UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF EDUCATION STUDENTS' INTEGRATED SCIENCE ENTRY GRADES AND THEIR END-OF-COURSE COMPLETION GRADES: AN EXPLANATORY STUDY

SIEMOH ROBERT KWADWO

MASTER OF PHILOSOPHY

2022

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A thesis in the Department of Science Education, Faculty of Science Education submitted to the School of Graduate Studies, in Partial Fulfilment of the requirements for the award of the degree of Master of Philosophy (Science Education) in the University of Education, Winneba

DECEMBER, 2022

DECLARATION

STUDENT'S DECLARATION

I, Siemoh Robert Kwadwo, declare that this thesis, with the exception of quotations and references contained in published works which have been identified and duly acknowledged, is entirely my own original work, and that it has not been submitted, either in part or whole, for another degree elsewhere.

Signature: ………………………………..

Date: ………..……………………………

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis as laid down by the University of Education, Winneba.

Supervisor: Professor John K. Eminah

Supervisor's Signature: ………………………

Date: ………………………………………….

DEDICATION

I dedicate this work to my lovely wife, Rosina Donkor, and in memory of my late mother.

ACKNOWLEDGEMENTS

I am very grateful to the Almighty God for seeing me through this work successfully. This thesis would not have been feasible without the assistance and guidance of a number of people, to whom I am grateful. I would like to express my heartfelt appreciation to my supervisor, Professor John K. Eminah, for the invaluable assistance he provided me in the form of suggestions, coaching, and reading through my scripts and making the required modifications despite his hectic schedule. Thank you, sir.

Also, I am grateful to my father, Asafoakye Obah Kwame Albert, and my siblings for their moral support and encouragement. My appreciation also extends to all of the lecturers, technicians, administrators, and other workers of the Department of Science Education, University of Education, Winneba, for their suggestions, encouragement, and assistance throughout my studies. Again, I would like to thank my colleague tutor, Dr. Isaac Amoako, for his useful suggestions and assistance. Finally, my sincere appreciation to all my colleagues who, in diverse ways, contributed to my success.

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ABBREVIATIONS

%	Percentage
AE	Assistant Examiner
ATECoE	Atebubu College of Education
B.Ed	Bachelor of Education
BECE	Basic Education Certificate Examination
CGPA	Cumulative Grade Point Average
CoE	College of Education
CTL	Chief Team Leader
EMS	English Language, Mathematics and Integrated Science/Social Studies
Freq.	Frequency
GTEC	Ghana Tertiary Education Commission
HEI	Higher Educational Institution
IoE	Institute of Education
IS	Integrated Science
MOE	Ministry of Education
NPCF	National Pre-tertiary Education Curriculum Framework
SC	Script Checker
SHS	Senior High School
SRCs	Science Related Courses
SSCE	Senior Secondary Certificate Examination
TL	Team Leader
TLRs	Teaching Learning Resources

TVET	Technical and Vocational Education and Training
UCC	University of Cape Coast
UEW	University of Education, Winneba
WAEC	West African Examinations Council
WASSCE	West Africa Senior Secondary Certificate Examination

ABSTRACT

The study investigated the relationship between College of Education students' entry grades in integrated science and their end-of-course completion grades in science-related courses (biology, chemistry, and physics) at college. The explanatory sequential mixed method design was used in this study. The target population was the 2018/2019 batch of the Bachelor of Education Primary Education programme and tutors in the Science Education Department at Atebubu College of Education. A sample size of one hundred and twenty-seven (127) comprising one hundred and twenty-four (124) students and three tutors (3) were purposively selected for the study Three (3) College tutors were also involved in the study. A Checklist and interview guide were used in gathering data for the study. Frequencies, percentages, Pearson's Moment Correlation, and themes were used to analyse the data collected. The results showed a weak positive correlation between the students' integrated science entry grades from the West African Senior School Certificate Examination and general biology, chemistry, and physics end-of-course completion grades at the College. Also, the type of senior high school that a student attended played a role but not a major role in affecting their future academic performance in science-related courses in College. The study therefore concludes that the type of senior high school the students attended and their integrated science entry grades did not have a significant influence on their end-of-course completion grades in science-related courses at the College. It is recommended that college management should not place too much emphasis on the type of senior high school the students attended and their entry grades during their admissions because it has little impact on their academic success at college. But they should rather put priority on infrastructure and other amenities; availability of teaching learning resources; teacher personality, competency, experience, and efforts; motivation; and student behaviour/truancy which are the various subsets of personal, teacher, and institutional factors since they were identified as key influencers of students' academic performance.

CHAPTER ONE

INTRODUCTION

1.1 Overview

In this chapter, the background to the study, the statement of the problem, and the purpose of the study are presented. Also, the objectives and research questions that directed the study are captured here. The significance, delimitations, limitations of the study, definition of terms and abbreviations are discussed as well.

1.2 Background to the Study

The issue of academic performance is an area of concern for all academic programs in higher educational institutions (HEIs) across the globe. Managers of tertiary institutions therefore desire to see their students do well since the performance of graduates of any educational institution is considered the most important indicator of its quality.

Generally, admission into HEIs, including colleges, is predominantly based on past academic performance (entry grades) (Lambe & Bristow, 2011; Mercer & Puddey, 2011; Radhakrishnan et al., 2012; Roşeanu & Drugaş, 2011; Sandow et al., 2002; Shehry & Youssif, 2017; Vidal-Rodeiro & Zanini, 2015). As a result, students admitted to any CoE must not only have satisfied certain minimal standards for specific academic programs, but they must also have been highly rated among the applicants, as admission is based only on SHS entry grades (Aidoo-Buameh & Ayagre, 2013; Chathuranga, 2016; Nshemereirwe, 2014; Wambugu & Emeke, 2013). For example, in Ghana, the general requirement for admission to the Bachelor of Education (B.Ed) Programme in the CoE is as follows:

(i). WASSCE holders: credit (A1-C6) in six (6) subjects, comprising three (3) core subjects, including English Language and Core Mathematics, and three (3) elective subjects relevant to the course of study. (ii). SSSCE holders: credit (A-D) in six (6) subjects, comprising three (3) core subjects, including English Language and Core Mathematics, and three (3) elective subjects relevant to the course of study. (iii). Holders of TVET qualifications: Credit in three core subjects including English and Mathematics and Passes in three elective subjects relevant to the course of study. This is an indication that for anybody to gain admission into any CoE, their pre-tertiary grades and, for that matter, academic performance are key.

Also, the course descriptions from the curriculum for biology, physics, and chemistry for University of Cape Coast affiliated CoE are premised on the fact that, "... the course is designed to consolidate and also upgrade the content and skills that students have acquired from their lessons in Integrated Science at the SHS level." This buttresses the point that previous knowledge and, for that matter, entry grades of students are key to their performance at a higher level. According to Richardson et al. (2012), tertiary institutions usually admit students based on their previous academic performance since they presume it will predict how well they will perform in academics while on campus.

Despite the fact that many countries have consistently employed such an admission standard to admit their students into tertiary institutions, its use as the major factor for undergraduate admission has been condemned for a variety of reasons. To start with, there is a paucity of awareness of its efficacy in predicting student academic performance at the tertiary level (Danilowicz-Gösele et al., 2017); that is, not everyone believes that a student's good previous entry grade will certainly translate into improved academic achievement at the tertiary level.

Also, in addition to their pre-tertiary grades, several other experts have supposedly identified many other factors that affect students' academic performance in tertiary institutions. Kyoshaba (2009) and Aspelmeier et al. (2012), for instance, stated that the academic performance of a student in a tertiary institution could be influenced by numerous factors, including the parents' educational background, family size, type of high school attended, and the socio-economic status of the student. Nonetheless, according to Richardson et al. (2012), the use of previous grades still stands out as a strong factor of the academic ability of students in higher educational institutions. The evidence for this generally appears to be scanty in the literature on Ghana. This implies that there is a need to conduct more research into this area in Ghana so as to see whether what is pertaining to areas may be supported or contradicted. The current situation in Ghana points to the admission of CoE students based on the minimum entry requirements as stated above, but there are still gaps in relating those entry grades of students with their college academic performance; thus, the need for this kind of study.

1.3 Statement of the Problem

Colleges of Education in Ghana, which are now degree awarding institutions and other higher educational institutions (HEI), strive to be centres of excellence in knowledge and skills generation among students. In view of this, conditions and factors leading to better students' academic performance prior to and after joining these institutions become crucial. Almost all HEIs admit students based on their entry grades with the intention of admitting the most qualified students. This is premised on the fact that, since learning is a cumulative process, a student admitted with higher entry grades is expected to be better prepared for the course content than one admitted with lower grades. The researcher's observation over the years on students who do science-related courses (SRCs) [biology, chemistry, and physics] at Atebubu College of Education (ATECoE) revealed that the performance of most of the students in science-related courses differed from their entry grades in integrated science. That is, some students who did not do well in integrated science end up doing well in SRCs, whereas others who did well in integrated science do not perform well in SRCs.

Several researchers have looked into the relationship between entry grades and the academic performance of students in different courses, including science in HEIs. The results of these investigations, on the other hand, have never been conclusive because the researchers have always reported a variety of, often contradictory, findings. Literature has revealed the existence of strong (Lawal et al., 2020; Mlambo, 2011; Ogbonnaya et al., 2014; Salahdeen & Murtala, 2005), weak (Agbo, 2003; Edokpayi & Suleiman, 2011), and mixed (Ugwu, 2011; Wambugu & Emeke, 2013) links between students' entry grades in science-related courses and their grades and performance at various levels of education. For instance, Ogbonnaya et al. (2014) investigated the association between university students' entry grades in science and academic achievement and discovered a substantial positive relationship between the two scores. This was corroborated by Lawal et al. (2020), who found a positive relationship between students' entry grades in integrated science with their performance in integrated science at college.

Notwithstanding the above research supporting the fact that students' entry grades in integrated science predict their later performance in science-related courses, there are also studies that have found a low relationship between entry grades and academic performance. Salahdeen and Murtala (2005) conducted a study about the relationship between admission grades and the performance of students at Lagos State Tertiary College of Medicine in Nigeria and found that there was no significant correlation between the Senior Secondary School Certificate Examination (SSCE) results and the Joint Admissions and Matriculation Board-organised Higher Educational Institutions Matriculation Examination (JAMB-UME) scores. Also, some other studies have shown mixed results. For example, Ugwu (2011) in a study revealed that students' scores/grades in Pre-Nigeria Certificate on Education (Pre-NCE) Chemistry, Physics, and Biology relate positively, though low, to their grades in Nigeria Certificate on Education (NCE) Integrated Science. This finding contradicts the earlier assertion that pre-tertiary academic performances of students predict their performances at tertiary level.

The few studies conducted in Ghana on pre-tertiary entry grades and academic performance in different courses at the tertiary level have also revealed similar results as discussed. However, these studies focused on courses including Accounting (Aidoo-Buameh & Ayagre, 2013), African Studies, Communicative Skills and Computer Literacy (Nkrumah, 2021), Mathematics (Osei & Adu-Poku, 2020), factors other than entry grades (Issahaku, 2017), entry and exit grades [aggregates and CGPA] (Anane, 2018; Doe et al., 2018; Gyampoh, 2020; Kwapong, 2018). From the foregoing discussion, there appears to be inadequate research on students' entry grades in integrated science and their performance in science-related courses in higher educational institutions in Ghana. This current study therefore examined the relationship between CoE students' entry grades in integrated science and their end-of-course completion grades in science-related courses at CoE.

1.4 Purpose of the Study

The purpose of the study was to investigate the relationship between the entry grades of College of Education students in Integrated Science and their end-of-course completion grades in science-related courses at college.

1.5 Objectives of the Study

The objectives of the study were to:

1. Determine the range of the students' entry grades in integrated science and the SHS categories from which they were admitted.
2. Determine the range of the students' end-of-course completion grades in general biology, chemistry, and physics at the College.
3. Explore the relationship between the students' entry grades in integrated science and their end-of-course completion grades in general biology, chemistry, and physics.
4. Find out the views of students and tutors about the causes of any observed disparity between the students' entry grades in integrated science and their end-of-course completion grades in general biology, chemistry, and physics.

1.6 Research Questions

The following research questions guided the study:

1. What is the range of the students' entry grades in integrated science and the SHS categories from which they were admitted?

2. What is the range of the students' end-of-course completion grades in general biology, chemistry, and physics?
3. What is the relationship between the students' entry grades in integrated science and their end-of-course completion grades in general biology, chemistry, and physics?
4. What are the views of students and tutors about the causes of any observed disparity between the students' entry grades in integrated science and their end-of-course completion grades in general biology, chemistry, and physics?

1.7 Significance of the Study

The findings of the study would aid practitioners, especially tutors of science-related courses at Atebubu College of Education, to know whether there is any relationship between students' entry grades in integrated science from WASSCE and their end-of-course completion grades in science-related courses at CoE as well as other drivers, if any, of end-of-course completion grades in SRCs. This would enable them adopt appropriate teaching methodologies and consider other factors that would aid students' performance. The findings of the study would also help the College management as well as practitioners in making relevant recommendations to the policymakers such as MOE and GTEC on tertiary admissions. The study would give recommendations that would affect policy on improving academic performance, especially in biology, physics, and chemistry at the College. Other studies may be conducted based on the recommendations and suggestions of this research to expand the empirical evidence on students' entry grades and academic performance.

1.8 Delimitations of the Study

The researcher delimited the study to measuring the relationship between entry grades in integrated science at SHS and end-of-course completion grades (academic performance) in science-related courses at college. It was further limited to students who were admitted into the B.Ed. in Primary Education programme in the 2018/2019 academic **year, that is**, the first batch of the B.Ed. program. This was because they had all their college results released. This study was an explanatory study. This design was chosen because the researcher wanted to gain a thorough understanding of the subject under investigation. Explanatory research enables researchers to develop a thorough understanding of a certain subject. This can make them understand a given issue better (Curty, 2016).

1.9 Limitations of the Study

The WASSCE and College results of some of the students could not be obtained at the time the study data was been taken. They could, therefore not, be added as participants in the study.

1.10 Operational Definition of Terms

- **College:** College of Education.
- **End-of-course grades**: Refers to the final grades of the students in biology, chemistry and physics.
- **Entry grades**: Refers to the grades the students had in integrated science in WASSCE.
- **Science related courses**: Refers to biology, chemistry and physics.

1.11 Organisation of the Study Report

The study is organised into five chapters. The chapter one focused on the general overview and background to the study, the statement of the problem, purpose and objectives of the study, research questions, and the significance of the study. Delimitations, limitations of the study, definition of terms and abbreviations are presented as well. Chapter two dealt with a literature review related to the study, highlighting theories and findings by other researchers. Chapter three focused on the methodology, tackling the research procedures and techniques that were employed by the researcher for the study. They include the research design, population and sampling procedure, data collection instrument(s), instrument validity and reliability, data collection procedure, data analysis plan, and ethical issues. Chapter four presents the results of the analysis of the data collected from the respondents. Finally, chapter five discussed the summary of the study, the summary of major findings, conclusions, recommendations, and suggestions for further research.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Overview

This chapter reviews relevant literature related to the study. The literature has been reviewed on the following: The history of science education in Ghana; the current structure of primary, junior, senior high school, and tertiary education in Ghana; the structure and organisation of senior high school integrated science and college general biology, chemistry, and physics syllabi; the categorisation of senior high schools in Ghana; and the selection mechanism in colleges of education from past to present. It also considered factors which affect the academic performance of students, the theoretical framework of the study, the conceptual framework of the study, and the empirical framework of the study as well as a summary of the literature review.

2.2 The History of Science Education in Ghana

Any nation's development is measured in terms of its progress in science. This means that a nation's advancement in science will directly contribute to its socio-economic growth. Since science has now become a key indicator driving growth, no country, including Ghana, well-known or developing, can afford to limit its learning in schools if it wants to advance socioeconomically. In consonance with this thought, Lorek and Spangenberg (2014) laid emphasis on the fact that every country that desires to see economic growth needs to have a strong pledge toward the development of science. This suggests that science plays an important role in the technological, environmental, political, and economic growth of every country since science has infiltrated all aspects of humankind. Some countries in the world are classified as developed and superpowers as a result of their advancement in science. The move to promote the effective teaching and learning of science and mathematics has become a universal endeavour in the contemporary world (Abd-El-Khalick & Lederman, 2000). There has been an increased national interest in improving and expanding science, technology, and mathematics education at all levels.

Science had always existed in Ghanaian society prior to the colonial masters' introduction of science education. Unwittingly, they used scientific knowledge in farming, fishing, and herbal medicine for disease treatment. They also used technology to make rudimentary instruments like hoes, cutlasses, knives, and axes that they used in their daily tasks (Brown-Acquaye, 2004). Science became a subject in the schools following a report by the educational committee to the colonial officer in 1847 (Adu-Gyamfi et al., 2016). During this period, science was introduced as hygiene, nature study, and gardening. The educational act of 1887 introduced science teaching as elementary science. Science was designed to be of practical use to the individual. There were no curricula or textbooks; hence, teachers and head teachers used their own resources (Hanson & Ngman-Wara, 2021). Hygiene, nature study, and agriculture were established as compulsory subjects in training institutions during the colonial era to prepare potential teachers to teach primary school courses. The practical nature of science courses could not be maintained since criticisms were raised against it on the grounds that they were not offering conditions comparable to those in clerical employment. It was therefore changed to have a more theoretical approach and, as such, at the primary school level, nature study and hygiene gave way to a more theoretical science course called elementary science. Science was also introduced at the teacher training college to train teachers for elementary science teaching (Hanson & Ngman-Wara, 2021).

The curriculum was designed to help students develop desirable attitudes and interests, mental skills, practical and psychomotor skills, and basic scientific knowledge. The content included animal and plant life, water, soil, the universe and the heavenly bodies, and keeping the body healthy. General science was made mandatory for the first two years of the second cycle, after which students who chose science could pursue any of the following combinations: Biology, Chemistry, and Physics, or Additional General Science. Other students were to pursue any of the following: Agricultural science, Health science, or Home science in the last three years. Science programmes were also made available at the sixth form level (Hanson & Ngman-Wara, 2021).

The theoretical nature of science teaching and learning was unsatisfactory, so the Government of Ghana set up a committee in 1972 called the Dzobo Committee to review science education in Ghana. Among other things, the Committee was tasked to come out with recommendations on how best science teaching could shift from its theoretical nature to include a more practical approach to teaching science at the pre-university levels of education. The recommendations led to the 1987 educational reforms. The major goal of the reforms has been to equip the Ghanaian child with pre-requisite scientific and technological knowledge to help provide much-needed solutions to socio-economic problems such as environmental degradation, low agricultural productivity, pollution issues, and the prevalence of diseases. The science curricula for the various levels of basic education were therefore revised in line with the major goals. Science was now taught as environmental studies at the lower primary school level to deal with problems related to the environment such as housing and diseases, and as integrated science at the upper primary level. It dealt with basic ideas in science, such as plants and animals and their behaviour. It also dealt with the nature and properties of different forms of matter and with basic concepts in earth science, such as the universe and the heavenly bodies. The junior secondary schools offered general science and agricultural science. Science was taught at the senior secondary school level as integrated science and as a mandatory (core) course for all students. Various combinations of science subjects constituted the general science programme for students who opted for elective science courses. The universities offered degree courses in separate science subjects and not as general science or integrated science. The methodology to be used in both primary and junior secondary schools was activity-oriented with the teacher expected to play the facilitator role. However, the actual classroom transactions tended to be based on chalk and talk method with very little or no practical experience. There was still a great dependence on the teacher and the textbook by the pupils (Dei, 2004).

