria Education Zone, 2022). Six schools were purposively selected based on gender inclusiveness and the availability of Information and Communication Technology (ICT) facilities. The Genetics Performance Test (GPT) was administered to the selected schools as a pretest, and the results were analyzed using Analysis of Variance (ANOVA) at a significance level of P = 0.05. No substantial disparity were observed across the schools.

By way employing chance selection technique, two schools were choosen: one was designated as the Experimental Group (EG) and the other as the Control Group (CG). Students from two intact classes in each school constituted the sample for the study. The identification of slow learners was based on interviews with teachers, observation of the learning process, and a review of students' performance records from Senior

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Secondary 1 (SS1) second and third terms to Senior Secondary 2 (SS2) first term. This period was chosen as it represents a phase where students are considered academically stable.

The Experimental Group was instructed using the Station-Rotation Learning Strategy, while the Control Group received instruction via the conventional lecture method for a period of six weeks. The topics covered included definitions of genetic terms, monohybrid and dihybrid inheritance, simple crosses involving single characters in organisms, Mendel's laws of inheritance, and the application of genetics in human populations. This method allowed for an in-depth examination of the effects of the intervention. The sample comprised of 61 students, 25 males and 26 females.

This study utilized two instruments: the Genetics Concepts Motivation Questionnaire (GCMQ) and the Genetics Performance Test (GPT), to assess students' motivation and performance in genetics. The GCMQ was adapted from Vallerand et al. (1992) and consisted of two sections: Section A included demographic data, while Section B comprised 21 items designed to assess students' motivation regarding genetics. The GCMQ was based on a 5-point Likert scale, ranging from Strongly Agree (5) to Strongly Disagree (1).

The GPT was developed by adapting items from past Senior Secondary Certificate Examination (SSCE) question papers (2017–2021). It comprised 30 multiple-choice questions, each with four options (A–D), and was designed to measure students' achievement in genetics. The topics covered included definitions of genetic terms, monohybrid and dihybrid inheritance, simple crosses involving single characters in organisms, Mendel's laws of inheritance, and the application of genetics in human populations. Each correct answer was awarded one mark, resulting in a maximum score of 30.

Both instruments were validated by a panel of experts, including three biology teachers with at least a first degree in Biology Education and a minimum of ten years of teaching experience, as well as two PhD holders who were lecturers in the Science Education at a university level. The reliability of the GCMQ was determined using the split-half method, yielding a reliability coefficient of 0.76, while the GPT's reliability was assessed using the test-retest method with a Pearson's Product Moment Correlation Coefficient (PPMC) of 0.74.

A pilot test was conducted in a senior secondary school within the study population but outside the selected sample. This process allowed the researcher to evaluate the feasibility of the teaching model and the functionality of the instruments. Additionally, the pilot test helped determine the appropriateness of the testing duration, identify potential issues with the instruments, and refine them for the final study.

The experimental group was taught genetics using the Station-Rotation Learning Model, which aims to provide students with diverse knowledge and experiences across various learning stations. In contrast, the control group was taught using the conventional lecture method, which involved defining key concepts, providing explanations, and writing key points on the chalkboard. Students in the control group referred to biology textbooks for additional information.

The teaching intervention lasted six weeks, after which a posttest was administered to assess the students accomplishment and motivation levels of the students. Data collection involved pretest and posttest scores for both performance and motivation. The collected data were subsequently analyzed to address the research querries and evaluate the null hypotheses.

RESULTS

To address the research querry one, post-test scores of experimental and comparison groups generated from Genetics Performance Test (GPT) underwent descriptive analysis. The mean scores and standard deviation of the statistics is presented in Table 1.

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Table 1: Average and Standard Deviation of Post-test Scores of Students in the Experimental and Control Groups

Groups	n	Mean	Std. Deviation	Mean Difference
Experimental	20	15.26	2.69	2.98
Control Group	31	12.33	3.29	

The result in Table 1 showed that Mean scores of 14.25 and 12.33 were obtained with a mean difference of 2.98 in support of students in the experimental group. This shows that differences exist across students mean results when taught genetics utilising the Station-Rotation Blended Learning Strategy. The table revealed that students exposed to the Station-Rotation Blended Learning Strategy performed better than their counterparts taught using conventional method. To determine whether the mean difference is significant or not, hypothesis one was tested at $\alpha \leq 0.05$.

To test null hypothesis one, the post-test scores obtained from GPT of the experimental and control groups were open to an independent samples t-test statistics at $\alpha \leq 0.05$. Summary of the analysis is presented in Table 2.

Table 2: Independent Samples t-test Analysis of Mean Performance Scores between Experimental and Control Groups

Group	n	Mean	Std. Dev.	df	t	p	Remark	Decision
Experimental	20	15.26	2.67	1	2.11	0.001	Significant	Ho_1 Rejected
Control	31	12.33	3.18					

Significant at p ≤0.05 level

Table 2 revealed that p = 0.001, which is less than 0.05 level of significance at 48 degrees of freedom. This indicates that a marked difference exists between the performance mean scores of students in the experimental and control groups in favour of the experimental group. Therefore, the null hypothesis which stated that there is no notable distiction between academic performance mean scores of slow learners taught genetics using the Station-Rotation Blended Learning Strategy and those taught using conventional method is hereby rejected. This implies that students' scores were enhanced after exposure to the Station-Rotation Blended Learning Strategy implying that the Station-Rotation Blended Learning Strategy is more effective in improving students' performance in genetics than the Conventional Method.

