Determinants of Good Students' Performance in Biology Subject in Ngara District, Tanzania

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Abstract: The study employed descriptive research design based on both qualitative and quantitative approach in order to meet the research objectives. Both purposive and randomly sampling techniques were employed in selecting 132 respondents i.e., 120 students and 12 biology teachers from six selected secondary schools in Ngara district. The data obtained from 132 respondents obtained using questionnaires and interview were coded, cleaned, and punched into SPSS (Statistical Package for Social Science) Version 20 for analysis. Descriptive statistics and multiple linear regression models were used to deduce necessary findings. The marginal effects of a unit change in the value of regressor in the multiple linear regression analysis were used to interpret the results of the study to establish the influence of each explanatory variable on the variation of the students' academic performance. From Multiple Linear Regression analysis, the study found that students' academic performance in biology subject in Ngara district is highly influenced by i.e., availability of biology teachers, availability of learning and teaching facilities, student's perception towards biology subject, availability of well-equipped laboratories and libraries, motivation to teachers, in-service training, parents' level of education and conducive learning environment. Basing on the study results the researchers concluded that biology performance in secondary schools can be improved if students would be involved in practical lessons under the guidance of well trained and qualified personnel.

Keywords: Determinants, Students' Performance, Biology Subject

1. Introduction

Biology as science subject is primarily concerned with the nature of organisms and their relationship to each other and to their environment. Biological disciplines imply a significant responsibility for the protection and welfare of all living species [11]. Biology provide a range of balanced learning experiences through which students develop the necessary scientific knowledge and understanding, skills and processes, values and attitudes embedded in the life and living aspect and other aspects of science education for personal development and for contributing towards a scientific and technological world [1].

The Tanzanian school curriculum stipulates that science subjects at the ordinary level in secondary schools be among the high profile subjects. In an ordinary level, sciences subjects are not compulsory for students except biology. Declining achievement in the subject has caused great concern among science educators within Tanzania, which resulted in improving the pedagogical approach and in the shaping of the science subjects curriculum to promote the performance. One among those efforts includes the MOEC Science Education in Secondary Schools (SESS) project that operated between 1997 and 2001. The project reviewed the curriculum, cutting across many subjects offered at the level of secondary schools. However, such efforts have not enabled students to perform better in science subjects including biology. For several years, Certificate of Secondary Education Examination (CSEE)

results in science subjects have been showing a similar trend, which is considered as poor performance [17]. The main goal of the Biology Curriculum is to offer biology-related learning experiences for students to improve scientific literacy so that they can participate actively in our fast-changing knowledge-based society, prepare for further studies or careers in the fields associated to life science, and become life-long learners in science and technology (MoEST, 2005).

In Tanzania, the key factor used to measure educational achievement is performance in examinations. The academic performance of students in Certificate of Secondary Education Examinations (CSEE) in recent years i.e., the pass rate of biology subject showed that, a total of 423,887 candidates were registered for the examination. 232,960 (55.26%) passed and 190,927 (45.74%) failed. This implies that, the general performance in biology subject was average. But this performance is lower by 5.63% when compared to that of 2018 where 217,531 (60.89%) candidates passed in NECTA 2020. Table 1 shows the performance trend in biology subject for six conservative years at national level (2014-2019).

Table 1. Biology Summary Results (CSEE-2014-2019) Nationwide.

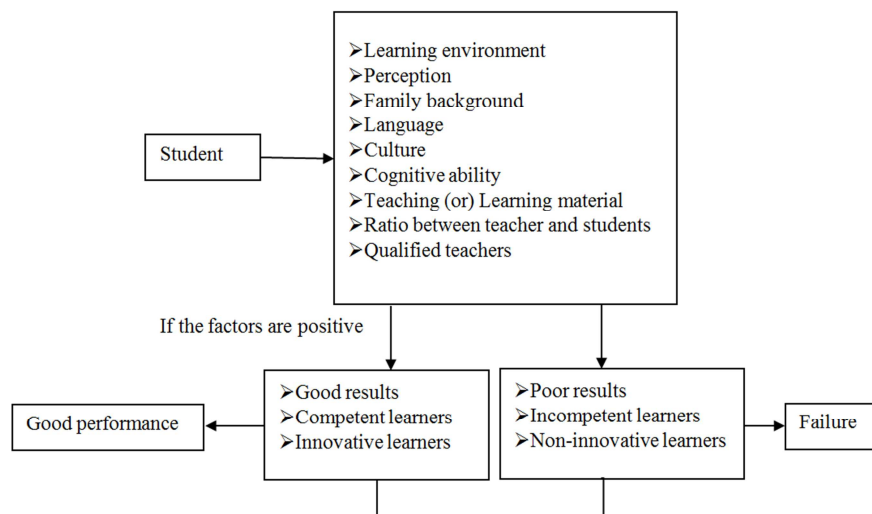| YEAR	Passed in percent (%)	Failed in percent (%)	Comment on Performance
2014	48.30	51.70	Poor
2015	53.74	46.26	Average
2016	55.69	44.31	Average
2017	61.37	38.63	Average
2018	60.89	39.11	Average
2019	55.26	44.74	Average

