

Impact of Cross-Age Peer-Tutoring Strategy on Interest in Genetics Concepts among Upper Basic Science Students in Zaria, Kaduna State, Nigeria

Tanko Jolly Atto

Department of Integrated Science, Federal University of Education, Zaria, Nigeria.

Corresponding author: jollytanko55@gmail.com

DOI: <https://doi.org/10.62154/qjhcer.2026.022.01023>

Abstract

This research examined the impact of the Cross-Age Peer-Tutoring Strategy on interest in genetics concepts among upper basic science students in Zaria, Kaduna State, Nigeria. The study utilized a quasi-experimental design featuring experimental and control groups. The participants were drawn from a population of 8,439 students across 29 public schools. A multi-stage sampling approach resulted in a sample size of 140 students, selected through purposive and simple random techniques. The Students' Genetics Interest Questionnaire (SGIQ), with a high reliability coefficient of 0.87, served as the primary instrument for data collection. Experts from the Department of Biological Science and Science Education validated the instrument. Mann-Whitney U-test was applied to test the null hypotheses at the 0.05 level of significance. The results revealed that significant difference exists between the interest level of students in the experimental and control groups but differences do not exist in the interest of male and female students taught using peer tutoring instructional strategy. Based on these outcomes, it was suggested that the government at the federal, state and local through the Ministry of Education should organize and sponsor science teachers to go for workshops and seminars on teaching methodologies to inculcate their professional skills on peer tutoring, among others.

Keywords: Student Interest, Genetics Concepts, Basic Science, Cross-age Peer-Tutoring, Quasi-Experimental Design.

Introduction

The survival of a nation in the modern era depends heavily on scientific literacy achieved through robust science education. At the upper basic level, the Basic Science curriculum is designed to evolve positive attitudes, foster enquiry, and develop essential mental skills among young learners. However, a significant barrier to achieving widespread scientific literacy is the notable lack of interest shown by students towards challenging thematic areas. As reported by the Education Resource Centre, Kaduna (2022), a lack of interest in science concepts, specifically Genetics, contributes heavily to the downward trend in science engagement within the region. This lack of enthusiasm often arises when students perceive the subject matter as disconnected from their daily lives or too abstract to comprehend. According to Jansen, et al (2016), there is a critical link between a learner's

interest and their eventual success; a positive attitude towards a subject translates into a higher need for achievement. Therefore, addressing the affective domain by stimulating student interest is as vital as the cognitive delivery of the lesson itself.

Interest represents a learner's psychological predisposition to respond positively to specific aspects of their environment. As Harackiewicz, et al (2016) noted, a high level of interest in a particular subject typically translates into a greater need for achievement and a more profound commitment to the learning process. Consequently, if students possess a positive attitude towards genetics, their likelihood of academic success increases substantially. Currently, however, the abstract and complex nature of genetics often alienates learners, creating a sense of detachment from the curriculum. Peer tutoring serves as a conventional yet effective instructional strategy where experienced students support those with less knowledge, fostering a comfortable and non-threatening environment for enquiry (Dias, et al., 2026). This individualised guidance provides more opportunities for students to express themselves and ask questions without fear of ridicule, which can significantly lift their enthusiasm for the subject. By shifting the focus from the teacher to the learner, this approach nurtures a sense of ownership over the material, transforming abstract genetics concepts into relatable knowledge.

The relationship between gender and interest remains a critical factor in understanding how students engage with scientific disciplines. Isma'il, et al. (2023) observed that female students often show a significant increase in interest in STEM subjects when exposed to peer-led strategies, suggesting that collaborative environments may mitigate traditional gender anxieties in science. This study is firmly grounded in Skinner's (1938) theory of Operant Conditioning, where the tutoring process itself acts as a structured form of reinforcement. Within this framework, as a tutor and tutee successfully complete a learning task, the resulting sense of accomplishment serves as a positive stimulus to spark further interest. By applying these psychological principles through peer tutoring, this research seeks to determine if students can develop a lasting passion for genetics concepts. According to Shao, et al. (2024), such peer-mediated reinforcements are essential for maintaining motivation in subjects that students initially perceive as difficult. By rewarding the effort of discovery through social validation, the strategy aims to transform the learning of genetics from a requirement into a self-sustaining interest.

