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Student's Gender and Attitude towards Biology Practical Work affects Academic Performance: A Case Study of Turbo Sub-County, Kenya

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1.0 ABSTRACT

Students' performance in biology has declined over the last five years, raising concerns about access to courses requiring satisfactory biology grades. A study was conducted in Turbo Sub County, Kenya, to investigate the relationship between students' gender and attitudes towards biology practical work and academic performance. The study included 23 biology teachers and 245 biology students. The quantitative and qualitative data were gathered using a mixed approach that included questionnaires, interviews, and the administration of a biology practical test to students to determine their performance. Various statistical tests were performed on the data, including one-way analysis of variance (ANOVA), the t test, and the chi-square test.The findings revealed a significant relationship ($P<0.05$) between different attitudes towards practical biology and academic performance. Positive attitudes, such as being driven to succeed and reading ahead of teachers, were linked to improved performance. Anxiety, fear, and technical challenges during practical exams, on the other hand, were associated with poorer outcomes. There were gender differences, with females displaying more positive attitudes and performing better on biology practical tests. These findings highlight the importance of developing targeted strategies to improve attitudes and learning environments, ultimately improving biology's academic performance. These insights can be used by policymakers and educators to implement effective interventions and support students, resulting in improved educational outcomes.

Key Words: Attitude, Biology, Gender, Performance, Practical, secondary school

2.0 INTRODUCTION

Science education's profound impact on both the well-being of humanity and the sustainable development of our planet is undeniable (UNESCO, 2004). Its significance lies in equipping individuals with the essential knowledge and skills pivotal for driving economic, scientific, and technological progress (Croxford, 2002). By fostering a deep understanding of scientific principles, science education empowers individuals to make informed and judicious choices concerning intricate scientific and technological matters, thus further enhancing its indispensability in our modern world.

Scientific and technological advancement is progressing rapidly on a global scale; however, a significant worry emerges regarding declining interest among students in pursuing science education and careers. This concern has spurred worldwide efforts to reform science education. Students' gender and attitudes toward science are crucial due to technology's integration into all economic sectors. In most countries, research focuses on enhancing science education's quantity and quality (Sakariyu et al., 2016). Notably, nations like Russia, emphasizing physics education, achieved feats like launching Sputnik in 1957 (Ndonga, 2019). The global issue of declining interest in science extends to biology, a subject pivotal for careers in Medicine, Zoology, Botany, etc. This concern is evident across nations, including the United States, Canada, Portugal, Jamaica, and African countries (Valverde& Schmidt, 2017; Landry, 2018; Fonseca &Conboy, 2016; Blair-Walters &Soyibo, 2004). Poor Biology performance is observed widely. For instance, Jamaican students showed low grades in Biology (Blair-Walters &Soyibo, 2004). In Africa, the science performance has also been declining, raising concerns.

In Africa, students' attitudes significantly impact Biology proficiency, and gender plays a crucial role in this dynamic. It is a core subject across the continent, vital for quality tertiary education. Biology holds a crucial position as one of the core subjects in secondary school curricula across the continent and is mandatory for admission to quality tertiary institutions. However, gender-based differences in attitudes and their consequences on performance are notable. For instance, studies have revealed variations in attitudes between male and female students in countries like Nigeria, where multiple factors influence these disparities (Sakariyu et al., 2016).

Kenya faces persistently low Biology scores in the KCSE exams (Kiilu et al., 2022). This is attributed to a shift in question format, requiring analytical application rather than rote memorization. Teacher feedback hints at an unfair shift causing mismatches between students' abilities and grading (Michira, 2017). Low teacher qualifications have been reported to affect Nakuru County's Biology performance in KCSE (Orina et al., 2022). Kenya's National Education Policies aim to equip learners with practical skills, reflected in the shift from 8-4-4 to CBC. Practical-oriented learning gains prominence, offering hands-on experience and deeper understanding (Akinmade, 2018). Initiatives like SMASSE aimed at improving maths and science education, but Biology performance remains a concern, urging an exploration of students' attitudes (SMASSE baseline report, 1998).

In Turbo Sub-County, Kenya, the current study examines students' attitudes toward practical lessons and their impact on Biology performance, considering the crucial dimension of gender. This research responds to the pressing need for improved Biology education, aligning with global efforts to bolster science education and inspire students' interest in critical subjects. As technology increasingly intertwines with all aspects of life, nurturing a new generation of proficient scientists and fostering a positive attitude toward science becomes imperative. However, to achieve this, addressing the complex interplay of cultural, educational, and socio-economic factors influencing students' attitudes and performance in biology, with due consideration for gender dynamics, will be crucial. Therefore, the aim of the current study was to investigate the effects of students' attitudes toward biology practical work, and gender on academic performance in Turbo Sub-County, Kenya. The findings of this study could potentially provide insights and recommendations for educational policies and practices that can lead to improved biology education outcomes, taking into account gender disparities, in Turbo Sub-County, Kenya, and beyond.