Source: NECTA 2014-2019

Therefore, our study is set to investigate the factors that contribute to the good performance of biology subject in Ngara district.

1.1. Analytical and Theoretical Framework

The study used Constructivist Learning Theory, which was developed by Vygotsky in 1978. Researchers in this study adopted this theory as it is relevant which states that learners construct knowledge rather than just passively take in information. As people experience the world and reflect upon those experiences, they build their own representations and incorporate new information into their pre-existing knowledge (schemas). The theory emphasizes that individuals learn and become most competence through building their own knowledge, connecting new ideas and experiences to existing knowledge and experiences to form new understanding. Vygotsky [20] and Dewey [6] believed that learners either can assimilate new information into an existing framework, or can modify that framework to accommodate new information that contradicts prior understanding. In our classroom, teachers can promote active learning often explicitly by asking students to make connections between new information and their current mental models, extending their understanding. In other cases, teachers may design learning activities that allow students to confront misconceptions, helping students reconstruct their mental models based on understanding that is more accurate. In either case, approaches that promote active learning promote the kind of cognitive work identified as necessary for learning by constructivist learning theory. Active learning approaches also often embrace the use of cooperative learning groups, a constructivist-based practice that places particular emphasis on the contribution that social interaction can make [3]. In the study of biology, the ability to build interrelationships among concepts and related topics, and to relate newly acquired knowledge to prior knowledge, is crucial to the understanding of biological concepts and how the systems work together to bring about a coordinated response. In the biology classroom, this approach is very important because students are able to discover the links between concepts themselves, they move away from rote or surface learning, and replace it with deep and meaningful learning, thus increasing the level of understanding and an appreciation for the subject.

Source: Author's Conceptualization

Figure 1. Conceptual Framework.

1.2. Conceptual Framework

Conceptual framework in this study is an assemblage set of research concepts cum variables together with their relationships which represented in the form of diagram. It is arranged in a logical structure to aid provide a picture or visual display of how ideas in a study relate to one another [10]. Therefore, a conceptual framework presented in Figure 1 depicts that; students' performance in biology subject is determined by learning environment, perception, family background, language and culture, cognitive ability, teaching and learning materials, teacher-students ratio and number of qualified biology teachers.

2. Research Methods and Methodology

2.1. Study Area

The study was conducted in Ngara district, which is located in Kagera region in Lake Zone part of Tanzania. The District has 28 secondary schools of which 23 are public schools and six (5) are private schools. Ngara District Council is one of the eight councils in Kagera Region. It was established on 1st January 1984 under the Local Government Act No. 7 of 1982, with Local Government. The total area for Ngara is 3,744 km2. Ngara DC lies on the very west of the Mainland Tanzania between Latitudes 2   45" S and Longitudes 30   64" E. It borders the Republics of Rwanda in the Northwest and Burundi in the Southwest. Its elevation is approximately 6,000 feet (1,800 m) and is considered to be in the highlands of Tanzania. Ngara district is small with an estimated population of 8000 up to 10000 people. Moreover, Ngara district was chosen because of the presence of different socio-economic status of its dwellers and different status of academic performance in most of the schools to possibly provide adequate data or information for the study.

2.2. Research Design

This study employed descriptive research design based on mixed approach i.e., both qualitative and quantitative approaches due to its suitability in social research that can be done in the subjects' natural setting. The study adopted this design because of its strength in interpreting conditions, practices, beliefs, views, perceptions and effects that exist in the real world [18].