Several curriculum reforms have taken place since after the 1987 reforms. The major reform was the 2007 school reforms which were based on the Anamuah-Mensah Committee report of 2002 on the state of education in Ghana. The science curriculum was once again revised. The environmental studies which was taught at the lower primary was replaced by natural science. The former is now taught at the kindergarten level of education which now forms part of the educational system. Integrated science remains a subject from upper primary to senior high school level. The content of the integrated curriculum was revised to include basic electronics to equip pupils with content knowledge and practical skills to be deployed in maintenance of repairs of electronic gadgets including mobile phones (Owusu et al., 2016).

The rationale for the integrated science curriculum lies in the fact that Ghana needs to participate meaningfully in the world of science and technology so that as a developing country, she can advance in this era of rapid global scientific and technological advancement. The impact of science and technology is felt on education, health, nutrition, transport and communication. Our survival depends on the mastery of the knowledge and attitudes of science and technology. For Ghana to develop there is a need to eliminate superstition and rather encourage the rapid development of scientific and technological literacy among individuals. These issues have been considered in the integrated science curriculum (Adu-Gyamfi et al., 2016). The primary objective of science is to give knowledge and information about the world we live in. To live as an efficient, member of modern society, each citizen needs to know some facts of the natural phenomena (living and non-living), laws and properties of matter, and the application of the knowledge of science and the scientific principles that we come across in our daily life. The basic integrated science course should therefore be on humanistic lines so that it may be of value to all. But such should be based upon pupils' familiar experiences in the environment. The content of the curriculum for the integrated science programme has been selected to introduce the pupil to the enquiry processes of science as well as to basic ideas in science. The content covers the basic science disciplines, agriculture, health and industry. Every pupil must acquire an adequate background of ordered knowledge that is useful in maintaining health, promoting safety, and in understanding the environment. They should be acquainted with the different branches of science, which will enable them to understand and interpret their environment. The recommended approach to the teaching of basic science is activity-oriented based on investigations, projects and discovery learning. The activity approach challenges pupils to develop their own ideas, and secondly makes the subject more meaningful and relevant to them. The teacher serves as a facilitator and motivates the pupils in various ways to sustain their interests. The teacher should ask questions that will guide them to other areas of useful investigation. The most important objective of school science instruction is to make the pupils aware of the scientific methods of procedure and to inculcate scientific attitude of mind. The school will not only give the pupils adequate scientific knowledge and requisite skill to meet the problem of existence but also train them in proper scientific attitude. The methods of investigation are as important as the facts themselves. It is therefore important to train the pupils in scientific method (Adu-Gyamfi et al., 2016).

2.3 The Current Structure of Primary, Junior, Senior High School and Tertiary Education in Ghana

Ghana's education system currently includes fourteen years of basic education and four years of tertiary education. That is, two years of kindergarten education, six years of primary education (three years of lower and three years of upper primary), three years of junior high school, three years of senior high school, and four years of university education (Quainoo et al., 2020). Since the introduction of the formal education system in Ghana, the number of years spent in primary school is six (6) years. Since the inception of formal education in the 16th century, various reforms introduced and implemented by governments have not affected the number of years in primary school. The number of years in primary school has been consistent since then (Adu-Gyamfi et al., 2016). Currently, education in Ghana starts with two (2) years of kindergarten, which is incorporated into the formal system to help children receive basic foundation level education, preparing them for an easy transition from home to primary school. However, primary education covers a period of six (6) years, which builds upon the two years of kindergarten education. Primary education is divided into two sections, thus the lower and upper primary. These stages help in the growth and development of the child. Furthermore, the lower primary constitutes the first three (3) years and the upper primary constitutes the last three (3) years. These stages in the primary division help children to acquire knowledge, develop attitudes and skills to enable them to solve problems and also satisfy their curiosity (Eshun, 2013).

There are various objectives for primary education in Ghana's education system. Among them are: to develop sound moral attitudes and appreciate one's cultural heritage and identity; inculcate good citizenship in children to enable them to participate in National development; develop an understanding of how to lead a healthy life and achieve a good health status; and lay the foundation for inquiry, creativity, and innovation (Cannon, 2015). The content of primary education comprises subjects such as English Language, Mathematics, Science, Creative Arts, Our World Our People (OWOP), History, Ghanaian Language, Religious and Moral Education (RME), Physical Education (PE), French, and Computing (Ministry of Education, 2017). The colonial government's administrative structure of education in Ghana was similar to the system practiced in their motherland. Since the introduction of formal education, pupils have been enrolled in a four-year middle school. After Ghana gained independence, the middle school system was maintained until 1987, when reforms replaced the four (4) year middle school with three (3) years of junior secondary school. The Junior Secondary School (JSS), now Junior High School, constitutes a three-year post-primary education. It is the transitional period from basic to secondary education. It introduces students to basic scientific and technical knowledge and skills and prepares them for further academic work and the acquisition of technical/vocational skills at the secondary level. These are the various subjects studied in junior high school: English Language, Mathematics, Ghanaian Language, Social Studies, Pre-Technical Drawing, Integrated Science, Agricultural Science, Religious and Moral Education, and Pre-Vocational Skills (Inkoom, 2012). Students in the final year of all junior high schools in Ghana are currently assessed by the Basic Studies Certificate Examination in order to choose students who are qualified to continue their education in senior high schools. This selection criterion may change following the ongoing Educational Reform in Ghana.

The structural system since the introduction of formal education in Ghana saw Secondary School for five (5) years and an additional two (2) years for "Ordinary level" and "Advance level" certificates. The various reforms introduced by governments reduced the seven (7) years of Secondary School to three (3) years of Senior Secondary Education in the 1980s (Buabeng et al., 2020).

Various reforms introduced into Ghana's education system have had a greater impact on Senior Secondary Education in terms of the number of years spent in this section, the name for this level of education, and the curriculum content than on Universal Basic Education. The senior high school enrols qualified students to further advance their education by building on the knowledge they acquired in the junior high school. Ghanaian students take the Basic Education Certificate Examination (BECE) at the end of JHS three (3). Students who meet the demands and terms of the admission requirements of various senior high schools were admitted to pursue their programme of choice (Anamuah-Mensah, 2006). The duration of this level of education is three (3) years. In the public schools, it is compulsory for all students to take a core curriculum consisting of English Language, Integrated Science, Mathematics, and Social Studies. It is also essential to note that each student also takes three or four elective subjects, chosen from one of the seven categories: Sciences, Arts (social sciences and humanities), Vocational (visual arts or home economics), Technical, Business and Agriculture (Darling-Hammond, 2006). This means that all students admitted to any HEI have had a taste of integrated science, which comprises biology, physics, chemistry, and agriculture. Students who take the elective sciences have additional content knowledge in these subjects.

The introduction of Tertiary Education in Ghana, launched in 1948, was a great initiative by the British. Tertiary institutions, including Colleges of education in Ghana enroll students for undergraduate, diploma and certificate programmes with regards to other academic and professional fields (Buabeng et al., 2020). The Colleges of education started as four-year Post Middle Teacher's Certificate 'A' and later 2-year Post Secondary and 3-year Post Secondary Teacher Training Institutions. In September 2004, the first batch of students was admitted into the college to pursue a three-year course for a Diploma in Basic Education following the upgrade of the colleges into diploma-awarding institutions. After fourteen years of operation as diploma-awarding institutions, the colleges were upgraded to four-year degree-awarding institutions in September 2018.

2.4 Structure and Organisation of Senior High School Integrated Science and college General Biology, Chemistry and Physics Curricula

Table 1 presents the structure and organisation of the senior high school Integrated Science curriculum. The curriculum is arranged according to major themes, with the various units under the themes categorised based on the three years or forms (SHS 1, SHS 2, SHS 3).

Table 1

Structure and Organisation of the Senior High School Integrated Science Curriculum

SECTIONS	SHS1	SHS2	SHS3
DIVERSITY OF MATTER	Unit 1: Introduction to Integrated Science. (p. 1-2) Unit 2: Measurement (p. 2-3) Unit 3: Diversity of living and non-living things. (p. 3-4) Unit 4: Matter (p. 4-5) Unit 5: Cells and cell division (p.6) Unit 6: Rocks (p.6)	Unit 1: Acids, Bases and Salts (p. 21-22) Unit 2: Soil conservation (p. 22-23) Unit : Water (p. 24)	Unit1: Metals and Non Metals (p. 41) Unit 2: Exploitation of minerals (p. 41) Unit 3: Rusting (p. 42) Unit 4: Organic And Inorganic Compounds(pg.43)
CYCLES	Unit 1: Air movement (p.7) Unit 2: Nitrogen cycle (p.8)	Unit 1: Hydrological Cycle (p.25-26) Unit 2: General principles of farm animal production (pg. 26).	Unit 1: Life Cycles of Pests and parasites (p. 44) Unit 2: Crop Production (p.45)
SYSTEMS	Unit 1: Skeletal System (p.9) Unit 2: Reproduction and growth in Plants (p. 9-11) Unit 3: Respiratory System (p.11-12) Unit 4: Food and Nutrition (p.13) Unit 5: Dentition, Feeding and Digestion in mammals (p.13) Unit 6: Transport-Diffusion, Osmosis	Unit 1: Excretory system (p.27) Unit 2: Reproductive Systems and growth in mammals (p.27-29) Unit 3: Circulatory System (p.29)	Unit 1: The Nervous System (p.46)

Table 1 *continued*

ENERGY	Unit 1: Forms of Energy and Energy Transformation (p.15 Unit 2: Solar Energy (p.16) Unit 3: Photosynthesis (17) Unit 4: Electronics (p.17)	Unit 1: Electrical Energy(p.30-31) Unit 2: Electronics.(p.32) Unit 3: Sound Energy(32-33) Unit 4: Nuclear Energy(pg.33)	Unit 1: Light Energy (p.48) Unit 2: Heat Energy (p.49) Unit 3: Electronics (p.50)
INTERACTIONS OF MATTER	Unit 1: Ecosystem (p.18-19 Unit 2: Atmosphere and Climate Change (p.19-20) Unit 3: Infections and diseases (p.20)	Unit 1: Magnetism (p.34) Unit 2: Forces, Motion and pressure (p.35-36) Unit 3: Safety in the Community (p.37-38) Unit 4: Endogenous Technology (pg.38-39) Unit 5: Biotechnology (pg.39-40) Unit 6: Work and Machines(pg. 40)	Unit 1: Variation and inheritance (p.51)

Source: CRDD, 2010

Table 2

Structure and Organisation of the college General Biology Curriculum

Units	Topics:	Sub-topics (if any):
1	Classification and naming of organisms	Concept of classification
		Organization plan of classification
		Binomial system of nomenclature
2	General characteristics of the five Kingdoms of organisms	The five Kingdoms of Prokaryotae/Monera, Protoctisita/Protista, Fungi, Animalia and Plantae to be established
		NB: Treat characteristics of animalia-phyla, classes under chordata and class insecta under arthropoda
3	The cell	The cell as the living structural and functional unit
		The cell theory and classification of cells
		Cells in relation to tissues, organs and systems
4	Structure and function of flowering plants	Vegetative parts of a flowering plant
		Reproductive parts of a flowering plant
		NB: Pollination: definition, types, agents and their characteristics.
		Fertilization: definition
5	Food and nutrition in animals	Balanced diet
		Dentition
		Digestion in humans

Table 2 *continued*

6	Nutrition in plants	Raw materials for photosynthesis
7	Reproductive system in mammals	Reproductive systems of the male and female mammal
8	Respiratory system in mammals	Respiratory system to take in and out gases
		Anaerobic and aerobic respiration
		Disorders of the respiratory system
9	Excretory system of mammals	Differences between excretion and egestion
		Structure and function of the excretory organs of the mammal: kidney, skin, liver, lungs
10	Circulatory system in mammals	Structure and functions of the components of the circulatory system
		The heart
		Blood
		Blood vessels
11	Health and diseases	Causative organisms of diseases
		Consideration of symptoms and treatment of tuberculosis, malaria, common cold and typhoid

Source: IoE, UCC (2018)

Table 3

Structure and Organisation of the college General Chemistry Curriculum

Units	Topics:	Sub-topics (if any):
1	Structure of the Atom and Arrangement of Electrons	a. Gross features of the atom. b. Arrangement of electrons in the main and sub-energy levels. c. Atomic number, mass number, isotopes and atomic mass
2	Formation of Ionic and Covalent Compounds	a. Ionic bonds b. Covalent bonds
3	Mole as a Unit and Formula Mass	a. The mole as a unit b. Formula mass
4	Chemical Formula and Equation	a. Chemical Symbols and formula. b. Chemical equation c. Balancing equations and state symbols
5	Pure and Impure Substances and Mixtures	a. Pure and impure Substances. b. Methods of purification of impure substances.

Table 3 *continued*

		c. Importance of purification of impure substances.
6	Acids, Bases And Salts	a. Definition of acids and bases. b. Physical and chemical properties of acids and bases. c. Acids, bases and salts as electrolytes. d. pH e. Weak acids and weak bases. f. Hydrolysis g. Acid-Base indicators. h. Acid-base titrations
7	Chemistry of Carbon Compounds	a. Classification and nomenclature of alkanes, alkenes and alkynes. b. Isomerism c. Alkanes, Alkenes and Alkynes i. Sources/ preparation ii. Physical and chemical properties iii. Reactivity iv. Uses d. Alkanols and Alkanoic acids i. Sources/reparation ii. Structure and shape iii. Physical and chemical properties iv. Uses v. Petroleum

Source: IoE, UCC (2018)

Table 4

Structure and Organisation of the college General Physics Curriculum

Units	Topics:
1	Measurement of physical quantities
2	Density and relative density
3	Motion and pressure
4	Forces
5	Work, energy and power
6	Machines
7	Basic electronics
8	Optics
9	Current, electricity and magnetism

Source: IoE, UCC (2018)

Similarities between the SHS Integrated Curriculum and the College General Biology, Physics, and Chemistry Syllabi

As stated previously in the background of this study, the prerequisite for offering general biology, physics, and chemistry at the college level is prior knowledge of integrated science from SHS. It is on this basis that the comparison is made to ascertain the commonalities and differences, if any. A careful study of the SHS integrated science curriculum revealed the following biology topics: diversity of living and non-living things; cells; reproduction and growth in plants; respiratory system; food and nutrition; dentition; feeding and digestion in mammals; photosynthesis; excretory system; reproductive systems and growth in mammals; circulatory system; infections and diseases. All these topics are similar to the content of the general biology curriculum at college for UCC affiliated colleges. Also, the following chemistry topics are found in the SHS integrated science curriculum: Matter, acids, bases, and salts; metals and non-metals; exploration of minerals; rusting; organic and inorganic compounds. With the exception of mineral exploitation, rusting, and metals and non-metals, all other units in integrated science are taught at the college level. Matter as a unit in the SHS integrated science curriculum has been divided into five (5) units at the college for UCC affiliated colleges. The divisions are: structure of the atom and arrangement of electrons; formation of ionic and covalent compounds; mole as a unit and formula mass; chemical formula and equation; pure and impure substances and mixtures. Again, measurement, forms of energy and energy transformation, solar energy, electronics, electrical energy, sound energy, nuclear energy, light energy, heat energy, magnetism and forces, motion and pressure are physics topics taught in the SHS in Integrated Science. The general physics curriculum has the following units: measurement of physical quantities; density and relative density;

motion and pressure; forces; work; energy and power; machines; basic electronics; optics; current; electricity; and magnetism. From the two syllabi, it could be seen that their contents are almost the same.

A careful comparison of the curricula for SHS integrated science and the college general biology, chemistry, and physics revealed that their contents appeared to be the same. This is therefore an indication that the grades of students (academic performance) in SHS integrated science can be compared with these science-related courses (biology, chemistry, and physics) in a disintegrated manner in College as done in this study.

2.5 Categorisation of Senior High Schools in Ghana

Senior high schools in Ghana are classified by the Ghana Education Service (GES) and the Computerised School Selection and Placement System (CSSPS) based on academic performance at WASSCE, school achievement, infrastructure, and facilities. The categories are: category 'A' schools; category 'B' schools; category 'C' schools; and category 'D' schools. Junior High School pupils who have successfully gone through the BECE are placed in any of these categories based on their selection and their average score. The category A senior high schools are thought to be the best in the country. These schools have good infrastructure and also perform well in the WASSCE. Category 'B' schools are seen as next to the 'A' schools in terms of infrastructure and performance in WASSCE. In addition, Category 'C' and 'D' schools also follow in order of infrastructure and performance in WASSCE.

School infrastructure is very critical for effective teaching and learning in educational institutions. According to Parnwell (2015), the purpose of infrastructure in educational institutions is to increase students' school attendance, enhance staff motivation, and improve the academic performance of students. School infrastructure includes classrooms, laboratories, auditoriums, open fields, games equipment, dormitories/halls, water and sanitation facilities. It is in the classrooms that the day-to-day formal teaching and learning takes place. In the libraries, learners get the opportunity to conduct their own personal studies and carry out research. It is in the field that co-curriculum activities take place. Learners and teachers need to be housed in the school and, at the same time, need sanitation facilities like toilets, waste disposal services, and clean water. School infrastructure is therefore a very important component in ensuring successful education (Mokaya, 2013).

Several studies at the basic, secondary, and tertiary levels have found that an institution's infrastructure has a significant impact on the development of both school performance and students' academic performance (Duarte, Gargiulo, & Moreno, 2011; Jamil, Mustafa, & Ilyas, 2018; Mokaya, 2013; Murillo & Román, 2011; Parnwell, 2015; Sulemana, 2011). Parnwell (2015) investigated the influence of school infrastructure on academic performance in public primary schools in Ruiri, Kenya. The study findings revealed that most classrooms were overcrowded, not fitted with doors and windows, not painted, not plastered, and the floors were not cemented. They also had inadequate desks and were poorly lit. This negatively affected the academic performance of the pupils. This is confirmed by Sulemana (2011) in a study that revealed poor infrastructure facilities were the major cause of poor academic performance of students on the Wa Campus of the University for Development Studies. Similarly, Murillo and Román (2011) conducted a study and the results showed that the availability of basic infrastructure and services (water, electricity, sewage), didactic facilities (sport installations, laboratories, libraries), as well as the number of books in the library and computers in the school do have an effect on the performance of primary school learners in Latin America, but their relative weight varies significantly from country to country. Also, Mokaya (2013) carried out a study to establish the impact of school infrastructure on the provision of quality education in public secondary schools in Kajiado, Kenya. It was found that improved academic performance is associated with more adequate and well-spaced classrooms; adequate and ample spacing in the libraries; adequate science laboratories; adequate water and sanitation facilities; and adequate participation in co-curricular activities. Again, Duarte et al (2011) explored the state of infrastructure in primary schools in Latin America using the SERCE database, and analysed the connection between school infrastructure conditions and language and mathematics test results for third and sixth grade students. The results of the analysis indicate that school infrastructure and access to basic services (electricity, water, sewerage, and telephone) were highly deficient. The analysis of the relationship between school infrastructure and academic results in the SERCE tests indicates that the factors most significantly associated with learning outcomes are: the presence of spaces that support teaching (libraries, science and computer laboratories); the connection to electric and telephone utilities; and access to potable water, drainage and bathrooms. In a similar manner, Jamil et al. (2018) show that electricity, gas, library, and teaching quality have a positive effect on school performance in Khyber Pakhtunkhwa, Pakistan. However, Jamil et al. (2018) results showed that science laboratories and playgrounds have no impact on school performance. In contrast, Assoumpta and Andala (2020) found that there was a significant but low positive correlation between school infrastructure and students' academic performance in 12YBE in Rwanda.

