Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.13, No.1, 2022

Performance of Biology Major and Minor Students of University of Education, Winneba in Two Biology Courses Compared

Wisdom Harrison K. Hordzi, PhD
Department of Biology Education; Faculty of Science Education; University of Education, Winneba;
P. O. Box 25, Winneba

Abstract
The study investigated the differences in performances of Biology major and minor students and determined the differences in performance of male and female students in levels 100 and 200 in two Biology courses in the University of Education, Winneba. Two hypotheses were tested using one factor analysis of variance and t-test. The design used was results analysis and comparison. The population was level 200 Biology major and minor students who were taught Cytology in level 100 and Introduction to Molecular Biology and Biotechnology in level 200. Two hundred and sixty eight students took Cytology in level 100, whereas 274 took Introduction to Molecular Biology and Biotechnology in level 200. Performances in the two biology courses were analysed and compared after the continuous assessment and examination scores were put together. In Cytology, Biology students performed best (64.94±1.2), followed by Chemistry (62.26±1.30 and Integrated Science (60.99±1) students. There were significant differences between the means of the students of the three programmes ($F = 3.31$; $df = 2/267$; $P = 0.04$ and $\alpha = 0.05$). Chemistry students performed best in Introduction to Molecular Biology and Biotechnology followed by Biology students and then Integrated Science students. However, there were no significant differences between the means for Introduction to Molecular Biology and Biotechnology ($F = 2.16$; $df = 2/273$; $p = 0.12$ and $\alpha = 0.05$). Furthermore, male and female students performed equally in the two courses. The recommendation is that the University should expand its Biology laboratories and procure more science equipment for its Biology students.
Keywords: Cytology, Biology, Integrated Science, Chemistry, easy course, Biotechnology
DOI: 10.7176/JEP/13-1-04
Publication date: January 31st 2022

Introduction

Science has been taunted to be a major tool for development. It is considered to create equitable opportunities. One can learn science to acquire the culture of Science. United Nations International Children's Emergency Fund [(UNESCO), 2004] is of the opinion that science education has, and will continue to have, a significant influence on quality of life of man and contribute to sustainable development of the planet. This is because it equips people with the knowledge and skills necessary to promote economic, scientific and technological development (Croxford, 2002). It is also capable of giving people knowledge and skills which will help them to make informed decisions on scientific and technological issues.

Biology is one of the science subjects learned by people all over the world. Nakano (2017) considers Biology as the science that deals with the study of living things and as such certain recognizable characteristics of living things such as movement, death, respiration, growth, excretion, irritability, reproduction, and nutrition are prominent. It is a natural science which tries to understand the living world. According to Umar (2011) Biology involves the study of how the world is structured, its functions and what these functions are, how living things came into existence, and how they react to one another and with their environment. Among others, Biology is most often divided into zoology, botany, ecology, genetics, morphology, anatomy, physiology, histology, microbiology, biochemistry and evolution (Ahmed, 2008).. Biology is a precursor for many professions such as medicines, pharmacy, nursing, agriculture, forestry and biotechnology.

Aniaku (2012) pointed out the importance of Biology by saying that it is the bedrock of great economic importance to nations in areas like medicine, pharmacy, nursing, biochemistry, genetics, agriculture and others. Ali, Toriman, and Gasim (2014) corroborated this by saying that Biology is a very important subject which must be given more priority. It enables one to understand oneself and the intermediate environment. Ali, et al. (2014) confirmed among others that the knowledge acquired in Biology is applied in many fields such as Medicine, Biochemistry, Pharmacy, Microbiology and Agriculture .Biology education most often covers investigative skills such as observing, measuring, classifying, recording, analyzing, differentiating, experimenting and others (Omorogbe & Ewansiha, 2013).