2.3. Sample Size and Sampling Technique

Both purposive and random sampling techniques were used in this study. The researchers used purposive sampling technique in selecting 6 representative schools and 12 biology teachers i.e., two (2) biology teachers from each school while random sampling technique was used in selecting 120 students i.e., from each school 20 biology students were randomly selected. Therefore, the sample size of this study stood at 132 respondents.

2.4. Data Type and Collection

The study used both primary and secondary source of data collection. Primary data were collected from 132 respondents using questionnaires and interview while secondary data were obtained through documentary reviews from books, NECTA, schools' reports, and from the internet sources.

2.5. Data Analysis

Data analysis in qualitative research involves summarizing data in a dependable and accurate manner and leads to the presentation of study findings in a manner of processing the information and coding them thematically [9]. Collected data were cleaned, coded and punched into SPSS software for analysis. Regression analysis was performed to ascertain the relationships between the dependent variable (students' academic performance in biology subject) and independent variables i.e., availability of biology teachers, availability of learning and teaching facilities, student's perception towards biology subject, availability of well-equipped laboratories and libraries, motivation to teachers, in-service training, parents' level of education and conducive learning environment.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_n X_n + \cdots + \mu \quad (1)$$

Where Y =Dependent variable (Students' Academic Performance)
β=Coefficients to be estimated
X_i=Independent variables (i=1, 2, 3…8)
X_1=availability of biology teachers (BTCH)
X_2 =availability of learning and teaching facilities (LTMAT)
X_3=student's perception towards biology subject (STPRC)
X_4=availability of well-equipped laboratories and libraries (LAB&LIB)
X_5=motivation to teachers (MOTV)
X_6=in-service training (TRANG)
X_7=parents' level of education (EDU)
X_8=conducive learning environment (ENV)
μ =Error term
Therefore; the researcher using multiple linear regression models with eight (8) explanatory variables rearranged the equation to be;

$$Y = \beta_0 + \beta_1 BTCH + \beta_2 LMAT + \beta_3 SPRC + \beta_4 LAB\&LIB + \beta_5 MOTV + \beta_6 TRANG + \beta_7 EDU + \beta_8 ENV + \mu \quad (2)$$

***Table 2.** Treatment of Independent Variables in the Model.*

Variables	Type	Measurement	Expected Sign
Dependent Variable			
Students' Academic Performance	Dummy	Good/Poor	+/-
Independent Variables			
Availability of biology teachers	Dummy	1 if Available, 0; Otherwise	+/-
Learning and teaching facilities	Dummy	1 if Available, 0; Otherwise	+/-
Student's Perception	Dummy	1 if Positive, 0; Otherwise	+/-
Well-equipped Laboratories and Libraries	Dummy	1 if Available, 0; Otherwise	+/-
Motivation to Teachers	Dummy	1=Motivated, 0; Not Motivated	+/-
In-service Training	Dummy	1 if Trained, 0; Otherwise	+/-
Parents' Level of Education	Dummy	1 if Educated, 0; Otherwise	+/-
Learning Environment	Dummy	1 if Conducive, 0; Otherwise	+/-

3. Results and Discussion

The study focused on assessing the determinants of good students' performance in biology subject among students in secondary schools. In achieving this objective, the study used Multiple Linear Regression model to ascertain the relationships between the dependent variable (Student' Academic Performance in biology subject) and independent variables.

MLR is a statistical technique that uses several explanatory variables (X_i) to predict the outcome of a response variable (Y). The goal of multiple linear regressions (MLR) is to model the linear relationship between the explanatory (independent) variables and response (dependent) variable. The study employed multiple linear regressions (MLR) because it is used to determine a mathematical relationship among a number of random variables. In other terms, MLR examines how multiple explanatory variables (i.e., availability of biology teachers, availability of learning and teaching facilities, student's perception towards biology subject, availability of well-equipped laboratories and libraries, motivation to teachers, in-service training, parents' level of education and conducive learning environment) are related to one dependent variable (i.e., Students' Academic Performance).

The regression model was used to determine the extent to which the predictors (i.e., availability of biology teachers, availability of learning and teaching facilities, student's perception towards biology subject, availability of well-equipped laboratories and libraries, motivation to teachers, in-service training, parents' level of education and conducive learning environment) can explain the dependent variable i.e., Students' Academic Performance.