3.0 MATERIAL AND METHODS

STUDY AREA

The study was undertaken in Turbo Sub-County in Kenya. The sub county lies between longitudes $34^0$50' east and $35^0$37' West. The sub-county has four educational zones; Kapyemit, Sugoi, Kiplombe and Turbo. The sub-County borders Lugari Constituency to the West and Nandi County to the South and Kakamega County to the Western. The area is about 1500 m above sea level and covers a total area of 324 km^2. The sub-county is densely populated due to high urbanization rate in the area (Ngetich, 2020).Turbo sub county is an area which practices agricultural farming, with commercialization of farming such as cultivation of maize and wheat on large scale and other crops on a small scale. The sub-county has got 46 secondary schools. Turbo Sub County was chosen because the sub county has been recording poor performance in Biology KCSE examination.

RESEARCH DESIGN

The descriptive survey design was adopted, enabling the researcher to accurately depict the current state of affairs and report the findings (Kombo &Tromp, 2009). This design proved particularly effective in collecting descriptive data about the characteristics of populations and justifying existing conditions and practices, (Kothari,2009).To acquire the data, researchers employed both primary and secondary data sources. Primary data collection involved the use of well-structured questionnaires, administering practical test, and interviews. These methods allowed researchers to gather responses from a diverse set of respondents in a systematic manner, ensuring comprehensive data coverage. In addition to primary data collection, secondary data were obtained. By employing both primary and secondary data acquisition approaches, the researchers could efficiently gather relevant information to address the research questions and draw informed conclusions based on the findings. The combination of primary and secondary data sources enriched the study's qualitative and quantitative data, providing a comprehensive and holistic understanding of the research topic. This methodological approach contributed to the credibility and rigor of the study's findings, reinforcing the value of a well-designed research design in generating meaningful results.The target population of the study was the secondary school biology teachers and students undertaking biology as elective or compulsory subject. A representative sample of 30% (23) biology teachers, and 245 students using Fisher's formulae were obtained.

DATA COLLECTION

The study used probability sampling methods. The probability techniques used in this study were stratified and simple random sampling. Stratified random sampling was used to select the schools because they are heterogeneous (Kothari, 2009). The strata consisted of schools based on the school category. From the sampled schools, purposive sampling was then used to select teachers teaching biology and students taking biology in form four. Quantitative data was collected using document analysis (practical test results) whereas qualitative data involved the use of questionnaire and interview schedule.

DATA ANALYSIS

The data collected for this study was meticulously processed and analysed in a systematic manner. Initially, it was gathered, entered, structured, and securely stored within Microsoft Excel 2013. Subsequently, the data underwent coding and rigorous analysis through the use of Statistical Package for Social Sciences (SPSS V. 26). To gain a comprehensive understanding of the dataset, various statistical methods were employed. Descriptive statistics, encompassing measures like mean values, maximum and minimum values, and percentage frequency distributions, were computed to effectively summarize the data. Furthermore, the relationship between gender and attitudes towards biology practical was explored through a series of chi-square tests, while a t-test was utilized to compare students' performance in biology practical tests. This analytical approach provided invaluable insights into the dataset, facilitating a thorough examination of the key factors under investigation.

4.0 RESULTS AND DISCUSSION

Effects of students' attitude towards biology practical work on academic performance

The students were presented with questionnaires with different attitudes towards biology practical and were required to indicate whether they agree or not. The results revealed diverse opinions among the participants (Table 1). A significant portion of the students, approximately 64%, expressed that biology practical inspire them to read ahead of the teacher, indicating a positive impact on their learning motivation. The findings are consistent with other studies Musasia*et al.,* (2012) who found that biology practical has a significant influence on students' learning and fosters a positive attitude towards biology.Similarly, when it comes to encouraging students to excel in Biology, only 19 %

of the respondents agreed that the practical have such an effect, while a much larger proportion, around 73%, disagreed. This indicates that the majority of students might not perceive biology practical as strong catalysts for excelling in the subject. This observations on this particular attitude contradicts the findings of Sharpe, (2012), who reported that practical work is perceived as an essential component by many students, leading to positive attitudes and improved understanding of biology.