Unlike Physics and Chemistry, Biology is largely a reading subject. This makes a lot of people to consider it as an easy course to deal with. As a result, many science students choose it at the university level. However, some of such students later realize that Biology is not an easy subject to deal with after choosing it. Hence, a lot of students experience underachievement in Biology. Several reasons are attributed to such underachievement by experts. For example, Owino, Ahmad and Yungungu (2014) attributed the underperformance in Biology to

inadequate supply of teaching and learning resources such as chemicals, charts, apparatus, models, local specimens, laboratories, textbooks, and libraries leading to poor performance in Biology. Owino, et al. (2014) further observed that irregularities related to the teaching of Biology such as irregularity in administration of practical, class discussion, teachers not allowing students to ask questions, teachers not giving prompt feedback on assignments or exams, by not making the Biology subject interesting and teachers not conducting demonstration during practical lessons are some other things bringing about underperformance in the subject and Biology courses. Dinah (2013) as cited in Solar (2015), concluded that availability of text books, laboratory apparatus and other learning resources contribute significantly to the performance of students in Biology examination. It was further stated that it takes students with positive attitude to perform better in Biology compared to when students have negative attitude. Thus, those with positive attitude are motivated to work hard and thereby better performance (Dinah, 2013 cited in Solar, 2015).

When talking about academic performance, one can also talk about differential performance for male and female students. Often, it is generally though that Male students academically perform better than females in science subjects. For example, Adigun, Onihunwa, Irunokhai, Sada and Adesina (2015) observed that, generally, in Nigeria if not the whole Africa, it is a considered view that male students do better than their female counterparts in science. However, a number of researchers reported conflicting findings on this issue. Bamidele, Odusola and Ojerinde (2006) reported that male students performed better than female students in different science subjects that they studied. On the other hand, Umar (2008) and Amoo (2011) reported in their various studies that the performances of female students in science subjects studied were better than that of the male counterparts. Abe (2004), Bichi (2004), and Lawal (2009) intimated that there were no significant differences in the achievements between male and female students in their various science subjects studied. These, out of others show that there are conflicting views about the different academic performances of male and female students in science.

Performance can be defined as the accomplishment and execution of tasks (The Oxford English Dictionary, 2006). Solar (2015) indicated that the accomplishment of tasks, in the context of the academic function of schools, refers to academic excellence or efficiency which is measured in terms of learner performance in class work and national examinations. Akiri and Nkechi (2009) defined performance as a measure of outputs and that the main outputs in education are expressed in terms of learning. These can be seen as changes in knowledge, skills, behaviour, and attitudes of learners as a result of their experiences within the school system. Adeymi (2010) describes academic performance as the scholarly standing of a learner at a given moment. The scholarly standing can be measured in terms of the grades obtained in a course or groups of courses. In this study, performance or academic performance refers to final scores obtained by students that can determine their grading at the end of each course.

Considering the tremendous benefits of studying Biology, it is not out of place that University of Education, Winneba offers it as one of its natural sciences in the faculty of Science Education. In the Faculty of Science Education of the University of Education, Winneba, Biology Education is offered under the Department of Biology Education. The Biology Curriculum involves a number of courses including BIO 121: Cytology and BIO 232: Introduction to Molecular Biology and Biotechnology (University of Education, Winneba, 2008).

The academic structure of the Faculty of Science Education is such that Chemistry and Integrated Science major students can take Biology courses at levels 100 and 200 as their minor courses. However, unofficial position of most of the lecturers of the Department of Biology Education is that non-biology major students such as Chemistry and Integrated Science students do better in Biology courses in terms of academic performance than the biology major students. Furthermore, both male and female students offer the biology courses just as students of any other programme. However, there is no empirical data to suggest which of the two sexes perform better academically in Biology courses. Therefore, this study tried to find out the level and differences between the performances of Biology major and minor students as well as determine the differences in the performance of male and female students in levels 100 and 200 in two Biology courses.

The research questions that the study provided answers to were, to what extent were there differences between the performances: of

- Biology major and minor students in two Biology courses in levels 100 and 200?
- male and female students in two Biology courses at levels 100 and 200?

Two hypotheses were put up as follows:

Null hypothesis 1: At 0.05 level of significance there is no significant difference between the performances of Biology major and minor students in Cytology and Introduction to Molecular Biology and Biotechnology

Alternate hypothesis 1: At 0.05 level of significance there are significant differences between the performances of Biology major and minor students in Cytology and Introduction to Molecular Biology and Biotechnology.

Null hypothesis 2: There are no significant differences between the performances of male and female students in two biology courses at 0.05 level of significance.

Alternate hypothesis 2: There are significant differences between the performances of male and female students in two biology courses at 0.05 level of significance.

