European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available online at: www.oapub.org/edu

DOI: 10.46827/ejes.v11i11.5610 Volume 11 | Issue 11 | 2024

DETERMINANT OF UNDERGRADUATE STUDENTS' INTEREST AND ENGAGEMENTS IN THE STUDY OF GENETICS AT THE UNIVERSITY OF EDUCATION, WINNEBA

Collins Owusu-Fordjour[1i],
Rosemary Naana Kumi-Manu[2],
Charles Kwesi Koomson[1]
[1]Department of Integrated Science Education,
University of Education, Winneba,
Ghana
[2]Department of Biology Education,
University of Education, Winneba,
Ghana

Abstract:
Genetics is a fundamental aspect of biological education, crucial for understanding heredity, variation, and molecular mechanisms in life. Despite its importance, student engagement in genetics courses at the University of Education, Winneba (UEW) varies widely. This study investigates the factors influencing undergraduate students' interest and engagement in the study of genetics, focusing on the perceived relevance of genetics, pedagogical approaches, challenges faced by students, and misconceptions. A descriptive survey design was used, with data collected from 150 undergraduate students enrolled in the Biology and Integrated Science Education programs. Results indicate that the perceived relevance of genetics to students' lives, including its application in health and global issues like food security, is the most significant predictor of interest and engagement ($R^2 = 0.56$). Pedagogical approaches, particularly hands-on activities and interactive learning methods were also found to enhance engagement. However, students faced moderate challenges in understanding genetic concepts, which reduced their overall engagement. Misconceptions about genetics were less impactful but still contributed to shaping students' attitudes. The findings suggest that aligning teaching strategies with real-life applications and addressing student misconceptions can improve student engagement in genetics education.

Keywords: employment, intellectual disability, learners with intellectual disability, parental involvement, transition

[i] Correspondence: email cofordjour@uew.edu.gh

1. Introduction

Genetics forms a core part of biological education, playing a vital role in understanding heredity, variation, and the molecular mechanisms underlying life itself. The importance of genetics in numerous fields—ranging from medicine and biotechnology to agriculture and environmental conservation—makes it essential for students to develop a deep interest in this subject. However, students' engagement in genetics courses can vary significantly, influenced by several factors, including the perceived relevance of genetics to their daily lives and the effectiveness of the teaching methods used (Collins & Halverson, 2018; Johnson *et al.,* 2020).

At the University of Education, Winneba (UEW), both Biology Education and Integrated Science Education programs incorporate genetics into their curriculum. Despite the subject's significance, many undergraduate students exhibit moderate levels of interest and engagement, potentially limiting their academic performance and future career prospects. Understanding the factors that shape students' attitudes towards genetics is critical for improving teaching strategies and increasing student engagement (Casanoves, Salvadó, González, Valls, & Novo, 2017).

This study aims to explore the determinants of undergraduate students' interest and engagement in the study of genetics at UEW. Specifically, it examines how the relevance of genetics, pedagogical approaches, challenges faced by students, and misconceptions about the subject influence student interest. Identifying these factors can inform educational practices that foster deeper student engagement and enhance learning outcomes in genetics courses.

2. Methodology

This study employed a descriptive survey design, which is well-suited for examining the relationships between various factors and student attitudes (Creswell, 2014). The target population consisted of undergraduate students enrolled in the Biology Education and Integrated Science Education programs at UEW. A total of 150 students were selected through a simple random sampling technique, ensuring diversity in terms of gender, age, and academic program.

2.1 Data Collection

Data were collected using a structured questionnaire designed to assess five constructs: relevance of genetics to life, pedagogical approaches to teaching genetics, student challenges in studying genetics, student interest and engagement in genetics, and misconceptions about the subject. The questionnaire items were adapted from previously validated instruments used in educational research (Johnson *et al.,* 2020). Responses were measured on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." Relevance to life was evaluated based on students' perceptions of genetics in health, agriculture, and global issues like food security. Pedagogical approaches included

assessments of interactive methods such as hands-on activities, group discussions, and online simulations. The construct for student challenges captured difficulties in understanding complex genetic concepts, while interest and engagement were assessed through students' participation in extracurricular genetics-related activities. Misconceptions were identified based on common errors in genetic understanding, such as confusion between genetic modification and genetic engineering.