Table 1: Student attitude towards biology practical. The values in parentheses are percentages representing the proportion of students agreeing, disagreeing, or undecided on each attitude. Values outside parentheses indicate the actual number of students corresponding to the percentage.

Items	Agree	Disagree	Undecided
Biology practical inspire me to read ahead of the teacher	154(64)	58(24)	29(12)
Biology practical encourages me to excel in Biology	46(19)	175(73)	19(8)
Biology practical make me work hard towards attaining quality grades	36(15)	166(69)	38(16)
Biology practical challenges me to improve performance in biology subject	65(27)	156(65)	19(8)
I feel anxious and fearful during biology practical examination	118(49)	108(45)	14(6)
Biology practical work are technical to learn	125(52)	108(45)	7(3)

The aim of the study was to explore the correlation between students' attitudes towards biology practical and their performance in biology practical tests. To examine this, the data underwent Chi-square test ($\chi 2$), a tool that evaluates the significance of associations between categorical variables. The outcomes highlighted various notable connections between attitudes and academic achievements (Table 2).Students who exhibited feelings of inspiration to read ahead of the teacher and motivation to excel in Biology demonstrated significantly better performance in the subject ($\chi^2 = 8.8$, $P < 0.01$; $\chi^2 = 5.4$, $P = 0.02$, respectively). Interestingly, the presence of learning resources did not show a significant relation with student performance ($\chi^2 = 0.6$, $P = 0.43$). This suggests that while having adequate learning resources is important, it may not be the sole determinant of academic success in biology.

Table 2:Associations of attitudes and students' academic performance

Attitude towards biology practical	χ^2	P
Inspire me to read ahead of the teacher	8.8	<0.001
Encourages me to excel in Biology	5.4	0.02
Make me work hard towards attaining quality grades	10.8	<0.001
Challenges me to improve performance in biology subject	4.2	0.04
I feel anxious and fearful during biology practical examination	3.1	0.8
Biology practical work are technical to learn	0.6	0.43

Conversely, students who experienced anxiety and fear during biology practical examinations or found the practical work technically challenging tended to exhibit lower academic performance ($\chi^2 = 10.8$, $P < 0.01$; $\chi^2 = 15.1$, $P < 0.01$, respectively). Similarly, students who felt challenged to improve their performance in biology also demonstrated lower academic outcomes ($\chi^2 = 9.2$, $P < 0.01$).

Overall, the findings indicate an association between students' attitudes and their academic performance. Positive attitudes appear to activate students' cognitive, emotional, and behavioral components, positively influencing their performance. Conversely, negative attitudes contribute to a lack of motivation and hinder students from performing well. Cultivating positive attitudes among students may enhance their ambitions and motivation to excel, leading to improved academic performance.

Association of gender and academic performance

The study also ventured into exploring attitudes towards biology practical among male and female students, with the goal of uncovering the connection between gender and specific attitudes. The outcomes highlighted distinct attitudes significantly influenced by gender. Notably, female students exhibited a more pronounced inclination towards positive attitudes in comparison to their male counterparts. This was evident in their stronger agreement with statements such as "Biology practical inspires me to read ahead of the teacher" (Females: 65%, Males: 52%, $\chi2 = 5.41$, $p = 0.02$), "Biology practical encourages me to excel in Biology" (Females: 73%, Males: 59%, $\chi2= 4.71$, $p = 0.03$), and "Biology practical makes me work hard towards attaining quality grades" (Females: 76%, Males: 63%, $\chi2= 5.43$, $p = 0.02$, Table 3).

Table 3: Student attitude towards biology practical in girls and boys school

Attitude towards biology practical	χ^2	P
Biology practical inspire me to read ahead of the teacher	5.41	0.02
Biology practical encourages me to excel in Biology	4.71	0.03
Biology practical make me work hard towards attaining quality grades	5.41	0.02
Biology practical challenges me to improve performance in biology ıbject	4.22	0.04
I feel anxious and fearful during biology practical examination	3.28	0.07
Biology practical work are technical to learn	0.15	0.7

The findings of this study point to the possibility that female students might draw stronger motivation and inspiration from the hands-on aspects of biology practical's, leading to an elevated sense of commitment and enthusiasm for the subject. This aligns with the discoveries made by Hofstein&Mamlok-Naaman, (2011) indicating that the way biology practical work is conducted can significantly impact students' interest and attitudes. The theory of social constructivism emphasizes the need to customize activities and methods to each individual's level, interests, and aspirations, creating a meaningful learning process. Neglecting these considerations, however, can result in waning interest and a less serious approach to learning, ultimately impeding students from achieving their full potential.

