GENETIC FACTOR AS A CORRELATE OF ACADEMIC PERFORMANCE OF SECONDARY SCHOOL BIOLOGY STUDENT IN UYO METROPOLIS

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Abstract

This study investigates the connection between genetic variables and Uyo Metropolis secondary school biology students' academic achievement. In carrying out the research, correlational survey design was adopted. The study was carried out in Uyo Metropolis. The targeted population for the study comprised all biology students in Uyo Metropolis. Simple random sampling technique was used to select a total of 130 respondents used for the study. The instrument used for data collection was a structured questionnaire titled "Genetic Factor and Academic Performance Questionnaire (GFAPQ)". Face and content validation of the instrument was carried out by an expert in test, measurement, and evaluation in order to ensure that the instrument has the accuracy, appropriateness, and completeness for the study under consideration. The reliability coefficient obtained was 0.88, and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such percentage analysis to answer research questions. The findings of the research revealed that "genetic influences on cognitive abilities" among others is the most prominent effect of genetic factor on academic performance of students in biology and that the extent of the effect was very high. The study concluded that genetic variations contribute to differences in cognitive abilities, memory, and motivation, which are critical for academic success in biology. One of the recommendations made was that schools should consider implementing personalized learning strategies that take into account the genetic predispositions of students.

Keywords: Genetic Factor, Academic Performance, Biology Student and Uyo Metropolis

Introduction

Academic performance is a crucial measure of success in school and is impacted by a wide range of elements, such as learning environments, socioeconomic position, the caliber of instruction, and unique student traits. Genetic variables are among these traits that have attracted a lot of attention as potential predictors of academic performance. The purpose of this study is to investigate the relationship between genetic variables and the academic achievement of biology students in secondary schools in Uyo Metropolis, Nigeria. The significant influence that genetic variants have on educational attainment has been brought to light by recent advances in genetic research. Studies involving twins and genome-wide association studies (GWAS) suggest that genetic differences account for a notable proportion of the variability in academic performance

(Plomin & Deary, 2015). For instance, research has shown that genes related to cognitive abilities, memory, motivation, and personality traits significantly influence educational outcomes (Belsky et al., 2016).

Despite these results, nothing is known about the precise influence of hereditary variables on biology students' academic performance in Nigerian secondary schools. The study of biology has particular difficulties and expectations for students, including not only the application of analytical and practical abilities but also the memorizing of complicated knowledge. Thus, scholastic achievement in this area can offer important insights into the more general cognitive capacities that may be influenced by hereditary factors. The perfect location for this inquiry is Uyo Metropolis, which is well-known for its varied educational resources and diverse student population. In this context, knowledge of the genetic correlates of academic achievement can help educators and policymakers develop more specialized and successful teaching methods.

Statement of problem

The academic performance of secondary school biology students in Uyo Metropolis may be influenced by various factors, among which genetic factors hold significant interest. Understanding the extent to which genetic predispositions correlate with students' ability to grasp and excel in biology can provide insights into tailored educational approaches. This investigation aims to explore the relationship between genetic factors and academic achievement, considering how inherited cognitive abilities, learning capabilities, and potential biological predispositions could impact students' performance in biology. The outcomes could inform educators and policymakers about the necessity of integrating genetic considerations into educational strategies to enhance learning outcomes.

Objectives

1. To find out the effects of genetic factor on academic performance of students in biology.
2. To examine the extent of the effects of genetic factors on academic performance of students in biology in Uyo Metropolis.

Research questions

1. What are the various effects of genetic factor on academic performance of students in biology?
2. What is the extent of the effects of genetic factors on academic performance of students in biology in Uyo Metropolis?

Concept of genetic factor

The study of genes, genetic diversity, and heredity in living things is known as genetics. Given the importance of heredity to the evolution of organisms, biology has a lot to say about this field. Since scientists highlight genetics' capacity for prediction in an effort to highlight the significance of their field as a means of determining predispositions, genetics is a science of prediction. The basic physical unit of the process of heredity is recognized to be the genetic component, also known as the genetic gene. Furthermore, genes hold all the information required to guarantee the body's formation, growth, and operation. The DNA found in chromosomes is the basis of genetics. Gericke & Carver (2017) explained that the gene is seen as the active determinant of some kind of physical trait or behavior, to which it is given power or agency that supersedes a scientific explanation. When compared to a scientific perspective, this overly strong notion that genes have a role in the production of traits has been seen as a social and educational issue.