2.2 Data Analysis

Descriptive statistics, including frequencies, means, and standard deviations, were used to summarize the data. Pearson's correlation analysis was applied to examine the relationships between student interest and engagement in genetics and the identified factors—relevance to life, pedagogical approaches, challenges, and misconceptions. Additionally, Ordinary Least Squares (OLS) regression was used to predict the extent to which these factors could explain variations in student interest and engagement. The statistical significance was set at $p < 0.05$.

Ethical approval was obtained from the Institutional Review Board at UEW. Participation in the study was voluntary, and all participants provided informed consent. Confidentiality was maintained by anonymizing participant responses.

3. Results

3.1 Background Characteristics of Students

Table 1 presents the background information of the respondents. The results show that four-fifths (80.0%) of the respondents were males, while the females represent one-fifth (20.0%). More than six in every ten students (64.7%) were Biology Education students. The programme for the remaining students is Integrated Science Education. The students fall into different age categories. The table shows that 44.7% of the students are aged between 18 and 24 years, 44.0% are between 25 and 34 years, while more than one-tenth are aged between 35 and 44 years.

Table 1: Background characteristics of students

Variables	Frequency	Percent (%)
Sex of student		
Male	120	80.0
Female	30	20.0
Programme of study		
Biology	97	64.7
Integrated science	53	35.3
Age categories		
18-24	67	44.7
25-34	66	44.0
35-44	17	11.3

3.2 Factors Influencing Undergraduate Students' Interest and Engagement in Genetics

Table 2 presents factors influencing undergraduate students' interest and engagement in genetics as a subject in biology. Five constructs were identified and used in the study. The results revealed that the relevance of genetics to life was rated by the students with the highest mean (overall mean = 3.65±1.45), indicating that undergraduate students accepted that the study of genetics is relevant to life. The students agreed that the study of genetics is relevant because it helps to understand the basis of inherited traits and diseases, and aids in making informed decisions regarding health and lifestyle choices. The students also agreed that the study of genetics is a fundamental science that provides insight into the evolution and diversity of life on Earth, hence making it relevant to life. On the other hand, students observed that genetics is moderately relevant to addressing global challenges such as food security and genetic disease. The second-ranked factor among the five factors was pedagogical approaches to teaching genetics. Generally, students agreed that the pedagogical approaches to learning genetics are significant (mean = 3.53±1.35).

Students agreed that the use of practical experiments and hands-on activities significantly enhances understanding of genetics. Again, students agreed that group discussions significantly contribute positively to grasping the concept of genetics. Also, the use of interactive online simulations and visual aids is effective in conveying complex genetic processes, making it significant. The next factor in the rating is students' challenges regarding the study of genetics. Overall, the students perceived the study of genetics as moderately challenging (mean = 2.97±1.07). Specific areas where students are perceived as moderately challenging include noting that understanding genetics concepts requires a lot of effort and concentration. Furthermore, students revealed that genetics is one of the most difficult courses in the academic programme, and they often feel overwhelmed by the amount of information and concepts covered in genetics. These were perceived as moderate challenges. Students' interest and engagement in genetics is the fourth rated variable by the respondents. Students had moderate interest and engagement in the study of genetics (mean = 2.91±1.10).

Students' moderate interest is seen from the fact that genetics is as engaging as some other concepts in biology. Hence, their interest in the concept of genetics is manifested through interactions with genetics-related materials outside their coursework, such as articles, books or documentaries. Students, however, indicated that they are slightly interested in participating in genetics-related extracurricular activities, clubs or research projects. Misconceptions about genetics are the final variable in the list of factors. Students perceived some misconceptions in the study of genetics (mean = 2.61±0.90). Some of the misconceptions students perceived include the assertion that all observable traits in organisms are controlled by dominant alleles, dominant traits are the most common traits in a population, traits that are not inherited cannot be influenced by genetics, and genetic engineering is the same as genetic modification. Students, however, observed that the assertion that all inherited diseases are caused by faulty genes, genetic mutations always result in harmful or negative outcomes, only genetically modified

foods have genes and genetic traits are solely determined by a single gene are minor misconceptions.