Methodology

In this study the design used was results analysis and comparison. The researcher taught both Cytology and Introduction to Molecular Biology and Biotechnology to the same students in two different semesters. Cytology was a level 100 second semester course while Introduction to Molecular Biology and Biotechnology was a level 200 first semester course. In each semester students were assessed using continuous assessment (CA) and examination scores.

The target population for the study was level 200 Biology major and minor students. The accessible population was all level 200 Biology major and minor students who were taught Cytology in level 100 and Introduction to Molecular Biology and Biotechnology in level 200. In this study the Biology major students were simply referred to as students of Biology Programme whereas the Biology minor students were referred to as students of Chemistry and Integrated Science Programmes. In level 100 at which the accessible population took Cytology they were 268 in number comprising 57 students of Chemistry Programme, 101 for Biology Programme and 110 for Integrated Science Programme. At level 200 where they took Introduction to Molecular Biology and Biotechnology they were 274 in number comprising 58 students of chemistry Programme, 102 for Biology Programme and 114 for Integrated Science Programme. The extra 1 student for the Chemistry Programme was somebody who deferred the course from a previous year group; the one extra Biology student was a Post Diploma student admitted in the year in which Introduction to Molecular Biology and Biotechnology was taken and that student was placed in level 200 whereas the four extra students of Integrated Science Programme were also students who deferred the course from previous years. Purposive sampling was used to select all the students who took part in the two courses taught by the researcher- Cytology when the students were in Level 100 and Introduction to Molecular Biology and Biotechnology when the same students were in level 200. Therefore in all samples of 268 students were involved in level 100 and 274 when they were in level 200.

The main instruments used were the continuous assessment (CA) and examination scripts of the students. The continuous assessment was made up of quizzes, assignments and practical work. The quizzes, assignments and practical scores (continuous assessment) constituted 40% of the total marks while examination scores constituted 60% making a total of 100 marks as prescribed by the University (University of Education, Winneba, 2008). The researcher was the one who conducted the continuous assessments and the examinations and marked the scripts. Each examination question paper comprised 20 compulsory multiple choice items for 30 marks, 10 compulsory short answer questions for 20 marks and 4 essay type questions for which each student was expected to answer 2 for 20 marks. The validity of the items were ensured by a moderating team of three. Since the items were to be administered for examination they were not pilot tested before administration. However, the reliability of each item of each paper was determined after administering it. A Cronbach Alpha reliability coefficient of 0.73 was obtained for Cytology while that of Introduction to Molecular Biology and Biotechnology was 0.78. In this study the dependent factor was students' performance in two Biology courses; Cytology and Introduction to Molecular Biology and Biotechnology while the independent factor was the programme being pursued by the students (Chemistry, Biology and Integrated Science).

Scores from the CA and examination scripts were recorded at the end of each semester and the scores put together to determine the grade obtained by each student. The grading system as laid down by the University of Education, Winneba (University of Education, Winneba, 2008) in Table 1 was used.