Statement of the Problem

Despite the foundational importance of genetics in the Basic Science curriculum, students in Zaria, Kaduna State, continue to record poor academic outcomes in this area. Genetics concepts, such as heredity, variation, and DNA structure, are often perceived by learners as abstract, complex, and difficult to comprehend. This difficulty is frequently exacerbated by the continued reliance on the traditional lecture method, which promotes passive learning and fails to stimulate student engagement. The persistent low performance is not merely a matter of cognitive ability but is deeply linked to a lack of interest. When students find a subject matter intimidating or disconnected from their experiences, their motivation to

engage with the content diminishes, leading to a cycle of disinterest and failure. Furthermore, there remains a lack of consensus on how gender influences learning outcomes when modern instructional strategies are introduced, particularly in the local context of Kaduna State. The Cross-Age Peer-Tutoring Strategy (CAPTS) offers a potential solution by utilizing older, more experienced students to mentor younger peers, thereby breaking down complex concepts into relatable language. However, it is not yet clear to what extent this strategy can bridge the performance gap or spark a genuine interest in genetics among upper basic students. Therefore, this study is designed to investigate the impact of Cross-Age Peer-Tutoring Strategy on Interest in Genetics Concepts among Upper Basic Science Students in Zaria, Kaduna State, Nigeria.

Objectives

The objectives of the study are to:

1. To determine the effect of the Cross-age Peer Tutoring Strategy on students' interest towards genetics concepts compared to those taught using the lecture method.
2. To find out the effect of the Cross-age Peer Tutoring Strategy on interest towards genetics concepts based on gender.

Research Questions

The following research questions were posed to guide the study:

1. What is the difference in the mean interest scores of students taught genetics concepts using the Cross-age Peer Tutoring Strategy and those taught using the lecture method?
2. What is the difference in the mean interest scores of male and female students towards genetics concepts when taught using the Cross-age Peer Tutoring Strategy?

Null Hypotheses

The null hypotheses postulated are as follows:

Ho₁: There is no significant difference in the mean interest scores of students taught genetics concepts using the Cross-age Peer Tutoring Strategy and those taught using the lecture method.

Ho₂: There is no significant difference in the mean interest scores of male and female students towards genetics concepts when taught using the Cross-age Peer Tutoring Strategy.

Theoretical Framework

The structural integrity of this study is anchored on a dual-theoretical pillar: Skinner's Operant Conditioning Theory and Slavin's Educational Psychology Framework on Peer-Mediated Motivation. Skinner (1938) posits that human behaviour is shaped and

maintained by its immediate environmental consequences, meaning that when actions are met with positive stimuli, they are far more likely to be repeated. Within the context of the Cross-Age Peer-Tutoring Strategy (CAPTS), the interactive exchange between the older tutor and the younger tutee functions as a real-time reinforcement engine. As the junior student successfully navigates complex genetic tasks, the senior peer provides immediate verbal praise and social validation, which directly relieves performance anxiety and translates cognitive success into a positive psychological disposition.

To build upon these individual reinforcement mechanics, Shao, et al (2024) model accounts for the broader social classroom architecture required to sustain learner engagement. Slavin (2014) argues that peer-mediated environments neutralise the intimidating, competitive atmosphere of traditional teacher-centred lectures by reframing difficult topics as a collaborative space for discovery. Older student mentors break down abstract, three-dimensional biological concepts such as DNA matrices and inheritance laws into accessible, shared peer language (Uminski, et al., 2025). This collaborative approach removes gender anxieties and ensures that interest is distributed equitably across both male and female learners. This study conceptualises student interest as a malleable state that can be successfully cultivated when genetics lessons are transformed from passive requirements into collaborative, active discoveries. It does this by layering Skinner's reinforcement loops onto Slavin's social framework.

Methodology

This research employs a pretest-posttest quasi-experimental and control group design to examine the influence of the Cross-Age Peer-Tutoring Strategy on student interest in genetics. This design is particularly suitable for educational settings as it allows the researcher to measure changes in student attitude before and after the intervention while using intact classes to maintain a natural school environment. The study is situated within the Zaria Education Zone of Kaduna State, targeting a population of 8,439 Upper Basic 2 students across 29 public secondary schools. To ensure a representative sample, a multi-stage sampling technique was adopted: six schools were first purposively selected based on gender composition, followed by a simple random sampling process to assign schools to either the experimental or control groups. This rigorous approach ensures that the groups are comparable at the baseline, allowing for a clear assessment of how the peer-tutoring strategy shifts student interest compared to traditional methods.