***Table 3.** Model Summary.*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.829[a]	0.687	0.665	0.087

Source: Field Study, 2021

The coefficient of determination (R-squared) is a statistical metric that is used to measure how much of the variation in outcome can be explained by the variation in the independent variables. R^2 always increases as more predictors are added to the MLR model even though the predictors may not be related to the outcome variable. The study results revealed that the predictors i.e., availability of biology teachers, availability of learning and teaching facilities, student's perception towards biology subject, availability of well-equipped laboratories and libraries, motivation to teachers, in-service training, parents' level of education and conducive learning environment) have a potential to explain up to 66.5% of the students' academic performance (Adjusted R Square=0.665).

Analysis of variance (ANOVA) results provide information about variability within a regression model that used as a basis of testing the significance of the model. Table 4 presents the study results.

***Table 4.** ANOVA[a].*

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	20.533	8	2.567	30.521	0.000[b]
1	Residual	9.334	123	0.084		
	Total	29.867	131			
a) Dependent Variable: Students' Academic Performance						
b) Predictors: (Constant), availability of biology teachers, availability of learning and teaching facilities, student's perception towards biology subject, availability of well-equipped laboratories and libraries, motivation to teachers, in-service training, parents' level of education and conducive learning environment						

Since the ANOVA test allows a comparison of more than two groups at the same time to determine whether a relationship exists between them. The result of the ANOVA formula, the F statistic which also known as the F-ratio, allows for the analysis of multiple groups of data to determine the variability between samples and within

samples. Basing on the study result F-statistic is 30.521 which is highly statistically significant at 1% (p=0.000) level of significance implying that the model was relevant and all the variables i.e., availability of biology teachers, availability of learning and teaching facilities, student's perception towards biology subject, availability of well-equipped laboratories and libraries, motivation to teachers, in-service training, parents' level of education and conducive learning environment which were included in the model were jointly different from zero (0).

Table 5. Multiple Linear Regression Results.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.081	0.032***		64.225	0.000
Availability of biology teachers	1.006	0.024***	0.988	41.215	0.000
Learning and teaching facilities	0.749	0.051***	0.822	14.658	0.000
Student's Perception	0.024	0.026**	0.022	0.923	0.035
Well-equipped Laboratories and Libraries	0.434	0.135***		3.219	0.002
Motivation to Teachers	0.015	0.074	0.036	0.207	0.836
In-service Training	0.040	0.023*	0.048	1.763	0.081
Parents' Level of Education	0.012	0.025	0.027	0.485	0.628
Learning Environment	0.063	0.023***	0.061	2.734	0.007
Number of Observation=132					
Note: ***, **, and * Significance at 1%, 5% and 10% Respectively					
F=30.521 at P<0.000					
R square=0.687, Adjusted R square=0.665					
Dependent Variable: Students' Academic Performance					

Source: Field Study, 2021

The study results indicated that students' academic performance in biology subject in Ngara district is highly influenced by i.e., availability of biology teachers, availability of learning and teaching facilities, student's perception towards biology subject, availability of well-equipped laboratories and libraries, motivation to teachers, in-service training, parents' level of education and conducive learning environment. Table 5 above presents the estimated study results from linear regression analysis through SPSS 20.

The multiple linear equations results were as follows;

$$Y = 2.081 + 1.006X_1 + 0.749X_2 + 0.024X_3 + 0.434X_4 + 0.015X_5 + 0.040X_6 + 0.012X_7 + 0.063X_8$$

$$se \ (0.032) \ (0.024) \ (0.051) \ (0.026) \ (0.135) \ (0.074) \ (0.023) \ (0.025) \ (0.023)$$

$$t \ (64.225) \ (41.215) \ (14.658) \ (0.923) \ (3.219) \ (0.207) \ (1.763) \ (0.485) \ (2.734)$$

3.1. Availability of Biology Teachers

The study findings revealed that availability of biology teachers was positive and highly statistically significant on students' academic performance at 1% level of significance ($p = 0.000$) and the coefficient value of 1.006. The study result implies that for every unit increase in a number of biology teacher, students' academic performance increases by 1.006 units holding other factors constant. The study result is in line with the findings of various related studious [8, 7, 19] who found that having enough science teachers specifically biology teachers in this case is vital in influencing students to develop positive attitude towards biology subject and interest results into good performance. Basing on this finding a teacher as facilitator plays a great role in enhancing the students' performance specifically in biology subject.

