

IMPACT OF GRAPHICAL ADVANCED ORGANIZERS ON SECONDARY SCHOOL STUDENTS' MOTIVATION IN GENETIC CONCEPTS IN KADUNA STATE

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Abstract

This study investigated impact of graphical advanced organizers on secondary school students' motivation in genetic concepts in Kaduna State. A quasi-experimental pretest–posttest non-equivalent control group design was adopted. The population comprised 3,031 SS2 Biology students from 11 public co-educational secondary schools, while a sample of 113 students was selected using simple random sampling. Two schools were assigned to experimental and control groups. The experimental group was taught genetics using graphical advanced organizers, whereas the control group received instruction through the conventional method. The Genetics Motivation Questionnaire (GMQ), with a reliability coefficient of 0.80, was used for data collection. Research questions were answered using mean rank and sum of ranks, while the null hypotheses were tested using the Mann–Whitney U-test at 0.05 significance level. Findings revealed a substantial motivational advantage for students taught using graphical advanced organizers. The experimental group recorded a higher mean rank (84.61) compared to the control group (30.81), with a significant Mann–Whitney U-value of 76.50 ($p = 0.000$). This indicates that graphical advanced organizers significantly enhanced students' motivation toward learning genetic concepts. Gender analysis further showed no significant difference in motivation between male and female students exposed to the strategy ($U = 302.00$, $p = 0.25$), suggesting that graphical advanced organizers are equally effective for both genders. The study concludes that graphical advanced organizers positively influence students' motivation in genetics. It recommends that Biology teachers adopt graphical advanced organizers and that educational bodies provide continuous training to promote their effective use in teaching science concepts.

Keywords: Graphical Advanced Organizers, Motivation, Genetic Concepts.

Introduction

The development of any nation today hinges significantly on its advancement in science and technology. Hohenberg (2017) distinguishes between 'science' (lowercase) as the activity of scientists and 'Science' (uppercase) as the collective body of knowledge produced; Science is "collective, public knowledge, universal and free of contradiction, emerges from science, and is subject to change. The cardinal objectives of science according to Federal Ministry of

Education in the National Policy on Education (FRN, 2013) is to enable students acquire process skills, and products of science, and to be able to apply those skills in students' everyday life to enable students achieve National goals. Science in Nigerian secondary schools are taught as Biology, Chemistry, Physics, Geography and Mathematics at the Senior Secondary School level.

Oluwafemi and Ojo (2023) explained that, Graphical Advanced Organizers, plays an important role in helping students achieve a deeper comprehension of complex concepts. They argued that the approach encourages students to actively participate in the learning process, shifting them away from passive listening and enabling them to link new knowledge with what have already been learnt. According to Emmanuel and Nwachukwu (2020), Graphical Advanced Organizers are an integral part of this approach. These visual tools assist students in organizing and structuring information throughout the lecture, promoting better understanding and retention of the material. The authors point out that tools such as concept maps, flowcharts, and venn diagrams help students visualize the relationships between ideas, providing them with a comprehensive view of the content and making it easier to recall later.

Umar and Ayodele (2022) noted that, graphical advanced organizers empower students to take greater responsibility for their learning. Their study shows that students who are encouraged to critically analyze and apply the knowledge they gain in class demonstrate a greater depth of understanding and perform better in assessments. The authors suggest that this method helps to engage students in ways that conventional methods do not. These organizers not only provide a framework for reviewing and organizing information independently but also promote self-confidence and autonomy in students' academic endeavors. The combination of these strategies creates a more engaging and participatory learning environment, which improves students' ability to synthesize information and enhances their overall academic performance and motivation.