2.6 Selection Mechanism into Colleges of Education from Past to Present

The colleges of education in Ghana have transitioned over the years in terms of the criteria used in admitting students and the certificates awarded. Socio-political trends have had a great impact on teacher education reforms in Ghana. That is, nearly every political party that has ruled the country since independence has engaged in some form of teacher education reform that was aimed at preparing qualified teachers to meet the educational needs of the country. These reforms have produced different sets of teachers with different types of certificates (Anamuah-Mensah, 2006). Teacher Training Colleges, now known as Colleges of Education, initially offered 2-year Post-Middle Certificate "B" programs, followed by 4-year Post-Middle Certificate "A" and 2-year Post-Secondary Certificate "A" programmes. In the 1980s, the 2-year Post-Secondary programme was extended to a 3-year program, but it ran alongside the 4-year certificate "A" programs until it was cut short (Buabeng, Ntow & Otami, 2020). However, the reforms had little impact on students' learning outcomes (MoE, 2012), such as achievement and the development of critical values like problem solving. The colleges were subsequently elevated to diploma awarding institutions in 2004/2005. The Colleges of Education in Ghana, with effect from October, 2018, were upgraded to four-year degree awarding institutions and are no longer three-year diploma awarding colleges.

There have been different entry requirements and selection criteria that have been used over the past sixty-three (63) years since the inception of teacher education in Ghana. In most cases, a credit pass in five (5) or six (6) subjects is required. That is, three or two elective subjects and three core subjects (i.e., EMS). Apart from the minimum entry requirement, in some cases, shortlisted applicants were made to write entrance examinations in English Language and Mathematics, followed by an oral interview. At other times, short-listed applicants were only interviewed. Currently, the Colleges admit students with the same minimum qualifications as all other tertiary institutions in Ghana. That is, a credit pass (C6) in two elective subjects and three core subjects including English Language and Mathematics from WASSCE. The purpose of all these entry requirements and selection criteria was to admit the best applicants who would be able to academically perform at College.

2.7 Factors Which Affects Academic Performance of Students

Educational institutions would be nothing without teachers and students. The two groups play a key role in every academic institution. Academic performance of students is the link between teachers and students as well as the institution; without it, there is no yardstick for measuring the academic institution's development and growth (Gilbert, 2018). Due to this, the students' performance in academics is very key in any educational institution. Educational researchers all over the world are concerned about the academic performance of students. Many factors influence students' performance, yet they vary between individuals and also between institutions. Over the years, educational researchers have been interested in investigating factors that seem to have a substantial effect on the academic performance of students at different tertiary institutions globally (Azhar et al., 2014; Fernex et al., 2015; Khan et al., 2020; Sael et al., 2017; Wintre et al., 2011). Most of these studies focus on three elements, which are personal, teacher, and institutional factors in students' performance. Other literature reviews have revealed many factors, including environmental, economic, social, and psychological, that have a significant impact on students' performance in academics (You, 2018).

Several studies have been conducted in an attempt to identify the elements influencing pupils' overall achievement or performance. These studies are explored to support the claim that any student's performance at the HEI is affected by a variety of elements, including personal, teacher, and institutional factors (Umar et al., 2010). Students are the primary resources of their HEIs, irrespective of field or area. Higher education institutions, in this regard, play an important role in producing higher-quality individuals who will be great leaders and workforce in their countries, thus responsible for the social and socioeconomic development of other countries (Soto & Anand, 2012). This is only possible if the students' academic performance is good in every way.

Academic performance has traditionally been influenced by students' self-esteem, creativity, and commitment to academic success. Poor performance influences students' future doubts about the overall outcomes of the HEI and can reduce the likelihood of students pursuing higher achievements, such as higher grades (Egunsola, 2014). As a result, a student's academic performance is unquestionably a focus for teachers (Saele et al., 2017; Wintre et al., 2011). The focus of teachers has shifted to elements that lead to student academic performance. Educational researchers have identified home, family, school, demographics, and environment as influences on a student's academic performance.

A family's responsibility is to care for, educate, and protect its offspring. Therefore, all of these activities or tasks are performed in the home, which plays a crucial role in education. The home environment has a significant effect on the child or student, particularly throughout the adolescent years. The nurturing and coaching of children begin with the family. The actions they learn at home help the children identify with their socioeconomic class, religion, society, and culture (Ajila & Otutola, 2000, as cited in Francisca & Mezoh, 2018). In a study of 300 male and female Pakistanis, Farooq et al (2011) discovered that higher social economic status results in higher student performance. Students' knowledge received from their parents and other key people at home is most likely to have a positive and valuable impact on their academic performance (Beaumont & Soyibo, 2010). The concepts taught at home, as well as the family's motivation for education and a better life, affect a student's success or failure in school. Parents shape their children's academic performance through developing their abilities, attitudes, and actions toward education and school (Davis-Kean et al., 2019). The influence of parents on their wards comes from the environment and how they interact with their children when training and grooming them. It means that parents' socioeconomic status can have an impact on academic issues (Davis-Kean et al., 2019). As a result, more educated parents can provide good learning contexts for their children (i.e., students).

Student personality factors also play a significant role in their academic performance. Several scholars who conduct research on personality contend that personality factors contribute to a considerable difference in the academic performance of students (Almlund et al., 2011; Komarraju & Karau, 2005; MacCann et al., 2020; Martin et al., 2006; Noftle & Robins, 2007; Roberts et al., 2007). A study conducted by Martin et al. (2006) revealed that personality characteristics had a distinct role in the academic performance of undergraduate students as compared with their performance in high school and cognitive capacity. Mammadov (2022) in an experimental study indicated that personality traits, specifically neuroticism and extraversion, were major factors that influenced students' academic performance. Hazrati-Viari et al. (2012) assessed the effects of personality on academic motivation and performance. Conscientiousness influenced both intrinsic and extrinsic motivation, whereas extroversion influenced only intrinsic motivation. In a current meta-analysis by Mammadov (2022), it was discovered that a combination of cognitive capacity and personality factors accounted for 27.8 percent of the difference in students' academic performance. With a relative importance of 64%, cognitive ability, representing 64%, was identified as the major factor that influenced students' academic performance. Conscientiousness was also shown as a strong and reliable factor influencing academic performance, accounting for 28 percent. Students' attentiveness, self-study, active class participation, as well as self-motivation have also been identified as relevant factors that influence academic performance. Au et al (2016) posited in a study that self-study and better attentiveness were predictors of students' academic performance. Students' participation in lessons modulates the high relationship between attendance and academic performance (Kim et al., 2020). Zheng and Warschauer (2015) opined in a study that students' active participation and interaction in lesson had a great influence on their performance in online discussion environment.

Teacher-related factors again affect students' progress in their academics. According to studies, the performance of a teacher has a great effect on the performance of a student, albeit this differs depending on location (Çetin & Eren, 2022; Gilbert, 2018). Students have a better chance of comprehending the subject matter if the teacher has complete control over it (Stronge, 2018). With that control, the teacher will easily deliver the knowledge in a way that the students comprehend without challenge. At times, the teacher understands the subject but is unable to properly explain it owing to poor communication skills, which has an impact on the tertiary performance of students. Similarly, having control over the subject matter does not imply that students will perform well (Stronge, 2018). The teacher's late attendance to a lecture or failing to show up (being absent) may have an adverse effect on students' academic performance (Muzenda, 2013). If the teacher fails to attend lectures, the students' motivation in the subject has already been lost. This will result in them not paying attention to the subject and the teacher. Consequently, this will lead to a situation where the students may not like the teacher and the subject in the future (Muzenda, 2013). Even though not all students react in the same manner, many students will remain interested in the subject because they enjoy it, but they may not perform to expectations due to the teacher's irresponsibility (Muzenda, 2013). Furthermore, the teacher's criticism and encouragement of students play an important role in their academic performance (Sali-Ot, 2011). The effect of motivation on students is regarded as a significant aspect of student learning in higher education. Kusurkar et al. (2013) opined that motivation had a significant impact on the academic performance of students. Several theories have been formulated to explain psychological behaviour from a motivational perspective. Constant critiquing by the teacher may demotivate the student and cause them to perform poorly in the subject when compared to their true self. According to Petty (2014), motivation helps students stay interested in their academics. Students require motivation that is both concrete and intangible, because it is part of the teacher's responsibility to not only instruct students but also to nurture, advise, and have confidence in them, as well as to appreciate them on occasion (Rasul & Bukhsh, 2011). Appreciation can be expressed through pleasant remarks or by presenting them with something else to enhance their confidence.

Acknowledge them for their efforts in academics as well as extra-curricular activities; this will go a long way toward assisting the students.

Institutional procedures, practices, resources, and materials available are also important determinants of student performance (David, 2014). What happens inside the school has a direct relationship to a student's overall performance.

The majority of a student's time at an educational institution is spent in a classroom. This is where students learn the majority of the skills required to assist them in achieving their intended future goals in order to have a better future (Hajizadeh & Ahmadzadeh, 2014). The classroom is where students learn what they want for their future and how to achieve that goal (Viaria et al., 2012). The classroom is a critical place in a student's development; it is crucial to understand the aspects influencing the overall class environment in order to attain optimum performance. It must be realised that if schools are to play a significant role in educating the next generation of students how to be successful members of society, then every precaution must be made to guarantee that the children flourish in an appropriate learning environment (Viaria et al., 2012). If this is not taken seriously, the overall layout of the classroom will stifle innovation or promote a good attitude in the students (Viaria et al., 2012). There are many factors that could have an impact on the classroom climate. The physical attributes of a classroom include wall art and chair arrangements. Many other factors that may influence students' focus include the energy in the classroom, the rules, and the sound quality in the classroom (Obeta, 2014). The classroom climate is also influenced by the teacher's attitude toward students. The way teachers organise their classrooms, maintain control, deliver lessons, and communicate with students leaves a favourable or negative impression on the students' minds (Obeta, 2014). The teacher's participation in class is important in delivering the lesson to the students. If they are not in a positive mood, it will have an adverse effect on their students in the classroom. Similarly, if a teacher has high potential, influence, and has learned how to organise his or her listeners, it leaves students grounded in the subject. To establish a better learning atmosphere, a teacher must comprehend these factors (Obeta, 2014).

Teaching and learning resources are also believed to play a major role in the academic performance of students in an educational institution. A study conducted by Bizimana and Orodho (2014) in Rwanda showed that there was a positive and significant correlation between most of the teaching and learning resources and students' academic performance in secondary schools across the country. This finding is supported by Adebayo et al. (2020), who say that educational resources have a significant impact on student performance. Similarly, Dahar and Faize (2011) investigated the effects of the availability and use of instructional materials on the academic performance of students in Punjab (Pakistan) and identified that the unavailability of instructional materials or less effective usage of instructional materials lowers academic performance. Also, Obodo et al. (2020) in a study indicated that there was a positive significant difference in the performance of students taught basic science with the use of improvised teaching-learning when compared with those taught basic science without the use of improvised teaching-learning materials.

To add to the factors described above, research has shown that students who participate in co-curricular activities such as drama, music, and sports have strong associations (Ritchie, 2018; Semer & Harmening, 2015). Some research suggests that students who participate in co-curricular activities perform better academically, whereas those who do not participate in such activities do not perform well academically.

2.8 Theoretical Framework of the Study

Entry grades are about the only requirement for entering into any higher educational institution for any programme. The theory of learning relevant to this study is discussed here. Theories have formed the basis for the most accurate and realistic decisions. As a result, it is important to examine theories related to this study in order to have a solid foundation on which to build my assumptions. The theory was reviewed with the aim of discovering and explaining the effects of previous experience on future performance.

The theoretical framework of this study is based on the cognitivist learning theory proposed by Ausubel (1963). According to Ausubel's Subsumption Theory, a learner assimilates new information by connecting it to previously acquired concepts and ideas. Ausubel sees the key to effective learning as the learners' relating their new learning to existing cognitive structures. He advocates the use of "advance organisers" that is, bridges between what the students know and what they need to know. In this case, integrated science entry grades or knowledge serve as "advance organizers" for their performance in science related courses at college. Transfer of learning, knowledge, or experience is simply the aid of an old experience in the acquisition of a new one. It is the effect of prior learning on present learning or the effect of prior learning on the subsequent performance of different tasks (Day & Goldstone, 2012). This transfer could be positive, negative, or zero. However, according to the learning to learn theory by Harlow, individuals improve their ability to learn tasks when they practiced a series of related or similar tasks (Harlow as cited in Kohonen, 2007). This is probably the reason why most institutions of higher learning use entry grades for admission into academic programmes. It must be noted that for a previous experience to be regarded as entering behaviour, it must be related to the intended learning, in which case the knowledge of it will facilitate the knowing of the intended learning. It is on this note that the present study sought to investigate the extent to which students' integrated science entry grades will facilitate their performance in science-related courses.

Cognitivists rely on the fact that previous experience enables learners to modify their reaction to present stimuli (Ertmer & Newby, 2013). It is on the basis of this that the researcher took up this study to determine whether or not students' integrated science entry grades will predict their performance in science-related courses. Learning is believed to build upon learning in the same way success builds on success (Ugwu, 2011). Also, future construction, if possible, at all, will be dangerous if foundation blocks are lacking. It will therefore be unproductive to assume students will perform well in situations where they have no previous experience.

Bruner (1961), another cognitivist, considers the learning process as the learning of acquiring new information, transforming that learning with regard to existing knowledge, and then checking it against the new situation. So, knowledge is a process rather than a product. The learner creates models that not only explain what is, but also predict what might be.

In a nutshell, cognitive theory is premised on the fact that experience is important in learning and that past knowledge serves as a building block for tackling subsequent problems. Also, transfer of learning is facilitated by highlighting similarities between one learning activity and another.

2.9 Conceptual Framework of the Study

The conceptual framework of this study was adapted from the Input-Transformation-Output model proposed by Leontief (1987), which was initiated in a factory setting to illustrate the role of operations in creating and delivering goods and services in an organisation (Henri, 2004). According to Melan (2002), the Input-Transformation-Output model represents three components of operations: the input, transformation processes, and outputs. In the case of this study, inputs represent students' integrated science entry grades; transformation processes represent the experiences students undergo while at the college, including the teaching and learning practices in science-related courses, the infrastructure and resources they are exposed to, and the type and quality of interactions students have with their science related course tutors; while output in this study represents the final end-of-course grades of the students. This model supports the cognitive theory, which is premised on the fact that previous experience (entry grades) is important in learning and that past knowledge serves as a building block for tackling subsequent problems, which is, being able to get good grades (Ertmer & Newby, 2013).

Figure 1 presents the conceptual framework for the relationship between students' entry grades in IS and their final end-of-course grades in SRCs.

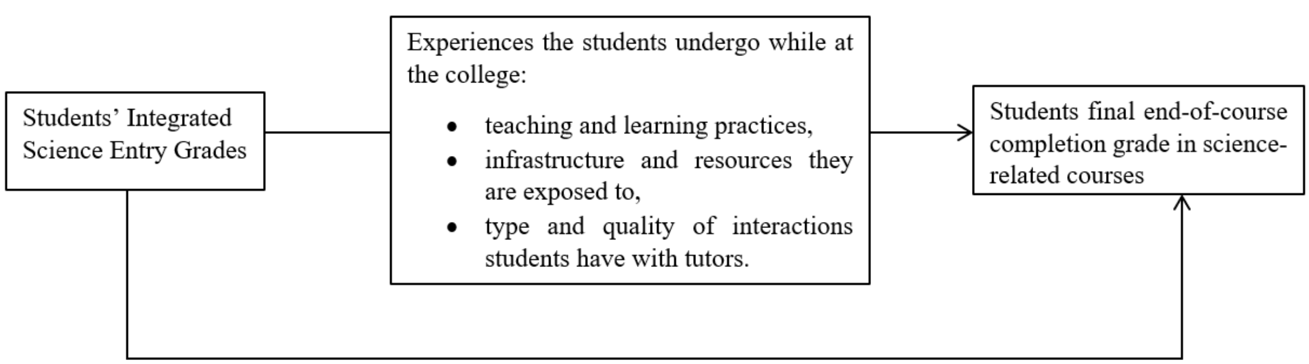

Figure 1: *Flow chart of relationship between students' entry grades in IS and their final end-of-course grades in SRCs.*

In the context of what is presented in Figure 1 and in resemblance with Sahney and Thakker's (2016) perspective, students' integrated science entry grades in the above model represent inputs, whereas their final end-of-course completion grades in the science-related courses represent the outputs. Therefore, as shown above, it is believed that better quality inputs (in terms of good integrated science entry grades of students from SHS) will be transformed into better grades in terms of end-of-course completion grades in science-related courses (Abdullah & Mirza, 2018). That is, if the college admits students with good integrated science entry grades into the B. ED Primary Education Program, they will be taught and easily get good grades in their end-of-course completion grades in science-related courses.

2.10 Empirical Framework of the Study

Several researchers have looked into the relationship between entry grades and the academic performance of students in different courses in HEIs. The results of these investigations, on the other hand, have never been decisive because the researchers have always reported a variety of, and often contradictory, findings.

In fact, some researchers [Abdullah & Mirza (2018); Ferrão & Almeida (2019); Kurlaender & Cohen (2019); McKenzie & Schweitzer (2001), Myburgh (2019); Wamala et al., 2013)] identified academic performance at pre-tertiary levels as the most significant predictor of tertiary performance. They argued that a student who enters tertiary with better grades is most likely to perform academically better than his/her counterpart who has not scored good grades in pre-tertiary examinations. Hoare and Johnson (2011) confirmed this assertion when they studied the relationship of graduate record examination (GRE) scores with the students' achievement from different disciplines (degree programs) in a university and found a significant correlation but the value of the correlation coefficient ranged from weak to medium strength for different degrees. The students who were high on GRE scores were also high on university scores.

Several other researchers share this view. Chathuranga (2016) and Hodara and Lewis (2017), for instance, opined that high school grade point average was consistently predictive of tertiary performance among recent high school graduates regardless of whether they were from rural or urban locations. This particular finding by Hodara and Lewis, however, contradict that of other studies, which had reported that the correlation between entry grades and academic performance in tertiary education differed between students of urban and rural high schools. In another study by Geiser and Santelices (2007), it was found that high school results are consistently the best predictor not only of freshman grades in college, but predictive validity studies of four-year College outcomes as well. This finding was corroborated by the findings of Birch and Rienties (2014) as well as Vidal-Rodeiro and Zanini (2015), which indicated that 'A' grades at A-level schools increased the probability of attaining good tertiary outcomes—a notion that was supported by Kurlaender et al (2018) but had earlier on been alluded to by Saupe and Eimers (2010). Indeed, Kurlaender et al pointed out that the primary predictors of college performance are high school grade point averages, which are stronger predictors than standardised test scores. This use of secondary school grades as predictors for college performance is based on a simple philosophy which states that the best predictor of future behaviour is past behaviour (Roşeanu Drugaş, 2011; Shehry & Youssif, 2017; Zwick, 2012). Unfortunately, different stakeholders—including tertiary education lecturers as well as education policy-makers—who have come to realise that this assertion is not necessarily true are now challenging the assertion that there is always a significant positive correlation between entry grades and the academic performance of tertiary students. This scenario calls for further studies on this subject; thus, the need for the current research.