The primary data collection tool for this study is the Students Genetics Interest Questionnaire (SGIQ), a structured instrument designed to capture the affective response of learners toward genetics concepts. To maintain high academic standards, the SGIQ underwent validation by experts in Science Education and Biological Sciences, achieving a robust reliability coefficient to ensure consistency in measurement. Data gathered from the questionnaire are analysed using inferential statistics, specifically Mann Whitney U-test, to provide a clear picture of interest levels across the groups at a $p \leq 0.05$ level of significance. This statistical framework allows the study to determine if any observed increases in

student enthusiasm are mathematically significant, thereby providing a reliable basis for recommendations to educational stakeholders in Kaduna State.

Results

Ho₁: There is no significant difference in the mean interest scores of students taught genetics concepts using the Cross-age Peer Tutoring Strategy and those taught using the lecture method.

To test the null hypothesis two, the data generated were subjected to Mann-Whitney U-test statistics and the summary of the result is presented in Table 1.

Table 1 Summary of Mann-Whitney U-test on the Difference between the Interest Levels of Students in the Experimental and Control Groups

Variable	Groups	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z-value	P-value	Remark
Genetics Interest	Experimental Group (EG)	75	78.31	5873.00	1191.00	-5.83	0.01	Significant
	Control Group (CG)	65	61.49	3997.00				

Significant at $P \leq 0.05$ level of significance

The data presented in Table 1 outlines a comparative analysis of the interest levels of upper basic science students across the two instructional treatment environments. The results of the Mann-Whitney U-test reveal a statistically significant difference between the interest scores of the experimental group and the control group ($U = 1191.00$, $Z = -5.83$, $P = 0.01$). Because the calculated P-value of 0.01 is less than the chosen alpha level of significance ($P \leq 0.05$), the first null hypothesis (Ho₁) is successfully rejected. A closer inspection of the directional data shows that the students in the experimental group, who were exposed to the Cross-Age Peer-Tutoring Strategy (CAPTS), achieved a noticeably higher mean rank of 78.31 compared to the control group, who recorded a mean rank of 61.49. This clear difference in rank parameters demonstrates that peer-assisted learning frameworks are significantly more effective at generating student enthusiasm and intrinsic motivation toward abstract genetics concepts than standard, conventional teacher-led lecture methods.

Ho₂: There is no significant difference in the mean interest scores of male and female students towards genetics concepts when taught using the Cross-age Peer Tutoring Strategy.

To test the null hypothesis two, the data generated were subjected to Mann-Whitney U-test and the summary of the result is presented in Table 2.

Table 2: Summary of Mann Whitney U-test on the difference between the Interest Level of Male and Female Students in Experimental Group.

Variable	Gender	n	Mean. Rank	Sum of Ranks	Mann-Whitney	Z	P	Remark
Interest	Male	45	41.00	1845.00	540.00	1.59	0.51	Not Sign.
	Female	30	32.75	982.50				

Not significant at $P > 0.05$ level of significance.

The data presented in Table 2 outlines the gender-based comparative analysis of interest levels specifically within the experimental group. The results of the Mann-Whitney U-test show that male students achieved a mean rank of 41.00, while female students achieved a mean rank of 32.75. The resulting test parameters ($U = 540.00$, $Z = 1.59$, $P = 0.51$) reveal that the difference between the two groups is not statistically significant. Because the calculated P-value of 0.51 is greater than the chosen alpha level of significance ($P \leq 0.05$), the second null hypothesis (H_{02}) is retained. This outcome demonstrates that the Cross-Age Peer-Tutoring Strategy (CAPTS) works equally well for both male and female students. The collaborative, peer-led structure ensures an equitable environment that avoids gender discrimination and stimulates a shared interest in abstract genetics concepts across both groups.

Discussion of Findings

The study results indicate a significant difference in interest levels between students in the experimental and control groups. The higher mean interest scores in the experimental group led to the rejection of the null hypothesis, confirming that the peer tutoring instructional strategy is more effective than conventional methods in teaching genetics. This outcome aligns with Shao et al. (2024), Sabo and Mika'ilu (2025), who all observed that peer-mediated learning fosters deeper engagement. Supporting this shift, Brigati, et al (2020); Cooper, et al. (2018) found that active student-to-student interaction reduces the anxiety often associated with abstract biological topics like genetics, thereby naturally increasing intrinsic motivation. Similarly, Al Yahyaei, et al. (2024) argued that peer tutoring creates a "social learning hub" that makes science feel less like a lecture and more like a collaborative discovery. Furthermore, Hernández-Amorós, and Martínez, (2024) posits that when students take on the role of tutor, their sense of ownership over the material skyrockets, leading to a sustained interest that outlasts the duration of the lesson. These findings contrast with Lai and Lin (2025), whose lack of significant results may be attributed to a less structured tutoring protocol or a focus on rote memorisation rather than conceptual clarity.