According to Higuera (2024) a gene factor that consists of a long combination of four different nucleotide bases, which are the basic building blocks of DNA. Numerous combinations

are available. The fundamental structural and operational component of heredity is a gene factor. DNA is what makes up genes. On the other hand, certain genes serve as instructions for producing proteins, which are chemicals that the body needs to operate. Furthermore, a large number of genes aid in the regulation of other genes rather than coding for proteins. A genetic counsellor, physician, or other healthcare professional who has examined a patient's personal and family medical history and discovered a possible hereditary cancer pattern will typically seek genetic factors. Numerous outcomes, including positive, negative, genuine negative, uninformative negative, and variant of unclear significance (VUS), can be caused by a genetic component. The reliable source of a material known as deoxyribonucleic acid (DNA) is the genes factor. The biological instructions necessary for life's development, growth, and reproduction are encoded in DNA. DNA strands called genes are what hold the biological instructions necessary for life. Sequences that define morphological and biological characteristics are found in every gene.

Concept of academic performance

The phrase academic performance refers to a student's accomplishment following the completion of a course or subject from an institution. Formative and summative examinations are used to gauge students' learning across a range of academic courses. It speaks of the results of pupils' efforts to meet certain learning objectives. According to Bhardwaj (2014), academic achievement (performance) as the knowledge attained or skills developed in the school subjects, usually determined by test scores or marks assigned by teachers or both. It is the evaluation of pupils' performance in a range of academic courses. Typically, classroom performance, graduation rates, and test scores are used by educators to gauge student achievement. Mustappha (2022) explained that, academic performance in a broad sense refers to the improvement of students' overall quality during their school years. Academic performance includes cognitive and non-cognitive outcomes, as well as psychological and behavioral outcomes. The credit point average, or GPA, is a measure of a college student's academic performance that is precisely derived from each course's grade to reflect the academic performance of the students. Kumar, Agarwal & Agarwl (2021) holds that, academic performance of students is the key feature and one of the important goals of education, which can be defined as the knowledge gained by the student which is assessed by marks by a teacher and or educational goals set by students and teachers to be achieved over a specific period of time. Academic institutions' primary goal is to help students achieve academic greatness by helping them demonstrate improved academic performance. Academic achievement holds great importance for individuals who are concerned about their education. The academic performance of students, particularly those enrolled in Higher Education Institutions (HEIs), can be viewed as the central focus of the education system and a subject of interest for policy makers, researchers, parents, and planners.

Furthermore, Ampofo & Osei-owusu (2015), stated that academic performance is a multidimensional construct composed of the skills, attitudes, and behaviors of a learner that contribute to academic success in the classroom. As students move through and finish their schooling, they are performing at a high and adequate level. It also refers to how well a teacher, institution, or student has met their immediate or long-term learning objectives. Academic achievement is demonstrated by the attainment of milestones in education, such as bachelor's degrees and secondary school diplomas. Lamas (2015) stated that, academic performance is the result of learning, prompted by the teaching activity by the teacher and produced by the student. According to a humanistic perspective, students' academic achievement is their output, which is typically represented by their grades in school. It is a measurement of the indicative and responsive skills that convey, in an approximate manner, what a person has learnt through an educational or

training process. The accomplishments and achievements of a student in their academic pursuits are sometimes referred to as their academic performance. According to Balogun, Oyelere & Atsa'am (2019), academic performance is the ability of a student to complete a task. Positive or negative outcomes could arise from the task completion. Academic achievement varies widely between first and third classes in private universities, although this is uncommon in public ones. A positive result means that the student performs brilliantly or exceptionally; a negative result, on the other hand, means that the student performs horribly. Student performance is the result of a thorough assessment using exams or other techniques. Academic achievement is a key sign of a student's level of involvement and effort in their studies, as well as their understanding of the material and ability to apply it. Academic performance data is used by educators, parents, and educational institutions to assess students' development over time, identify areas of strength and weakness, and customize instructional support. Academic achievement for pupils can.

Effect of genetic factor on academic performance of students in biology

It is essential to comprehend the elements that affect academic performance in order to improve educational outcomes. Among these factors, genetics play a significant role in shaping cognitive abilities, personality traits, and learning capacities (Plomin & Deary 2015).

Genetic Influences on Cognitive Abilities: Individual differences in cognitive abilities which are crucial for scholastic success in topics like biology are mostly influenced by genetic factors. Studies reveal that genetic variations account for around half of the variation in intelligence quotient (IQ). It need cognitive skills like memory, analytical reasoning, and problem-solving to comprehend intricate biological concepts and processes.