Meanwhile, some of the studies that produced results with significant positive correlations between entry grades and the academic performance of tertiary students were focused on specific subjects or courses offered at either the high school or tertiary level. For example, according to Eiselen et al. (2007), passing mathematics in the final high school year in South Africa is an admission requirement for undergraduate students in science, engineering, and technology and has predictive validity for good performance while at tertiary institution. This view was supported by Wamala et al. (2013), who discovered that students' performance increases with their A-level mathematics scores; that is, competence in A-level mathematics predicts success in the science, engineering, and technology programmes while at tertiary. This conclusion was grounded on the idea that mathematics language proficiency plays a critical role in terms of performance in mathematics at the tertiary level (Niessen et al., 2016; Seelen, 2013). This equally explains why researchers like Bush (2012) and Wambugu and Emeke (2013) opined that, educational institutions admit students based on their entry qualifications because they believe that such students will perform better while at school. These authors actually reiterate that, given that learning is a cumulative process, it is often assumed that a student admitted with a higher entry qualification is better prepared to perform well in any course than one admitted with a lower qualification. This assertion supports Kyoshaba's (2009) argument, which posits that there is always a significant positive relationship between admission points and the academic performance of tertiary students.

Nonetheless, not all researchers agree with the assertion that there is a significant positive correlation between entry grades and the academic performance of students at tertiary institutions. According to Opoko et al. (2014), who compared the results of direct entry students, unified tertiary matriculation examination students, and remedial students at Covenant Tertiary in Nigeria, there was no significant difference between the cumulative grade point averages of the three groups of students. This was consistent with the findings of Emaikwu (2012), who found no significant statistical difference in the mean academic achievement of students admitted to tertiary institutions via the unified tertiary matriculation examination, remedial program, or direct entry. Therefore, students did not differ significantly in their academic achievement based on the mode of admission into tertiary or even their entry grades. However, these findings were contradicted by the work of Wamala et al (2012), which revealed that the Graduate Management Admission Test (GMAT) has proven to be a good predictor of academic performance of students admitted to Makerere Tertiary for Master of Business Administration (MBA) programme in the 2011 and 2012 enrolment cohorts. Hence, the correlation between the performances of MBA students after passing the GMAT proved to be positive. However, this Wamala et al's study was a case of admission to a master's degree programme unlike the current study that focuses on the relationship between college students' entry grades and their academic performance at college.

On the other hand, several other researchers who have investigated the relationship between entry grades and the academic performance of tertiary students have also reported the existence of no significant correlations between the two variables. In a study by Salahdeen and Murtala (2005), for instance, about the relationship between admission grades and the performance of students at Lagos State Tertiary College of Medicine in Nigeria, the two researchers discovered that there was no significant correlation between the Senior Secondary School Certificate Examination (SSCE) results and the Joint Admissions and Matriculation Board-organised Higher Educational Institutions Matriculation Examination (JAMB-UME) scores. Besides, they also found no significant correlation between JAMB scores and the students' performance at pre-clinical science school. This finding was also similar to that of Mlambo (2011), who conducted a survey study on a random sample of 66 registered students at the Tertiary of the West Indies and discovered that entry qualifications did not cause any significant variation in the academic performance of the students. In yet another study by Koretz et al. (2016), it was reported that both college admissions and high school tests in mathematics and English had no significant effects on freshman grade point averages at college. These findings contradicted the earlier assertion that students who perform well academically at high school will end up performing well at tertiary level. Nonetheless, the debate about whether there is a strong relationship between entry grades and the academic performance of students in tertiary education still rages on; thus, the need for this and further research.

In other circumstances, some researchers have reported the existence of both positive and negative correlations between entry grades into higher educational institutions and student academic performance. These signified the existence of mixed correlations between the entry grades of tertiary students and their academic performance. According to Kalowole et al. (2011), for instance, cognitive entry points in selected Nigerian higher educational institutions are weak predictors of students' academic performance in Chemistry. The same study also revealed that all the cognitive entry points are poorly related to students' academic performance in chemistry and not even related to tertiary performance in Physics. However, many of these studies were limited to only one or two programmes of study, with no effort to control for overall college performance (Green & Vignoles, 2012). In addition, the use of A-level achievement by higher education institutions as the primary criterion for admission to undergraduate degree programmes has been subject to criticism and has been shown to vary substantially across faculties (Danilowicz-Gösele et al., 2017). Indeed, Danilowicz-Gösele et al stated that in some fields of study, the probability of those with a high entry grade graduating was rather low, while in others, weaker students had a greater chance of graduating. This explains why a scholar like Stegers-Jager (2018) advocated for the weighting of academic as well as non-academic instruments when considering students for admission to higher educational institutions. He opined that considering the combination of the two during admission will fit both the needs of validity and diversity at the tertiary level of education.

In a two-nation study by Roşeanu and Drugaş (2011), it was discovered that the scholastic assessment test (SAT) in the United States and the baccalaureate examination or the college admission examinations in Romania, which were originally seen as reliable indicators of academic achievement, did not prove the same in all college results. This explains why Geiser and Santelices (2007) contended that the earlier belief was just a misperception. However, earlier studies, like those ones reported above, had already shown the fact that high school GPA was consistently the best indicator for first-year college students. The predictive weight associated with high school GPA increases after the first year, making this variable a good indicator for long-term college outcomes like graduation. Besides, in a study done by Lasselle et al. (2014), there was an indication that students with three "A" grades at A' Level from schools performing below the national average are more likely to graduate with a First or Upper Second-class degree than those with the same qualifications from an above-average school.

In addition, according to Garton et al. (2000), most criteria used for college admission of students are good predictors of academic performance but have limited power and value as predictors of student retention and consistent performance. Bush (2012), meanwhile, indicated that entry to higher education in the United Kingdom (UK) was predominantly based on prior attainment of General Certificate of Education (GCE) and advanced level (A' Level) courses. However, he noted a dissonance between independent school and state-educated students' performances before and post-admission. In fact, he observed that independent school students took longer to complete their studies, and their superior performance prior to admission was not seen at the point of graduation. Wright and Bradley (2010), on the other hand, opined that the United Kingdom Clinical Aptitude Test (UKCAT) that was used for admitting medical students could only offer better prediction for examinations in their first year than for those in their second year, indicating that the predictive ability of the entry grades seems to decline over time. But while analysing the performance of students at undergraduate levels, Aidoo-Buameh and Ayagre (2013) discovered that both positive and negative relationships exist between pre-tertiary and tertiary academic performance. Their study revealed that there was a significant relationship between core mathematics and accounting at the pre-tertiary level and the performance of undergraduate accounting students, but no significant relationship was found between pre-tertiary English and their tertiary-level performance. According to Mutiso and Muthama (2019), the academic performance of first-year tertiary students is determined by the category of primary school attended and the tertiary course taken by the students. This, therefore, does not give determinant factors to only entry grades but other factors as well.

Also, some researchers have discovered a strong link between students' entry grades in science related courses and their grades and performance at various levels of education. For instance, Ogbonnaya et al. (2014) investigated the association between university students' entry grades in science and academic achievement and discovered a substantial positive relationship between the two scores. Osei and Adu-Poku (2020) buttress this in a study on pre-service mathematics and science teachers' entry grades in mathematics and their performance in algebra II and found that their entry grades in core and elective mathematics as obtained at the senior high reflect their performance in the first year, first semester examination in Algebra II. Lawal et al (2020) further affirmed that there was a positive relationship between students' entry grades in integrated science with their performance in integrated science at college. Notwithstanding the above research supporting the fact that students' entry grades in integrated science predict their later performance in science-related courses, there are also studies that have found a low relationship between entry grades and academic performance. Agbo (2003) conducted a study on different science subjects at university level and identified a low correlation between entry grades and students' performance. Edokpayi and Suleiman (2011) also opined that grades obtained by students in integrated science in the Junior Secondary School Certificate (JSC) examinations among the selected Secondary schools in Zaria metropolis were a poor predictor of later performance in chemistry in the Senior Secondary School Certificate (SCE) examination.

Some other studies have shown mixed results. For example, Ugwu (2011) in a study revealed that students' scores/grades in Pre-Nigeria Certificate on Education (Pre-NCE) Chemistry, physics, and Biology relate positively, though low, to their grades in Nigeria Certificate on Education (NCE) Integrated Science. This assertion is confirmed by Wambugu and Emeke (2013), who conducted a study on the relationship between entry grades and academic performance in undergraduate science courses in Kenya and revealed that there was a significant positive correlation between entry grades and academic performance in Chemistry and Biology. In Physics, there was almost no linear relationship between entry qualification and academic performance. The results also showed that the variation explained by entry grade was below 50.0%, and therefore, entry grade was not the best variable to predict academic performance.

In addition, different researchers have investigated the linkage between gender, entry grades, and the academic performance of students at tertiary level in different countries. Some of these studies have recommended the use of affirmative action schemes for admitting students to public higher educational institutions. For instance, according to Ahikire (2013) and Onsongo (2009), affirmative action in tertiary admission means giving priority to disadvantaged groups without ignoring the minimum entry requirements of the institutions. Such priorities can be given based on factors like gender, disability, or any other minority group. According to Ahikire (2013), in Uganda, the consideration of 1.5 extra points awarded to female students during admission started at Makerere Tertiary in 1990, and as a result, the admission of female students in the tertiary steadily began to increase. In fact, according to Kwesiga and Ahikire (2006), the introduction of this scheme resulted in an increase in the percentage of female students enrolled at Makerere Tertiary from 23.9% in 1989/1990 to 45.8% in 2003/2004. However, the female students who were admitted under the affirmative action scheme at Makerere Tertiary in Uganda continued to perform well academically just like their male counterparts. For example, in the same study of 2006, Kwesiga and Ahikire reported that in the 1999/2000 academic year, among the best 20 third-year Bachelor of Science with education programme students, 13 were female students who had been admitted on an affirmative action scheme. This finding was in tandem with the work of many other researchers, including the work of Alfifi and Abed (2017), whose results showed that female students perform better than their male counterparts do. They argued that a student's gender strongly affects performance at tertiary level, with girls performing better than boys do. On the contrary, some studies have shown that male students obtain higher mean scores than females (Larose et al., 2005), while in other studies, it was discovered that gender is not a significant predictor of academic performance at higher educational institutions (Aderi et al., 2013; Fernández et al., 2017). According to Emaikwu (2012), the academic achievement of male students is usually higher than that of their female counterparts, irrespective of the mode of admission into tertiary education. This work affirms the earlier report by Wikström and Wikström (2017), who asserted that boys are academically ahead of girls, especially in the sciences.

Researchers who have advocated for affirmative action schemes in tertiary admissions based on gender, such as Ceballo et al. (2004) and Alfifi and Abed (2017), have frequently argued that female students admitted under the same criteria often outperform their male counterparts. Therefore, even when female students with lower pre-tertiary grades are admitted to tertiary, they will perform as well as their male counterparts. This argument has, however, been challenged by several other researchers who opine that male student generally perform better than their female counterparts do. In a study conducted by Emaikwu (2012), for instance, it was reported that the academic achievement of male students was higher than that of their female counterparts, especially in sciences, irrespective of the entry grades to tertiary. The above results show that gender has some significant impact on student performance at tertiary level.

Some other researchers, however, have had a neutral view on the relationship between gender, entry grades, and the academic performance of tertiary students. In studies conducted by Aderi et al. (2013) and Wikström and Wikström (2017), for example, it was reported that gender is not a significant predictor of academic performance at higher educational institutions. On the other hand, Birch and Rienties (2014) revealed that academic performance follows a positive trend from D-grade to A-grade, irrespective of gender. This argument was later supported by some aspects of a study done by Wikström and Wikström (2017), who also discovered that gender does not strongly influence tertiary performance. In fact, the two authors argued that the tertiary academic performance of students differs due to several factors—some of these factors are institutional-related while others are student-related—but not necessarily the student's gender.

Finally, the review of related literature has shown that there is a relationship between the entry grades and academic performance. However, there appear to be inadequate information on students' entry grades in integrated science and their performance in science related courses in higher educational institutions in Ghana, especially colleges of education. This study will therefore like to establish the relationship between the students' entry grades in integrated science and their performance in science-related courses at college in a Ghanaian context.

2.11 Summary of Review of Related Literature

Generally, the review of related literature in other subject areas revealed the existence of positive (Eiselen et al., 2007; Kyoshaba, 2009; Niessen et al., 2016; Seelen, 2013; Wamala et al., 2013), negative (Emaikwu, 2012; Koretz et al., 2016; Mlambo, 2011; Opoko et al., 2014; Salahdeen & Murtala, 2005), and mixed (Aidoo-Buameh & Ayagre, 2013; Danilowicz-Gösele et al., 2017; Green & Vignoles, 2012; Kalowole et al., 2011; Mutiso & Muthama, 2019) relationships between the entry grades and the academic performance of tertiary students as well as other levels. Other studies (Geiser & Santelices, 2007; Lasselle et al., 2014; Roşeanu & Drugaş, 2011), however, did not reveal any significant relationship between the two variables. Some researchers have discovered a strong (Lawal et al., 2020; Ogbonnaya et al., 2014; Osei & Adu-Poku, 2020), low (Agbo, 2003; Edokpayi & Suleiman, 2011), mixed (Ugwu, 2011; Wambugu & Emeke, 2013) link between students' entry grades in science related courses and their grades and performance at various levels of education. Overall, the review of related literature revealed that there is no consensus over whether pre-tertiary academic performances of students predict their performances at tertiary level, thus indicating the need for further research in this area.

CHAPTER THREE

METHODOLGY

3.1 Overview

This chapter describes the research procedures and techniques that were employed by the researcher for the study. These include the research design, population and sampling procedure, data collection instrument(s), validity and reliability of the instrument(s), data collection procedure, and data analysis. Ethical issues are also addressed in this chapter.

3.2 Design of the Study

Research design is essentially a plan illustrating the strategy of investigation by the researcher (Cohen et al., 2002). According to Yin (2013), a research design is an action plan for getting from one point to another, where the starting point is a set of questions to be answered and the final point is a set of conclusions. The research design is the study's general plan or framework (Creswell, 2005). The purpose of a good research design is to ensure internal validity while also answering the study questions.

Also, Hantrais (2005) asserts that attempts to make sense of diversity have resulted in a blurring of the conventional methodological distinction between quantitative and qualitative approaches, opening up new views and providing chances for synergies and complementarities. The philosophical orientation associated with mixed methods is pragmatist, employing both narrative (qualitative) and numeric (quantitative) approaches to answer research questions (Tashakkori & Teddlie, 2003). Literature indicates that mixed methods provide accurate and increased levels of confidence in research findings (Kelly, 2010), as well as producing new knowledge by the combination of findings from different research approaches (Foss & Ellefsen, 2002). In addition, when methods are combined, the weaknesses of one method can be enhanced by the strength of the other (Johnson & Onwuegbuzie, 2004).

Azorín and Cameron (2010) classified mixed method designs basically into four. These are: the convergent parallel design, the explanatory sequential design, the exploratory sequential design, and the embedded design.

The convergent parallel design (convergent design) occurs when the researcher uses concurrent timing to implement the quantitative and qualitative strands during the same phase of the research process, prioritises the methods equally, keeps the strands independent during analysis, and then mixes the results during the overall interpretation.

Explanatory sequential design (explanatory design) occurs in two distinct interactive phases. This design starts with the collection and analysis of quantitative data, which has the priority of addressing the study's questions. This first phase is followed by the subsequent collection and analysis of qualitative data. The second, qualitative phase of the study is designed so that it follows from the results of the first, quantitative phase. The researcher interprets how the qualitative results help to explain the initial quantitative results. The exploratory sequential design (exploratory design) also uses sequential timing. In contrast to the explanatory design, the exploratory design begins with and prioritises the collection and analysis of qualitative data in the first phase. Building from the exploratory results, the researcher conducts a second, quantitative phase to test or generalise the initial findings. The researcher then interprets how the quantitative results build on the initial qualitative results. An embedded design occurs when the researcher collects and analyses both quantitative and qualitative data within a traditional quantitative or qualitative design.

In an embedded design, the researcher may add a qualitative strand within a quantitative design, such as an experiment, or a quantitative strand within a qualitative design, such as a case study. In the embedded design, the supplemental strand is added to enhance the overall design in some way.

The explanatory sequential mixed method design was used to investigate college students' integrated science entry grades and their end-of-course completion grades at Atebubu College of Education in the Atebubu-Amantin Municipality in the Bono East Region of Ghana. This is due to the fact that the study was of quantitative priority, where greater emphasis was placed on the quantitative method while the qualitative method played a secondary role. Quantitative data was first collected (that is, students' grades) and, based on the information gathered from the quantitative data, qualitative data was later collected through interviews.

Azorín and Cameron (2010) said that the advantages of the explanatory design make it the most straightforward of the mixed methods designs. Some of these advantages include the following: Its two-phase structure makes it straightforward to implement because the researcher conducts the two methods in separate phases and collects only one type of data at a time. This means that a single researcher can use this design; a research team is not required before one can use the design. Also, the final report can be written with a quantitative section followed by a qualitative section, making it straightforward to write and providing a clear demarcation for readers.

3.3 Population and Sampling Procedure

A research population is mostly a large collection of characters who have comparable traits and are the subject of a scientific inquiry. The research population includes all the

2018/2019 batch of students of the B.Ed programme and the tutors in the department of science education at ATECoE.

The total population of the 2018/2019 batch of students at the college was three hundred and eighty-five (385). According to Cohen, Manion, and Morrison (2007), a targeted population is a group of respondents from whom the researcher is interested in collecting information and drawing conclusions. Thus, for this study, the target population comprised the 2018/2019 batch of the B.Ed Primary Education programme since they offered science-related courses at the college. Their total number was one hundred and fifty-four (154), comprising eighty-six (86) males and sixty-eight (68) females. One hundred and twenty-four (124), consisting of seventy (70) males and fifty-four (54) females, of these students were used for the study since data on their WASSCE and college results were available. Three (3) tutors were also involved in the study. Atebubu College of Education was purposively chosen because of its proximity to the researcher. Purposive sampling was used to select respondents that are most likely to yield appropriate and useful information (Kelly, 2010) and is a way of identifying and selecting cases that will use limited research resources effectively (Palinkas et al., 2015).

3.4 Instruments for Data Collection

A research instrument is a tool used by researchers to essentially collect, measure, and analyse data in the research process (Kumar, 2018). The researcher used checklist (document analysis) and interview guide to gather data for this study. In this explanatory study, the students' previous grades in integrated science in WASSCE and their grades in science-related courses were collected from the college under study and analysed.

Interview guides were designed to probe further to enable the researcher to have an in-depth knowledge on the performance of the students.