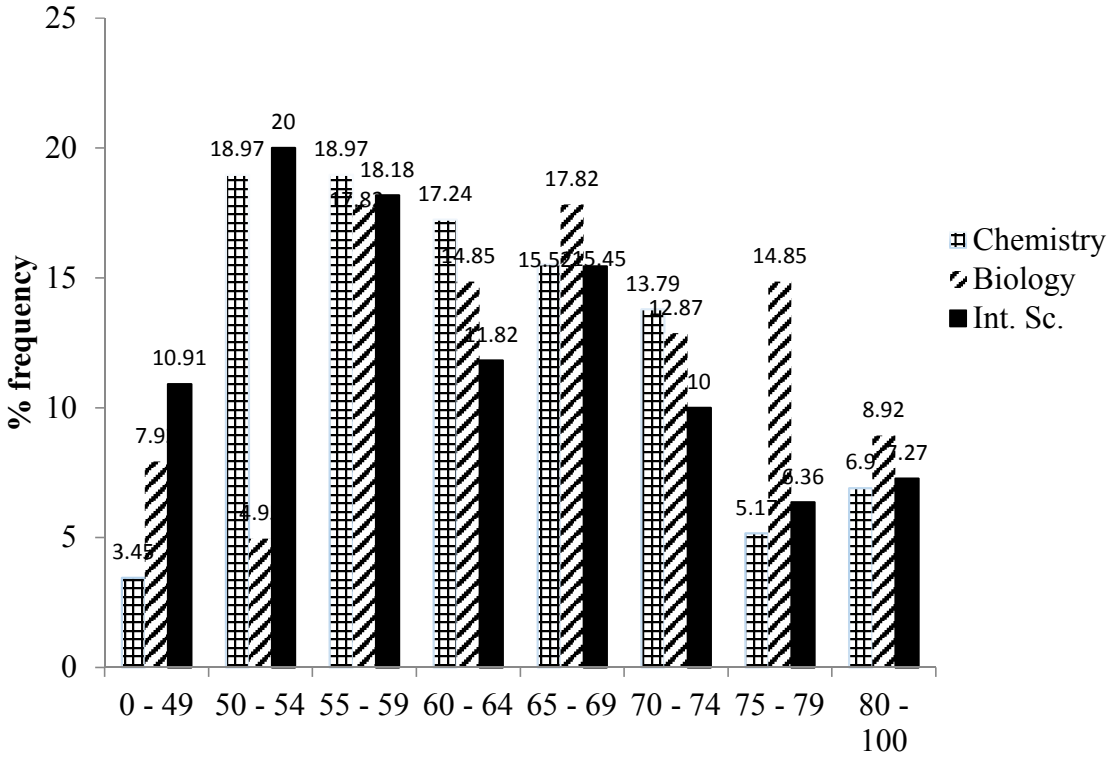
Table 1. Grading system of University of Education, Winneba

Mark	Grade	Grade Point	Description
80 – 100	A	4.0	Excellent
75 – 79	B+	3.5	Very good
70 – 74	B	3.0	Good
65 – 69	C+	2.5	Satisfactory
60 – 64	C	2.0	Very Fair
55 – 59	D+	1.5	Fair
50 – 54	D	1.0	Pass
0 – 49	E	0	Fail
-	IC	-	Incomplete
-	X	-	Disqualified
-	Z	-	Examination Malpractices

The results were analyzed using the University standard in Table 1. Results were organized into frequencies and percentage frequencies of performance in line with the University's grading system and presented in bar charts for comparison. Means were also computed and presented in tables. Scores were also sorted according to the performance of male and female students and the means determined. The means for Biology major as well as Chemistry and Integrated Science minor students were compared using one factor analysis of variance. Also, mean performances for male and female students in the two courses were compared using student's t-test.

Results and discussion

The results of the performance of the students in Cytology have been presented in Figure 1 and Tables 2 and 3. Indications are that the major subject group students that failed most (Grade E) was Integrated Science (10.91%) followed by Biology students (7.92%) and Chemistry students (3.45%) respectively. Further, (51.73%) Chemistry students had grades between D and C+ followed by Integrated Science students (50%) and then Biology students (37.62%). Finally, Biology students were the majority (36.64%) to score grades B to A followed by Chemistry (25.86%) and Integrated Science (23.63%) students respectively (Figure 1). The mean scores suggest that Biology students had the best marks (64.94±1.2), followed by Chemistry (62.26±1.30 and Integrated Science (60.99±1) students respectively (Table 2). One factor analysis of variance (ANOVA) showed that there were significant differences between the means (F = 3.31; df = 2/267; P = 0.04 and α =0.05). Thus, the alternate hypothesis was accepted over the null hypothesis. This means that there were significant differences between the performances of Biology major and minor students in Cytology.



