UNIVERSITY OF CAPE COAST

TRENDS IN THE PERFORMANCE OF SCIENCE STUDENTS IN THE SENIOR SECONDARY SCHOOL CERTIFICATE EXAMINATION IN KUMASI HIGH SCHOOL

BY

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DECLARATION

I hereby declare that this dissertation is a result of my own original research and that no part of it has been presented for another degree in this University of elsewhere.

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SUPERVISORS' DECLARATION

I hereby declare that the preparation and presentation of this dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast.

Principal Supervisor. DR. Y.K.A. ETSEY ..... Signature ..... Date: Feb. 16, 2006

electives, the study showed that the 1999 year group performed better followed by the 1996, 2001, 2000, 1998 and the 1997 year groups respectively.

The results of the study implied that government and school authorities must take steps to improve the quality of science education in Kumasi High school such as the provision of physical and material resources, adequate financing of education, teaching, training and development, improvement of the conditions of service of teachers and supervision of instruction.

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DEDICATION

This dissertation is dedicated to my mother, Madam Mary Ofosuah Ntiri, a retired nurse, who found it expedient to give me formal education despite her limited financial resources.

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CHAPTER ONE

INTRODUCTION

Background to the study

Education is generally recognised as the keynote to national development in all societies. It is a life long process whereby the innate abilities and talents of people, both young and old are brought out and developed. It is the most potent force shaping people's knowledge, attitudes, perceptions, skills and personality (Antwi, 1992).

It is generally accepted that education is an investment in human capital. Antwi (1992) observed that schooling and training increase people's lifetime earnings, their social skills, perceptive powers, task performance levels, ability to communicate and opportunities for advancement. Singer (1964) also noted that, "it is only where the working force at all levels is sufficiently literate, educated, trained and mobile to take advantage of new advances in techniques and organisation of production that the creation of a built-in industry of progress becomes possible" (p. 70). It is also recognised that the socio-economic development of any country depends on a cadre of well-educated and well-trained personnel produced especially through secondary school and tertiary levels of education.

The Report of the Conference of African States on Education in 1961 urged all African states to accelerate their socio-economic development by placing emphasis on secondary education. In response to this call, UNESCO figures have shown that these African states have had to allocate between 15 and 20 percent of their total national expenditure, or between 3 and 5 percent of the gross national product to education (Antwi,

1992). Lewis (1969) also observed that the best way to develop a country's economy is to turn out more and more youngsters through secondary schools. In Ghana, the first major attempt to link educational policies with manpower development through the secondary schools was initiated by the Nkrumah administration in the Seven-Year Development Plan (Ghana Seven-Year Development Plan, 1963/64; 1969-70).

From the above, one can understand why over the years Ghana has had to formulate various educational policies and had spent a substantial proportion of her recurrent expenditure on education. One can also understand the rationale behind the on-going educational reform in the country. Ghana's educational system from independence in 1957 to the mid 1960's was described as one of the best in the whole of Africa (Roemer, 1992).

However, by the 1970s, deterioration of the system had become manifest, both in terms of quality and quantity (the 1970's was a period of economic decline in Ghana and several sub-Saharan countries). In response to growing public demand for reforms, the Acheampong military government appointed the Dzobo Commission in 1974 to embark upon appropriate reforms of the educational sector. Proposals of the reform programme included the abolition of the middle schools and recasting secondary schools into a two-stage system of Junior Secondary Schools (JSS) followed by the Senior Secondary Schools (SSS). However, the harsh economic climate at the time aborted the comprehensive implementation of the reform.

By 1982/83, the decline in the educational system had reached a level where urgent reforms were absolutely necessary. The widespread view was that, except in favoured schools, very little of educational value was actually happening in the schools. Teachers were underpaid, resulting in substantial losses of well educated and highly qualified teachers to neighbouring countries such as Nigeria, and those who chose to

remain in the country did not attend classes regularly and engaged in secondary occupations to earn additional income. Nearly half of all primary school teachers were unqualified in 1982/83, as were about a third of the middle school teachers and a fifth of the secondary school (Cobbe, 1992). Appropriate textbooks for both teachers and students were woefully lacking, so were other inputs such as furniture, classrooms, well furnished science laboratories etc. Maintenance of physical structures of the schools was severely neglected, resulting in some classrooms being totally unusable, particularly during the rainy season.

Behind the educational decline in 1982/83 was the poor state of the Ghanaian economy at the time. By 1983, Ghana's per capita output and income had been declining for over twenty years and the state had reached a fiscal crisis of severe proportions. In 1982/83 government revenues were less than six per cent of G.D.P; recurrent expenditure on education, which had averaged about 3.4 per cent of GDP in the 1970's, was below 2 percent of GDP and may have been as low as 1 per cent (Cobbe, 1992).

Under the World Bank's sponsored Economic Recovery programme (ERP), later to become the Structural Adjustment Programme (SAP), the Rawlings military government initiated the process of massive reforms in education in 1986. By 1986, under ERP II, the Provisional National Defence Council (PNDC) government had come out with a new educational policy for implementation. In September 1987, the implementation began.

Ghana adopted a new structure of pre-university education of 6-3-3-4 systems as against the old system of 6-4-5-2. The new system, which was a replica of the 1974 one, was made up of 6 years primary education, 3 years Junior Secondary School education and 3 years of Senior Secondary School education. Pre-University education was, therefore,

reduced from 17 years to 12 years in order to release more resources for educational development.

The Reform Programme was divided into two broad phases. The first phase was the introduction of the new JSS system running from 1987 to 1990 while the second phase involved the introduction of the new SSS system running from 1993 to 2002. Both the JSS and SSS students are terminal and continuing. Continuing students in JSS moved to SSS while the SSS students enter the University and other tertiary institutions. The terminal students in JSS enter into apprenticeship and non-formal programmes while those from the SSS join the non-formal sector of the economy. However, it is possible for some terminal SSS graduates to continue their formal education later.

The main thrust of the reforms was directed towards the vocationalisation of education, especially at the Secondary School level, and to restructure the entire educational system from the primary or basic to the tertiary level. The overall objectives of the New Educational Reform Programme, according to the Ministry of Education (1987), are;

(a) to expand and make access more equitable at all levels of education

(b) to change the structure of the school system, and reduce the length of pre-University education from 17 to 12 years

(c) to improve quality and relevance of the curriculum and
to re-orient education away from purely academic focus towards one that includes vocational skills and attitudes that lead to productive activities

(d) to improve pedagogic efficiency and increase cost effectiveness of education and partially recover its cost; and

(e) to enhance sector management and efficiency of budgeting procedures.

The Reform Programme went through its full cycle with the release of the first Senior Secondary School Certificate Examination (SSSCE) results in April 1993. The appalling nature of the results sparked off scathing public criticism of the Reform Programme culminating in the setting up of the de-Heer Amissah Education Reforms Review Committee (ERRC) in July 1993.

In October 1993, the ERRC submitted its report to the Ministry of Education. The Ministry in collaboration with other stakeholders, studied the report and some of the critical issues that emerged which according to the Ministry of Education (1987) included, the duration of the SSS course, continuity of some subjects, the subjects to be offered under the Agricultural science programme at the SSS level, and the status of Ghanaian languages in the SSS curriculum.

With respect to the duration of the SSS course, the ERRC recommended an extension of the length of the course by one year, that is, from 3 to 4 years to allow more time for the acquisition of academic skills which students in many public schools lack. In relation to issue (ii) above, the ERRC recommended that foundation subjects such as English and Mathematics be emphasised and then expanded so that the curriculum at the JSS level would not be unnecessarily overloaded. In connection with the Ghanaian languages, the ERRC recommended that these subjects be taught as elective rather that core subjects.

In the case of the subjects to be offered under the Agricultural Science Programme, the ERRC recommended that certain subjects would assist students go into farming after SSS. The subjects include Crop Husbandry, Horticulture and Animal Husbandry, which must be taught as an elective for all Agricultural Science students instead of alternating them. That is, all students offering Agricultural Science in the Senior Secondary School Programme must pursue Crop Husbandry, Horticulture and Animal Husbandry.

According to the Ministry of Education (1987), the government endorsed the recommendations. This affected Senior Secondary School education and this included the following:

i. The 3-year Senior Secondary School education be maintained in order not to negate one of the key principles of the Reform Programme that is, reducing the length of pre-University education to save cost and to re-allocate financial resources to other sectors of the economy;

ii. Core subjects should be studied up to the level of the former form five; School Certificate, General Certificate of Education, Ordinary Level (SC/GCE 'O' Level and the elective subjects should be studied up to a level above the SC/GCE 'O' Level but below General Certificate of Education, Advanced Level (GCE 'A' Level);

iii. Religion should be introduced as a subject in its own right and named Religion and Moral Education;

iv. Christian Religious Studies, Islamic Studies, Music and Ghanaian Language should be taught as elective subjects; and

v. Training in practical skills should be taught at least once a week as part of the normal school timetables.

The Senior Secondary School became the next ladder after the Junior Secondary School. It now has duration of three years at the end of which students who passed the Senior Secondary School Certificate Examination (SSSCE) entered into the University and any other tertiary institution. A student is expected to read between six and nine subjects for both core and elective subjects, but six subjects made up of three core and three elective subjects will be counted for university admission and any other tertiary

institution. A prospective student to the University has to obtain an aggregate of 24 in six subjects with at least D or better scores in each of the subjects.