3.5 Validity and Reliability of the Instruments

Validation is the process of assessing the authenticity and dependability (Creswell, 2005) of the means used to collect data while reliability shows the degree to which instruments are without partiality and therefore ensure constant measurement with time... (Mohajan, 2017). According to Patton (2002), validity and reliability are two factors every researcher should be concerned about while designing a study, analysing results, and judging the quality of the study. For example, while the terms "reliability" and "validity" are essential criteria for quality in quantitative approaches, in qualitative approaches the terms "credibility," "neutrality" or "confirmability," "consistency" or "dependability," and "applicability" or "transferability" are the essential criteria for quality (Yilmaz, 2013).

In order to establish the validity and reliability of the documents (results) used in this study, the test items or the examination questions that yielded the documents (results) the researcher used for this study went through a rigorous validation process by WAEC and IoE, UCC, which are the accredited institutions that conducted those examinations. During the marking process of the scripts after the conduct of the examinations, scripts marked by Assistant Examiners (AE) are vetted by Team Leaders (TL) and even Chief Team Leaders (CTL). The scripts and recorded marks are also checked and tallied by script checkers (SC). All this is done to make sure the scripts are marked well in order to make the results valid. After the marking process, scores (marks) were moderated by course or subject coordinators and a team of officers from these accredited institutions. The final grades of the students were therefore considered authentic and dependable and could be used for this study. Also, the results (WASSCE and College) of the students and the examination questions that produced the results were standardised by accredited external examining bodies such as WAEC and the Institute of Education, University of Cape Coast (IoE, UCC). The results (documents), once released by these examination bodies, do not change and are always available for reference. The research can therefore be repeated at any time with the same documents.

Also, to establish the validity and reliability of the interview guides, after a thorough review of the created items of the interview guides by the researcher, they were given to some of his colleagues and an expert in Educational Measurement and Evaluation to inspect the content representativeness and relevance of the items. They also checked whether the questions were relevant, precise, worded properly and if there was any ambiguity in the questions so that items could be interpreted correctly by respondents. After this, the interview guides were handed over to the study's supervisor for further review and scrutiny. Secondly, a pilot testing exercise was carried out to test the interview questions as well as the interviewing style and approach. The focus of the pilot testing exercise was to inspect the credibility of the guide items responses. Practically, four tutors and five students were engaged in the pilot testing exercise. To ascertain the credibility of the responses being obtained during the pilot testing interview sessions, the inherent plausibility of the responses was inspected (i.e., Is the testimony believable at face value?). Also, the demeanour of the respondents was inspected (i.e., does the facial expressions and actions of a respondent suggest truthful testimony or lies?). Corroboration was also a key point that helped to ascertain credibility. During the pilot testing interview sessions, researcher sought for evidence that substantiated the testimony of respondents (i.e., Is there any evidence to help my understanding of the situation?). Furthermore, in line with Gibbs (2007) concerning the reliability of qualitative research, all the transcripts were crosschecked and confirmed to ensure there were no apparent mistakes during the pilot testing exercise. In line with this, all recorded and transcribed manuscripts were shown to respondents to indicate and endorse whether those were their views shared during the interview. Lastly, it was ensured that the codes were well defined and used consistently and crosschecked by my supervisor for accuracy and authenticity. All the strategies for validity and reliability exhibited during the pilot testing exercise (such as checking for credibility and confirmability) were also followed during the main data collection phase of the study.

3.6 Data Collection Procedure

A formal permission and request to the college management for the data was made to the college Principal (Appendix A). The grade each student had in integrated science and the name of the senior high school they attended were isolated from their WASSCE result slips and recorded using a checklist. The grades were sorted out into three (3) performance categories for the purpose of this study and coded appropriately for analysis. The performance categories were: above average (i.e., grade A1, B2, B3); average (i.e., grade C4, C5, C6); and below average (i.e., grade D7, E8, F9).

Their grades in general biology, chemistry, and physics were also isolated from the Institute of Education-University of Cape Coast broadsheets and recorded. They were also grouped into three (3) categories. These were: above average (i.e., grade A, B+, B, C+), average (i.e., grade C, D+, D), and below average (i.e., grade E).

This categorisation was done in line with the Stanine (standard nine) method of scaling test scores. According to Borawska (2014), stanine scores are defined using the properties of the normal curve. This system is what WAEC uses to grade students in the BECE in Ghana.

The SHS category from which the students obtained the grades in integrated science was also extracted and recorded. The categories were based on the GES system used in grading SHS in Ghana. After the sorting, the researcher purposively selected and interviewed ten (10) of the students. Five (5) were students who had below average grades in integrated science in WASSCE but had average or above average grades in general biology, chemistry, and physics or all. The remaining five (5) were also students who had above-below average grades in integrated science in WASSCE but had below-average grades in general biology, chemistry, and physics. Interview guides were prepared for both tutors and student, comprising two items (Appendices D and E). The responses from the interview were also sorted and transcribed.

3.7 Data Analysis Procedure

3.7.1 Document Analysis

The sorted and coded data were analysed using the Statistical Package for the Social Sciences (SPSS) software version 26. The data was analysed into frequencies, percentages, Pearson's Moment Correlation at a 0.05 significance level and themes.

3.7.2 Analysis and coding of the interview data

The purpose of this part is to give an indication of how the interview data was transcribed and coded. During an interview, a bulky amount of data is obtained, which needs to be presented in a meaningful manner. The researcher read various works on qualitative analysis (Braun & Clarke, 2006; Creswell, 2009; Robson, 2011; Taylor & Gibbs, 2010;

Teddie & Tashakkori, 2003). Some of the core principles of the thematic approach to qualitative data analysis (Braun & Clarke, 2006) were adapted for use in this study. This is undoubtedly the most dominant technique, at least in the social sciences, because it provides such a simple and practical framework for conducting thematic analysis. Thematic analysis is a method for identifying, analysing, and reporting patterns (themes) within the data. It minimally organises and describes your data set in (rich) detail (Braun & Clarke, 2006).

Thematic analysis by Braun and Clarke (2006) has six phases, which have been stated and described in Table 5, and in this study the analysis was conducted thematically building on these steps.

Table 5

Phases of the thematic analysis

1. Familiarising yourself with the data:	Transcribing the data, reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all the data relevant to each potential theme.
4. Reviewing themes:	Checking if the themes work in relation to the coded extracts and the entire data set generating a thematic 'map' of the analysis.
5. Defining and naming themes:	On-going analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names of each theme.
6. Writing-up:	The final opportunity for analysis. Selection of vivid compelling abstracts examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Adapted from Braun and Clarke (2006, p. 87)

Familiarisation with the data

The audio recordings of the interviews were listened to several times for familiarisation purposes (Gay et al., 2009). Each interviewee was given a numeric code for easy identification (Sommers & Sommers, 2002). The code assigned was based on the order in which the selected students and tutors were interviewed. The recording of each interview was typed verbatim, and hesitations and pauses were noted (McLellan et al., 2003). This was to maintain originality and ensure that no information was misinterpreted. The transcribed version was read through while listening repeatedly to the audio tape to ensure there were no omissions. Each interview was then summarised. Doing this helped to conceptualise what the interviewees said and identify similarities and differences in their statements. It also drew attention to the close link between the research questions and the responses given.

Generating initial codes

Coding is part of analysing qualitative data and helps the researcher think critically about the meaning of the data (Bryman, 2012). Coding, according to Taylor and Gibbs (2010), is the process of examining the data for themes, ideas, and categories and marking similar passages of text with a code label so that they can easily be retrieved at a later stage for further comparison and analysis. Similarly, Creswell (2007, p.148), describing the steps in the coding process, said: The central steps in coding data are: reducing the data into meaningful segments and assigning names to the segments; combining the segments into broader categories or themes; and displaying and making comparisons in the data graphs, tables, or charts. These are the core elements of qualitative data analysis.

Robson (2011) points out that the segment of the raw data to which the codes will be applied should be meaningful and should have something of interest and be related to the study. The units of analysis were identified. These are described as the basic text units that contain the essential ideas in relation to the research questions (Zhang & Wildemuth, 2009). To make sense of the text, similar essential ideas were underlined and notes were made (Taylor & Gibbs, 2010). This process was guided by the needs of the research questions.

In order to avoid coding of multiple issues in a single response, the researcher divided the response into segments and coded them under the appropriate theme or sub-theme. The interviews were coded manually because the researcher was not conversant with any of the available software programs.

Searching for themes

Braun and Clarke (2006) point out that searching for themes involves sorting the different codes into potential themes and collating all the relevant coded extracts within the identified theme. Essentially, you are starting to analyse your codes and consider how different codes may combine to form an overarching theme. This stage involves thinking about the relationship between codes, themes, and subthemes, and re-arranging and organising the coded extracts to be meaningful. In doing this, the procedure outlined by Braun and Clarke (2006) was not followed. This was because the researcher used a structured interview schedule and had predefined main themes that were closely linked to the research questions and the quantitative data. This exercise helped me to see how the different parts of the data fitted together to form a whole and helped to generate a framework for the analysis. Braun and Clarke (2006) recommend that this phase be concluded with a set of potential themes and subthemes, as well as all data extracts coded in connection to them. The main themes were compiled along with the extracts and the codes given to them. At the end of this stage, four (4) themes were obtained.

Reviewing subthemes

The model proposed by Braun and Clarke (2006) was adapted to help review the subthemes. The subthemes were evaluated and refined since the main themes had been predefined. The data was also crosschecked to ensure that all subthemes had been captured.

Defining and naming subthemes

According to Braun and Clarke (2006), this stage was necessary in order to define and further refine the themes you will represent in your analysis, and analyse the data within them. Again, this process was adapted to the subthemes. The researcher further read the coded data and the illustrative extract of the responses, and organised them into a coherent whole. It was ensured that the names given to the subthemes were concise, punchy, and immediately give the reader a sense of what the theme is about. At the end of the whole process, four (4) themes and nine (9) subthemes were identified.

Writing-up

According to Braun and Clarke (2006), writing the report is an important aspect of the analytic process. The researcher must now interpret the raw data and present it in a way that others can understand. The analysis must also provide a clear, coherent, logical, non-repetitive, and intriguing presentation of the story the data tells both within and between themes. Additionally, the write-up must include sufficient evidence for the themes found in the data, i.e., enough data extracts to demonstrate the theme's predominance. In view of this, when writing the findings of the study, all the ideas were reviewed and put under themes. The main themes were selected and included in the final report. This provided an opportunity for the final analysis of selected extracts, the choice of vivid, appealing extract examples, and the connection between the study and the literature (Braun & Clarke, 2006). The selections of verbatim extracts included in the final write-up were chosen from the pool of responses based on their detail, clarity, relevance, and vividness. The number of responses used to support each theme varied; this was to give emphasis and also to illustrate the different aspects of the responses to that particular theme. The researcher tried to go beyond just describing the data to interpreting the results obtained in the analysis.

Figure 2 presents the summary of the themes and sub-themes obtained from the interview of students and tutors.

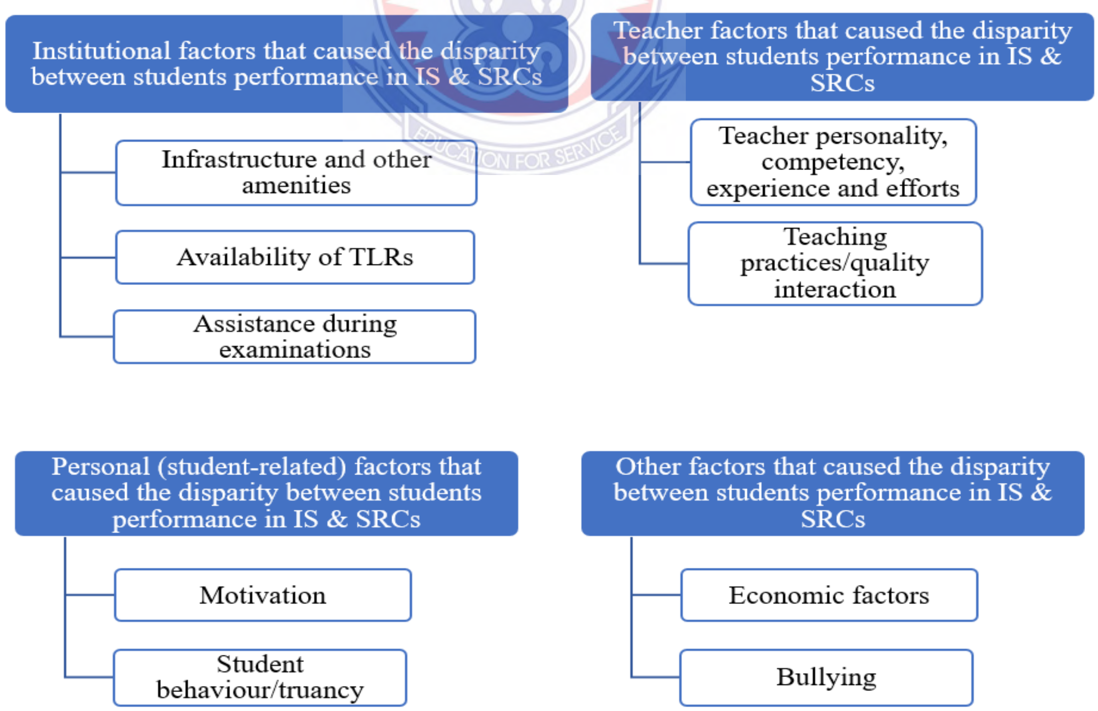

Figure 2: Summary of themes and subthemes

3.9 Ethical Considerations

Ethical considerations in data collection were followed. Formal request to the College management was made through the Principal of the College. The researcher met with the interviewees (tutors and students) on separate occasions to discuss the study's purpose and significance. They were informed of their right to confidentiality and anonymity in the course of the conduct of the study. They were also told that they had the right to withdraw from the study at any point in time that they so desired. Before the interview was conducted, participants were made to willingly sign an informed consent form (Appendices B and C) before specific time periods for the interview were scheduled with them.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the analysis of the data collected from respondents (Level 400 B.Ed Primary Education students and tutors of biology, chemistry, and physics). Checklist (document analysis) and interview guide were used to collect data for the following research questions:

1. What is the range of the students' entry grades in integrated science and the school categories from which they were admitted?
2. What is the range of the students' end-of-course completion grades in general biology, chemistry, and physics?
3. What is the relationship between the students' entry grades in integrated science and their end-of-course completion grades in biology, chemistry, and physics?
4. What are the views of the students and tutors about the causes of the observed disparity between the students' entry grades in integrated science and their end-of-course completion grades?

The data was analysed into frequencies, percentages, Pearson's Moment Correlation, and themes. The results of the analysis were presented in tabular form and the results were discussed according to the research questions. This chapter also presents the findings of the study.

4.1 Background Information on the Students and Tutors

4.1.1 Demographic Characteristics of Students

This section presents the analyses of students' sex, age, and the category of SHS they attended.

4.1.1.1 Sex of respondents (students)

The sex distribution of students, showed that 70 (56%) of the respondents were males, while the remaining 54 (44%) were females. This means the males outnumbered the females by 12% indicating that gender disparity still existed in the 2018/2019 batch of the Primary Education students who were admitted to the College.

4.1.1.2 Respondents' Age range

The age range of respondents (students) out of the one hundred and twenty-four (124) students used for the study, 70 (56.5%) were aged between 21 and 25 years; 46 (37.0%) between 26 and 30 years. The remaining 8 (6.5%) were 31 years and above. This result shows that the majority of the students were aged between 21 and 25 years. Also, it could be said that 93% of students were aged between 21 and 30 years, while 26% were aged 26 and above. These results indicate that most of the students were young adults. This is the stage where students are energetic and eager to learn, which could influence their academic performance.

4.1.1.3 Categories of SHSs the respondents (students) attended

Table 6 presents the categories of SHS where the students obtained their WASSCE certificates.

The results on the categories of SHS where the students obtained their WASSCE certificates revealed that all the students used for the study were from category B and C SHS, representing 48% and 52%, respectively. None of the students came from categories A and D SHS as depicted in Table 6.

Table 6

Categories of SHS respondents (students) attended

School category	Frequency	Percentage
A	0	0
B	60	48
C	64	52
D	0	0
Total	124	100

This result was possible because most of the SHS in the catchment area of the college are category B and C schools. Meanwhile, students from the few category A schools end up attending the traditional universities. As for category D schools, they are virtually nonexistent in the system now due to the bridging of infrastructural gaps between the less endowed and the endowed schools.

4.1.2 Demographic Characteristics of Tutors

This section presents the analyses of tutors' sex and teaching experience.

4.1.2.1 Sex of respondents (tutors)

Table 7 presents the distribution of tutors by sex.

The tutors from the science department involved in the study were all males as recorded in Table 7.

Table 7

Sex distribution of tutors

Sex	Frequency	Percentage
Male	3	100
Female	0	0
Total	3	100

The reason for the all-male participants was that there was only one female in the department and she could not participate in the study due to her schedule.

4.1.2.2 Tutors teaching experience at college level

Table 8 presents the tutors' teaching experience at college level.

All the three (3) tutors of science-related courses involved in the study had taught in the college for more than five years as shown in Table 8.

Table 8

Tutors' teaching experience

Tutor	Number of years
A	6
B	10
C	9

The tutors could therefore be considered experienced tutors, as posited by some researchers. For instance, according to Karışan et al. (2013), experience in teaching becomes stable after around five years. This could positively influence the teaching practices, interactions, and experiences that students will go through in the hands of these tutors.

4.2. Presentation of the Analysed Data by Research Questions

In this section, the main data collected for answering the research questions is presented. The results were obtained through checklist (document analysis) and interview guide. The results from the checklist (document analysis) and interview are presented to address the needs of the research questions.

4.2.1 Research Question 1

What is the range of the students' entry grades in integrated science and the school categories from which they were admitted?

The results of the analysis of the performance of students in integrated science and their SHS categories showed that 51 (41.13%) of the students had grades between A1 and B3 (above average) in integrated science from WASSCE (Table 9). Thirty-five (35) of them attended category B SHS while sixteen (16) attended category C SHS. Also, 54 (43.55%) of the students had between grade C4 and C6 (average) in integrated science from WASSCE. Nineteen (19) of the students in this performance category attended category B SHS while thirty-five (35) attended category C SHS. Again, 19 (15.32%) of the students had grades between D7 and F9 (below average) in integrated science from WASSCE. Six (6) out of the nineteen (19) students attended category B SHS, and the remaining thirteen (13) students attended category C SHS as indicated in Table 9.

Table 9

Performance of students in integrated science and their school categories

Performance Category	Frequency	Percentage (%)	School category		
			School Type	Frequency	Percentage
Above average	51	41.13	B	35	68.63
			C	16	31.37
Average	54	43.55	B	19	35.19
			C	35	64.81
Below average	19	15.32	B	6	31.58
			C	13	68.42
Total	124	100		124	

This means it could be inferred from Table 6 that out of the one hundred and twenty-four (124) students used for the study, 60 (48.39%) and 64 (51.61%) attended category B and C SHS, respectively. Furthermore, none of the students attended a category A or D SHS.

4.2.2 Research Question 2

What is the range of the students' end-of-course grades in general biology, chemistry, and physics?