Regarding the influence of gender, the study found no significant difference in the interest levels of male and female students taught using the peer tutoring strategy. This suggests that the approach is gender-friendly and does not favour one group over the other when navigating genetics concepts. This consistency is in agreement with Merayo and Ayuso (2022), Kang, et al. (2018), and Grassi and Garcia de Cajén (2024), who all reported a narrowing of the gender-interest gap in collaborative science settings. Further corroborating this, Llorens, et al. (2021) demonstrated that peer-led environments neutralise the "competitive" atmosphere of traditional classrooms, which often inhibits female participation in STEM. Additionally, Aniaku, et al. (2021) argues that peer tutoring is inherently inclusive because it relies on shared peer language, which bypasses traditional gender-biased instructional cues. Ultimately, the strategy serves as a powerful tool for ensuring that interest in complex science topics is distributed equally across the student body, regardless of gender.

Conclusion

It is concluded from this research that the use of the Cross-Age Peer-Tutoring Strategy significantly boosts student interest in genetics concepts compared to conventional instructional methods. The study provides evidence that interest is not a static trait but a malleable one that can be positively influenced by the choice of teaching strategy. By empowering students to take on roles as tutors and active tutees, the strategy reduces the intimidation factor associated with genetics, making the subject matter more accessible and enjoyable. This shift from a passive to an active learning state serves as a psychological reinforcement, encouraging students to participate more fully in science lessons and view the curriculum with greater enthusiasm.

In addition, the findings confirm that the increased level of interest remains consistent across both male and female student populations. This inclusive impact highlights that the Cross-Age Peer-Tutoring Strategy effectively addresses the motivational needs of all learners, helping to bridge the gap between initial curiosity and sustained academic engagement. Since a high level of interest is a vital precursor to long-term success in the sciences, the adoption of this strategy offers a viable pathway to improving the overall attitude of junior learners towards STEM disciplines. Ultimately, the study concludes that creating a social learning space through peer tutoring is a reliable method for fostering a positive and lasting interest in complex scientific concepts.

Recommendation

The following recommendations are made:

1. The government at the federal, state and local through the Ministry of Education should organize and sponsor science teachers to go for workshops and seminars on teaching methodologies to inculcate their professional skills on peer tutoring.
2. Basic science teachers should make use of peer tutoring instructional strategy to teach genetics concepts in Upper Basic Secondary Schools.

3. Basic science teachers should encourage active participation of both male and female students during teaching and learning process to reduce boredom and increase students' interest.