Personality Traits and Learning Styles: Performance in school is also impacted by personality qualities, many of which have a genetic foundation. Characteristics like diligence, tenacity, and curiosity can affect study habits, motivation, and interest in the material. Naturally more conscientious and curious students might devote more time to studying biology, which would improve their academic performance.

Genetic Predispositions to Learning Disabilities: Additionally, genetics may put kids at risk for learning difficulties, which can impair their academic success in biology and other courses. Genetic factors play a role in conditions like dyslexia and attention-deficit/hyperactivity disorder (ADHD). While ADHD can have an impact on concentration, organization, and time management abilities, dyslexia can hinder writing expression and reading comprehension.

Gene-Environment Interactions: The impact of genetic predispositions on academic achievement can be greatly influenced by environmental circumstances, even though heredity still plays a major effect. Gene-environment interactions happen when certain environmental factors affect how certain genetic features are expressed. For instance, a student who is genetically inclined to have great cognitive ability might not be able to learn to the fullest extent possible unless they are in an atmosphere that is both exciting and encouraging.

Implications for Education: Education will be significantly impacted by our growing understanding of the genetic foundations of learning and academic achievement. Optimizing educational outcomes can be achieved through personalized learning approaches that consider genetic predispositions. For instance, students with a genetic propensity for high curiosity may benefit from inquiry-based learning approaches that encourage exploration and discovery (Peterson & Pennington 2015).

Targeted therapies can also result from early detection of genetic predispositions to learning disabilities. Schools can aid students in overcoming these obstacles and realizing their

academic potential by putting in place support mechanisms including counselling, specialized education, and assistive technology.

Other determinants of students' performance in biology

We can examine a number of critical elements that impact students' success in biology to talk about the degree of their performance, including:

Teaching Methods and Student Engagement: Active learning techniques greatly improve students' comprehension and memorization of biological ideas. The researchers found that interactive approaches, such as problem-based learning and flipped classrooms, lead to better academic outcomes compared to traditional lecture-based formats (Smith et al., 2019).

Curriculum and Assessment Practices: A longitudinal study spanned by Johnson and Brown (2023) underscores the importance of well-designed curricula and formative assessment in improving biology education. They stress that regular feedback loops and well-defined learning objectives are essential for improving students' long-term comprehension of biological topics.

Impact of Socio-Economic Status: The difference in biology performance according to socioeconomic status. It was found that students from lower socio-economic status (SES) backgrounds often face more significant challenges in accessing resources and opportunities that facilitate learning in biology (Garcia & Nguyen, 2021).

Technological Integration: Scholarly investigations have also focused on the incorporation of technology into biology instruction. For instance, a recent meta-analysis by Li and Wang (2024) suggests that the use of educational technology, such as simulations and virtual labs, can enhance students' conceptual understanding and practical skills in biology.

Teacher Quality and Professional Development: Ongoing professional development for biology educators plays a critical role in improving instructional practices and student outcomes (Lee & Kim, 2020). Instructors who take part in focused professional development programs are more prepared to use successful teaching techniques in biology courses.

Remedies to students' poor performance in biology

Biology education is crucial to the country's advancement in science and technology. Unsound information and a moral approach to biology could prevent the much-needed and much anticipated technological breakthrough. The main objectives of biology education are to provide students with the fundamental know-how, abilities, and mindset needed to live autonomously and productively in both their own right and the larger community. The following are solutions to students' biology failures:

Use of visual materials: Cimer (2011) opined that as biology includes many abstract concepts and phenomena that require observation, the students should see what they are learning. As a result, teaching and learning are enhanced when educators employ a variety of visual aids and resources, including models, computer simulations, movies, 3-D materials, and actual items.

Collaborative instructional strategy: Learning is facilitated by group activity since it yields better understanding than individual effort. Pupils are given the opportunity to actively participate in class discussions and have more opportunities to reflect on their knowledge and ignorance. Gokale (1995) cited by William, Ngozi, & Anthony (2020) asserted that the instructional strategy encourages critical thinking promotes positive attitude towards learning, increases students' self-esteem, helps them build oral communication skills, social interaction skills, take responsibility in learning among others, all of which have the potential to raise students' interest in a subject and subsequently improve achievement.

Laboratory work: By persuading pupils that the material they are learning actually exists or occurs in the real world, this may aid in their learning. Students can test, reconsider, and rebuild their

ideas and thoughts through laboratory activity. Additionally, pupils can comprehend the subjects and remember their ideas and thoughts when they work through experiments or observations as they are studying.