The analysis of the performance of students in General Biology, Chemistry, and Physics vis-a-vis SHS categories showed that 28 (22.6%), 90 (72.6%), and 6 (4.8%) of the students obtained grades between A and C+ (above average), C and D (average), and E (below average) in general biology, respectively (Table 10). Eighteen (18) of the above average students attended category B SHS and the remaining ten (10) students attended category C SHS. Forty-one (41) out of the students in the average performance category attended category B SHS and forty-nine (49) attended category C SHS. Two (2) and four (4) out of the six (6) students who performed below average attended categories B and C, respectively (Table 10). Also, 113 (91.0%) and 11 (9.0%) of the students obtained grades between A and C+ (above average) and C and D (average) in general chemistry, respectively. None of the students used in the study had obtained a grade of E (below average) in general chemistry. Fifty-two (52) out of the 113 students who performed above average in general chemistry attended category B SHS and sixty-one (61) of them attended category C SHS. Seven (7) of the students who performed averagely in general chemistry attended category B SHS and four (4) attended category C SHS. Again, 49 (40.0%) and 75 (60.0%) obtained grades between A and C+ (above average) and C and D (average) in general physics, respectively (Table 10). None of the students used in the study had obtained a grade of E (below average) in general physics. Twenty-five (25) of the above average students attended category B SHS and the remaining twenty-four (24) students attended category C SHS. Thirty-six (36) and thirty-nine (39) out of the seventy-five (75) students who performed on average attended categories B and C, respectively (Table 10).

Table 10

Performance of students in general biology, chemistry and physics at college with SHS categories

	General Biology					General Chemistry					General Physics				
Performance Category	Freq.	%	School category			Freq.	%	School category			Freq.	%	School category		
			School Type	Freq.	%			School Type	Freq.	%			School Type	Freq.	%
Above average	28	22.6	B	18	64	113	91	B	52	46	49	40	B	25	51
			C	10	36			C	61	54			C	24	49
Average	90	72.6	B	41	46	11	9	B	7	64	75	60	B	36	48
			C	49	54			C	4	36			C	39	52
Below average	6	4.8	B	2	33	0	0	B	0	0	0	0	B	0	0
			C	4	67			C	0	0			C	0	0
Total	124	100				124	100				124	100			

Further analysis of students' grades based on performance category

Table 11 presents data on students who performed above average in integrated science, general biology, chemistry, and physics.

According to the analysis of data on students who performed above average in integrated science, general biology, chemistry, and physics, thirty-five (35) and sixteen (16) of the fifty-one (51) students who performed above average in integrated science at SHS attended category B and C SHS, respectively. The number of students who performed above average in integrated science dropped from fifty-one (51) to twenty-eight (28) in general biology, with eighteen (18) students coming from category B SHS and ten (10) from category C SHS. In a sharp contrast to the drop in the above average performance in general biology with respect to integrated science, there was an astronomical increase in the number of students who performed above average in general chemistry as compared to integrated science. That is, one hundred and thirteen students (113) performed above average in general chemistry as compared to fifty-one (51) who fell above average in integrated science at SHS. Also, unlike in general chemistry, out of the fifty-one (51) students who performed above average in integrated science, forty-nine (49) of them obtained above average grades in general physics. This shows a drop of two (2) students in other performance categories. Ten (10) category B SHS students who obtained above average grades in integrated science had below above average grades in general physics, and eight (8) category C SHS students who had above average grades in integrated science had below above average in general physics. Again, the results showed that thirty-five (35) and eighteen (18), fifty-two (52) and twenty-five (25) category B SHS students got above-average grades in integrated science, general biology, chemistry, and physics, respectively.

Also, sixteen (16), ten (10), sixty-one (61) and twenty-four (24) category C SHS students obtained above average grades in integrated science, general biology, chemistry, and physics, respectively, as indicated in Table 11.

Table 11

Above Average Performance

SHS		College						SHS Category
Integrated Science		General Biology		General Chemistry		General Physics		
Freq. of above average	Freq. of SHS category	Freq. of above average	Freq. of SHS category	Freq. of above average	Freq. of SHS category	Freq. of above average	Freq. of SHS average	
51	35	28	18	113	52	49	25	B
	16		10		61		24	C

The results described from Table 11 revealed that twenty-three (23) students who performed above average in integrated science at SHS had dropped to lower performance categories when it came to their performance in general biology. Seventeen (17) of the students out of thirty-five (35) who attended category B SHS and had above average grades in integrated science could not maintain their average performance in general biology at college. Likewise, six (6) out of the sixteen (16) students who attended category C SHS and had above average grades in integrated science could not also maintain their above average performance. Also, some students who performed below above average in integrated science at SHS moved to above average in general chemistry. Sixty-two (62) students who performed below above average in integrated science at SHS had above average grades in general chemistry at college. Seventeen (17) category B SHS students who performed below above average in integrated science had above average grades in general chemistry, while forty-five (45) category C SHS students who obtained below above average grades in integrated science performed above average in general chemistry. Finally, students from category B SHS performed marginally better in an above-average category than those from category C SHS.

Table 12 presents data on students who performed averagely in integrated science, general biology, chemistry, and physics.

Analysis of results of students who performed averagely in integrated science, general biology, chemistry, and physics showed that, nineteen (19) and thirty-five (35) of the fifty-four (54) students who performed well in integrated science at SHS attended category B and C SHS, respectively. The number of students who performed averagely in integrated science increased from fifty-four (54) to ninety (90) in general biology, with forty-one (41) students coming from category B SHS and forty-nine (49) from category C SHS. In a sharp contrast to the increase in the average performance in general biology with respect to integrated science, there was a drastic decrease in the number of students who performed averagely in general chemistry as compared to integrated science. That is, eleven (11) students had average grades in general chemistry as compared to fifty-four (54) who had average grades in integrated science at SHS. On the other hand, unlike in general chemistry, the number of students who had average grades in integrated science increased from fifty-four (54) to seventy-five (75) in general physics. Furthermore, it could be deduced from the Table 12 that nineteen (19), forty-one (41), seven (7) and thirty-six (36) category B SHS students got average grades in integrated science, general biology, chemistry and physics respectively. Also, thirty-five (35) forty-nine (49), four (4) and thirty-nine (39) category C SHS students got average grades in integrated science, general biology, chemistry, and physics, respectively as Table 12 depicts.

Table 12

Average Performance

SHS		College						SHS Category
Integrated Science		General Biology		General Chemistry		General Physics		
Freq. of average	Freq. of SHS category	Freq. of average	Freq. of SHS category	Freq. of average	Freq. of SHS category	Freq. of average	Freq. of SHS category	
54	19	90	41	11	7	75	36	B
	35		49		4		39	C

Therefore, it could be inferred that thirty-six (36) students from other performance categories other than average improved from a lower performance category to an average performance or dropped from an above average performance category when it came to their performance in general biology. The number of students who attended category B SHS and had average grades in integrated science increased from nineteen (19) in integrated science to forty-one (41) in general biology at college. In a similar manner, the number of students who attended category C SHS and had average grades in integrated science increased from thirty-five (35) to forty-nine (49) in general biology. Also, some students who had average grades in integrated science at SHS moved to above average or below average in general chemistry. Forty-three (43) students who had average grades in integrated science at SHS had above or below average grades in general chemistry at college. Twelve (12) category B SHS students who performed averagely in integrated science either had above or below average grades in general chemistry, while thirty-one (31) category C SHS students who obtained average grades in integrated science also performed either above or below average in general chemistry. Again, there was an increase of twenty-one (21) students from other performance categories. The number of category B SHS students who obtained average grades in integrated science increased from nineteen (19) to thirty-six (36) in general physics and that of category C SHS students who had average grades in integrated science increased by four (4) students in general physics. Furthermore, in contrast to what was observed in the above average category, students from category C SHS performed slightly better in the average category than those from category B SHS.

Table 13 presents data on students who performed below average in integrated science, general biology, chemistry, and physics.

The analysis of students who performed below average in integrated science, general biology, chemistry, and physics revealed that out of the nineteen (19) students who performed below average in integrated science at SHS, six (6) and thirteen (13) of them attended category B and C SHS, respectively. The number of students who performed below average in integrated science decreased from nineteen (19) to six (6) in general biology, with two (2) students coming from category B SHS and four (4) from category C SHS as shown in Table 13.

Table 13

Below Average Performance

SHS		College						SHS Category
Integrated Science		General Biology		General Chemistry		General Physics		
Freq. of below average	Freq. of SHS category	Freq. of below average	Freq. of SHS category	Freq. of below average	Freq. of SHS category	Freq. of below average	Freq. of SHS category	
19	6	6	2	0	0	0	0	B
	13		4		0		0	C

This suggests that thirteen (13) students who had below average in integrated science at SHS performed above the below average category in general biology.

4.2.3 Research Question 3

What is the relationship between the students' entry grades in integrated science and their end-of-course completion grades in general biology, chemistry, and physics?

The relationship between students' integrated science scores (obtained from WASSCE) and general biology scores (measured using students' general biology scores at college) was examined using Pearson's correlation coefficient (Table 14). A weak, positive connection existed between the two variables [$r = 0.192$, $n = 124$, $p<0.05$], that is, integrated science scores from WASSCE and with general biology scores at the college as indicated in Table 14. The researcher has defined the Pearson's r score of 0.192 to be an estimate of a weak association using Pallant (2010) category of strong, medium, and weak.

Table 14

Pearson's Product Moment Correlation Coefficient on integrated science scores and general biology scores. (N=124)

Sig. (2-tailed)	Pearson Correlation (r)	Coefficient of determination (r^2)
0.033	0.192	0.037

$p<0.05$; $r^2=3.7$

The association between students' integrated science scores and general chemistry scores was determined using Pearson's moment correlation coefficient (Table 15). There was a weak positive association between integrated science scores from WASSCE and general biology scores at the college [r = 0.234, n = 124, p<0.05] (Table 15).

Table 15

Pearson's Product Moment Correlation Coefficient on integrated science scores and general chemistry scores. (N=124)

Sig. (2-tailed)	Pearson Correlation (r)	Coefficient of determination (r^2)
0.009	0.234	0.055

$p<0.05$; $r^2=5.5$

Table 16

Pearson's Product Moment Correlation Coefficient on integrated science scores and general physics scores. (N=124)

Sig. (2-tailed)	Pearson Correlation (r)	Coefficient of determination (r^2)
0.011	0.227	0.052

$p<0.05$; $r^2=5.2$

Results in Table 16 show that there was also a weak positive connection between integrated science scores from WASSCE and general biology scores at the college [$r = 0.227$, $n = 124$, $p<0.05$].

4.2.4 Research Question 4

What are the views of the students and tutors about the factors that caused the observed disparity between the students' entry grades in integrated science and their end-of-course completion grades in SRCs?

The causes of the disparity between students' performances in IS and SRCs as revealed by the interviews

Institutional factors: the students' and tutors' views

The responses of the students and tutors to the institutional factors that caused the observed disparity between the performances of the students in IS and SRCs revealed three (3) factors. These include: infrastructure and other amenities; availability of TLRs; and assistance during examinations (exam malpractice).

Infrastructure and other amenities: The responses of students 6 and 8 showed that infrastructure (classrooms, accommodation, and toilet facilities) and other amenities such as access to water played a key role in their performance in SRC. Student 6 had this to say: *Sir, at my SS we were lacking so many things such as … classrooms, accommodation and toilet facilities. So we suffered in our studies.* Student 8 also said, "We *were always moving around to look for water to bath, so I was tired when it was time for me to revise in the evening."*

Availability of TLRs: This is what student 3 had to say,*"… My SHS had a science lab, so our science teacher was taking us there for practical, but here it is not like that. There is nothing at the science lab here* [college]*…"* This student may be a visual learner, so he regards teaching and learning resources (TLRs) as critical to his success in the SRC. Also, Tutor B saw the availability of TLRs and their usage as key to influencing students' performance in science. Due to this, the tutor saw the need for improvisation (virtual lab) in the absence of a functional lab. This is what the tutor said,"… *Even though our science lab is not in good shape, we do our best to apply the concept of virtual lab in our teaching so it makes the lessons interactive and the students understand well."*

Assistance during examinations (exam malpractice): One of the students (student 9) admitted that it was the assistance he received that positively influenced his performance in IS, but since the same opportunity was not available at the college, that is why the performance dropped in the SRCs. He had this to say, *"Hmm sir, at SHS we were helped small during the exams but here no one will mind you".*

Tutor B believed that the performance of some of the students in IS was greatly influenced by the assistance they had received during WASSCE and, therefore, the absence of that assistance also had an impact on their performance in SRCs at college. "*My brother, you are aware of what sometimes we hear of during WASSCE, so some of these students are* *able to make it to the college through assistance from their teachers during the WASSCE." So such students will not perform when they come here since they will not get the same opportunity at the college. ...".*

Teacher Factors: students' and tutors views

The views of the students and tutors on the teacher factors which caused the disparity between the students' performance in IS and SRCs revealed two (2) causes, including: teacher personality, competency, experience, and efforts; and teaching practices/quality interaction.

Teacher personality, competency, experience and efforts: The responses from the interviews revealed that most of the students (1, 2, 3, 4, 5, and 9) saw the ability of the teacher to organise the teaching and learning process in a way that would help them to comprehend as critical to their performance in SRC. Also, the teacher's personality was another key factor. These were portrayed in their responses below:

Student 1 said, *"At SHS our science teacher always asked us to go and read on our own so I didn't like science." I didn't also understand some of the topics when I'm reading them because of this I was not learning science often. For college here the science teachers are very serious."* Also, student 2 said, *"... Our science teacher at SHS also did selective teaching, he taught us some topics and left others."* Again, this is what student 3 had to say, *"The teacher who taught us science at SHS was very good. My SHS had a science lab, so our science teacher was taking us there for practical, but here it is not like that. ...".* In addition, student 4: said, *"Our SHS science teacher was not teaching us well so I was always confused in his class. He was boring so I didn't like learning science."* Furthermore, student 5 said, *"... Here at the college the teachers explain the science well for me to* *understand, but it was not like that at secondary school." Finally,* student 9 also said, *"... At the college here, when some of the teachers are teaching, they go fast so I don't understand".*

Teaching practices/quality interaction: Three (3) students (5, 7 and 10) were of the view that the teaching practices and quality of interaction they had with teachers influenced their performance in IS and SRCs. This was reflected in the responses. For instance, student 5 said, "*Here at the college, the teachers explain the science well for me to understand, but it was not like that at secondary school."* Also, student 7 put it this way, "Sir, *here it is because we do many classwork, group work and assignments so it helped me read more." Here* [college] *the teachers are good so I understand what we learn therefore I read science 'paa'* [well]". Finally, student 10 said this, *"The science teachers here take us through many demonstrations and activities using different materials unlike SHS. ...".* In addition to this, two (2) of the tutors (1 and 3) were of the view that the students had quality interactions with tutors when they came to the college as compared to SHS. This assertion was revealed by the responses the tutors gave, shown in these quotes. *"Well, when the students come to the college, the teaching and learning practices they undergo may be different from their SHS..."* (Tutor A). Tutor C said, "*Kwadwo, I think the students when they come here have quality interactions with us as compared to SHS…"*

Personal Factors: students' and tutors' views

The opinions of both students and tutors on personal (student-related factors) which caused the disparity between the students' performance in IS and SRC brought to light motivation and student behaviour/truancy.

Motivation: Concerning motivation, four (4) students (1, 2, 4, and 7) provided responses indicating the role of positive or negative motivation in the students' performance in IS and SRCs. This motivation may originate from the actions of teachers or tutors and from the persona of the students themselves. This is what student 1 said, *"... I didn't also understand some of the topics when I'm reading them because of this I was not learning science often. ...". "Science is difficult so I don't like learning it. ..."* (Student 2). Also, student 4 said, *"Our SHS science teacher was not teaching us well so I was always confused in his class. He was boring so I didn't like learning science." ".... Here* [college] *the teachers are good so I understand what we learn therefore I read science 'paa'* [well]*"* (Student 7). In addition to the views of the students above, one of the tutors (Tutor A) said that *"... There are some students who relax in their academics when they come to college due to peer pressure. Some of the students do not know how to study".* This means that the desire of the student to take his/her academics seriously plays an important role in their performance and, for that matter, in IS and SRCs.

Student behaviour/truancy: Student behaviour/truancy was also deduced from the responses of the students as one of the factors that affected their performance in IS and SRCs. This can be shown in the responses given by students 3 and 5. *"... At level 100 I was not serious"* (Student 3). Student 5: *"At secondary school I was always playing and loitering with friends so I was not learning but for here I am serious."* Tutor C stated this,"... *I have realised that some of the students become serious when they come to the tertiary institution. Some of them also don't like attending lectures".* The response Tutor C showed that student behaviour and truancy had implications on their academic performance, which IS and SRCs are no exception.

Other Factors

Economic factors and **bullying:** Students' responses also highlighted economic factors and bullying as additional relevant factors affecting their performance in college SRCs. On economic factors, student 10 stated, *"... I'm taking care of myself here* [college] *so I have to struggle during vacation to get money for my fees and my upkeep on campus and due to this I'm not able to report early when school reopens. This affects me because by the time I come they have learn so many things".* On bullying, student 8 said, *"Sir, when we came to level 100 the pressure on us was too much. Our seniors were always worrying us so I was afraid and was not able to learn. ...".*

The responses of the tutors did not reveal any other related cause of the disparity between students' performance in IS and SRCs.

4.3 Discussion of Findings

Research question one looked at the range of the students' entry grades in integrated science and the school categories from which they were admitted.

The results on the range of the students' entry grades in integrated science showed that the majority (84.68%) of the students had grades ranging between A1 and C6. This means that those students were either above average or average and were expected to do well in SRCs at college. This finding corroborates the assertion of Richardson et al. (2012), who posited that tertiary institutions usually admit students based on their previous academic performance since they presume it will inform how well they will perform in academics while at tertiary. In addition, several researchers, such as Abdullah and Mirza (2018), Ferrão and Almeida (2019), Kurlaender and Cohen (2019), McKenzie and Schweitzer (2001), Myburgh (2019), Wamala et al (2013), identified academic performance at pre-tertiary [SHS] levels as the most significant predictor of tertiary performance. They argued that a student who enters tertiary with better grades is most likely to perform academically better than his or her counterpart who has not scored good grades in pre-tertiary examinations. Hoare and Johnson (2011) confirmed this assertion when they studied the relationship of graduate record examination (GRE) scores with the students' achievement from different disciplines (degree programs) in a university and found a significant correlation, but the value of the correlation coefficient ranged from weak to medium strength for different degrees. The students who were high on GRE scores were also high on university scores. Several other researchers shared this view.

For instance, Chathuranga (2016) and Hodara and Lewis (2017) opined that high school grade point averages were consistently predictive of tertiary performance among recent high school graduates regardless of whether they were from rural or urban locations. This particular finding by Hodara and Lewis, however, contradicted that of other studies, which had reported that the correlation between entry grades and academic performance in tertiary education differed between students of urban and rural high schools. In another study by Geiser and Santelices (2007), it was found that high school results are consistently the best predictor not only of freshman grades in college, but predictive validity studies of four-year College outcomes as well. This finding was corroborated by the findings of Birch and Rienties (2014) as well as Vidal-Rodeiro and Zanini (2015), which indicated that 'A' grades at A-level schools increased the probability of attaining good tertiary outcomes—a notion that was supported by Kurlaender et al (2018) but had earlier on been alluded to by Saupe and Eimers (2010). Indeed, Kurlaender et al pointed out that the primary predictors of college performance are high school grade point averages, which are stronger predictors than standardised test scores. This use of secondary school grades as predictors for college GPA is based on a simple philosophy which states that the best predictor of future behaviour is past behaviour (Roşeanu Drugaş, 2011; Shehry & Youssif, 2017; Zwick, 2012).