It must be noted that a science student should get a good grade in Integrated Social Studies as well as the Integrated Science, which are core subjects. Students in other programmes, namely, Business, Arts, Agricultural Science, Technical and Vocational Studies should pass very well in Integrated Science.

There are five (5) programmes at the Senior Secondary School. These are: (i) General (Science and Arts) (ii) Agricultural Science (iii) Technical (iv) Vocational (Visual Art and Home Economics) and, (v) Business.

Each student selects one programme of his/her choice and reads for three years.

The core subjects for all programmes include; (i) English Language, (ii) Mathematics, (iii) Integrated science, (iv) Integrated social studies and (v) Physical Education, Religious and Moral Education, which are internally examined.

The elective subjects in Science include; (i) Mathematics, (ii) Physics, (iii) Chemistry and, (iv) Biology. The elective subjects in General Arts include 3 or 4 of the following;(i) Literature in English, (ii) French, (iii) Ghanaian Language, (iv) Music, (v). Christian/Islamic/Traditional Religious Studies, (vi) Economics, (vii) Geography, (viii) History, (ix) Elective Mathematics, and (x) General Knowledge in Art.

The elective subjects in Agricultural Sciences are; (i) General Agriculture, (ii) Physics, (iii) Chemistry, (iv) Crop Husbandry,(v) Horticulture, and (vi) Animal Husbandry. The elective subjects in Business are; (i) Accounting, (ii) Business Management, (iii) Costing, (iv) Elective Mathematics, and (v) Economics. The elective subjects in Visual Art are; (i) General Knowledge in Art, (ii) Textiles, (iii) Economics, (iv) Picture Making, (v) Sculpture, (vi) Graphics, and (vii) Ceramics.

This study is set to look at the trends in the performance of Science students who were admitted to Kumasi High School from 1996-2001 and wrote the Senior Secondary Certificate Examinations to find out whether their performance improved or retrogressed year after year.

Statement of the problem

The introduction of the new educational reform in 1987 sought to shorten the unduly long statutory period of pre-University schooling from seventeen (17) years to the international norm of twelve (12) years consisting of six (6) years primary, three (3) years Junior Secondary School and three (3) years Senior Secondary School. The introduction of the reform brought about wranglings among parents and teachers whose responsibility it is to teach these students about the enormous content of the Senior Secondary School programme and the relatively short period of the time as compared to the old system of education.

The reform went through its full cycle with the release of the Senior Secondary School Certificate Examination results in 1994. The release of the results sparked off adverse comments and criticisms from the public. The furor following the release served as a catalyst to the review process and moved it from the Ministerial to the public arena. In July 1994, the Education Review Committee (EERC) was appointed to look at the whole school reform programme and make recommendations necessary for improvement. These problems coupled with lack of the required textbooks, workshops and equipment for the Technical and Vocational courses and inadequate Science Resource Centers for the schools, made teachers and parents to advocate for the increase in the number of years of the Senior Secondary School programme.

As a result of lack of science textbooks and other facilities, the Ghana Association of Science Teachers (GAST) came together as a professional association with the aim of promoting effective science teaching in all pre-university institutions in Ghana through activities such as workshops, science content update and development of resources for science teaching. The Association is very much involved with bringing science into the life of every Ghanaian. It does this by co-operating with interested bodies both inside and outside the country. According to Ameyibor and Wiredu (1989) the current reforms sweeping the educational sector have been of particular interest to the Association. The Ministry of Education has drawn up the new science syllabus in Physics, Chemistry, Biology and Core Science for the SSS to assist the science teacher to feel comfortable in using the syllabus effectively.

Between 1988 and 1990 the Ghana Association of Science Teachers (GAST) organised courses, workshops and conferences to discuss the syllabi of the various science subjects (Biology, Physics, Chemistry and Core Science) at the SSS level and made recommendations to the Ghana Education Service and Ministry of Education. According to Ossei-Anto (1999), at the Junior Secondary school (JSS) level in 1988/89 academic years, each school was supplied with an average of two boxes of assorted science materials and equipment including General Science textbooks. At the SSS level the government supplied schools with science equipment and materials though inadequate. The government also established science resource centers throughout the country, which was a laudable idea because students who hitherto had no access to some equipment and materials can now have hands-on experience at these centers.

Despite these efforts by the GAST to improve student's performance in science, the initial wranglings about the time frame for the SSS programme was interpreted by students and teachers alike to mean their inability to cover enough of the content. This

Specifically, the research is designed to achieve the following objectives:

1. **To find the correlation between science students' performance in the Basic Education Certificate Examination and their performance in the Senior Secondary School Certificate Examination from 1996-2001.**

2. To determine the trend in the performance science students in Physics, Chemistry, Biology and Elective Maths in the SSSCE from 1996-2001.

3. To compare the performance of science students from the basic Public and Private schools in the SSSCE from 1996-2001.

4. To make recommendations to the appropriate authorities based on the findings of the research.

Research questions

The following research questions guided the study.

1. What difference exists in the performance of students from the basic public and private schools in the SSSCE from 1996-2001?
2. What is the relationship between the performances of science students in the BECE and the SSSCE results from 1996-2001?
3. What is the trend in the performance of science students in Physics in the SSSCE from 1996-2001?
4. What is the trend in the performance of science students in Chemistry in the SSSCE from 1996-2001?
5. What is the trend in the performance of science students in Biology in the SSSCE from 1996-2001?

6. **What is the trend in the performance of science students in Elective Maths in the SSSCE from 1996-2001?**

Significance of the study

The findings in the research would guide the government and other stakeholders in education to come out with the necessary changes in the science curriculum in the education reforms to enable it achieve its stated objectives.

It is also anticipated that the study would help science teachers in Biology, Physics, Elective Mathematics and Chemistry to study the trend in the performance of science students in their subject areas and to improve upon it. This would also help the teachers to improve upon their teaching methods and advocate for up-to-date science equipment for the laboratories. The findings in this research would also help the school admission committee to select students from public and private schools to the science programme during admissions, by studying the entry and exit grades of these students.

Lastly, it is hoped that the research would help the school administration to monitor the performance of science teachers in the school with the knowledge in the trend of performance of science students.

Delimitations

The study covered all science students who were admitted to Kumasi High School from 1996-2001. It was delimited to the basic school attended by science students, that is, private or public. Results or grades of the science students in BECE and SSSCE for the years 1996-2001 were used for the study. Lastly, elective subjects in science, namely, Physics, Chemistry, Biology and elective Mathematics were used for the study.

Limitations

The performance of science students in the Senior Secondary School Certificate Examination is a problem that needs to be looked at nationwide. However, this study was limited to Kumasi High School due to the problem of funding and time limit at the hand of the researcher.

Definition of terms

Structural Adjustment Programme (SAP)

The Structural Adjustment Programme (SAP) was a programme to restructure the economy of Ghana. It was launched in 1986 by the erstwhile Provisional National Defence Council regime.

Economic Recovery Programme 11 (ERP 11)

The Economic Recovery Programme was a programme to correct imperfections in the country's economy and to ensure increasing productivity out of which the needs of the people could be adequately met. It was implemented from 1986 as a follow up to the Economic Recovery programme phase 1.

Gross Domestic Product (GDP)

Gross Domestic Product (GDP) is the monetary value of goods and services (at the market price)produced by factors of production within the economy regardless of who owns the resources or whether the goods and services produced is coming from Ghanaians or foreigners.

National Teacher Training Council (NTTC)

The National Teacher Training Council (NTTC) is now known as the Teacher Education Division of the Ghana Education Service. The Council was responsible for the provision

of general education, special education (such as education of the handicapped), tec and business education.

Junior Secondary School (JSS)

This is a three-year upper basic for 12-15 year olds. It is expected to cover the first 3 years of the existing secondary school courses and consist of general education, science education, technical and vocational education.

Senior Secondary School (SSS)

The Senior Secondary School (SSS) is a three-year second cycle education consisting of secondary, technical and vocational schools. The course objectives are similar to those of the junior secondary schools. The courses are however more advanced than those for the JSS. The programme for this cycle is so structured that each school is expected to have some or all of the following programmes; general arts, science, technical, vocational, business and agricultural programmes.

Elective Subjects

Elective subjects are the compulsory subjects pursued in each programme of the senior secondary course. These compulsory subjects determine the type of programme pursued. There are five programmes in the senior secondary school system. These are Vocational/Technical, Business, Science, Agricultural and General Arts. All senior secondary school student study six core subjects namely, English Language, Core Mathematics, Social Studies, Integrated Science and Physical Education and Moral Education (which are not externally examinable). In addition to the core subjects, all the five programmes have four special subjects known as elective subjects which determine one's programme. For example, science students in addition to the core subjects, study Physics, Chemistry, Biology and Elective Mathematics.

Basic Education Certificate Examination (BECE)

This is an external examination taken at the end of the junior secondary school programme. It is conducted by the West African Examinations Council (WAEC). The external examination carries 70 percent of the total mark for final grade in each subject. To qualify for consideration into the senior secondary, a candidate should obtain at least aggregate 30 or less in six (6) of the JSS subjects.