Marks obtained

Figure 1: Performance of students in Cytology

Table 2. Summary of performance of the students in Cytology

Programme of students	Count	Sum	Mean
Chemistry	57	3549	62.26±1.3
Biology	101	6559	64.94±1.2
Integrated Science	110	6709	60.99±1.1

Table 3. One factor analysis of variance (ANOVA) results for Cytology

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	838.56	2	419.28	3.31	0.04	3.03
Within Groups	33593.69	265	126.77			
Total	34432.25	267				

The performance of the students in Introduction to Molecular Biology and Biotechnology have been presented in Figure 2 as well as Tables 4 and 5. While all Chemistry students had their results complete and none had grade E, 2.94% of Biology students and 2.61% of Integrated Science students respectively had grade E. In addition 2.61% of the Integrated Science students had their results incomplete. It is clear from the results that 33.92% of Integrated Science, 29.30% of Chemistry students and 28.43% of Biology students respectively had grades D to C+. On the other hand 70.69% of the Chemistry students, 68.63% of Biology students and 60.87% of Integrated Science

students respectively had grades B to A (Figure 2). Similarly, the mean performance for Chemistry students was 74.07±1.2 whereas Biology and Integrated Science students recorded mean performances of 72.97±1.0 and 70.43±1.3 respectively (Table 4). The differences between the means were not significant (F = 2.16; df = 2/273; p = 0.12 and α =0.05). Thus, the null hypothesis was accepted and the alternate hypothesis rejected. The implication is that the differences in the means were due to chance. However, on its face value, Chemistry students performed best in Introduction to Molecular Biology and Biotechnology followed by Biology students and then Integrated Science students.

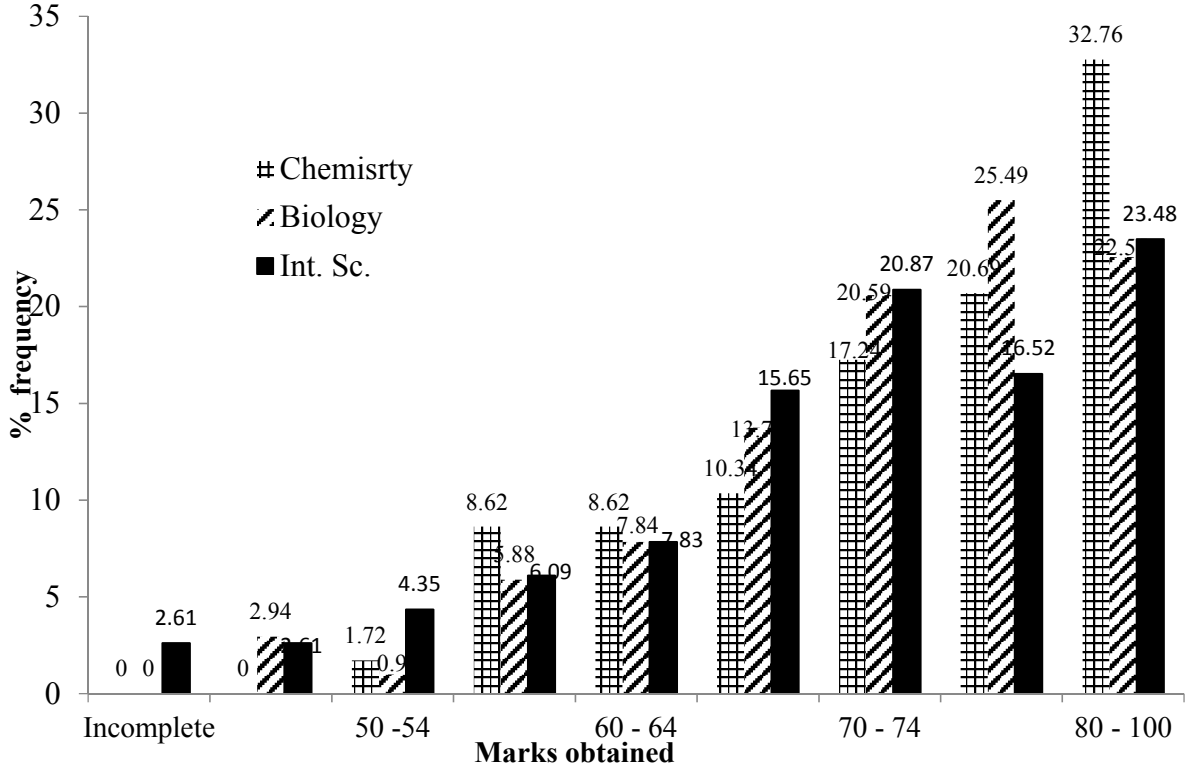


Figure 2: Performance of students in Introduction to Molecular Biology and Biotechnology

Table 4. Summary of performance of the students in Introduction to Molecular Biology and Biotechnology

Programme of students	Count	Sum	Mean
Chemistry	58	4296	74.07±1.2
Biology	102	7443	72.97±1.0
Integrated Science	114	8029	70.43±1.3

Table 5. One factor analysis of variance for Introduction to Molecular Biology and Biotechnology

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	619.59	2	309.79	2.16	0.12	3.03
Within Groups	38874.57	271	143.45			
Total	39494.16	273				

The t-statistical data comparing male and female performances in Cytology and Introduction to Molecular Biology and Biotechnology have been presented in tables 6 and 7.