Also, the results showed that out of the one hundred and twenty-four (124) students used for the study, 60 (48.39%) and 64 (51.61%) attended category B and C SHS, respectively, while none of the students attended category A or D SHS. This finding implies that most of the students attended SHS, which had inadequate infrastructure and other facilities. The researcher believed that this finding did not have a great impact on the performance of the students in integrated science since the students who had between grades A1–C6 were distributed evenly between the categories of B and C SHS. However, this finding contradicts the assertion that school infrastructure improves the academic performance of students (Mokaya, 2013) and supports the notion put forth by Assoumpta and Andala (2020), who found that there was a significant low positive correlation between school infrastructure and students' academic performance in 12YBE in Rwanda.

Research question two considered the range of the students' end-of-course completion grades in general biology, chemistry, and physics.

Generally, the results showed that 95.2% of the students had grades between A and D (above average and average) in general biology. Only 4.8% of them had a grade E in general biology. Also, 100% of the students had grades between A and D (above average and average) in both general chemistry and physics. This means that none of the students recorded an E or performed below average in these courses. This finding is consistent with the earlier claim that the previous academic performance of students had an influence on their future performance, as posited by Kyoshaba (2009), who argued that there is always a significant positive relationship between admission points [entry grades] and the academic performance of tertiary students. It is for this reason that the course description from the curriculum for biology, physics, and chemistry for UCC affiliated colleges is premised on the fact that, "... the course is designed to consolidate and also upgrade the content and skills that students have acquired from their lessons in Integrated Science at the SHS level." This buttresses the point that previous knowledge and, for that matter, entry grades of students are key to their performance at a higher level. The 4.8% of students who had grade E (i.e., performed below average) in general biology may be attributed to factors other than entry grades or requirements. In addition to their pre-tertiary grades, other experts have supposedly identified many other factors that affect students' academic performance while at tertiary. Aspelmeier et al (2012), for instance, stated that the academic performance of a student at a tertiary could be influenced by numerous factors, including the parents' educational background, family size, type of high school attended, and the socio-economic status of the student. Other studies have claimed that any student's performance at the HEI is affected by a variety of elements, including personal, teacher, and institutional factors (Umar et al., 2010).

Further details of the results according to the performance categories (above average, average, and below average) revealed firstly that twenty-three (23) students who had between grade A and C+ (i.e., performed above average) in integrated at SHS had dropped to lower performance categories when it came to their performance in general biology. Also, in general chemistry, out of the fifty-one (51) students who performed above average in integrated science, forty-nine (49) of them obtained above average grades in general physics. This showed a drop of two (2) students in other performance categories. In contrast to the drop in the above average (A and C+) performance in general biology and chemistry with respect to integrated science, there was an astronomical increase in the number of students who performed above average in general chemistry as compared to integrated. That is, one hundred and thirteen students (113) performed above average (A and C+) in general biology as compared to fifty-one (51) who fell above average in integrated at SHS. This shows that some students who performed below above-average in integrated science at SHS moved to above average in general chemistry. Sixty-two (62) students who performed below above-average in integrated science at SHS had above average grades in general chemistry at college. Secondly, the number of students who performed averagely (C and D) in integrated science increased from fifty-four (54) to ninety (90) in general biology. This is an indication that thirty-six (36) students from other performance categories other than average appreciated from a lower performance category to an average performance or dropped from an above average performance category when it came to their performance in general biology. Like in general biology, the number of students who had average grades in integrated science increased from fifty-four (54) to seventy-five (75) in general physics. This shows an increase of twenty-one (21) students from other performance categories. In contrast to the increase in the average performance in general biology and physics with respect to integrated science, there was a drastic decrease in the number of students who performed averagely in general chemistry as compared to integrated science. That is, eleven (11) students had average grades in general chemistry as compared to fifty-four (54) who had average grades in integrated science at SHS. This shows that some students who had average grades in integrated science at SHS moved to above average or below average in general chemistry. Forty-three (43) students who had average grades in integrated science at SHS had above or below average grades in general chemistry at college. Finally, the number of students who performed below average in integrated science decreased from nineteen (19) to six (6) in general biology. This suggests that thirteen (13) students who had below average in integrated science at SHS performed above the below average category in general biology. None of the students performed below average in general chemistry or physics.

From the further details of the results on the range of the students' end-of-course grades in general biology, chemistry, and physics, it was observed that the number of students who obtained above-average grades in integrated science in WASSCE dropped in general biology and physics but showed a sharp rise in general chemistry. Also, it was observed that the number of students who obtained average grades in integrated science in WASSCE increased astronomically in general biology and physics but decreased in general chemistry. Lastly, the number of students who obtained below average grades (failed) in integrated science in WASSCE was drastically reduced from nineteen (19) to six (6) in general biology at college. Interestingly, none of the students who obtained below average grades (failed) in integrated science in WASSCE recorded below average (failed) grades in general chemistry and physics.

The rise and fall in the performance of the students across the three performance categories may be credited to the teaching practices, interactions, and experiences that the students had with their tutors at the college, as well as other factors. According to studies, a teacher's performance [including his or her experience, behaviour, and personality] has a significant impact on a student's performance, though this varies depending on location

(Cetin & Eren, 2022; Gilbert, 2018). Students have a better chance of comprehending the subject matter if the teacher has complete control over it (Stronge, 2018). With that control, the teacher will easily deliver the knowledge in a way that the students comprehend without challenge. At times, the teacher understands the subject but is unable to properly explain it owing to poor communication skills, which has an impact on the tertiary performance of students. Similarly, having control over the subject matter does not imply that students will perform well (Stronge, 2018). The teacher's late attendance to a lecture or failing to show up (being absent) may have an adverse effect on students' academic performance (Muzenda, 2013). If the teacher fails to attend lectures, the students' motivation in the subject has already been lost. This will result in them not paying attention to the subject and the teacher, which may affect their performance in the subject.

The categories of SHS the students attended relative to their performance in the above average and average grades showed contrasting results. With respect to the performance of the students in the above-average category, it was revealed that students from category B SHS performed marginally better in the above-average category than those from category C SHS. On the other hand, when it comes to the average category, it was observed that students from category C SHS performed slightly better in the average category than those from category B SHS. These findings support Yusif et al (2011) who reported that, ... type of school attended, … have significant effect on students’ academic performance in Ghana. Conversely, the findings contradict Tobias (2003), who found that measures of high school quality have small or no impact on the likelihood of college entry in the US.

Research question three looked at the relationship between the students' entry grades in integrated science and their end-of-course completion grades in biology, chemistry, and physics

The relationship between students' integrated science scores (obtained from WASSCE) and general biology, chemistry, and physics scores (measured using students' general biology, chemistry, and physics scores at college) was examined using Pearson's moment correlation coefficient. In all cases, a weak, positive relationship existed between the two variables, with integrated science scores from WASSCE connected with general biology, chemistry, and physics scores at the college. This means there was a significant low positive correlation between the students' integrated science scores from WASSCE and general biology, chemistry, and physics scores at the college. This implies that the academic environments at the various SHSs the students attended may have differed, but at the college the environment was equalised, so their performance now depended on their own efforts, motivation, the college environment, and college tutor factors. This finding is in agreement with previous studies which found a low relationship between entry grades and academic performance. For instance, Agbo (2003) conducted a study on different science subjects at university level and identified a low correlation between entry grades and students' performance. Also, Edokpayi and Suleiman (2011) opined that grade obtained by students in integrated science in the Junior Secondary School Certificate (JSC) examinations among the selected secondary schools in Zaria metropolis were a poor predictor of later performance in chemistry in the Senior Secondary School Certificate (SCE) examination.

Research question four examined the views of the students and tutors about the causes of the observed disparity between the students' entry grades in integrated science and their end-of-course completion grades in general biology, chemistry, and physics.

The range of grades of the students in integrated science in WASSCE and SRCs at college revealed that there were disparities in the performance of the students. These disparities in the performance of the students were attributed to the teaching practices, interactions, and experiences that the students had with their tutors at the college, as well as other factors. This presupposes that the entry grades of the students in integrated science in WASSCE could not wholly inform their future performance in tertiary institutions. The findings of the current study are consistent with those of others who, in addition to their pre-tertiary grades, identified many other factors that affect students' academic performance while at tertiary. Aspelmeier et al (2012), for instance, opined that the academic performance of a student at a tertiary could be influenced by numerous factors, including the parents' educational background, family size, type of high school attended, and the socio-economic status of the student. Also, literature reviews have revealed many factors, including environmental, economic, social, and psychological, that have a significant impact on students' performance in academics (You, 2018). Other studies have claimed that any student's performance at the HEI is affected by a variety of elements, including personal, teacher, and institutional factors (Umar et al., 2010). Some of these factors, apart from entry grades, were mentioned by both students and tutors as causes of the disparity in the students' performances. Institutional, teacher, and personal (student-related) factors were identified by both as the main causes of the disparity.

Institutional factors

Infrastructure and other amenities; availability of TLRs; and assistance during examinations (exam malpractice) were seen as the major institutional factors.

Infrastructure and other amenities: School infrastructure is very critical for effective teaching and learning in educational institutions. The results revealed that the students saw a lack of water on campus and that moving around in search of water had an impact on their academic performance. Research has shown that infrastructure (classrooms, accommodation, and toilet facilities) and other amenities such as access to water play a key role in students' academic performance (Mokaya, 2013). Murillo and Román (2011) conducted a study and the results showed that the availability of basic infrastructure and services (water, electricity, sewage), didactic facilities (sport installations, labs, libraries), as well as the number of books in the library and computers in the school do have an effect on the performance of primary school learners in Latin America, but their relative weight varies significantly from country to country. Also, Mokaya (2013) conducted a study to establish the impact of school infrastructure on the provision of quality education in public secondary schools in Kajiado, Kenya. It was found that improved academic performance is associated with more adequate and well-spaced classrooms; adequate and ample spacing in the libraries; adequate science laboratories; adequate water and sanitation facilities; and adequate participation in co-curricular activities. This study identified school infrastructure and other amenities, especially water, as a very important component in ensuring successful education.

Availability of TLRs: The results of the study also revealed the availability of TLRs and their usage as key factors influencing students' performance. Due to this, a tutor saw the need for improvisation (virtual lab) in the absence of a functional laboratory. In accordance with this finding, previous studies have demonstrated that teaching and learning resources play a major role in the academic performance of students in an educational institution. In a study conducted by Bizimana and Orodho (2014) in Rwanda, it was shown that there was a positive and significant correlation between most of the teaching and learning resources and students' academic performance in secondary schools across the country. This finding is supported by Adebayo et al. (2020), who say that educational resources have a significant impact on student performance. Similarly, Dahar and Faize (2011) investigated the effects of the availability and use of instructional materials on the academic performance of students in Punjab (Pakistan) and identified that the unavailability of instructional materials or less effective usage of instructional materials lowers academic performance. Also, Obodo et al (2020) in a study indicated that there was a positive significant difference in the performance of students taught basic science with the use of improvised teaching-learning when compared with those taught basic science without the use of improvised teaching-learning materials.

Assistance during examinations (examination malpractice): The results of the study revealed that some of the students received assistance from their teachers during WASSCE and that positively influenced their performance in IS, but since the same opportunity was not available at the college, that is why the performance dropped in the SRCs.

Teacher Factors

Another major contributing factor to the cause of the disparity between the students' performance in IS and SRCs, as mentioned by students and tutors, was teacher factors.

These included teacher personality, competency, experience, and efforts; and teaching practices/quality interaction.

Teacher personality, competency, experience and efforts and Teaching practices/quality interaction: The results revealed that the teaching practices and quality of interaction as well as the ability of the teacher to organise the teaching and learning process in a way that would help students to comprehend were critical to their performance in SRCs. Also, the teacher's personality was another key factor. According to studies, the performance of a teacher has a great effect on the performance of a student (Çetin & Eren, 2022; Gilbert, 2018). Students have a better chance of comprehending the subject matter if the teacher has complete control over it (Stronge, 2018). With that control, the teacher will easily deliver the knowledge in a way that the students comprehend without challenge. At times, the teacher understands the subject but is unable to properly explain it owing to poor communication skills, which has an impact on the tertiary performance of students. Similarly, having control over the subject matter does not imply that students will perform well (Stronge, 2018). The teacher's late attendance to a lecture or failing to show up (being absent) may have an adverse effect on students' academic performance (Muzenda, 2013). If the teacher fails to attend lectures, the students' motivation in the subject has already been lost. This will result in them not paying attention to the subject and the teacher. The results of this study confirm the assertion that teacher-related factors also affect students' progress in their academics.

Personal Factors

Personal (student-related factors), including motivation and student behaviour/truancy, were also identified to have caused the disparity between the students' performance in IS and SRCs.

Motivation: The role of motivation, either positive or negative, was identified to influence the students' performance in IS and SRCs. This motivation may sometimes originate from the actions of teachers or tutors or from the persona of the students themselves. This means that the actions of teachers and also the desire of the student to take his/her academics seriously play an important role in their performance and, for that matter, in IS and SRCs. This assertion is confirmed by studies which reveal that the teacher's criticism and encouragement of students play an important role in their academic performance (Sali-Ot, 2011). The effect of motivation on students is regarded as a significant aspect of student learning in higher education. Kusurkar et al (2013) opined that motivation had a significant impact on the academic performance of students. Several theories have been formulated to explain psychological behaviour from a motivational perspective. Constant critiquing by the teacher may demotivate the student and cause them to perform poorly in the subject when compared to their true self. According to Petty (2014), motivation helps students stay interested in their academics. Students require motivation that is both concrete and intangible, because it is part of the teacher's responsibility to not only instruct students but also to nurture, advise, and have confidence in them, as well as to appreciate them on occasion (Rasul & Bukhsh, 2011). Appreciation can be expressed through pleasant remarks or by presenting them with something else to enhance their confidence.

Student behaviour/truancy: Student behaviour/truancy was identified as one of the factors that affected their performance in IS and SRCs. This result supports previous research into this brain area which showed a significant relationship between truancy and the academic performance of students (Brew et al., 2021; Fareo, 2019; Mlowosa et al., 2014; Oluremi, 2013).

Other Factors

Economic factors and **bullying:** The results of this study revealed economic factors and bullying as additional relevant factors affecting their performance in college SRCs. The results again revealed that economic factors have some influence on students' academic performance. This was confirmed by one of the students who posited that his inability to report early to campus when college re-opens affected his academic work. This finding supports Abdu-Raheem (2015), Azhar et al (2014), Barry (2006), and Kyoshaba (2009), who reported a significant relationship between social economic status and academic performance. Conversely, this result contradicts Ajila and Akinyede (2000), who found no significant difference between socio-economic status and a university student's academic performance and that students from high socio-economic status homes will not perform better than students from low socio-economic status homes.

This current study reveals that socio-economic factors are of vital importance in effecting students' academic achievement performance. They are the backbone of providing financial and mental confidence to students. There are therefore clear differences between students from different socio-economic backgrounds. Additionally, bullying was also one of the other factors which were identified to have contributed to the cause of the disparity between the students' grades in IS and SRCs. Studies have shown that it has a considerable negative effect on a student's academic performance (Al-Raqqad et al., 2017; Ponzo, 2013; Rusteholz et al., 2021; Van-der-Werf, 2014). Bullying students, either by teachers, seniors, or anyone superior to them, has a negative effect on their academic performance.

CHAPTER FIVE

SUMMARY, CONCLUSION, RECOMMENDATION AND SUGGESTION

5.0 Overview

This final chapter is presented under the headings: summary of study, major findings, conclusions, recommendations, and suggestions for further research.

5.1 Summary of the Study

The study investigated the relationship between the entry grades of college students in Integrated Science and their end-of-course completion grades in science-related courses (biology, chemistry, and physics) at Atebubu College of Education in Atebubu-Amantin municipality in the Bono East Region of Ghana. The population comprised all the 2018/2019 batch of students of the B.Ed programme and the three tutors in the department of science education at ATECoE. The total population of the 2018/2019 batch of students at the college was three hundred and eighty-five (385).

The target population comprised the 2018/2019 batch of the B.Ed Primary Education programme since they offered science-related courses at the college. Their total number was one hundred and fifty-four (154), comprising eighty-six (86) males and sixty-eight (68) females. One hundred and twenty-four of these students were sampled for the study since data on their WASSCE and college results were available. Three (3) tutors were also involved in the study. Atebubu College of Education was purposefully chosen because of its proximity to the researcher. Checklist and interview guide were used in gathering data for the study. Frequencies, percentages, Peason's Moment Correlation and themes were used to analyse the data collected.

5.2 Summary of the Major Findings

Generally, the range of grades of the students in integrated science in WASSCE and SRCs at college revealed that there were disparities in the performance of the students.

Based on the results and discussions presented in relation to the four (4) research questions, the following were the major findings:

1. The range of the students' entry grades in integrated science revealed that the majority (84.68%) of the students had their grades ranged between A1 and C6 in the WASSCE and 19 (15.32%) had between D7 and F9.
2. The results showed that out of the one hundred and twenty-four (124) students used for the study, 60 (48.39%) and 64 (51.61%) attended category B and C SHS, respectively, while none of the students attended category A or D SHS.
3. Generally, the results showed that 95.2% of the students had grades between A and D (above average and average) in general biology. Only 4.8% of them had a grade E in general biology. Also, 100% of the students had grades between A and D (above average and average) in both general chemistry and physics. This means that none of the students recorded an E or performed below average in these courses.

4. From the further details of the results on the range of the students' end-of-course grades in general biology, chemistry, and physics, it was revealed that the number of students who obtained above-average grades in integrated science in WASSCE dropped in general biology and physics but showed a sharp rise in general chemistry. Also, it was observed that the number of students who obtained average grades in integrated science in WASSCE increased astronomically in general biology and physics but decreased in general chemistry. Lastly, the number of

students who obtained below average grades (failed) in integrated science in WASSCE was drastically reduced from nineteen (19) to six (6) in general biology at college. Interestingly, none of the students who obtained below average grades (failed) in integrated science in WASSCE recorded below average (failed) grades in general chemistry and physics.

5. The categories of SHS the students attended relative to their performance in the above average and average grades showed contrasting results. With respect to the performance of the students in the above-average category, it was revealed that students from category B SHS performed marginally better in the above-average category than those from category C SHS. On the other hand, when it comes to the average category, it was observed that students from category C SHS performed slightly better in the average category than those from category B SHS.
6. The relationship between students' integrated science scores (obtained from WASSCE) and general biology, chemistry, and physics scores (measured using students' general biology, chemistry, and physics scores at college) revealed that in all cases, a weak, positive relationship existed between the two variables, with integrated science scores from WASSCE connected with general biology, chemistry, and physics scores at college. This means there was no significant correlation between the students' integrated science scores from WASSCE and general biology, chemistry, and physics scores at the college.
7. The views of both students and tutors on the causes of the observed disparity between the students' entry grades in integrated science and their end of course grades in SRCs revealed institutional, teacher, and personal (student-related) factors

as the main causes. Other factors, such as socioeconomic status and bullying, have been identified as contributing to the disparity.

a. Infrastructure and other amenities; availability of TLRs; and assistance during examinations (exam malpractice) were seen as the major institutional factors.
b. Teacher personality, competency, experience, and efforts as well as teaching practices/quality interaction with the teacher were identified as the major teacher contributing factors.
c. Motivation and student behaviour/truancy were the personal (student-related factors) identified.