Motivation constitutes a central psychological construct that propels individuals to pursue specific goals and sustain engagement in purposeful activities. Kachii (2017) conceptualizes motivation as the underlying reasons that guide behavior and enhance effort toward achieving desired outcomes. Within the educational context, two major forms of motivation are commonly distinguished; intrinsic and extrinsic. Ryan and Deci (2017) explain that intrinsically motivated actions arise from personal interest and enjoyment, whereby the activity itself serves as its own reward. In such cases, the perceived locus of causality is internal. Extrinsically motivated behaviors are shaped by external contingencies rewards, recognition, or sanctions that exist apart from the task itself. In promoting student motivation, biology teachers must recognize the value of subsumption, or the meaningful integration of new concepts with pre-existing cognitive structures through the use of advanced organizers. This instructional approach enhances comprehension and stimulates learners' interest. Mila and Ines (2020) affirm that teachers play a critical role in stimulating students' motivation, emphasizing that motivated learners approach science with enthusiasm, demonstrate confidence in their

abilities, and willingly assume responsibility for completing assigned tasks. Similarly, Urhahne and Wijnia (2023) contend that motivation represents an interplay between internal drives and external goals, shaping learning behaviors and enhancing academic performance and research further indicates that gender differences may influence how this motivation is experienced and expressed.

Research indicates that gender differences may influence how motivation is experienced and expressed. Male and female students often demonstrate distinct motivational orientations and responses, necessitating pedagogical strategies that are inclusive and gender-sensitive (Jabbar, Barkati & Tabish, 2025). By incorporating student-centered strategies such as advanced organizers, teachers can better accommodate these differences, thereby promoting equitable engagement and improved performance in biology for both male and female learners. Kuśnierz, Rogowska and Pavlova (2020) stated that, although gender-related differences in motivation and personality are assumed to be key predictors of disparities in performance, little research has been conducted in these areas. Grobmann et al. (2021) asserted that, in engaging diverse student groups, teachers should understand that gender not only affects motivational orientations toward subject areas but also the ways students respond to different teaching behaviours and the learning environments teachers offer. Schürmann and Quaiser-Pohl (2022) reported that, studies show that girls have a stronger motivational orientation toward and a higher interest in biology and are assumed to perform better in this subject than boys. Therefore, this study investigated the impact of graphical advanced organizers on motivation in genetic concepts among senior secondary school students in Zaria Education Zone, Kaduna state, Nigeria.

Statement of the Problem

Genetics is one of the difficult topics in biology that student failed in the final year examination conducted annually according to WAEC Chief Examiners' Report (2024). Ramzan, Javaid and Maham (2023) opined that, the academic performance of students is influenced by various factors, among which motivation plays a pivotal role. Ihejimaizu and Neji (2020) identified various factors contributing to poor performance in biology, which include lack of motivation, teaching methods, insufficient teaching resources, unqualified teachers, and abstractness of biology concepts. These often-hinder students' comprehension and engagement, making it harder for them to pass the subject. To address these persistent challenges and improve students' performance in genetics, advanced organizers could provide an effective solution. Therefore, this study investigated the use of graphical advanced organizers on motivation in genetic concepts among Senior Secondary School students in Zaria Education Zone, Kaduna state, Nigeria.

Objectives of the Study

The main objective of this study was to investigate the impact of graphical advanced organizers on motivation in genetic concepts among secondary school students in Zaria, Kaduna State, Nigeria. Specifically, the study sought to:

1. find out the impact of graphical advanced organizers on students' motivation in genetic concepts among senior secondary school students in Zaria Education Zone, Kaduna State.
2. determined the impact of graphical advanced organizers on motivational level of male and female students in Zaria Education Zone, Kaduna State.

Research Questions

The following research questions were answered in the study:

1. What is the difference in the motivational levels of students taught genetic concepts using graphical advanced organizers and those taught using conventional method?
2. What is the difference in the motivation levels of male and female students taught genetic concepts using graphical advanced organizers?

Hypotheses

Based on the research questions, the following null hypotheses were formulated and tested at $P \leq 0.05$ level of significance:

H₀₁: There is no significant difference between the motivational level of students taught genetic concepts using graphical advanced organizers and those taught using conventional method.

H₀₂: There is no significant difference between the motivational levels of male and female students taught genetic concepts using graphical advanced organizers.