Senior Secondary School Certificate Examination (SSSCE)

This is an external examination taken at the end of the senior secondary school programme. It is conducted by the West African Examinations Council (WAEC). The external examination carries 70 percent of the total mark for the final grade in each subject. A prospective student to the University has to obtain an aggregate of 24 in six (6) subjects with at least D or better scores in each of the subjects.

Ghana Association of Science Teachers (GAST)

This is an Association formed by science teachers in Ghana to diagnose problems of science teaching and learning. The Association also organises workshops refresher courses and conferences to discuss the syllabi of the various science subjects and make recommendations to the Ghana Education Service and the Ministry of Education.

Organisation of the rest of the thesis.

Chapter two reviewed the literatures of other studies related to this study. It included educational reforms from the colonial period to the present day, the overview of the science curriculum and its relevance, training of science teachers and the teaching of science as a subject, the provision of physical and material resources and the performance of science students.

Chapter three discussed the methods and procedures used in this research. This included the research design, population and sampling, instruments, data collection and how the data were analysed using statistical procedures.

Chapter four provided the results of the statistical procedures used in analysing the data for the study. The results are presented by research questions. Lastly, a summary of the chapter was provided

In Chapter five discussions of the results were presented concluding and offering recommendations. The chapter also gave an overview of the research problem and methodology, providing a summary of the key findings. Interpretation of the findings was done with reference to the literature and each finding was evaluated examining its implications with respect to the current theoretical position on the study as well as its educational practice. Recommendation for future research was also made.

CHAPTER TWO

REVIEW OF LITERATURE

INTRODUCTION

In the history of Ghana, the sixties of the twentieth century were noted as an outstanding decade of change. Special concern of people all over the country has been the provision of education, the quality of which is becoming the measure of progress and development. What the citizen of a country becomes is dependent upon the sort of education offered them (Asiedu-Akrofi, 1978). According to Asiedu-Akrofi (1978) Ghana was one of the African countries, which invested about one-fifth of its public expenditure in education between the 1960s and 1970s. Governments of Ghana made this massive investment in education because they believed, like most African governments did, that education was the key that unlocked the door to modernisation, that is, economic, technological, scientific and political modernisation.

The Colonial Period (1844-1951): Governor Roger's reform

In 1908, Governor Roger, taking advantage of the healthy state of the economy appointed a committee to consider various matters in connection with education in the Gold Coast (Abosi and Brookman-Amissah, 1992; McWilliam and Kwamena-Poh, 1975). Among others, the reforms dealt with the following issues:

(i) The introduction of Education Rules of 1909 which was designed to improve teaching methods and to make the primary school course less bookish. It replaced the infamous "Payment by Results"

(ii) Government direct entry into the field of primary education in Asante and North;

(iii) The introduction of technical/vocational education into the primary school curriculum; and

(iv) Government's active involvement in teacher training affairs, leading to the opening of Accra Training College in 1901.

Most of the reform policies, however, could not be implemented largely as a result of the harsh effects of the First World War (McWilliam and Kwamena-Poh, 1975).

Guggisberg's reforms

In 1920, Governor Guggisberg appointed the Education Committee "to investigate past education efforts in the Gold Coast, their success or failure and reasons thereof to consider the whole educational policy (McWilliam and Kwamena-Poh, 1975; Abosi and Brookman-Amissah, 1992).

Some of the important reforms were the following: (i) the making of English Language as a subject of instruction and the vernacular as a medium of instruction; (ii) The establishment of Prince of Wales College, now Achimota School; (iii) Improvement of the service conditions of teachers and; (iv) increased attention given to Technical/Vocational Secondary and Teacher education.

Education Committee of 1937-41

In 1937, the Education Committee was set up to design a proper system of education that would suit the social, economic and political aspiration of the people (Abosi and Brookman-Amissah, 1992). The implementation of the Report led to the expansion of

educational facilities in the Primary, Secondary and Teacher Training Colleges while the University of the Gold Coast (now University of Ghana, Legon) was established in 1948.

Post-Colonial Period Accelerated Development Plan of 1951

In August 1951, the Nkrumah Administration introduced the Accelerated Development Plan for Education to provide for the rapid development of education at all levels. The Plan was implemented in January 1952 and addressed several issues including the following:

i. A free-tuition and compulsory elementary education for children between the ages of 6 and 12

ii. Increased subsidy to Mission schools and development of local and council schools; and

iii. Expansion of facilities for primary, Secondary, Technical and Teacher education.

The Education Act of 1961

In October 1961, the Nkrumah Administration established the Education Act of 1961 to give legal backing to changes introduced in the 1951 Development Plan, and to policy measures in education that the government wanted to pursue. For example, the government established the legal basis for compulsory education, and also specified the role of local educational authorities. The Act also specified the organisation and position of teachers.

The Education Review Committee of 1967

In 1967, the National Liberation Council (NLC) Administration appointed a 32-member committee, headed by the then Vice-Chancellor of the University of Ghana,

Professor Alex Kwapong "to conduct a comprehensive review of the educational system of Ghana at all levels and to make recommendations and suggest reform for improvement and for eliminating inefficiency and waste" (McWilliam and Kwamena-Poh, 1975, p. 50).

Among the recommendations of the Committee, were the following:

i. The use of a Ghanaian Language as a medium of instruction for the first 3 years of primary education and substituted by English from the fourth year;

ii. The raising of the academic and professional levels of teachers, as well as improvement in their conditions of service comparable to other types of employment;

iii. The restructuring of the education system of 6 years primary course, followed by 4 years of secondary school education with 2 years of sixth form work leading to a 3-year university degree course (4 or more years for specialised courses).

The Dzobo committee of 1974

In 1974, the Acheampong Military Administration appointed an educational reform committee under the chairmanship of Reverend Professor N. K. Dzobo, then of the University of Cape Coast, to consider the New Structure and Content of Education for Ghana. Out of the report, the National Redemption Council (NRC) Government approved the following structure and duration for the educational system (McWilliam and Kwamena-Poh, 1975; Antwi, 1992):

i. Kindergarten education; 18-24 months;

ii. Basic First Cycle Education: 6-year primary plus 3-year Junior Secondary. This was to be basic, free and compulsory for all;

iii. Second Cycle education made up of;

a) Senior Secondary Lower of 2 years leading to the then Ordinary Level Technical/Commercial Course;

b) Senior Secondary upper of 2 years leading to the Advanced Level, Teacher Training, Technical and Commercial course;

iv. Third Cycle Education, 3- year of University Education.

The implementation of the New Structure of Education took place in September 1976 with pupils taken from Primary 6 to constitute nine experimental Junior Secondary Schools (JSS). However, the poor financial status of the nation in the 1970s prevented the full-scale implementation of the programme.

The Education Reforms of 1987

In 1986, under the World Bank/IMF sponsored Economic Recovery Programme (ERP II), the Provisional National Defence Council (PNDC) Government came out with a plan to embark upon school reforms. In September 1987, the New Educational system was launched. A new educational structure of 6-3-3-4 similar to the 1974 one came to replace the old structure of 6-4-5-2. The new structure had a 9-year mandatory Basic Education consisting of 6 years primary and 3 years JSS programmes; followed by a 3-year Senior Secondary School (SSS) programme and 4-year tertiary education.

The major characteristic features of the 1987 Education Reform Programme include the following:

i. A complete change in the content and structure of Ghana's educational system. For example in 1987, all the Middle Schools in the country were replaced with Junior Secondary Schools;

ii. Emphasis on the acquisition of practical manipulative skills to make recipients economically self-supporting after their course; and

iii. A shortening of the duration of the pre-University education from 17 to y enable the government realise savings on the educational expenditure for further investment in education.

Overview of science curriculum in Ghana

The traditional science curriculum

Under the old secondary school system, students offered a minimum of 6 and maximum of 9 subjects for the SC/GCE "O" Level. The average number of subjects was seven. The courses offered in Science were as follows (Antwi, 1992): (I) Mathematics (ii) English Language, (iii) General Science, (iv) Additional General Science, (v) Biology, (vi) Chemistry, (vii) Physics, (viii) Agricultural Science, and, (ix) Health Science.

Unlike the traditional system, a Senior Secondary School student is expected to read between six and nine subjects for both core and elective subjects, but six subjects made up of 3 core and 3 elective subjects would be counted for University admission and any other tertiary institution. According to Adjei (1999), the courses offered in Science are as follows:

Core subjects (for all programmes), as (i) English Language, (ii) Mathematics, (iii) Integrated Science, (iv) Integrated Social Studies, and (v) Physical Education and Religious/Moral Education, are internally examined.

Elective Subjects (Science) are; (i) Mathematics, (ii) Physics, (iii) Chemistry; and, (iv) Biology. Under the new SSS programme, successful candidates with aggregate 24 or better qualify to enter the University or any other tertiary institution.

Teaching of science

Science teaching is a complex activity that lies at the heart of the vision of science education. Teachers are central to education, but they must not be placed in the position of

being solely responsible for reform. Teachers will need to work within a collegial, organizational, and policy context that is supportive of good science teaching. In addition, students must accept and share responsibility for their own learning. Effective teachers of science create an environment in which they and students work together as active learners. While students are engaged in learning about the natural world and the scientific principles needed to understand it, teachers are working with their colleagues to expand their knowledge about science teaching. To teach science, teachers must have theoretical and practical knowledge and abilities about science, learning, and science teaching. The standards for science teaching are grounded in four assumptions:

1. What students learn is greatly influenced by how they are taught;
2. The actions of teachers are deeply influenced by their perceptions of science as an enterprise and as a subject to be taught and learned.
3. Student understanding is actively constructed through individual and social processes.
4. Actions of teachers are deeply influenced by their understanding of and relationships with students.