5.3 Conclusion

Based on the study's findings, the following conclusions were reached:

The evidence from this study suggests that the category of SHS that a student attend plays some role but not a major role in their future academic performance in SRCs at HEI. This was revealed when the categories of SHS the students attended relative to their performance in the above average and average grades showed contrasting results. That is, students from category B SHS performed marginally better in the above-average category than those from category C SHS. On the other hand, students from category C SHS performed slightly better in the average category than those from category B SHS. The results of this study also support the idea that there is a low (weak) relationship between entry grades and academic performance. This was confirmed when it was realised that there was a weak significant correlation between the students' integrated science scores from WASSCE and general biology, chemistry, and physics scores at the college. This implies that the academic environments at the various SHSs the students attended may have differed, but at the college the environment was equalised, so their performance now depended on their own efforts, motivation, the college environment, and college tutor factors.

Furthermore, the results of this study indicate that the teaching practices, interactions, and experiences that the students had with their tutors at the college, as well as other factors, had an influence on the academic performance of students. This presupposes that the entry grades of the students in integrated science in WASSCE could not wholly inform their future performance in SRCs in tertiary institutions. The study has confirmed the findings of Umar et al (2010), which found personal, teacher, and institutional factors as key influencers of students' academic performance. Infrastructure and other amenities; availability of TLRs; and assistance during examinations (exam malpractice) were seen as the major institutional factors. Teacher personality, competency, experience, and efforts as well as teaching practices/quality interaction with the teacher were identified as the major teacher contributing factors, and motivation and student behaviour/truancy were the personal (student-related factors) identified.

5.4 Recommendations

The following recommendations have been made based on the study's findings:

1. The college management should not place too much emphasis on the type of SHS the students attended during their admissions because it has little impact on their academic success in SRCs at college.

2. Even though the entry grades or scores of students in integrated science from WASSCE had a relationship with their performance in general biology, chemistry, and physics scores at the college, the relationship was a weak one. A key policy priority should therefore not focus much on students' entry grades in admissions into the college but rather improve the quality of infrastructure, teaching practices, interactions, and experiences that the students have with their tutors.
3. That the college management should put priority on infrastructure and other amenities; availability of TLRs; teacher personality, competency, experience, and efforts; motivation; student behaviour/truancy which are the various subsets of personal, teacher, and institutional factors because they are key influencers of students' academic performance.

5.5 Suggestions for further research

Based on the findings of this study, the following suggestions for further studies are enumerated for consideration by other researchers.

1. This study should be replicated in other Colleges of Education for a clearer picture of the situation.
2. It is suggested that a similar study be conducted in an all-female and all-male College of Education for the sake of comparison.
3. A study could be conducted to link the leadership styles of various College of Education Principals and the academic performance of the student vis-à-vis their entry grades in integrated science.

4. A study could also be conducted to link the influence of educational provisions and classroom climate on the academic performance of particular batches of College of Education students and their final end-of-course grades in science-related courses.

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APPENDICES

APPENDIX A

Document Request Letter

Atebubu College of Education
P.O. Box 29
Atebubu – B/A
4th February, 2022.

The Principal
Atebubu College of Education
P.O. Box 29
Atebubu

Dear Sir,

REQUEST FOR PHOTOCOPIES OF WASSCE RESULTS SLIPS AND END OF SEMENTER RESULTS

I write to seek permission and also request from your noble office the WASSCE results slips and end of first and second semester results of the 2018/2019 batch of students to enable me undertake my M.Phil research study on the topic: **College Students' Science Entry Grades and Their End-of-Course Completion Grades: An Explanatory Study.**

Sir, I want to assure you that the information will be treated as confidential and that the findings will also be made available to you for decision-making.

I hope that this request will be met with your kindest consideration.

Thank you
Yours faithfully,

Robert Kwadwo Siemoh

APPENDIX B

Informed Consent for Tutors

Dear Tutor,

Your participation in this study is highly appreciated and welcomed. This study is conducted by a Master of Philosophy student at the University of Education, Winneba. It aims at establishing a relationship between the entry grades of college students in integrated science from the senior high school (SHS) and their end-of-course completion grades in science-related courses at the college.

In this study, you will be interviewed about the causes of the disparity between students' entry grades in integrated science and their end-of-course completion grades in science-related courses at the college. An estimated time of 10 minutes would be used in conducting the interview.

Be assured that the information acquired as a result of this study will be kept under strict confidentiality, respecting the privacy and identity of interviewees, and will solely be used for the purposes stated in this study. As a participant in this study, you are at liberty to withdraw from the study at any time you wish.

Thank you

If you agree, please sign your name

Signature: ________________________

Date:____________________________

APPENDIX C

Informed Consent for Students

Dear Student,

Your participation in this study is highly appreciated and welcomed. This study is conducted by a Master of Philosophy student at the University of Education, Winneba. It aims at establishing a relationship between the entry grades of college students in Integrated Science from the senior high school (SHS) and their end-of-course completion grades in science-related courses at the college.

In this study, you will be interviewed about the causes of the disparity between your entry grades in integrated science from SHS and your end-of-course completion grades in science-related courses at the college. An estimated time of 10 minutes would be used in conducting the interview.

Be assured that the information acquired as a result of this study will be kept under strict confidentiality, respecting the privacy and identity of interviewees, and will solely be used for the purposes stated in this study. As a participant in this study, you are at liberty to withdraw from the study at any time you wish.

Thank you

If you agree, please sign your name

Signature: ________________________

Date:____________________________

APPENDIX D

Interview Guide for Students

Dear Student,

This study is aimed at investigating the relationship between your integrated science entry grades from SHS and final end-of-course completion grades in science-related courses (general biology, chemistry, and physics) at college.

The first part of the study has revealed disparities between your integrated science entry grades and end-of-course completion grades in the science-related courses. This interview is therefore to solicit your views on the factors that caused the observed disparities between your integrated science entry grade and the final end-of-course completion grades in biology, chemistry, and physics.

Questions

1. What in your opinion is/are the factors that caused the observed disparity in terms of

   (a). institutional factors (SHS and College)

   (b). teacher factors,

   (b). personal (student related) factors?

2. Do you have any other information to add to what you have already said?

APPENDIX E

Interview Guide for Tutors

Dear Tutor,

This study is aimed at investigating the relationship between students' integrated science entry grades from SHS and their final end-of-course completion grades in science-related courses (general biology, chemistry, and physics) at college.

The first part of the study has revealed disparities between their integrated science entry grades and final end-of-course completion grades in the science-related courses. This interview is therefore to solicit your views as a tutor of science on the factors that caused the observed disparities between their integrated science entry grade and the final end-of-course completion grades in biology, chemistry, and physics.

Questions

1. What in your opinion is/are the factors that caused the observed disparity in terms of

   (a). institutional factors (SHS and College)?

   (b). teacher factors,

   (b). personal (student related) factors?

2. Do you have any other information to add to what you have already said?

APPENDIX F

Grades, Scores, and Category of SHS of the Selected Students attended

Students	Int. Science		EBS 103 Gen. Biology		EBS 132 Gen. Chemistry		EBS 227 Gen. Physics		SHS Category
	Score	***Grade***	***Score***	***Grade***	***Score***	***Grade***	***Score***	***Grade***	
Student 1	66	B3	56	D+	66	C+	67	C+	B
Student 2	42	E8	55	D	71	B	64	C	C
Student 3	46	D7	60	C	77	B+	66	C+	C
Student 4	60	C4	62	C	80	A	75	B+	C
Student 5	72	B2	63	C	72	B	51	D	C
Student 6	76	B2	61	C	75	B+	77	B+	B
Student 7	65	B3	61	C	74	B	71	B	B
Student 8	52	C6	62	C	78	B+	73	B	C
Student 9	50	C6	65	C	61	C	53	D+	B
Student 10	77	B2	48	E	76	B+	62	C	B
Student 11	63	C4	65	C	82	A	68	C+	C
Student 12	66	B3	60	C	65	C+	61	C	C
Student 13	55	C5	52	D	68	C+	63	C	C
Student 14	64	C4	58	D+	60	C	52	D+	B
Student 15	51	C6	65	C	66	C+	72	B	C
Student 16	78	B2	65	C	75	B+	65	C+	C
Student 17	45	D7	61	C	69	C+	61	C	C
Student 18	65	B3	60	C	73	B	63	C	B
Student 19	53	C6	56	D+	70	B	73	B	C
Student 20	56	C5	58	D+	76	B+	67	C+	C
Student 21	67	B3	82	A	81	A	81	A	B
Student 22	52	C6	67	C+	83	A	66	C+	C
Student 23	67	B3	71	B	80	A	80	A	B
Student 24	65	B3	52	D	77	B+	50	D	B
Student 25	69	B3	53	D	75	B+	52	D+	C
Student 26	65	B3	66	C+	83	A	74	B	B
Student 27	83	A1	67	C+	80	A	76	B+	B
Student 28	51	C6	58	D+	76	B+	63	C	C
Student 29	62	C4	55	D	70	B	55	D+	B
Student 30	54	C6	63	C	76	B+	57	D+	C
Student 31	60	C4	61	C	78	B+	66	C+	C
Student 32	73	B2	70	B	82	A	80	A	B
Student 33	50	C6	62	C	73	B	77	B+	C
Student 34	67	B3	46	E	70	B	61	C	B

APPENDIX F CONTINUED

Student 35	50	C6	65	C	82	A	76	B+	B
Student 36	69	B3	63	C	72	B	56	D+	B
Student 37	56	C5	67	C+	83	A	68	C+	C
Student 38	84	A1	55	D	65	C+	51	D	B
Student 39	67	B3	56	D+	62	C	56	D+	B
Student 40	51	C6	62	C	74	B	55	D+	C
Student 41	60	C4	47	E	64	C+	58	D+	C
Student 42	68	B3	52	D	73	B	61	C	B
Student 43	47	D7	63	C	75	B+	63	C	C
Student 44	65	B3	51	D	66	C+	50	D	C
Student 45	52	C6	58	D+	77	B+	65	C+	C
Student 46	66	B3	53	D	75	B+	57	D+	C
Student 47	45	D7	61	C	79	B+	61	C	B
Student 48	55	C5	60	C	84	A	70	B	B
Student 49	66	B3	65	C	82	A	83	A	C
Student 50	74	B2	70	B	78	B+	66	C+	B
Student 51	67	B3	56	D+	85	A	60	C	B
Student 52	52	C6	66	C+	81	A	61	C	B
Student 53	60	C4	67	C+	69	C+	76	B+	C
Student 54	65	B3	60	C	63	C	61	C	B
Student 55	82	A1	52	D	65	C+	55	D+	B
Student 56	45	D7	51	D	80	A	51	D	C
Student 57	63	C4	58	D+	61	C	81	A	B
Student 58	65	B3	46	E	80	A	50	D	C
Student 59	56	C5	63	C	74	B	65	C+	C
Student 60	83	A1	72	B	77	B+	82	A	B
Student 61	48	D7	51	D	66	C+	56	D+	C
Student 62	51	C6	56	D+	82	A	52	D	B
Student 63	65	B3	61	C	80	A	65	C+	B
Student 64	57	C5	80	A	81	A	80	A	C
Student 65	66	B3	57	D+	72	B	63	C	B
Student 66	59	C5	52	D	79	B+	55	D+	B
Student 67	37	F9	52	D	65	C+	58	D+	C
Student 68	55	C5	57	D+	80	A	56	D+	B
Student 69	53	C6	52	D	76	B+	50	D	B
Student 70	45	D7	62	C	78	B+	61	C	C
Student 71	56	C5	56	D+	82	A	52	D	B
Student 72	56	C5	53	D	67	C+	55	D+	C
Student 73	42	E8	46	E	70	B	51	D	C
Student 74	61	C4	56	D+	84	A	66	C+	C
Student 75	68	B3	69	C+	82	A	68	C+	C

APPENDIX F CONTINUED

Student 76	70	B2	70	B	73	B	80	A	B
Student 77	65	B3	59	D+	75	B+	65	C+	B
Student 78	60	C4	65	C	71	B	67	C+	C
Student 79	45	D7	58	D+	77	B+	60	C	C
Student 80	63	C4	55	D	70	B	51	D	C
Student 81	46	D7	57	D+	60	C	55	D+	B
Student 82	47	D7	56	D+	63	C	50	D	C
Student 83	52	C6	56	D+	72	B	54	D	C
Student 84	50	C6	63	C	65	C+	56	D+	C
Student 85	62	C4	61	C	80	A	60	C	B
Student 86	64	C4	60	C	66	C+	57	D+	B
Student 87	65	B3	56	D+	74	B	52	D	B
Student 88	50	C6	51	D	79	B+	50	D	B
Student 89	65	B3	47	E	76	B	63	C	C
Student 90	55	C5	56	D+	67	C+	51	D	C
Student 91	56	C5	56	D+	70	B	55	D+	C
Student 92	81	A1	66	C+	80	A	53	D+	B
Student 93	61	C4	62	C	72	B	50	D+	C
Student 94	55	C5	67	C+	75	B+	61	C	B
Student 95	80	A1	57	D+	80	A	73	B	B
Student 96	66	B3	70	B	66	C+	62	C	C
Student 97	41	E8	51	D	62	C	50	D	C
Student 98	53	C6	55	D+	67	C+	63	C	C
Student 99	45	D7	60	C	50	D	60	C	C
Student 100	48	D7	52	D	55	D+	60	C	C
Student 101	44	E8	66	C+	77	B+	70	B	B
Student 102	67	B3	71	B	81	A	81	A	C
Student 103	71	B2	67	C+	80	A	56	D+	B
Student 104	45	D7	55	D	70	B	50	D	B
Student 105	51	C6	63	C	75	B+	53	D	C
Student 106	82	A1	53	D	80	A	50	D	C
Student 107	47	D7	52	D	65	C+	54	D	B
Student 108	61	C4	70	B	84	A	81	A	B
Student 109	54	C6	58	D+	63	C	54	D	B
Student 110	50	C6	58	D+	76	B+	62	C	C
Student 111	54	C6	66	C+	81	A	76	B+	C
Student 112	51	C6	58	D+	70	B	50	D	C
Student 113	65	B3	69	C+	75	B+	70	B	B
Student 114	69	B3	69	C+	75	B+	72	B	C
Student 115	66	B3	57	D+	71	B	51	D	C
Student 116	53	C6	62	C	77	B+	53	D	C

APPENDIX F CONTINUED

Student 117	67	B3	79	B+	80	A	81	A	C
Student 118	80	A1	58	D+	81	A	50	D	B
Student 119	83	A1	69	C+	78	B+	81	A	B
Student 120	69	B3	75	B	85	A	83	A	B
Student 121	54	C6	74	B	82	A	70	B	B
Student 122	68	B3	57	D+	78	B+	73	B	B
Student 123	57	C5	60	C	65	C+	65	C+	B
Student 124	66	B3	50	D	76	B+	55	D+	B

APPENDIX G

Grades, Scores, and Category of SHS of the Interviewed Students attended

Students	Int. Science		EBS 103 Gen. Biology		EBS 132 Gen. Chemistry		EBS 227 Gen. Physics		SHS Category
	Score	***Grade***	***Score***	***Grade***	***Score***	***Grade***	***Score***	***Grade***	
Student 2	42	E8	55	D	71	B	64	C	C
Student 3	46	D7	60	C	77	B+	66	C+	C
Student 10	77	B2	48	E	76	B+	62	C	B
Student 17	45	D7	61	C	69	C+	61	C	C
Student 34	67	B3	46	E	70	B	61	C	B
Student 41	60	C4	47	E	64	C+	58	D+	C
Student 67	37	F9	52	D	65	C+	58	D+	C
Student 89	65	B3	47	E	76	B	63	C	C
Student 101	44	E8	66	C+	77	B+	70	B	B
Student 124	66	B3	50	D	76	B+	55	D+	B

APPENDIX H

The transcribed responses from the interview of the students

Student 1: *"At SHS our science teacher always asked us to go and read on our own so I didn't like science. I didn't also understand some of the topics when I'm reading them because of this I was not learning science often. For college here the science teachers are very serious".*

Student 2: *"Science is difficult so I don't like learning it. Our science teacher at SHS also did selective teaching, he taught us some topics and left others".*

Student 3: *"The teacher who taught us science at SHS was very good. My SHS had a science lab so our science teacher was taking us there for practical but here it is not like that. There is nothing at the science lab here. At level 100 I was not serious".*

Student 4: *"Our SHS science teacher was not teaching us well so I was always confused in his class. He was boring so I didn't like learning science".*

Student 5: *"At secondary school I was always playing and chatting with friends so I was not learning but for here I am serious. Here at the college the teachers explain the science well for me to understand, but it was not like that at secondary school".*

Student 6: *Sir, at my SS we were lacking so many things such teachers, classrooms, accommodation and toilet facilities. So we suffered in our studies.*

Student 7: *"Sir here it is because we do many classwork, group work and assignments so it helped me read more. Here* [college] *the teachers are good so I understand what we learn therefore I read science paa".*

Student 8: *"Sir, when we came to level 100 the pressure on us was too much. Our seniors were always worrying us so I was afraid and was not able to learn. Also we were always* *moving around to look for water to bath so I was tired when it was time for me to revise in the evening".*

Student 9: *"Hmm sir, at SHS we were helped small during the exams but here no one will mind you. At the college here, when some of the teachers are teaching they go fast so I don't understand".*

Student 10: *"The science teachers here take us through many demonstrations and activities using different materials unlike SHS. I'm taking care of myself here* [college] *so I have to struggle during vacation to get money for my fees and my upkeep on campus and due to this I'm not able to report early when school reopens. This affects me because by the time I come they have learn so many things".*

APPENDIX I

The transcribed responses from the interview of the tutors

Tutor A: *"Well, here the teaching and learning practices they undergo may be different from their SHS. There are some students who relax in their academics when they come here due to peer pressure. Some of the students do not know how to study".*

Tutor B: "*My brother, you are aware of sometimes what we hear of during WASSCE, so some of these students are able to make it to the college through exam malpractice. So will they perform when they come here and do not get the same opportunity? Even though our science lab is not in good shape, we do our best to apply the concept of virtual lab in our teaching so it makes the lessons interactive making the students to understand well".*

Tutor C: "*Kwadwo, I think the students when they come here have quality interactions with us as compared to SHS. I have realised that some of the students become serious when they come to the tertiary institution. Some of them also don't like attending lecture*

APPENDIX J

WAEC GRADING SYSTEM

Grade	Numerical Strength	Score (%)	Interpretation
A1	1	80-100	Excellent
B2	2	70-79	Very Good
B3	3	65-69	Good
C4	4	60-64	Credit
C5	5	55-59	Credit
C6	6	50-54	Credit
D7	7	45-49	Pass
E8	8	40-44	Pass
F9	9	0-39	Fail

APPENDIX K

UNIVERSITY OF CAPE COAST GRADING SYSTEM

Grade	Numerical Strength	Score (%)	Interpretation
A	4.0	80-100	Excellent
B+	3.5	75-79	Very Good
B	3.0	70-74	Good
C+	2.5	65-69	Very Satisfactory
C	2.0	60-64	Satisfactory
D+	1.5	55-59	Very Fair
D	1.0	50-54	Fair
E	0.0	0-49	Fail