Methodology

This study adopted a quasi-experimental design involving pre-test and post-test non-equivalent control groups. Two groups were used: the Experimental Group (EG), which was taught genetic concepts using Graphical Advanced Organizers (X_1), and the Control Group (CG), was taught genetic concepts using conventional method alone (X_0). The design was adopted in line with Sambo (2005), who described it as one that ensures equivalence between experimental and control groups. It is also consistent with Kerlinger (1975), who recommended the design for educational research, as it helps to determine whether a particular instructional strategy is superior to others and to identify differences between groups under study. Both groups were pre-tested to confirm that, they did not differ significantly in their level of motivation in genetics. The treatment lasted for six weeks and was administered to both the experimental and control groups. At the end of the treatment, a post-test was conducted using the same instruments to assess students' motivation. The population for this study was all Government owned Co-educational Senior Secondary School (SS2) Biology students in Zaria Education Zone of Kaduna State, Nigeria. For this study, there are 3,031 SS2 students (1558 males and

1473 females) offering Biology in the SS2. The Zaria Education Zone also has a total of 11 public Co-educational Senior Secondary Schools.

The sample for this study consisted of 113 Senior Secondary II (SS II) Biology students (74 males and 39 females) drawn from two randomly selected public co-educational senior secondary schools in the Zaria Education Zone of Kaduna State, Nigeria. The Genetics Motivation Questionnaire (GMQ) adapted from Mila and Ines (2020). GMQ was used to assess students' motivation to learn biology. The (GMQ) was validated by experts. The GMQ was found to have a reliability coefficient of 0.80 using Cronbach Alpha. The administration of the treatment took for six weeks for each school. The experimental group was taught using the Advanced Organizers while the control group was taught using conventional method. The Genetic concepts taught were divided into sequential learning units for six weeks. Each learning unit was taught for 1hour 20 minutes (double period). The students were allowed to observe, discuss the advanced organizers presented to them by the teacher. The researcher ensured that, equal length of time was used to teach the concepts to the groups. After the six weeks of treatment, posttest was administered to the students to determine the impact of graphical advanced organizers on motivation in genetic concepts among SS2 biology students in Zaria Education Zone, Kaduna State, Nigeria.

The instrument Genetic Motivation Questionnaire (GMQ) was administered at the beginning (pretest) and after the treatment (posttest) to the experimental and control groups. The experimental group was taught using graphical advanced organizers, and the control group was taught using Conventional method. The data collected were analyzed based on the research questions and hypotheses formulated. The data collected were subjected to statistical analysis. The research questions were answered using Mean Rank and Sum of Rank while the null hypotheses were tested using the Mann Whitney U-test at $p \leq 0.05$ level of significance.

Results

Research Question One: What is the difference between the motivational levels of students taught genetic concepts using graphical advanced organizers and those taught using conventional method?

Table 1: Summary of Descriptive Analysis Involving Means Rank and Sum of Rank of Motivation Score for Experimental and Control Groups

Group	n	Mean Rank	Sum of Rank	Mean Rank Difference
Experimental	55	84.61	4653.50	53.8
Control	58	30.81	1787.50	

Table 1 present the result of descriptive analysis of the difference level of motivation of students taught genetic concepts using graphical advanced organizers and those taught using conventional method. The students in the experimental group had a mean rank score of 84.61, with a sum of rank of 4653.50. Their counterparts in the control group had a mean rank score

of 30.81, with a sum of ranks of 1787.50. The resulting mean rank difference of 53.8 indicates the motivation scores of students in the experimental group is higher than their counterparts in the control group taught genetics concepts. To find out whether difference is significance or not, the data was subjected further to inferential statistics of Mann Whitney u-test to test the null hypothesis two.

H₀₁ There is no significant difference between the motivational level of students taught genetic concepts using graphical advanced organizers and those taught using conventional method.

Table 2: Summary of Mann Whitney U-test Analysis of Student's Motivation Experimental and Control Groups

Gender	n	Mean Rank	Sum of Rank	Mann Whitney U-value	df	p-value	Remark
Experimental	55	84.61	4653.50	76.50	111	0.000	*Rejected
Control	58	30.81	1787.50				

***Significant $P \leq 0.05$**

Table 2 shows the result of Mann Whitney U-test on motivation scores of students in the experimental and control groups. The experimental group have a mean rank of 84.61 and a sum of ranks of 4653.50. In contrast, the control group had a mean rank of 30.81 and a sum of ranks of 1787.50. The Mann-Whitney U-value of 76.50, and a p-value of 0.000 is less than 0.5 at degree of freedom (df) of 111, indicates a significant difference in favor of the experimental group. This shows that students taught genetics concepts using the graphical advanced organizers had higher motivation compared to those taught using the conventional method. Therefore, the null hypothesis that states that, there is no significant difference between the motivation level of SS1I Biology students taught genetics concepts using graphical advanced organizers and those taught using conventional methods, is rejected. This meant that, the treatment giving to the experimental group using graphical advanced organizers enhanced the motivation of students in Genetic concept.