From Table 6, the mean score of the females (63.47%) was slightly higher than the mean score of males (62.77%). However, the calculated t-value of 0.42 was less than the critical t-value of 1.97. This means that there was no significant difference between the performance of male and female students (t = 0.42; df = 266; p = 0.05). Thus, the null hypothesis was accepted and the alternate hypothesis rejected. The implication is that the difference between the means was due to chance. This means that both male and female students performed equally or almost equally in Cytology.

A similar trend was noticed in the performance of male and female students in Introduction to Molecular Biology and Biotechnology (Table 7). Mean score of female students was 73.44% while that of male students was 72.77%. This suggests that the females performed slightly better than the males. However, calculated t-value (0.43)

was less than the critical t-value (1.97). This also implies that there was no significant difference between the two means (t = 0.43; df = 270; p= 0.05). Therefore, the null hypothesis was accepted and the alternate hypothesis rejected. In this case also the implication is that both male and female students performed equally in Introduction to Molecular Biology and Biotechnology.

Table 6. Two sample t-statistics for males and females who took part in Cytology

Statistics	Males	Female
Mean	62.77	63.47
Observations	213	55
df	266	
t Stat	0.42	
t Critical two-tail	1.97	

Table 7. Two sample t-statistics for males and females who took part in Introduction to Molecular Biology and Biotechnology

Statistics	Male	Female
Mean	72.77	73.44
Observations	212	60
df	270	
t Stat	0.43	
t Critical two-tail	1.97	

The findings suggest that Biology students were the best in Cytology, followed by Chemistry students and then Integrated Science students. On the other hand, in Introduction to Molecular Biology and Biotechnology Chemistry students performed best followed by Biology students and then Integrated Science students. Howver, the statistical differences were not significant suggesting that the differences were due to chance. In any case, it is not surprising that the Biology students had the best performance out of the three elective groups in Cytology and on its face value Chemistry students appeared to be the best in Introduction to Molecular Biology and Biotechnology. This is because the Biology students were Biology elective students in the University and they pursued Biology as one of their elective subjects at the Senior High School level. The story is not different for Chemistry students because, generally, they also pursued Biology as one of their elective subjects at the Senior High School level and they decided to offer Chemistry as their major course and Biology as the minor in the University. This does not necessarily mean that they could not do Biology as their major programme, but it was rather a matter of choice. On the other hand, majority of the Integrated Science students were mostly people who scored weak grades in Biology at the Senior High School level or they did not do Biology at all at the Senior High School level. Some of them were professional teachers who had Diploma in Basic Education from the colleges of education and had admission into the University as matured candidates. In many cases, most of such people had low grades in science courses including Biology before gaining admission into the teacher training colleges. Meanwhile, in the past, the science curriculum at the colleges of education for such students was of lower content than even what they pursued in the senior high schools. So, by the time they gained admission into the University, they are rusty academically in the sciences including Biology. As a result some of them struggle to perform well in Biology and the other sciences. Therefore, the performance of the Integrated Science students in the two Biology courses in this study just portrays the realities on the ground.

Two important determinants of performance are freedom to choose and interest. Mukhwana (2013) in a study found out that 56% students and 64% teachers interviewed confirmed that freedom of choosing the subjects influences performance in Biology. Mukhwana (2013) further intimated that having interest in Biology cultivates students' positive attitude towards the subject, hence enabling the student to work hard. In this study, it can be said that the students had the freedom to apply for Physics, chemistry, Biology or Integrated Science as their major programmes depending on where their strengths were. At the same time the chemistry and Integrated Science students had the freedom to choose Physics, Chemistry or Biology as their major programmes. Therefore, the fact that the Chemistry and integrated science students chose Biology minor means that they had interest in it. Therefore, they might have had the self-motivation to pursue Biology minor. Therefore, this should influence all of them to work hard to obtain good grades. However, this was not the case for all the minor students and even some of the major students.