To answer research question two, the posttest scores of experimental and control groups generated from Genetics Concepts Motivation Questionnaire (GCMQ). Descriptive statistics were applied to calculate the mean rank and sum of ranks. A summary of the analysis is provided below:

Table 3: Mean Rank and Sum of Ranks for motivation Scores for Experimental Groups

Group	n	Mean Rank	Sum of Ranks	Mean Rank Diff.
Experimental	20	21.10	522.00	8.33
Control	31	11.77	553.00	

Table 3 shows that the computed sum of ranks for both experimental and control groups was found to be 21.10 and 11.77 with respect to posttest respectively. The difference between the mean ranks in the experimental and control groups is 8.33 in favour of the experimental group.

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This shows that differences exist between the motivation levels of students taught genetics using Station-Rotation-Blended Learning Strategy with those taught using Lecture Method. To find out whether the difference is significant, the data was subjected to Mann Whitney U test at $\alpha \leq 0.05$.

To analyze the second null hypothesis, the motivation scores after the intervention from the GCMQ for both the experimental and control groups were scrutinized with the Mann-Whitney U-test statistic at a significance level of $\alpha \leq 0.05$. A complete summary of the analytical outcomes is displayed in Table 4.

Table 4: Mann-Whitney U-test Analysis of Students' Motivation Levels in the Experimental and Control Groups

Groups	n	Mean Rank	Sum of Ranks	U	p-value	Remark	Decision
Experimental	20	21.10	421.00	177.00	0.001	Significant	Rejected
Control	31	11.77	454.00				

Significant at $\alpha \leq 0.05$ level

As highlighted in Table 4, there is a clear and substantial disparity in the motivation levels observed in students from the experimental group in comparison to those from the control group ($U = 177.00$, $p = 0.001$), which is notably less than the 0.05 significance mark. This finding implies that there is a meaningful difference in the average motivation levels of students instructed in genetics through the Station-Rotation Blended Learning Strategy. Consequently, the null hypothesis, which posited that no significant variation exists in the interest levels of slow learners receiving instruction in genetics via the Station-Rotation Blended Learning Strategy compared to those taught through Conventional Method among secondary school Biology students, is thereby rejected.

This result indicates that the students in the experimental group demonstrated higher motivation than those in the control group.

DISCUSSION

This study sought to understand the impact of the Station-Rotation Procedure on the motivation together with academic performance of slow learners in genetics among adolescent students.

The first finding as shown in Table 1 revealed a crucial inequity between the mean performance outcomes of students in the treatment and comparison groups. This finding aligns with the results of Akpan and Aminikpo (2023), who opined that the Station-Rotation Learning approach effectively enhances the learning outcomes of students in science and social studies, particularly among slow learners. Similarly, Marianne and Maxima (2018) found that the Station-Rotation Strategy improves students' memory retention. Istigamah and Ichsan (2021) also reported that associating information within the human cognitive structure can be achieved effectively through the Station-Rotation approach. However, the findings of this study differ from Sherina (2015), who observed no significant variation in the performance of students with learning difficulties when taught using the Station-Rotation approach. This discrepancy could be attributed to differences in geographical location and the teacher's expertise in implementing the model.

The study in Table 1 also revealed a considerable difference in the motivation levels of slow learners taught genetics utilizing the Station-Rotation Strategy relative to those taught utilising the conventional method. The students in the experimental group demonstrated higher motivation levels than those in the comparison group, suggesting that the Station-Rotation Strategy is more effective in enhancing motivation than traditional lecture methods. These findings are consistent with Mikawati and Susianna (2024) and Shafie (2024), who independently concluded

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that the Station-Rotation Strategy enhances motivation and performance in biology while promoting active learning through diverse stations. Additionally, Yukhymenko et al. (2024) highlighted that teachers recognize the Station-Rotation model's potential for individualizing learning and fostering digital competencies.

However, the outcomes of this study differ from Martyn (2018) and Ortega and Arcos García (2021), who found no significant relationship between students' motivation and the Station-Rotation Blended Learning Instruction. These differences could be due to variations in the blending approach and geographical location.

The second finding as shown in Table 4 revealed a statistically significant variation in the mean motivation levels of students taught genetics utilizing the Station-Rotation approach. This aligns with the study by Dari et al. (2022), which suggested that students in blended learning environments exhibited significantly higher motivation levels than those in traditional settings, with a significance level of 0.000 < 0.05. Similarly, Rahman et al. (2020) reported that blended learning significantly enhances students' engagement and achievement compared to direct instruction. Furthermore, Syafii et al. (2016) reported a strong positive effect, with a ratio of 6.468, in their analysis of vocational students following the implementation of blended learning.

CONCLUSION

From the above findings and discussion above on the impact of the Station-Rotation Blended Learning Model on Motivation and Genetics achievement of School Slow Learners in Zaria, Nigeria, it has been firmly established that academic performance of slow learners was enhanced when taught Genetics concepts using Station-Rotation Blended learning strategy. It has also been solidly settled that slow learners taught genetics concept using Station-Rotation Blended Learning strategy were better motivated.

RECOMMENDATIONS

As indicated by the study and conclusions of this study, the following options are suggested:

i. The state ministry of education in collaboration with National Union of Teachers (NUT) should organize workshops on Station-Rotation for biology teachers in secondary schools in the state
ii. Bodies such as Science Teachers Association of Nigeria, Biology Society of Nigeria and Educational Research and development Council should integrate Station- Rotation Blended Learning instruction into school curricula.
iii. Writers of secondary school biology textbooks and other materials should modify them to in cooperate Station-Rotation Blended Learning.

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