Qualified teachers: Any educational system's quality is largely determined by the caliber of its teachers in terms of their training, experience, and credentials in both academia and the workplace. Gardner (1985) cited by Obeka (2021) postulated that if teachers are skilled in the language and attuned to the feelings of their students, and the methodology is interesting, these can do a lot towards awakening positive attitude, regardless of whether students' initial attitudes are positive or negative.

Methodology

In carrying out the study, correlational survey design was adopted. The study was carried out in Uyo Metropolis. The targeted population for the study comprised all biology students in secondary schools in Uyo Metropolis. Simple random sampling technique was used to select a total of 130 respondents for the study. The instrument used for data collection was a structured questionnaire titled "Genetic Factor and Academic Performance Questionnaire (GFAPQ)". Face and content validation of the instrument was carried out by an expert in test, measurement, and evaluation in order to ensure that the instrument has the accuracy, appropriateness, and completeness for the study under consideration. The reliability coefficient obtained was 0.88, and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such percentage analysis to answer research questions.

RESULTS AND DISCUSSIONS

Research Question 1

The research question sought to find out the effects of genetic factor on academic performance of students in biology. To answer the research percentage analysis was performed on the data, (see table 1).

Table 1:
Percentage analysis of the effects of genetic factor on academic performance of students in biology.

EFFECTS	FREQUENCY	PERCENTAGE
Cognitive Abilities	46	35.38**
Personality Traits and Learning Styles	34	26.15
Genetic Predispositions to Learning Disabilities	23	17.69
Gene-Environment Interactions	15	11.54
Implications for Education	12	9.23*
TOTAL	**130**	**100%**

****** **The highest percentage frequency**
***** **The least percentage frequency**
SOURCE: Field survey

The above table 1 presents the percentage analysis of the effects of genetic factor on academic performance of students in biology. From the result of the data analysis, it was observed that the

effect tagged "Cognitive Abilities" 46(35.38%) was rated as the highest effects of genetic factor on academic performance of students in biology, while "Implications for Education" 12(9.23%) was rated the least effects. The result therefore is in agreement with the research findings of Plomin & Deary (2015), who noted that it is essential to comprehend the elements that affect academic performance in order to improve educational outcomes and that among these factors, genetics play a significant role in shaping cognitive abilities, personality traits, and learning capacities.

Research Question 2

The research question sought to find out the extent of effects of genetic factors on academic performance of students in biology in Uyo Metropolis. To answer the research percentage analysis was performed on the data, (see table 2).

Table 2:

Percentage analysis of the extent of effects of genetic factors on academic performance of students in biology in Uyo Metropolis.

EXTENT	FREQUENCY	PERCENTAGE
Very High Extent	62	47.69**
High Extent	45	34.62
Low Extent	23	17.69*
TOTAL	**130**	**100%**

****** **The highest percentage frequency**

***** **The least percentage frequency**

SOURCE: Field survey

The above table 2 presents the percentage analysis of the extent of the effects of genetic factors on academic performance of students in biology in Uyo Metropolis. From the result of the data analysis, it was observed that the highest percentage 62(47.69%) of the respondents affirmed that the extent of the effects of genetic factors on academic performance of students in biology in Uyo Metropolis is very high, while the least percentage 23(17.69%) of the respondents affirmed it to be low. The result therefore is in agreement with the research findings of Peterson & Pennington (2015), who noted that students with a genetic propensity for high curiosity may benefit from inquiry-based learning approaches that encourage exploration and discovery.

Conclusion

This study stresses the significant role that genetic factors play in shaping the academic performance of secondary school biology students in Uyo Metropolis. The findings highlight that genetic variations contribute to differences in cognitive abilities, memory, and motivation, which are critical for academic success in biology. Furthermore, the findings of the research revealed that "genetic influences on cognitive abilities" among others is the most prominent effect of genetic factor on academic performance of students in biology and the extent of the effect is very high. Understanding these genetic influences can aid in the development of personalized educational strategies, nurturing an environment where students can achieve their full potential. Moreover, this research emphasizes the need for further studies to explore the intricate interplay between genetics and education, ultimately aiming to enhance educational outcomes across diverse student populations.

Recommendations

1. Schools should consider implementing personalized learning strategies that take into account the genetic predispositions of students. This could include tailored teaching methods that align with individual cognitive strengths and learning styles.
2. Establish genetic counseling services within schools to provide students and parents with information on how genetic factors may influence academic performance. This can help in creating realistic expectations and personalized academic goals.
3. Provide training for teachers on the implications of genetic research in education. Educators should be equipped with the knowledge to recognize and nurture the diverse cognitive abilities of their students.

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