Research Question 2: What is the difference between the motivational levels of students taught genetic concepts using conventional method-enriched with advance organizers and those taught using conventional method?

Table 3: Summary of Descriptive Analysis Involving Means Rank and Sum of Rank of Motivation Score for Experimental and Control Groups

Group	n	Mean Rank	Sum of Rank	Mean Rank Difference
Experimental	55	84.61	4653.50	53.8
Control	58	30.81	1787.50	

Table 3 present the result of descriptive analysis of the difference level of motivation of students taught genetic concepts using conventional method enriched with advance organizers and those taught using conventional method. The students in the experimental group have a mean rank score of 84.61, with a sum of rank of 4653.50. Their counterparts in the control group have a mean rank score of 30.81, with a sum of ranks of 1787.50. The resulting mean rank difference of 53.8 indicates the motivation scores of students in the experimental group is higher than their counterparts in the control group taught genetics concepts. To find out whether difference is significance or not, the analysis was furthered to inferential statistics using Mann Whitney u-test to test the null hypothesis two.

H₀₂: There is no significant difference in the motivational level of male and female students taught genetic concepts using graphical advanced organizers.

To test the null hypothesis 2, the posttest scores of Biology students obtained from Genetic Motivation Questionnaire (GMQ), were subjected to Mann Whitney u-test statistics. The summary of the analysis is presented in Table 4

Table 4: Summary of Mann Whitney U-test of Posttest Scores for Male and Female in Experimental Group.

Group	n	Mean Rank	Sum of Rank	Mann-Whitney	df	P-value	Remark
Male	33	29.85	985.00	302.00	53	0.25	Not Rejected
Female	22	25.23	555.00				

Significant at $P \leq 0.05$ level of significance.

Table 4 reveals the Mann Whitney U-test of male and female students in the experimental group. The result shows that the P-value of 0.25 is greater than the alpha value of 0.05 level of significance and a Mann Whitney U-value 302.00, indicating no significant difference between the motivation mean rank response of male and female SSII students in experimental group. Therefore, the null hypothesis which stated that there is no significant difference in the

motivation level of male and female SS1I Biology students taught genetics concepts using graphical advanced organizers is hereby, accepted and retained.

Discussion of Findings

The result in table 1 also revealed that significant difference exists between Motivational level of students taught genetic concepts using graphical advanced organizers and their counterpart taught using conventional method. This shows that students in the experimental group had higher motivation level than those in the control group. Therefore, graphical advanced organizers were found to be more impactful in enhancing students' motivation than conventional method. The results of this study are similar with that of Wanjala et al. (2023) also opined that the graphical advanced organizers are impactful in improving students' motivation and achievement in Biology concepts. The findings in this study disagrees with that of Komenda (2023) who found no significant difference on motivation level of students using graphical advanced organizers and conventional method.

The result also revealed that there is no significant difference between the mean Motivation level of male and female students taught genetic concepts using Graphical advanced organizers. This shows that female students in the experimental group had equal moderate Motivation level with their male counterparts. This result is similar to the findings of LIbao, Sagun, Tamangan, Pattalitan, Dupa and Bautusia (2016) and Rana, Mahmood and Reid (2015) who found that there is no significant difference between the motivation level of male and female students taught using Graphical advanced organizers. The findings are in disagreement with that of Kigo (2017) male students had higher motivation than female students taught genetic concepts using graphical advanced organizers.

Conclusion

Based on the findings of the research, the study concluded that graphical advanced organizers improve the academic performance and motivation of biology students in genetics. Also, the outcomes of the analysis have shown that graphical advanced organizers are gender friendly.

Recommendations

Based on the findings and conclusions reached in the study, the following recommendations were made:

1. Authors and publishers of text books materials for secondary school biology should expand the curriculum content to include the methodology used in this study on the use of Graphical advanced organizers so that both teachers and students can be exposed to the use of the strategy in teaching and learning process.
2. Biology teachers should be motivated and encouraged by State Ministry of Education and Science Teacher's Association of Nigeria (STAN) to attend seminars and workshops on the impactful use of Graphical advanced organizers in the teaching and learning of science in general and Genetics concepts in particular.