Science, according to Omari (1981) is concerned with "the exploration and interpretation of the physical world" (p.14). However different academics express different views on the term, "Science". Awuku (1977) pointed out that the scientific enterprise is a complex concept and so divergent that it is difficult to state a simple and universally accepted definition. In other words, there is no clear-cut definition for science. The nature of science can only be understood properly when both the process (way of finding out) and the product (a system of ideas) are considered together. Anamuah-Mensah (1987) considers science as:

(i) A body of inquiry, (ii) way of thinking; and, (iii) as a human endeavour.

Anamuah-Mensah (1987) contended that the goal of science education in the schools is to give students an understanding of some of the more basic of these concepts. Scientific concepts according to Anamuah-Mensah (1987) are generalisations, which attempt to make sense out of the great variety of observable objects and phenomenon in nature. They are man's view of how and why nature behaves as it does. Thus science education could simply be defined as the process of transmitting the characteristics of the scientific culture, which are worthwhile to the younger generation. The scientific culture is considered as both skills and attitude. These include: (i) beliefs, (ii) knowledge, and, (iii) ideas and activities which are worthwhile and passed on to the younger generation so that they can cope with the environment (Anamuah-Mensah, 1987).

The process of transmitting the scientific culture is not restricted to the methods and techniques of transmission but also includes the context values, attitudes and procedures as well as the development and utilisation of research activities aimed at bringing improvement into teaching and learning of science.

Read (1959) summed it up that education is used both to perpetuate a culture and to change it. Science emphasises empiricism. Science therefore must be taught as an activity. The activities involved and referred to as skills and attitude include, observing, measuring, classifying, communicating and inferring.

The above observations show that science implies direct observation as well as the organisation and interpretation of data logically and systematically. Renner and Stafford (1977) explained that during instruction learners should be "provided with opportunities to analyse problems, imagine experiments, clarify, compare and analyse their results; synthesise and test hypothesis, evaluate the effectiveness of those tests, and infer future results" (pp. 30-31).

The basis for discovery teaching and learning is the interaction between the teacher and student in discovering knowledge; hence the need to introduce students to basic principles and the tools of enquiry using concrete terms. However, those teachers teaching science are criticised for their overuse of "chalk and talk" methods. The result is that the students' only respond to the examples set up by their teacher, and then memorise the facts presented to them.

The importance of science

According to Cornog (1963), Science equips an individual to absorb the mental nourishment to be gained from comprehending the great and rapidly following streams of thought that is the scientific endeavour. It is in the pursuit of science that scholars can find instances of the mind of man working in a spectacularly inventive and creative manner. Thus, when students appreciate the scope of the great and rapidly flowing stream of thought, that is the scientific endeavour, they may grasp a bit of that subtle urge to exercise their own intellects. The total universe of man's activities during any phase of civilisation is sharply influenced by the pursuit of science. Not only during that phase, but also and often by the roles Science played during past phases of the evolution of civilisation.

In another sense, science has influenced and been influenced by man's moral, social, political, artistic and technological enterprises, (Cornog, 1963) According Cornog (1963) science can give the individual a dynamic awareness of his environment. As the pursuit of science takes mankind ever deeper into the nature of matter and energy, the structure of the universe and the mystery of life itself, intricacies of form and design and magnitudes of time and space are being revealed that can awaken deep emotional responses. To have these responses awakened is the right of young people in a civilised

society. In many ways, science provided an introduction for the individual to many facets of his natural and social environment. When the introduction is properly negotiated, a kind of familiarity is generated. Whole new dimensions of interests are aroused and these new interests add a new dimension to the sphere of activity that becomes the life of the individual (Cornog, 1963).

Training of science teachers

Science teacher education developed from the training of teachers to teach Nature Study and Hygiene. In 1972, a one-year rural science programme was mounted at Bagabaga Training College, Tamale, to train Certificate "A" post middle and secondary to handle science at the primary and then middle schools. The elementary school science syllabus at that time became the pivot of the science teacher education programme in training colleges. In 1973, a two-year science specialist programme was run in selected colleges throughout the country for a period of four years and this gave way to the three-year post-secondary science programme. In March 1975, the Agbenyega Committee was appointed to review the entire teacher education programme.

It recommended the establishment of a new teacher-training course to be called the three-year Post Secondary Course to replace the then two-year Post Secondary Course. Through this programme, the three-year "quasi-science specialist" replaced the two-year science specialist course as well as the two year post-secondary science programme. In January 1981, GAST, teacher training panel with support from National Teacher Training Council (NTTC) was to diagnose the problems of science teacher education in Ghana. This sparked off a chain reaction in science teacher education in the country. Thus before 1987, the calibre of teacher qualified to teach science at the basic school level included: (i)

the Certificate A Post-middle and secondary (ii) the two-year specialist science and, (iii) the one-year rural science teacher.

These requirements assumed that the science teacher had a professional training as a teacher as well as being grounded in the techniques and methods employed in the teaching of science, organizing and improvisation of basic science apparatus, programmed instruction, teaching mechanisms and many other new concepts coming as a result of the dynamic nature of science. The numbers of qualified teachers were woefully inadequate to meet school requirements. Hence pupil teachers with Middle School Certificates and G.C.E. 'O' and 'A' Levels were employed to teach and these taught science as well. Most of these teachers had very weak science backgrounds and so perpetuated the cycle of weak science backgrounds for the pupils they taught (Ossei-Anto, 1999).

According to Owusu (1987) the acute shortage of manpower in the area of science could be attributed to the low level of science teaching in the Teacher Training Colleges and Secondary Schools. He reiterated that the exposure of children to science and technology at a tender age would fortify them to create the industrial and technological revolution, "that will save Africa from its sinking boat" (Owusu, 1987, p. 10).

Tuffour (1986) examined the way science is taught in the Training Colleges in Ghana and argued that, "if the instruction was left in the hands of well trained science tutors and appropriate facilities were provided, student teachers would acquire good scientific concept" (p. 1). In his view, the type of science teachers currently engaged in teacher training and the facilities currently available lead him to conclude that things were not in favour of the acquisition of good scientific concepts. Training College science teachers according to Tuffour were themselves so "untrained" and had such poor knowledge of science and science teaching that the science programme in the college was not considered to be in any manner as an internal subject (examinable) and that the

facilities for science teaching were woefully inadequate. Hence it resulted in either illiteracy in science or inadequacy of acquisition of science concepts. To produce scientists as well as science educators requires that each of them must be well trained. In order to satisfy the public demand for more scientists and technologists, there is the obvious need to improve on teaching methodology and to incorporate the latest educational technology for the training of scientists as well as teachers. Teaching resources and technologies used in this context help to illustrate principles and methodologies of appropriate teaching.

Provision of physical and material resources

Learning by doing is one of the cardinal principles of teaching science. Experimentation has put many theories on a sound footing and has also resulted in the rejection of many. History reveals that many beliefs and superstitions were thrashed out from the minds of people as a result of experimentation. The achievements of modern science are mainly due to the application of the experimental method. Practical work must therefore be made a prominent feature in any science course (Sharma, 1995).

According to Sharma (1995) if science is poorly taught and badly learnt, it is little more than burdening the mind with dead information. and it could degenerate into a new superstition. For sometime now, many science teachers have had no option but to resort to the lecture method partly due to the demands of the type of external examinations students are prepared for, or to the inadequacy or lack of science materials and apparatus, such as microscopes, telescopes, burettes, glassware, library books, science museum materials, standard textbooks, workbooks, teachers' manuals, chemicals, etc.

Ghana's sweeping educational reforms theoretically laid greater emphasis on hands-on education, in addition to minds-on and values-on education. Considering the objectives of the 1987 Educational Reforms, one would expect the Government to supply

adequate and appropriate science equipment and materials to all levels of education. According to Ossei-Anto (1999), a survey of science equipment and materials at various levels of the formal education system precipitated the following findings:

i. Kindergarten through to primary six: Supply of basic science apparatus and materials like test tubes, beakers, etc. are still being considered. The environment is therefore being prepared to serve as the resource for basic science teaching to a large extent.

ii Junior Secondary School Level: in 1988/89 academic year, each school was supplied with an average of two boxes of assorted science materials and equipment including, General Science Text Books. The supply enables the science teacher to hold demonstration lessons for five groups of a least eight students each. Some of the items in the science kit were as follows: sieves, measuring cylinders, rubber bungs, funnels, hand lenses, magnets, glass tubes, wire gauze and chemicals like Benedict's solution, iodine, potassium permanganate, charcoal powder etc.

iii. Senior Secondary School Level: The Government already has a scheme for supplying schools with science equipment and materials though inadequate. The Government must be given credit therefore for establishing and equipping Science Resource Centers throughout the country.

According to Ossei-Anto (1999) an amount of £20 million had been committed by government for the project. The establishment of the science resource centers is a laudable idea because students who hitherto had no access to some equipment and materials cannot have hands – on experience at these centres.