3.2. Learning and Teaching Facilities

The study found that availability of learning and teaching facilities i.e., books, textbooks, physical resources like learning infrastructures was positive related to students' performance while highly statistically significant at 1% 1% level of significance ($p = 0.000$) and the coefficient value of 0.749. According to Wiggins [21] teaching materials i.e., textbooks, teacher's guides, reference books, classroom charts, and maps are the key ingredients in learning and teaching thus enhances students' academic performance. Therefore, the study result implies that a unit increase in learning and teaching materials results, students' performance in biology subject increases by 0.749 units holding other factors constant. The study finding is consistent with the findings of various related studies [13, 5, 21, 8, 19] who found that the availability of relevance and sufficient teaching materials lead to good performance in secondary schools. They further identified that a school with enough teaching and learning materials has a high chance of providing good quality of education to its students. Basing on the study findings the researcher concluded that learning and teaching materials help both teachers and biology students to teach effectively and effectively learn in convenient and comfortable surroundings.

3.3. Student's Perception

The study findings revealed that the students' perception was found to be statistically significant at five percent (5%) ($p = 0.035$) level of significance and coefficient value of 0.024. Also, students' perception met the a priori expectation that there is a direct relationship between students' attitude

towards biology subject and the students' performance. Considering its importance, the researcher categorized biology students into two groups, the students with positive attitude who were assigned 1 value and the students with negative attitude who were assigned zero value i.e., 1 if the student has positive attitude towards biology subject and zero otherwise. The study result implies that the students with positive perception towards science subjects are more likely to pass biology subject zero otherwise. This study result is in line and/or consistent with the findings of various related studies [2, 15, 19] who found that positive attitude towards biology subject indicate an overall positive perception of the learning environment, and are most likely to be associated with a strong motivation to learn biology hence good performance.

3.4. Well-equipped Laboratories and Libraries

The study findings revealed availability of well-established laboratories and libraries was found to be highly statistically significant at one percent (1%) ($p = 0.002$) level of significance and coefficient value of 0.434. Since the findings in this study show that libraries and laboratories in Ngara district were the problem in selected secondary schools. Therefore, this study suggest that a unit increase in well-equipped laboratories and libraries among in Ngara districts would increase students' performance by 0.434 units holding other factors constant. The study result is in line with findings of various related studies [16, 19] who found that the availability and well-equipped laboratories and libraries in secondary schools in Ngara district is an essential factor in teaching-learning process. Therefore, the study concludes that the factors influencing students' poor academic performance in science subjects specifically biology subject in secondary schools in Ngara district may have been caused by the lack of laboratories and its equipment's.

3.5. Motivation to Teachers

The study findings revealed that motivation to teachers though was not statistically significant but was positive related to students' academic performance indicating that a unit increase in teachers' motivation and working environment, students' academic performance would increase by 0.015 units holding other factors constant. Singano [19] identified that teachers' motivation is not only to improve their wages but also, working conditions to teachers which affects their ability and motivation to deliver quality education. The study result is in line with the findings of various related studies [8, 7, 19] who found that motivation to teachers is the contributing factor influencing the academic performance secondary schools.

3.6. In-service Training

The study findings revealed that in-service training was found to be statistically significant at ten percent (10%) ($p = 0.081$) level of significance and coefficient value of 0.040. The study result implies that holding other factors constant a unit increase in in-service training among biology teachers increases students' performance in biology subject by 0.040 units. The study result is line with the findings of

Gasper [8] argued that in-service training would help teachers to improve their job and motivate them in enhancing students' academic performance.

3.7. Parents' Level of Education

The study findings revealed that parents' level of education though was not statistically significant in this study but was positive related to the students' academic performance. This implies that a unit increase in education level to parents would increase students' performance in biology subject by 0.012 units holding other factors constant. The study sought to establish the distribution of education level of parent in order to ascertain their ability to assist their children on different school activities especially in biology subject. The study result is in line with the findings of various related studies [14, 4, 12, 19] who found that there is a positive relationship between the parent's educational level and their children success in their academics especially in science subjects.

4. Conclusion and Recommendation

The study results revealed that students' academic performance in biology subject in Ngara district is highly influenced by i.e., availability of biology teachers, availability of learning and teaching facilities, student's perception towards biology subject, availability of well-equipped laboratories and libraries, motivation to teachers, in-service training, parents' level of education and conducive learning environment. Basing on the study results the researchers concluded that biology performance in secondary schools can be improved if students would be involved in practical lessons under the guidance of well trained and qualified personnel.

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