Table 2: Factors Influencing Undergraduate Students' Interest and Engagement in Genetics

Relevance to life	**Mean**	**S.D.**
Studying genetics is important because it helps us understand the basis of inherited traits and diseases.	3.79	1.52
Learning genetics is valuable because it allows us to make informed decisions about our health and lifestyle choices.	3.70	1.54
Genetics is a fundamental science that provides insights into the evolution and diversity of life on Earth.	3.70	1.48
Genetics is relevant to a wide range of fields, including medicine, agriculture, and forensic science.	3.64	1.53
Understanding genetics is crucial in addressing global challenges such as food security and genetic diseases.	3.40	1.52
Overall mean	**3.65**	**1.45**
Pedagogical approaches to teaching	**Mean**	**S.D.**
The use of practical experiments and hands-on activities will significantly enhance my understanding of genetics concepts.	3.63	1.54
Group discussions contribute positively to my grasp of genetics.	3.59	1.45
Interactive online simulations and visual aids are effective in conveying complex genetic processes.	3.56	1.49
Instructors who encourage open discussions in genetics classes facilitate a better learning experience.	3.54	1.47
Problem-solving exercises that apply genetic principles to real-world scenarios are beneficial for my learning.	3.53	1.450
The use of case studies that apply genetics to real-life scenarios improves my engagement with the subject.	3.51	1.47
Instructors who encourage questions and answer sessions in genetics classes facilitate a better learning experience.	3.49	1.451
Collaborative learning activities contribute positively to my grasp of genetics	3.46	1.436
Instructors who adapt their teaching methods to cater to diverse learning styles enhance the overall genetics learning experience.	3.45	1.51
Regular formative assessments and quizzes assist in reinforcing genetics concepts.	3.40	1.52
Overall mean	**3.53**	**1.35**
Students' challenges	**Mean**	**S.D.**
Understanding genetic concepts requires a lot of effort and concentration.	3.33	1.48
I consider genetics to be one of the most difficult courses in my academic program.	3.28	1.41
I often feel overwhelmed by the amount of information and concepts covered in genetics.	3.15	1.45
I find that genetics assignments and exams are challenging to complete successfully.	3.03	1.41
I feel confident in my ability to perform well in the genetics course.	3.01	1.34
I often struggle to grasp the complexities of genetic inheritance.	2.90	1.27
Genetics is a subject that is found mentally taxing.	2.83	1.26
I think that with sufficient study and effort, genetics can be a manageable subject.	2.65	1.36
I find the genetics course to be more difficult than another science course I have taken.	2.59	1.21
Overall mean	**2.97**	**1.07**

Interest and Engagement	**Mean**	**S.D**
Genetics is as engaging as some other concepts in biology.	3.41	1.54
I am interested in the concept of genetics.	3.37	1.52
I engage with genetics-related materials outside of my coursework, such as articles, books or documentaries.	2.69	1.31
I have participated in genetics-related extracurricular activities, clubs, and research projects.	2.16	1.28
Overall mean	**2.91**	**1.10**
Misconception	**Mean**	**S.D**
All observable traits in organisms are controlled by dominant alleles.	3.28	1.58
Dominate traits are the most common traits in a population.	3.09	1.47
Traits that are not inherited cannot be influenced by genetics.	2.85	1.53
Genetic engineering is the same as genetic modification.	2.79	1.48
All genetic variation is due to mutations.	2.73	1.54
Once a mutation is discovered, it can be fixed.	2.68	1.34
All genetic tests are equally reliable and precise.	2.62	1.33
Fraternal twins have different DNA.	2.57	1.46
Genes are the sole factor in determining an individual's traits; the environment plays no role.	2.54	1.54
Identical twins have the same DNA.	2.54	1.49
All inherited diseases are caused by faulty genes.	2.42	1.47
Genetic mutations always result in harmful or negative outcomes.	2.41	1.37
Only genetically modified foods have genes.	2.19	1.37
Genetic traits are solely determined by a single gene.	1.87	1.24
Overall mean	**2.61**	**0.90**

Note: Means were calculated with a scale of 1 = Strongly disagree, 2 = Disagree, 3 = Moderately agree, 4 = Agree, 5 = Strongly agree.