According to Ossei-Anto (1999) each science resource centre has equipment and materials adequate for practical lessons. The Biology Departments of schools with a resource centre for example, had altogether 745 pieces of equipment and the co-ordinators

a) The science centres are meant for practical work to supplement science teaching and not to replace teaching in satellite schools. However, due to inadequate publicity and education, the impression created is that teachers in satellite schools have two options that is either to conduct lessons at the centres with the assistance of trained staff or just observe as the centre staff conduct the practical lessons.

b) The cost of transporting students to and from the science Resource Centers, excluding the maintenance of the vehicle is quite substantial. Centre co-ordinators complain that funds needed for the running of the buses are not readily available.

c) The 110 centers should be so located such that all 452 Senior Secondary Schools in Ghana would have access to the centers. For cost effectiveness, each centre is expected to serve about five schools. So far, with an average of three schools being tried out, there are disturbing problems with the timetabling. Currently, some schools have four or more streams of science students in SSS 3 alone. If four or five schools are assigned to one centre, only SSS 3 students may have access to the centre.

Most public schools urgently need materials, equipment, physical facilities, and tools for an effective teaching – learning process and to improve the productivity of teachers.

It should be noted that the aims of secondary education include preparation for useful living within the society and preparation for higher education (Federal Republic of Nigeria, 1998). It is believed that if students take subjects like Electronics, Metalwork, Woodwork, Auto-Mechanics, Home Economics and the like and combine this education with some form of apprenticeship training, they could be self-employed. Where a student opts for higher education, and specializes in any professional course urgently needed by the country, then our attempts at realizing national development will be fully fulfilled. Unfortunately, most public schools are ill equipped to execute their mandate.

A number of studies (Ojoawo, 1990; Ibukun, 1992; Mbipom, 1992; Bamkefa, 1994) in Nigeria have shown that these basic requirements for the instructional process are not adequate in most public schools at the state level. The studies revealed that although the research findings were obtained few years ago, the situation has not changed significantly in most public secondary schools in Nigeria up till today. Perhaps, those pupils in model colleges and Federal Government College in Nigeria are luckier than their counterparts in state schools in this regard. This is because the former have better facilities and other educational resources than the latter. Educational achievements of pupils in these two environments are often different. It is therefore suggested by Ojoawo (1990) that the public school system be rehabilitated. The rehabilitation should involve the construction of decent and conducive classrooms, laboratories, libraries and workshops. Educational materials needed in schools should also be provided.

The studies by Ojoawo (1992) again revealed that the grossly inadequate funding of education has exacerbated the poor condition of the public secondary school system. It has been remarked that developing countries like Nigeria still spend lower percentage of their gross national product (GNP) on education than most developed countries (World Bank, 1998). Even though the World Bank study was conducted in 1988, the situation today remains the same as that obtained in 1988. Public schools in Nigeria are not given sufficient funds to cover recurrent expenditure .It is a common knowledge that most school principals are not involved in budgeting. It therefore becomes difficult to determine the actual needs of the schools. Everything depends on the judgement of the officials of the Ministry of Education. It is not surprising that the basic needs of schools are never met since those who are supposed to give useful information in the budgetary process are alienated. According to the World Bank (1998) study, proper budgeting which involves estimation of the recurrent and capital expenditures on education and identification of the

sources of revenue to finance education have become necessary if schools will not continue to suffer from inadequate funding. The World Bank study therefore recommended that Principals must of necessity be involved in budgeting in schools. Government and parents also need to increase their financial support for the school system. Proceeds from education tax and part of the earnings from the value added tax could be utilised to salvage secondary education.

School type and students' performance

Both elites and non-elites perceive schooling in general as a structure providing opportunities for status maintenance and status attainment. That is, whereas the elites perceive schooling as a structure providing opportunities for them to clone themselves socially, the non-elites on the other hand perceive it as a means of upward social mobility. Most parents tend to compare themselves with successful elites in their choice of schools for their children and wards. The tendency may suggest that elites, in their bid for social reproduction through education, tend to compare themselves with their like who have succeeded in reproducing themselves socially through education. Successful and established elites thus serve as reference groups for the burgeoning elites. The two elite groups also serve as reference groups to the non-elite.

Opare (1981), comparing the academic achievement of public and private schools in the nation's Junior Secondary Schools indicated that pupils in the private schools did far better than those in the public schools. The more important explanation is that the private schools are better equipped and are generally committed to having small classes and providing individual attention to students and are more supported by parents.

Most of the literature explain the increasing popularity of private schooling, as well as why the greatest patronage comes from the elite of society. The first explanation is that private schools provide the mechanisms for social mobility (Cookson and Persell, 1985) in

that they provide environments that are particularly conducive to the academic improvement of even the average student (Poell, Farrar, and Cohen, 1985). The other explanation is that private schooling is perceived as a mechanism for perpetuating the stratification system in that it provides excellent instruction guaranteeing high levels of academic performance (Sernau, 1993). There is paucity of explanation for the high academic performance of pupils in private schools relative to those in public schools in Ghana. The literature, however, provides explanations for academic performance in general. Those factors often cited to explain academic performance and educational attainment are conditions in the home, conditions in the school, and the level of motivation of the student.

Literature suggests that elite parents set high academic standard for their children at an early age. They also take great pains to draw their children's attention to what socio-economic success is, and the means to that end. Such children naturally tend to take their schoolwork serious, and they invariably become high achievers (Addae- Mensah, Djangmah and Agbenyega, 1973). Using the resource dilution model, Blake (1989) shows that sibling size is inversely related to academic achievement and educational attainment. Resources such as time, money, attention, space and materials for learning, are not enough to go round all the children when there are too many relatives to the family resource available. Thus, lacking conducive learning environments in the home and lacking assistance in homework, children with many siblings cannot be expected to do well in school, when family resources are limited.

Many studies on school quality and its effect on learning outcomes indicate that the availability of textbooks is a basic pre-requisite for ensuring effective leaning (Heyneman and Loxley, 1983, Caillods, 1989, Altbach, 1987). The studies suggest that when textbooks are inadequate or are not available pupils cannot be expected to do well

academically. In a Ghanaian study, Opare (1981) also found that motivation is a strong determinant of academic performance. According to him, a student who is determined to excel in school would work hard on his books in order to attain the desired level of performance.

In a study conducted by Gajar (1997) in some Tunapuna Hindu schools in India on the performance of pupils from the public and private schools, she found out that in the common entrance top 100 list of children who performed best in the exam, only 17 private school attendants made the ranking, with 83 places, including the top spot, going to public schools.

The study also revealed that some heads of schools felt that private schools are being outclassed on a school-to-school basis in the common entrance examinations. They explained that public schools perform better than private schools because the quality of the education depends on the commitment, dedication and the qualification of the teachers which the public schools have. They further explained that rich parents do not want their children to be exposed to the rough and tumble of the public system, but they argued that that is what would make the better citizens, and the aim of education would have been better fulfilled. Gajar also argued that the socio-economic factors also make the public schools a better place of learning than the private schools. She continued that in the private schools, they are accustomed to everybody having all the books, pens, pencils and nice shirt, but in the public schools you meet children who have torn shirt, mother dead, or with no lunch or no shoes. In this school sometimes three children share a soft drink. Gajar insisted that by so doing they learn about sharing and caring which does not go on in the private schools.

Atakpa and Ankomah (1998) conducted a study on the state of school management in Ghana. The purpose of the study was to examine methodology for promoting quality

teaching and learning even under adverse conditions and in the face of serious resource constraints in schools.

The study focussed on specific elements of school management such as: managing human resources (teachers and pupils), maintaining discipline in schools; communication; managing instructional time; managing co-curricular activities; managing learning resources; managing school funds; managing school intake and attendance; assessing pupil performance; assessing teacher performance; staff development (in-service training) and school community relation. Two categories of schools emerged from the study: effectively managed schools and ineffectively managed schools. The study revealed that head teachers of the effectively managed basic schools involved teachers and pupils in the administration of school. Duties were assigned to teachers and pupils towards the attainment of the overall objectives of the school. In the area of discipline, the effectively managed schools were found to have established acceptable standards of behaviour for teachers and pupils. Rules on personal hygiene and punctuality were strictly adhered to.

The study also showed that the effectively managed schools had cordial interpersonal relationships and effective channels of communication within the schools and with the communities. Regular staff meetings were held to plan the term's work, discuss administrative directives, strengthen teaching methods, solve problems that arise within the term and review the term's work. It was also found out from the research that all the schools categorised as effectively managed had drawn up plans for effective time management and utilization by both teachers and pupils. They ensured that class attendance registers and staff attendance books were well kept.