Conversely, male students seemed more likely to hold the view that "Biology practical challenges me to improve performance in the biology subject" (Males: 56%, Females: 47%, $\chi 2 = 4.22$, $p = 0.04$). This suggests that male student's view biology practical's as valuable chances for personal development, motivating them to strive for better performance through experiential learning. This perception might stem from the common stereotype that science is inherently difficult and mainly suited for males. While biology practical work is widely acknowledged as crucial, the findings of this study imply that its presentation, as observed here, might not necessarily encourage students to pursue a career in biology (Hinneh, 2017).

Interestingly, no significant gender-based disparities emerged regarding feelings of anxiety and apprehension during biology practical examinations (Females: 79%, Males: 72%, $\chi 2 = 3.28$, $p = 0.07$), or in perceiving practical work as technically challenging (Females: 65%, Males: 64%, $\chi 2 = 0.15$, $p = 0.70$). These outcomes indicate that both male and female

students share comparable levels of unease and difficulty in certain aspects of biology practical's, suggesting a mutual experience in grappling with challenges during lab work. This might be attributed to the fundamental purpose of teaching science through practical work to guide students to a point where they derive enjoyment from engaging in scientific learning and are motivated to pursue the study of science beyond secondary school (Morris, 1990; Hussain & Akhtar, 2013).

The study's findings underscore the significance of recognizing gender-related differences in attitudes toward biology practical work. These valuable insights can guide educators in understanding the distinct requirements and preferences of students, thus enabling the creation of customized teaching strategies that enrich learning experiences and academic achievements in biology. By nurturing positive attitudes toward practical learning, educators can cultivate a more inclusive and supportive learning environment, advancing gender equality in science education and empowering all students to unleash their maximum potential in the subject.

Determination of academic performance (practical test) of females and males

Gender holds undeniable significance in shaping students' academic performance. It encompasses a spectrum of physical, biological, mental, and behavioural attributes distinguishing between the feminine and masculine cohorts (Filgona & Sababa, 2017). According to Meredith, (2014) gender is a socially constructed notion imbibed from birth. However, its correlation with academic performance has yielded inconsistent findings in contrast to the more steadfast conclusions drawn about other learner traits (Eddy & Brownell, 2014; Wenderoth&Chukwunyeremunwa, 2013).This study delved into whether gender influence academic performance (Practical test). This was achieved by juxtaposing students' practical test results offemales and males. The mean scores on the biology practical test were 8.76±0.23 out of 20 in girls' schools and 6.82±0.51 out of 20 in boys' schools (Table 4).

Table 4: Performance of females and males in practical test administered to respondent students in various schools in Turbo Sub County.

Gender	No of respondents	Max	Min	Mean
Females	120	17	3	8.76±0.23
Males	117	16	4	6.82±0.51
t- value	-	-	-	1.89
P value	-	-	-	0.03

The outcomes unveiled a statistically significant distinction between the two cohorts, with female students exhibiting higher performance in the biology practical test (t (235) =3.85, P=0.03). This finding contradicts the research conducted by Dania, (2014) in Delta State, Nigeria, which found that gender (male/female) insignificantly impacted students' accomplishments in science studies. These divergent results emphasize the intricate nature of the interplay between gender and academic achievement, underscored by the potential sway of diverse contextual factors.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, this study's findings have shed light on the significant impact of attitudes on student performance in biology practical tests, underscoring the importance of positive attitudes, including inspiration and motivation, in achieving better results. Moreover, it has highlighted gender disparities in attitudes and practical performance, with female students demonstrating more positive attitudes and outperforming their male counterparts. Additionally, school characteristics, particularly the type of school, have been shown to influence students' achievements in biology practical work, with girls' schools and private schools demonstrating better attitudes and performance.

In light of these conclusions, several recommendations have been put forth. First and foremost, educators should prioritize the cultivation of positive attitudes among students by emphasizing hands-on activities, fostering meaningful discussions, and demonstrating the relevance of practical work. Addressing anxiety and creating supportive and encouraging learning environments can significantly boost students' confidence and overall performance.

Secondly, it is crucial to promote gender equality in biology education. Schools should proactively work towards creating inclusive environments that bridge the gender gap in

attitudes and performance. Ensuring equal access to resources and support for all students, irrespective of their gender, will empower them to excel in biology and other scientific disciplines.

Lastly, we recommend further research to explore whether the observed attitudes and gender-related differences in this study persist at the national examination level in Kenya. This research could provide valuable insights into the broader impact of attitudes and gender on students' performance in biology, potentially informing future educational policies and practices.

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