3.3 Pearson Correlation of Students' Interest and Engagements in the Study of Genetics

Pearson's correlation was utilised to examine the magnitude and direction of the relationships between undergraduate students' interest and engagement in the study of genetics and related variables (Table 3). Davis's (1971) convention of determining the magnitude and direction of correlation coefficients was used to assess the relationships. The results showed that there was a very high positive significant relationship between students' interest and engagement in the study of genetics and the relevance of the study of genetics to life at 0.05 alpha level ($r = 0.75$, $p = 0.00$, CI; 0.75:0.81), and the pedagogical approaches to teaching the concepts ($r = 0.71$, $p = 0.00$, CI; 0.62: 0.78). The results indicate that a unit increase in the perception of the students about the relevance of the study of genetics to life and the pedagogical approaches to teaching the concept would significantly yield a unit increase in students' interest and engagement in the study of genetics. In addition, a substantially positive significant relationship was observed between students' interest and engagement in genetics and students' challenges with the study of genetics at 0.05 alpha level ($r = 0.62$, $p = 0.00$, CI; 0.52: 0.71). Implying that a unit increase in students' challenges in genetics would result in a unit increase students' interest and engagement in the study of genetics. Also, the study revealed a moderate

positive significant relationship between students' interest and engagement and their opinions about the misconception in the study of genetics at 0.05 alpha level (r = 0.47, p = 0.00, CI; 0.34: 0.59). The results mean that a 100 percent increase in students' opinion on the misconception about genetics would warrant a 100 percent increase in interest and engagement in the study of genetics.

Table 3: Pearson Correlation of Students' Interest and Engagement in the Study of Genetics

					Confidence interval	
	Relationships	**Type of correlation**	**Coefficient (r)**	**p-value**	**Lower bound**	**Upper bound**
X_1	IE – RL	Pearson's	0.75	0.00	0.75	0.81
X_2	IE – SC	Pearson's	0.62	0.00	0.52	0.71
X_3	IE – M	Pearson's	0.47	0.00	0.34	0.59
X_4	IE – PAT	Pearson's	0.71	0.00	0.62	0.78

Note: IE = Interest and Engagement, RL = relevance to life, SC = Student challenges, M = Misconceptions, PAT = Pedagogical approaches to learning.

3.4 Determinants of undergraduate students' interests and engagements in the study of genetics

Ordinary least square regression was adopted to examine the determinants of students' interest and engagement in the study of genetics. Table 4 presents the results of the study where undergraduate students' interest and engagement in the study of genetics as the dependent variable and the associated variables as the independent variables. The results indicate that the relevance of the study of genetics to life was the best predictor of undergraduate students' interest and engagement in genetics [F (1,148) = 188.01, p < 0.00, with R^2 of 0.56]. The value of the adjusted R^2 indices of 0.56 indicates that more than half (56.0%) of the variation in undergraduate students' interest and engagement in the study of genetics is predicted by the relevance of the study of genetics to the life of the students. The confidence interval of the regression coefficient of the independent variable, which differed from zero, was lower bound = 0.49 and upper bound 0.65. In summary, the relevance of the study of genetics to the life of the students accounted for 56 percent of the variation in their interest and engagement in the study of genetics. When the beta coefficient of the results was assessed, it revealed that the overall mean relevance of genetics to life was (mean = 3.65±1.45). Therefore, the magnitude and direction (standard beta) of the relationship between students' interest and engagement in the study of genetics and the relevance of genetics to life implies that with all variables held constant, a unit increases the relevance of the study of genetics to the lives of the students to 4.65 would result in a 75% increase in the interest and engagement of the students in the study of genetics. The results signify that when undergraduate students perceive the relevance of the study of genetics to their lives, it would strongly increase their interest and engagement in the concept of genetics.

Table 4: Ordinary Least Square Regression of Students' Interest and Expectation in Genetics

Entry	*R*	R^2	Adj. R^2	S.E.E	Stand. Beta	F Ratio	df	df	p-value	LB	UP
X_1	0.75	0.56	0.56	0.73	0.75	188.01	1	148	0.00	0.49	0.65

*p < 0.05 **p < 0.01, Intercept = 0.83.

4. Discussion

The findings of this study highlight several key factors influencing undergraduate students' interest and engagement in genetics. The most significant predictor was the perceived relevance of genetics to life, which accounted for over half of the variation in students' interest ($R^2 = 0.56$, $p < 0.00$). This result aligns with previous studies suggesting that students are more likely to engage with subjects they see as directly applicable to real-world issues (Collins & Halverson, 2018). In this case, students viewed genetics as crucial for understanding inherited traits, health decisions, and global challenges like food security, making the subject more engaging.