It was found out from the study that in some of the schools, a system had been designed whereby the roll is checked for all classes during assembly to check lateness and absenteeism. Class attendance registers were marked at the close of each day's work rather

than in the morning. Besides, the heads of those schools and the teachers on duty, as well as, prefects on duty were usually the first to arrive in school to supervise and monitor the activities of pupils and teachers. It was also observed that the heads regularly checked to ensure that the teachers and pupils were engaged in teaching/learning activities. They did this by going round the classes to monitor teaching and learning. Another finding was that the heads had schedules for receiving and vetting lesson notes of teachers. Many of them had devised schemes through which they were able to collect samples of pupils' exercise books to establish the quality and quantity of pupils work and thereby determine pupils and teachers work output. The organisation of co-curricular activities was common in the schools that were effectively managed. At the primary school level, co-curricular activities such as clubs and societies were virtually non-existent. At the JSS level however, the schools had clubs such as the debating societies and also had planned time schedules for the various activities such as debates, quizzes, etc. Field trips were organised by some of the well-managed JSS. Speech and prize giving days and open days were also organised to coincide with cultural festivities during which they invite the rulers of the community to participate. In terms of maintaining environmental aesthetic standards, trees, hedges, flowers and grass had been planted on the school compound. The trees and hedges were well trimmed at regular intervals to further enhance the beauty of the school.

In managing the school finance, the study revealed that the public basic schools were not collecting school fees; hence the head teachers were not keeping any books of accounts. The heads of the well-managed schools kept proper accounts on collection of these levies. Generally, the well-managed JSS did not make any special effort towards increasing admission by engaging in enrolment drives. Parents flocked these schools to seek admission for their wards because of the popularity the school had gained through their high academic performance. The effectively managed schools especially at the

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primary school level therefore had a problem of how to cope with the high public demand for enrolment. It was also noted that the level of teacher retention in the effectively managed schools was very high. This situation did not therefore make it necessary for new teachers to join the staff often.

However, whenever new teachers joined the staff, the heads did organise orientation courses for them on the school's traditions, values, regulations and administrative systems. Internal workshops or seminars were also occasionally organised by the heads to address issues relating to the syllabus changes and teaching methods. In the ineffectively managed schools, it was revealed that observance and enforcement of school's rules and regulations by both teachers and pupils were not evident. There was no system of authority, responsibility and accountability that enforced school rules and regulations. The school also lacked established acceptable standards of behaviour, and did not maintain basic standards of personal hygiene. Teaching and learning in these schools were characterised by general aloofness, total indifference and laxity on the part of both teachers and pupils.

A common feature of the ineffectively managed schools was that the marking of class attendance registers and the keeping of staff attendance books did not serve any purpose, as lateness and absenteeism on the part of both teachers and pupils had been accepted as normal by the heads. In some schools, it was fond out that records on staff and pupils' attendance did not exist. The heads did not have time to supervise teaching and learning in the school since they claimed they were overburdened with teaching themselves. Furthermore, it was observed that textbooks, library books, equipment, stores and supplies were most often not used to facilitate teaching and learning. Some of these schools did not have offices, or in some instances, the offices and classrooms lacked good doors and locks.

The research (Atakpa and Ankomah, 1998) also showed that the urban schools in the ineffectively managed category did not carry out any enrolment drives. They were fed from the high population of the urban areas. In the rural areas, however, some efforts were made to increase enrolment but because of the performance of the schools, parents were reluctant to send their children to the schools. Heads of the ineffectively managed schools, according to the study, did not carry out any purposeful assessment of pupils and teachers performance. Continuous assessment was not systematically done and teachers "conjured and cooked up" marks for continuous assessment records. Pupils and teachers work output could be described as poor.

Performance of science students in their elective subjects in the SSSCE

According to the West African Examination Council Chief Examiner's Report (1999) the standard of Biology 1B paper compared favourably with that of previous years. As far as the performance of the candidates was concerned, while a few good schools performed creditably well, the majority of the schools required to work harder. Most candidates from well-established schools could organize the information they have to answer the questions well. The report also stated that the Biology 2 Paper compared favourably with that of the previous years and could be considered as very fair, and based on the syllabus. The standard of performance by candidates, however, gave the impression that understanding Biology was a difficult matter for a great number of them.

West African Examination Council Chief Examiner's Report (1999) stated that the standard of the Chemistry 1 paper was quite high. It compared quite favourably with that of previous years in terms of standard. Candidate's performance was slightly better than that of previous years. Many candidates could not get the demands of the questions

because of their poor command of the English Language. Their answers therefore lacked luster.

The Chemistry 2, according to the report, the standard of all the three alternative papers were quite high and compared quite favourably with that of previous years. Most candidates answered all the three alternative papers satisfactory. There was a slight improvement in candidates' performance compared to that of previous years. According to the Chief Examiner's Report (1999) the standard of Physics 1 paper compared favourably with that of previous years. Candidates' performance was however; lower than noted in 1998 examination. This may, however, be due to poor preparation of candidates for the examination. The Physics 2 according to the reports compared favourably with that of the previous year. However, candidates' performance was slightly better.

According to the West African Examination Council Chief Examiner's report (1999), the standard of the elective mathematics paper compared favourably with that of previous years. The Chief examiner reported that the performance varied from centre to centre with some centres completely avoiding questions on certain topics suggesting that it was likely candidates were not taught those topics. In highlighting the weakness of candidates, the chief examiner stated that candidates could not expand a binomial expression for rational values. He further stated that candidates could not use differentials to determine the percentage error and failed to use the required number of ordinates.

Notwithstanding their weaknesses, the chief examiner commended candidates for demonstrating skills in simplification and rationalization of surds, determination of terms of a sequence using recurrence relations, evaluation and simplification of logarithmic functions. The chief examiner however, advised that teachers should examine the weaknesses of candidates and help them do more exercises on the neglected areas.

Summary

Science is generally acknowledged worldwide as an important tool for accelerated industrial development and nations strive to improve their industrial production capacity, hence the huge investment in science education. In most developing countries, a lot of emphasis is put on Science, Technology and Mathematics.

The literature revealed that science will need to work within a collegial, organisational and policy context that is supportive of good science teaching. In addition students must accept and share responsibility for their own learning.

The literature confirmed that the number of qualified teachers were woefully inadequate to meet school requirements. The acute shortage of manpower in the area of science could be attributed to the low level of science teaching in the Teacher Training colleges and secondary schools. The literature suggested that in order to satisfy the public demand for more scientists and technologists, there is the obvious need to improve on teaching methodology and to incorporate the latest educational technology for the training of scientists as well as teachers.

With regard to the type of school (public or private) attended and students' performance, the literature confirmed that elites and non- elites perceive schooling as a structure providing opportunities, status attainment and status maintenance. Comparing the academic achievement of public and private schools in the Junior Secondary Schools the literature showed that pupils in the private schools performed better than those in the public schools. The more important explanation is that the private schools are better equipped and are generally committed to having small classes and providing individual attention to students and are more supported by parents. On the other hand the literature also revealed that socio-economic factors also make the public schools a better place of learning than the private schools. It explained that the private schools are accustomed to

everyone having all the books, pens, pencils and nice shirt, but in the public schools children had torn shirt, mother dead, or no shoes.

With the performance of science students in their elective subjects in the SSSCE, the literature showed that candidates' performance in Biology in 1999 was slightly better than that of the previous years. It further revealed that many candidates could not get the demands of the questions because of their poor command of the English language. Their answers therefore lacked luster. In Chemistry, the literature revealed that in 1999, most candidates answered all the three alternative papers satisfactorily and there was a slight improvement in candidates' performance compared to that of previous years. In Physics, the candidates' performance was however lower than noted in the previous year, 1998. This, the examiner's report attributed to poor preparation of candidates for the examination.

CHAPTER THREE

METHODOLOGY

The general purpose of this study was to assess the trend in the performance of science students in the Senior Secondary School Certificate examination in Kumasi High School from 1996-2001. This chapter deals with; (i) Research Design, (ii) Population and Sampling, (iii) Data collection, (iv) Data analysis and (v) instruments.

Research design

Research questions were formulated and the descriptive survey design was subsequently used in answering the research questions.

According to Champion (1981), in descriptive survey research, the researcher has specific questions or hypotheses in mind and can imagine what a test of the hypotheses or an answer to a question might look like. In the descriptive survey, the events or conditions either already exist or have occurred and the researcher selects the relevant variables for an analysis of their relationship. Descriptive researches often employ methods of randomization so that error may be estimated when population characteristics are inferred from observation of samples. In descriptive statistics, according to Champion (1981), variables and procedures are described as accurately and completely as possible so that the study can be replicated by other researchers. A logical method of inductive-deductive reasoning is used to arrive at generalization. The weakness of the descriptive survey research is that it is susceptible to distortions through the introduction of biases in the measuring instruments.

Statistical tests or procedures used in the analysis of the data for this research included the mean, Kendall's tau and a t-test.

Population and sampling

The target population for this research was science students who were admitted to Kumasi High School for the Senior Secondary School Programme from 1996 to 2001.

All science students in each year group, that is, from 1996-2001 totalling five hundred and thirty-five (535) were used for the research, as shown in Table 1. The sample size of each year group was selected from the science class list for each year group.

As shown in Table 1 there was a rising enrolment over the years. The population of science students in 1996 was 47 representing 8.8% of the total population of science students. The students' population increased from 47 in 1996 to 52 in 1997 representing 10.6% increase over the previous year. In 1998, the enrolment grew to 82 representing 57.7% increase in population of science students over the previous year. In 1999, the population increased to 132 representing 60.9% increase in the population of science students over the previous year. In 2000, there was a drop in the enrolment figures, from 132 the previous year to 92 representing 30% decrease in the population of science students over the previous year. In 2001, the enrolment figure rose from 92 to 130 representing 41.3% increase in the population of science students over the previous year.