References

- Emmanuel, J. & Nwachukwu, T. (2020). The Role of Graphic Advanced Organizers in Enhancing Student Comprehension and Retention. *Nigerian Journal of Educational Research*, 38(4), 230-245.
- Federal Republic of Nigeria (FRN). (2013). *National policy on education*. NERDC Press.
- Grobmann, N., Hofferber, N., Wildel, M., & Basten, M. (2021). Students' motivation in biology lessons—Can student autonomy reduce the gender gap? *European Journal of Psychology of Education*, 38(1), 409–434. <https://doi.org/10.1007/s10212-022-00604-1>
- Hohenberg, P. C. (2017). *What is Science?* arXiv. <https://arxiv.org/abs/1704.01614>
- Ihejimaizu, C. C., Neji, H. A., & Agiande, I. U. (2020). Effect of cooperative learning strategy on senior secondary school students' academic performance in biology in Cross River State, Nigeria. *European Journal of Scientific Research*, 156(2), 138-144. <http://www.europeanjournalofscientificresearch.com>
- Jabbar, S. A., Barkati, M. G., & Tabish, M. (2025). The Gender-Sensitive Pedagogy: Tools for Promoting Inclusivity in the Classroom. *Diversitas Journal*, 10(2).
- Kachii, T. M. (2017). Impact of laboratory-based instruction on motivation, retention, and performance in geometry among junior secondary school students in Taraba State, Nigeria (Unpublished doctoral thesis, Ahmadu Bello University, Zaria).
- Komenda, E. N. (2023). Impact of advance organizers teaching approach on student's achievement and motivation in biology in secondary schools in Kitui central sub-county, Kitui, Kenya (Doctoral dissertation).
- Kuśnierz, C., Rogowska, A. M., & Pavlova, I. (2020). Examining gender differences, personality traits, academic performance, and motivation in Ukrainian and Polish students of physical education: A cross-cultural study. *International Journal of Environmental Research and Public Health*, 17(16), 5729. <https://doi.org/10.3390/ijerph17165729>
- LiBao, P. J. N., Sagun, B. J. J., Tamangan, E. A., Pattalitan, P. A., Dupa, D. E. M., & Bautusia, G. R. (2016). Science learning motivation as correlate of students' academic performances. *Journal of Technology and Science Education*, 6(3), 209-218. <http://dx.doi.org/10.3926/jotse.231>
- Mila, B., & Ines, B. (2020). The impact of online learning on student motivation in science and biology classes. *Journal of Elementary Education*, 13(1), 73–87.
- Oluwafemi, A. & Ojo, I. (2023). The Impact of Enriched Conventional Methods on Student Engagement and Understanding in Science Education. *Journal of Educational Strategies*, 45(2), 112-128.
- Ramzan, M., Javaid, Z. K., & Maham, F. (2023). Empowering ESL students: Harnessing the potential of social media to enhance academic motivation in higher education. *Global Digital & Print Media Review*, VI(2), 224-237.
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- Rana, R. A., Mahmood, M., & Reid, N. (2015). Motivation and science performance: Influence on student learning in science. *Science International (Lahore)*, 27(2), 1445-1452.
- Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Press.
- Schürmann, L., & Quaiser-Pohl, C. (2022). Out-of-school learning levels, prior achievement, and gender differences in secondary school students' motivation. *International Journal of Educational Research Open*, 3, 100158.
- Umar, M. & Ayodele, F. (2022). Promoting Independent Learning: The Use of Graphic Advanced Organizers in the Enriched Conventional Method. *Nigerian Journal of Education Development*, 12(3), 98-112.
- Urhahne, D., & Wijnia, L. (2023). Theories of motivation in education: An integrative framework. *Educational Psychology Review*, 35(2), 45.
- Wanjala, J., Wambugu, P., & Orora, W. (2023). Effects of advance organizers concept mapping teaching strategy on secondary school students' motivation to learn biology in Rongai Sub-County, Kenya. *Journal of Education and Practice*, 3(3), 14-26.
- West African Examinations Council (WAEC). (2022). *Statistics of performance report (2014-2022)*. Kaduna Office.