References

- Al Yahyaei, A., Natarajan, J. R., Seshan, V., Joseph, M. A., Valsaraj, B. P., & Hamed Al Abri, F. (2024). The Usefulness of Peer Tutoring and its Impact on Nursing Students' Academic Performance, Psychological Empowerment, and Satisfaction: Pre-Post Design. *SAGE open nursing*, 10, 23779608241282168. <https://doi.org/10.1177/23779608241282168>
- Aniaku, O. L., Ibe, E., Aham, A. C., Ugwu, T. U., & Nzewi, U. M. (2021). Effects of two modes of peer tutoring and gender on secondary school biology students' motivation. *International Journal of Psychosocial Rehabilitation*, 25(2), 183–196.
- Brigati, J. R., England, B. J., & Schussler, E. E. (2020). How do undergraduates cope with anxiety resulting from active learning practices in introductory biology?. *PloS one*, 15(8), e0236558. <https://doi.org/10.1371/journal.pone.0236558>
- Cooper, K. M., Downing, V. R., & Brownell, S. E. (2018). The influence of active learning practices on student anxiety in large-enrollment college science classrooms. *International journal of STEM education*, 5(1), 23. <https://doi.org/10.1186/s40594-018-0123-6>
- Dias, J. M., Al Kaabi, F. S. B. S., Al Hooti, S. T., Hammadi, N. O., Karim, R., AlYateem, N., Reefat Ahmed, F., Sara Abraham, M., Seshan, V., Arsyad Sub, M., Dias, A. R., & Mottershead, R. (2026). Exploring peer tutoring experiences in improving nursing students' academic success and performance: A qualitative study among Emirati undergraduate nursing students. *F1000Research*, 14, 1416. <https://doi.org/10.12688/f1000research.172023.2>
- Education Resource Centre. (2022). *Chief Examiner's Report on Basic Education Certificate Examination (BECE) in Basic Science*. Kaduna: Ministry of Education.
- Grassi, L., & Garcia de Cajén, S. (2024). Gender gap in attitudes towards science and STEM areas in lower secondary students. *Proceedings of the LACCEI International Multi-Conference for Engineering, Education, and Technology*. <https://doi.org/10.18687/LEIRD2024.1.1.688>
- Harackiewicz, J. M., Smith, J. L., & Priniski, S. J. (2016). Interest Matters: The Importance of Promoting Interest in Education. *Policy insights from the behavioral and brain sciences*, 3(2), 220–227. <https://doi.org/10.1177/2372732216655542>
- Hernández-Amorós, M. J., & Martínez, M. A. (2024). Exploring how tutors in higher education perceive their work and what direction they think it should take in the future: A case study. *Journal of University Teaching and Learning Practice*, 21(7), Article 21. <https://doi.org/10.53761/144wpb66>
- Isma'il, A., Abbas, M. and Ibrahim, A. (2023). Enrollment Trends, Motivations, and Future Aspirations of Female Undergraduate Students in STEM Courses at Federal University Gusau - Nigeria. *Global Academic Journal of Humanities and Social Sciences*, 5(3), pp. 142–150. doi:10.36348/gajhss.2023.v05i03.001.
- Jansen, M. C., Lüdtke, O., & Schroeders, U. (2016). Evidence for a positive relation between interest and achievement: Examining between-person and within-person variation in five domains. *Contemporary Educational Psychology*, 46, 74–84. <https://doi.org/10.1016/j.cedpsych.2016.05.004>
- Kang, J., Hense, J., Scheersoi, A., & Keinonen, T. (2018). Gender study on the relationships between science interest and future career perspectives. *International Journal of Science Education*, 41(2), 1–22. <https://doi.org/10.1080/09500693.2018.1534021>
- Lai, C.-H., & Lin, C.-Y. (2025). Analysis of Learning Behaviors and Outcomes for Students with Different Knowledge Levels: A Case Study of Intelligent Tutoring System for Coding and Learning (ITS-CAL). *Applied Sciences*, 15(4), 1922. <https://doi.org/10.3390/app15041922>

- Llorens, A., Tzovara, A., Bellier, L., Bhaya-Grossman, I., Bidet-Caulet, A., Chang, W. K., Cross, Z. R., Dominguez-Faus, R., Flinker, A., Fonken, Y., Gorenstein, M. A., Holdgraf, C., Hoy, C. W., Ivanova, M. V., Jimenez, R. T., Jun, S., Kam, J. W. Y., Kidd, C., Marcelle, E., Marciano, D., ... Dronkers, N. F. (2021). Gender bias in academia: A lifetime problem that needs solutions. *Neuron*, 109(13), 2047–2074. <https://doi.org/10.1016/j.neuron.2021.06.002>
- Merayo, N., & Ayuso, A. (2022). Analysis of barriers, supports and gender gap in the choice of STEM studies in secondary education. *International journal of technology and design education*, 1–28. <https://doi.org/10.1007/s10798-022-09776-9>
- Sabo, M. A., & Mika'ilu, H. (2025). Effects Of Peer Assisted Learning Strategies and Students Engagement on Academic Performance Among Senior Secondary Schools in Sokoto Metropolis, Sokoto State, Nigeria. *International Journal of Innovative Psychology & Social Development*, 13(4), 1–13. <https://doi.org/10.5281/zenodo.1782813>
- Shao, Y., Kang, S., Lu, Q., Zhang, C., & Li, R. (2024). How peer relationships affect academic achievement among junior high school students: The chain mediating roles of learning motivation and learning engagement. *BMC psychology*, 12(1), 278. <https://doi.org/10.1186/s40359-024-01780-z>
- Skinner, B. F. (1938). *The behaviour of organisms: An experimental analysis*. New York: Appleton-Century.
- Slavin, R. E. (2014). Cooperative learning in elementary schools. *Education*, 43(1), 5–14. <https://doi.org/10.1080/03004279.2015.963370>
- Uminski, C., Wright, L. K., & Newman, D. L. (2025). Sketchy understandings: drawings reveal where students may need additional support to understand scale and abstraction in common representations of DNA. *Journal of microbiology & biology education*, 26(2), e0007025. <https://doi.org/10.1128/jmbe.00070-25>