Table 1

Population of Science Students who wrote for SSSCE from 1996-2001

In Kumasi High School

Year	No. of science Students	Physics	Chemistry	Biology	Elective Maths
1996	47	47	47	30	17
1997	52	52	52	36	16
1998	82	82	82	52	30
1999	132	132	132	132	132
2000	92	92	92	92	92
2001	130	130	130	130	130
Total	535	535	535	472	417

Instruments

Non-structured personal interview, personal investigation and document analyses were used. Some science teachers who have been on the teaching staff of Kumasi High School since 1996 were interviewed. Basic schools attended by students, BECE and SSSCE results were collected from students personal record files and result sheets sent to schools by the West African Examinations Council.

Data collection

Data were collected from student's personal record file, B.E.C.E. results slips, and SSSCE results slip from the West African Examinations Council (WAEC) in November 2002. The researcher collected the data by going through the files of science students admitted from 1996 to 2001. Data collected from their personal record file, BECE and

SSSCE result slips included the J.S.S. attended by each student, i.e., either private or public school and aggregate of the BECE and the SSSCE results. A period of one month was used to collect the data.

Data analysis

The Statistical Package for the Social Sciences (SPSS 8.0) was used in the analysis of the data collected. The SPSS programme was used in analysing the research questions. Statistical tests or procedures used in the analysis of the data for this research included the mean, Kendall's tau-b and a t-test.

According to Champion (1981) mean is the most important and therefore the most widely used measure of central tendency. The mean conveys the idea of average value since it is derived from the exact values of the scores or items in a set. As a measure of central tendency, the mean gives a score that represents the total number of scores involved.

The usefulness of the mean stems from the fact that it uses every one of the scores of the group. This is because the sum on which the mean is based includes every score. Despite its usefulness, the mean has a limitation of being affected by extreme scores or observations. That is, very high and low scores tend to affect the mean. It is therefore sensitive to any change in the data values of the distribution.

Kendall tau-b according to Champion (1981) is a useful measure of association between two sets of scores that have been measured according to ordinal scales. The primary assumptions underlying Kendall's tau-b are that the researcher must have randomness and scores measured to an ordinal scale. There are no distributional requirements associated with this coefficient. An additional assumption is that N should be greater than 10 for proper application. Tau values also range from -1.00 to +1.00 (a prefect

negative relationship to a perfect positive relationship). One flaw associated with tau is that it is not suitable for situations where tied scores exist.

The t-test according to Champion (1981) is designed to determine the significance of differences between some hypothetical population μ and some observed mean ($\bar{x}$). The primary advantage of the t-test is that it is easy to use and a table of critical values exists for quick and convenient interpretation of the observed t values. The t-test has no sample size restrictions and many researchers are familiar with the t-test and it is conventional to apply such a test in research work. Lastly, it is the most powerful test a researcher can use when all assumptions associated with the data have been met. The primary disadvantage of the t-test is that it has rather stringent assumptions. Since the t-test has such restrictive and stringent assumptions, the research often finds it difficult to apply this test legitimately to collected data. Of course, the t-test is excellent whenever the assumptions associated with it have been satisfied.

The research questions analysed were;

1. What difference exists in the performance of students from the basic public and private schools in the SSSCE from 1996-2001?

   A t-test was used in analysing the data.

2. What is the relationship between the performances of science students in the BECE and the SSSCE results from 1996-2001?

   Kendall's tau-b was used in the analysis of the data.

3. What is the trend in the performance of science students in Physics in the SSSCE from 1996-2001?

   The mean of Physics results from 1996-2001 was computed. A line graph was plotted from the results to show the trend.

4. What is the trend in the performance of science students in Chemistry in the SSSCE from 1996-2001?

   The mean of Chemistry results from 1996-2001was computed. A line graph was plotted from the results to show the trend.

5. What is the trend in the performance of science students in Biology in the SSSCE from 1996-2001?

   The mean of Biology results from 1996-2001was computed. A line graph was plotted from the results to show the trend.

6. What is the trend in the performance of science students in Elective Maths in SSSCE from 1996-2001?

   The mean of Elective Maths results from 1996-2001 was computed. A line graph was plotted from the results to show the trend.

CHAPTER FOUR

RESULTS/FINDINGS

In this chapter, results and findings relating to the data collected are used to determine trends in the performance of science students in the Senior Secondary School Certificate Examinations (SSSCE) in Kumasi High School from 1996 – 2001 are presented.

Six (6) research questions were formulated to guide the study. The research questions were answered using the Statistical Package for Social Sciences (SPSS 8.0). The SSSCE results were categorised in the form of grades and frequency counts. Figures of 6, 5, 4, 3, 2 and 1 were assigned to the grades A, B, C, D, E and F respectively as weighted values. Descriptive statistics such as the mean, Kendall's tau .b and a t-test were used in the analyses of the data. Line graphs and frequency tables were also used to give further explanation.

Difference between the performance of students from public and private schools

What difference exists in the performance of students from the basic public and private schools in the SSSCE from 1996-2001?

In this research question, all science students who had their basic education in a private or a public school from 1996 to 2001and their performance in the SSSCE between the same periods of time was computed using a t-test to determine the difference in their performance.

The t-test conducted on the type of basic school (private or public) students attended and their performance in the SSSCE from 1996 -2001 revealed that there was no significant

difference between the performance of science students from the basic public and private schools in SSSCE on the basis of the aggregate grade value in the four elective science subjects. (M = 0.61, SD =3.61), t (533) = 1.69, p = .05). Performance of students from the basic public and private schools is expressed in Table 2.

Table 2

Performance of science students from the basic public and private schools in the SSSCE between 1996-2001 in Kumasi High school.

School Type	N	Mean	SD
Public	311	7.88	3.45
Private	224	8.49	3.79

Relationship between students' performance in the BECE and the SSSCE

What is the relationship between the performances of science students in the Basic Education Certificate examination (BECE) and their performance in the Senior Secondary School Certificate examination (SSSCE) from 1996-2001?

In this research question the performance of all science students in the Basic Education Certificate examination (BECE) was compared to their performance in the SSSCE to find out whether there was any relationship between the two performances. The study was computed using the Kendall's tau-b to find the relationship between the two performances.

The Kendall's tau-b measure used to find the relationship between the BECE results and the SSSCE results of science students from 1996 to 2001

revealed that there was a low but statistically significant relationship between the BECE and the SSSCE results. (r =.247, p=.01, N=535). The details of the students' performance in the BECE and the SSSCE have been presented in Appendix A.

Trend in students' performance in Physics

What is the trend in the performance of science students in Physics in the SSSCE from 1996-2001?

In this research question the results of science students in Physics in the SSSCE from 1996 to 2001 was computed using the mean to find the trend in performance of science students over the years under review. The results are shown in Table 3 and figure 1. The details of the performance of science students in Physics in the SSSCE between 1996-2001 have been presented in Appendix B.

The statistics presented in Table 3, shows the mean grade values of the results of science students in Physics in the SSSCE from 1996-2001. The table depicts that the 1996-year group with a population of 47 obtained a mean grade value of 1.80 which lies between grades E and F. The 1997-year group with 52 students obtained a mean grade value of 3.1 representing grade D, the 1998-year group with 82 students obtained a mean grade value of 2.33 representing grade E, the 1999-year group with 132 students obtained a mean grade value of 2.12 representing grade E, the 2000-year group with 92 students obtained a mean grade value of 2.35 representing grade E and lastly the 2001 year group with 130 students obtained a mean grade value of 1.71 which lies between grades E and F. The trend in the performance of science students in Physics from 1996-2001 is shown by the graph in figure 1. It depicts that the 1997 year group preformed best, followed by the 2000, 1998, 1999, 1996 and the 2001-year groups respectively as shown in figure 1. The

performance showed a downward trend after 1997 but rose in 2000 and fell in 2001. The general trend in the performance of science students in Physics in the SSSCE between 1996-2001 showed a downward trend.

Table 3.

Trends in performance of science students in Physics between 1996-2001 in Kumasi High school.

Year	No	Mean Grade Value
1996	47	1.80
1997	52	3.1
1998	82	2.33
1999	132	2.12
2000	92	2.35
2001	130	1.74

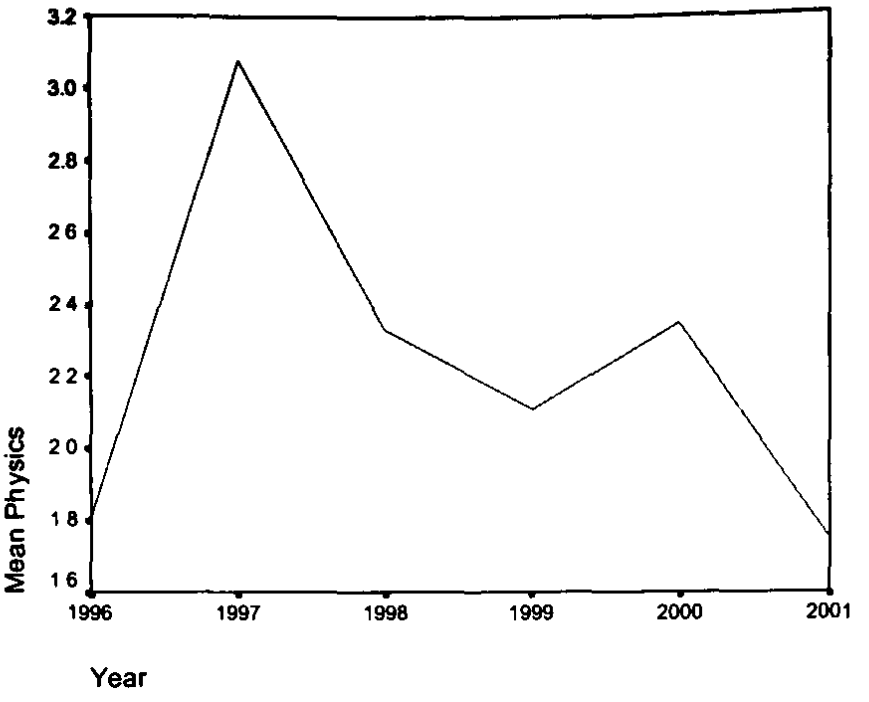

Figure 1. Performance of Physics students in SSSCE from 1996-2001.