Other factors that can affect academic performance are students' truancy or discipline, attitudes, interest in practical lessons, and ability to do practical works. Discipline and hard work is the key to success among students (Kurgat, 2008). Truant behaviour makes students to miss classes which in the end affect their academic performance because they will not be able to link what they missed with what they have in their books (Mukhwana, 2013). SMASSE (2004) is of the opinion that practical work entails application of theoretical concepts by performing experiments. Therefore, the willingness of the student to participate in practical activities, especially when in groups improves the performance in Biology (SMASSE, 2004). This is because participation leads to the

development of scientific skills for hands on practical skills. More importantly, Biology practical work supplements good marks to those students who are weak in theory (Kenya National Examination Council- KNEC, 2007) and thus influencing better performance.

Interestingly, some of the students played truancy during class hours, especially practical lessons. This is because of large student numbers where up to about ten people use one microscope at a time. In that kind of situation all the students find it difficult to have the opportunity to use the microscope and other laboratory equipment, especially the Integrated Science students. So, it was very easy for such students to sneak out of practical lessons because they would have the opportunity to copy what their colleagues did and present for marking. At the end of the day they end up not having the necessary skills that can be applied to examination questions. The worst is that some of the students do not step into the science laboratory at all throughout the semester and they do not present any practical work for assessment but would take part in some quizzes and examinations. Such students end up having incomplete work or very low grades at the end of the semester. Therefore, some of the weak grades and incomplete results are as a result of such attitudes. There are rules covering such developments, but the large student numbers makes it difficult to fully implement them. Therefore, the relatively poor performance of Integrated Science students in Cytology can be attributed to some of the issues being discussed. However, the fact that the differences in the performances for the three programme groups were not significant means that all the programme groups performed at the same level.

The results in Introduction to Molecular Biology and Biotechnology is similar to findings of similar work done by Dike, Anyanwu, Zachariah, Dalhatu and Folashade (2018) where they reported that there was no significant difference between the academic performances of students in Biology in the period studied. Similarly, the findings of this study where there were no significant differences between the performances between that of male and female students in Cytology and Introduction to Molecular Biology and biotechnology were similar to that of Dike et al. (2018). In their finding Dike et al (2018) concluded that there was no significant difference between the academic performance of male and female students in Biology. Thus, in this study it can be said that neither males nor female students outperformed the other.

Conclusions

In Cytology Biology students had the best performance followed by Chemistry and Integrated Science students respectively. There were also significant differences between the performances of Biology major and minor students in Cytology. On the other hand there were no significant differences between the performances for the various programme groups, but on its face value, Chemistry students performed best in Introduction to Molecular Biology and Biotechnology followed by Biology students and then Integrated Science students. Thefore, for both courses the worst performances came from the Integrated Science students. It can further be concluded that since there were not significant differences between the performances of male and female students in both courses, there is no need worrying about differential performances for male and female students of the University of Education, Winneba in Biology, especially the two courses.

Recommendations

1. Since Integrated Science students had the worst performances in the two courses, it will be necessary for the Faculty of Science Education of the University of Education, Winneba to make deliberate efforts to simplify Biology courses to the level of understanding of Integrated Science students.
2. It is further recommended for the University to expand its Biology laboratories and procure more science equipment that will eneble all Biology students enjoy practical lessons.
3. Furthermore, the Faculty is being encouraged to continue making its Biology programmes gender friendly so that the females will continue rubbing shoulders with their male counterpars just as it currently exists.

References

Abe, T.O. (2004. Comparative study of family type and sex difference on academic achievement of students in Mathematics. *Journal of Curriculum Studies Department,* 3, 33-44.

Adeymi, T. O. (2010). A comparative study of students' academic performance in public examinations in secondary schools in Onto States, Nigeria. *Current Research Journal of Economic Theory*, 3(2), 36-42.