Pedagogical approaches were also found to significantly influence student interest and engagement ($r = 0.71$, $p < 0.00$). Methods such as practical experiments, hands-on activities, and interactive simulations were perceived as particularly effective. This supports the notion that active learning strategies, which engage students in real-world problem-solving, enhance their understanding of complex concepts in genetics (Casanoves, Salvadó, González, Valls, & Novo, 2017). Additionally, group discussions and open classroom environments further contributed to student engagement, consistent with the literature on collaborative learning (Johnson *et al.*, 2020).

However, the study also identified significant challenges faced by students in genetics courses. While students generally found genetics to be moderately interesting, they struggled with the subject's complexity (mean = 2.97). Concepts such as genetic inheritance and molecular genetics were perceived as mentally taxing. A finding echoed in similar studies that identify genetics as one of the most challenging topics in the biological sciences (Bates, et al., 2016). These challenges may hinder student engagement and underscore the need for instructors to provide additional support and resources.

Misconceptions about genetics, though less influential, still played a role in shaping student interest ($r = 0.47$, $p < 0.00$). Some students held incorrect beliefs about dominant and recessive traits, genetic modification, and the inheritance of diseases. Addressing these misconceptions through clear, accurate instruction could further enhance student engagement (Johnson *et al.*, 2020).

5. Conclusion

In conclusion, this study demonstrates that undergraduate students' interest and engagement in genetics at UEW are significantly influenced by the perceived relevance of genetics to life and the pedagogical approaches employed in teaching. Students who view genetics as directly applicable to their health and broader societal issues are more likely to engage with the subject. Additionally, active learning strategies, such as hands-

on experiments and collaborative discussions, enhance students' understanding and interest in genetics.

Despite these positive influences, the challenges students face in understanding genetics, particularly its more complex aspects, need to be addressed to improve engagement. Educators should consider adopting more diverse instructional strategies, including differentiated learning approaches and additional support materials, to help students overcome these challenges. Furthermore, addressing common misconceptions about genetics can reduce confusion and foster a deeper interest in the subject.

Future research should explore interventions that can mitigate these challenges and assess the long-term impact of improved pedagogical practices on student engagement in genetics. By creating more engaging and supportive learning environments, institutions like UEW can cultivate a new generation of scientists equipped to apply genetic knowledge to real-world problems.

Conflict of Interest Statement

The authors declare no conflicts of interest.

About the Author(s)

Collins Owusu-Fordjour (PhD) is a lecturer with the Department of Science Education at the University of Education, Winneba. He holds PhD in Science Education. His research interest is in science education, science teaching and learning, curriculum studies and evaluation and higher education.

Rosemary Naana Kumi Manu (PhD) is a lecturer with the Department of Biology Education in the University of Education, Winneba. She holds PhD in Science Education and conduct research in science teaching and learning, teacher education and higher education.

References

Bates, M., Bigot, M., Cropp, R., Engwirda, D., Friedman, C., & D. W., H. (2016). On the formulation of environmental fugacity models and their numerical solutions. *Environ. Toxicol. Chem, 35*(9), 2182-2191. https://doi.org/10.1002/etc.3403

Casanoves, M., Salvadó, Z., González, Á., Valls, C., & Novo, M. T. (2017). Learning genetics through a scientific inquiry game. *Journal of Biological Education, 51*(2), 99-106. https://doi.org/10.1080/00219266.2016.1177569

Collins, A., & Halverson, R. (2018). *Rethinking education in the age of technology: The digital revolution and schooling in America.* Teachers College Press. Retrieved from https://www.researchgate.net/publication/264869053_Rethinking_education_in_the_age_of_technology_the_digital_revolution_and_the_schools

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed.). Thousand Oaks, CA: Sage Publications. Retrieved from

https://www.ucg.ac.me/skladiste/blog_609332/objava_105202/fajlovi/Creswell.pdf

Davis, J. A. (1971). *Elementary survey analysis.* Prentice-Hall. Retrieved from https://books.google.ro/books/about/Elementary_Survey_Analysis.html?id=c63ZAAAAMAAJ&redir_esc=y

Johnson, E. C., Demontis, D., Thorgeirsson, T. E., Walters, R. K., Polimanti, R., Hatoum, A. S., & Wang, J. C. (2020). A large-scale genome-wide association study meta-analysis of cannabis use disorder. *The Lancet Psychiatry, 7*(12), 1032-1045. https://doi.org/10.1016/s2215-0366(20)30339-4