Adigun I., Onihunwa, J., Irunokhai, E., Sada, Y, & Adesina, O. (2015). Effect of gender on students' academic performance in Computer Science in secondary schools in New Bussa, Borgu Local Government of Niger State. *Journal of Education and Practice,* 6(33), 1-7.

Ahmed, M. A. (2008). *Influence of personality factors on biology lecturers' assessment of difficulty levels of genetics concepts in Nigerian colleges of education* (Unpublished doctoral thesis). Ilorin, Nigeria: University of Ilorin

Akiri, A. & Nkechi, M. (2009). 'Teachers' effectiveness and students' academic performance in public secondary schools in Delta State Nigeria. *Stu. Hom Comm, Sci,* 3(2), 107-113,

Amoo, E.D. (2011). Gender and academic performance in Nigerian universities: Economic implications. *International Journal of Research in Education,* 8(1), 159-172.

Aniaku, O. L. (2012). *Effects of guided and unguided inquiry teaching methods on secondary school students' achievement and interest in biology* (Unpublished Master's Thesis). Enugu: State, Nigeria.

Bamidele, A.F., Odusola, O., & Ojerinde, D. (2006). Review of the environment and performance of male and female students in Education Economics programme of Obafemi Awolowo University, Ile-Ife. *Nigerian Journal of Social Science,* 12(2), 143-146.

Bichi, S.S. (2004). The effect of gender on academic achievement in evaluational concepts among secondary school students using problem solving instruction strategy. *Zaria Journal of Studies in Education,* 3(1), 123-138.

Croxford, L. (2002). Participation in Science Subjects: The Effect of the Scottish Curriculum Framework. *Res. Papers Educ.* 12(1), 69-89.

Dike, N. I., Anyanwu, R. I., .Zachariah, B., Dalhatu, H. & Folashade, S. (2018). Comparative Study of the Academic Performances in Biology, Chemistry and Physics of Male and Female Students in a Nigerian Tertiary Institution. *Journal of Education and Practice, 9*(20). 68 – 76.

Kenya National Examination Council (KNEC) (2007). *The Year 2006 KCSE Examination Report.* Nairobi: Kenya National Examinations Council.

Kurgat, H. K. (2008). *Five principles of student's Academic Success*. Talk presented at Arab Moi University Secondary School, June 18th. Eldoret, Kenya

Lawal, F.K. (2009).*Acquisition of entrepreneurial skills through Biology Education and the role of Biology teacher*. Proceedings of the 50th Annual Conference of the Science Teachers Association of Nigeria (STAN).

Nakano, M. R. (2017). *Factors Militating Against Female Students' Performance in Biology*. Being a paper presented at 2nd National science education conference held at Saadatu Rimi College of Education, Kumbotso, Kano, on 31st October-3rd November, 2017.

Omorogbe, E. & Ewansiha, J. C. (2013). The Challenges of Effective Science Teaching in Nigerian Secondary Schools. *Academic Journal of Interdisciplinary Studies*, 2 (7): 181-188.

Owino, O. A., Ahmad, O. & Yungungu, A. (2014). An investment of factors that influence performance in KSCE biology in selected secondary schools in Nyakach District, Kisumu Country Kenya. *Journal of Education and Human Development* 3(2), 957-977

Oxford Advanced Learner Dictionary (2006). New York: Oxford University.

SMASSE Project (2004). Project paper presented on Baseline studies at the INSET SMASSE Cycle 1, Uasin-Gishu District. Eldoret, August 2004. Unpublished

Solar, N. J. B. (2015). Attributions of Academic Performance among Third Year and Fourth Year Biology Major Students. *Asia Pacific Journal of Multidisciplinary Research,* 3(3). 31 – 38

Umar, A.Y. (2008). Comparative study of the enrolment and academic performance in Physics of male and female students in some selected secondary schools in Katsina State. *Nigerian Journal of Science and Educational Research,* 4(1), 131-139.

United Nations International Children's Emergency Fund (UNESCO, 2004). *Report on development of education in Kenya: Ministry of Education Science and Technology*. UNESCO-Nairobi Office.

University of Education, Winneba (2008). *Department of Biology Education hand book for Undergraduate students; four-year B. Sc. (Biology Education).* Winneba: Biology Education Department; University of Education, Winneba.