Trend in students' performance in Chemistry

What is the trend in the performance of science students in Chemistry in the SSSCE from 1996-2001?

In this research question the results of science students in Chemistry in the SSSCE from 1996 to 2001 was computed using the mean to find the trend in performance over the years under study. The results are shown in Table 4 and figure 2. The details of the performance of science students in Chemistry in the SSSCE between 1996-2001 have been presented in Appendix C.

Table 4.

Trends in performance of science students in Chemistry between 1996-2001 in SSSCE in Kumasi High School.

Year	No	Mean Grade Value
1996	47	1.35
1997	52	2.25
1998	82	3.34
1999	132	2.25
2000	92	2.60
2001	130	2.84

The statistics presented in Table 4 above shows the mean grade values of the results of science students in Chemistry in the SSSCE from 1996-2001. The table revealed that the 1996-year group obtained a mean grade value of 1.55 which lies between grades E and F, the 1997-year group obtained a mean grade value of 2.25 representing grade E, the1998-year group obtained a mean grade value of 3.34 representing grade D, the 1999 year group obtained a mean grade value of 1.91 which lies between grades E and F, the 2000 year group obtained a mean grade value of 2.60 representing grade E and lastly the 2001year group obtained a mean grade value of 2.84 which lies between grades D and E. The trend in the performance of science students in Chemistry from 1996-2001 depicted that the 1998 year group performed best, followed by the 2001, 2000, 1997, 1999 and 1996 year groups respectively as shown in figure 2. The performance showed a downward trend after 1998 but improved in 2000 and 2001. The general trend in the performance of science students in Chemistry in the SSSCE showed a downward trend between 1996-2001.

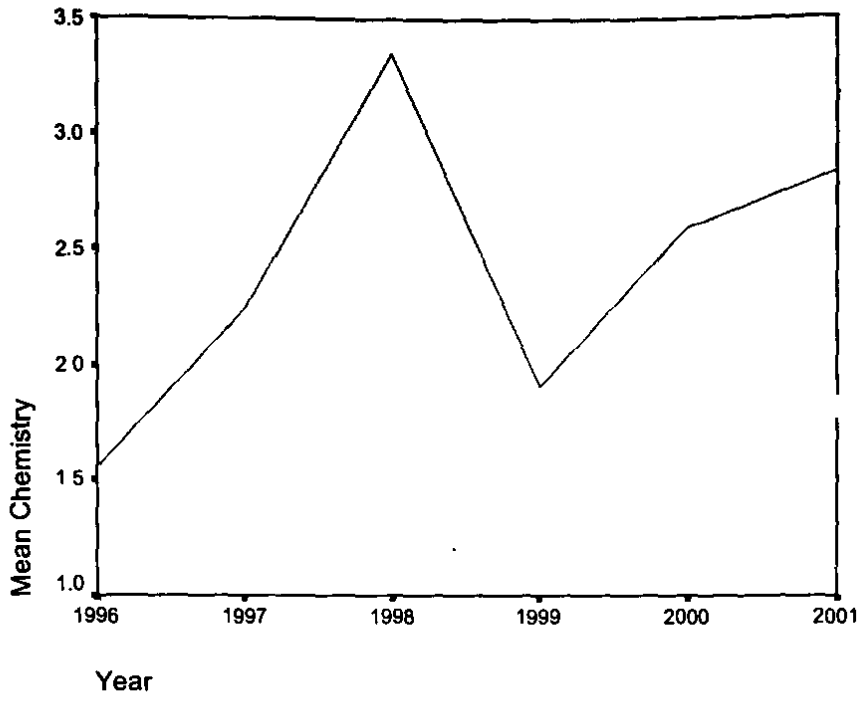

Figure 2. Performance of Chemistry students in SSSCE from 1996-2001.

Trend in students' performance in Biology

What is the trend in the performance of science students in Biology in the SSSCE from 1996-2001?

In this research question the results of science students in Biology in the SSSCE from 1996 to 2001 was computed using the mean to find the trend in performance over the years under review. The results are shown in Table 5 and figure 3. The details of the performance of science students in Biology in the SSSCE between 1996-2001 have been presented in Appendix D.

Table 5.

Trends in performance of science students in Biology between 1996-2001 in Kumasi High School.

Year	No	Mean Grade Value
1996	30	2.03
1997	36	2.47
1998	52	2.31
1999	132	1.58
2000	92	1.70
2001	130	1.70

The statistics presented in Table 5 above shows the mean grade values of the results of science students in Biology in the SSSCE from 1996-2001. The table showed that the 1996 year group obtained a mean grade value of 2.03 representing grade E, the 1997 year group obtained a mean grade value of 2.47 representing grade E, the 1998 year group obtained a mean grade value of 2.31 representing grade E, the 1999 year group obtained a mean grade value of 1.58 which lies between grades E and F, the 2000 year group obtained a mean grade value of 1.70 which lies between grades E and F. Lastly, the 2001 year group obtained a mean grade value of 1.70 which lies between grades E and F.

The trend in the performance of science students in Biology from 1996-2001 showed that the 1997 year group performed well followed by the 1998, 1996, 2000, 2001 and 1999 year groups respectively as shown in figure 3. The performance showed a downward trend after 1997 but improved slightly in 2000 and 2001. The general trend in

the performance of science students in Biology in the SSSCE between 1996-2001 showed a downward trend.

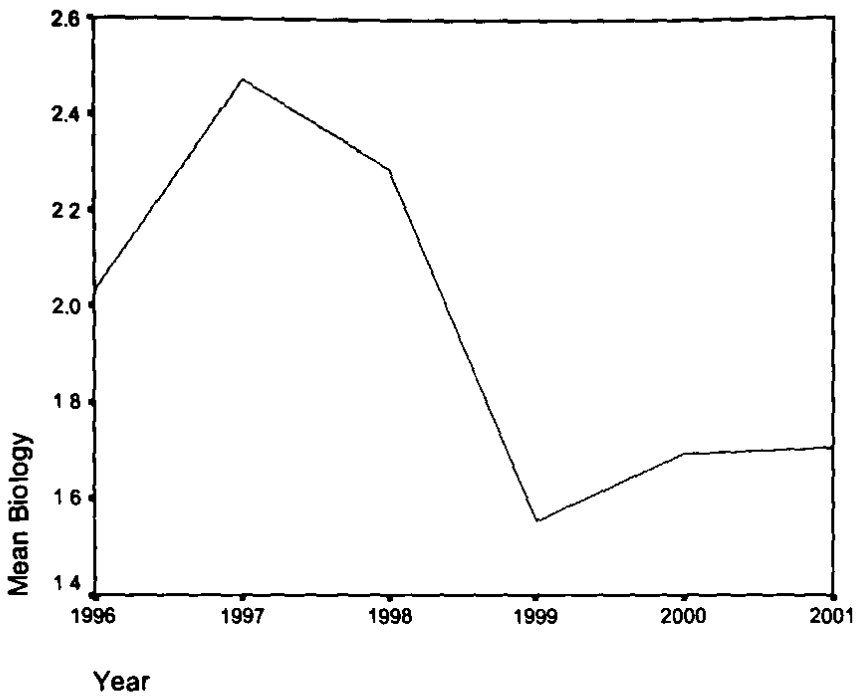

Figure 3. Performance of Biology students in SSSCE from 1996-2001.

Trend in students' performance in Elective Mathematics

What is the trend in the performance of science students in elective Maths in the SSSCE from 1996-2001?

In this research question the results of science students in elective mathematics in the SSSCE from 1996 to 2001 was computed using the mean to find the trend in performance over the years under study. The results are shown in Table 5 and figure 4. The details of the performance of science students in elective Mathematics in the SSSCE between 1996-2001 have presented in Appendix E.

Table 6.

Trend in performance of science students in Elective Mathematics between 1996-2001 in Kumasi High School.

Year	No	Mean Grade Value
1996	17	2.47
1997	16	2.94
1998	30	3.73
1999	132	2.06
2000	92	1.94
2001	130	2.49

The statistics presented in Table 6 above shows the mean grade values of the results of science students in elective Mathematics in the SSSCE from 1996-2001. The table revealed that the 1996 year group obtained a mean grade value of 2.47 representing grade E, the 1997 year group obtained a mean grade value of 2.94 representing grade D, the 1998 year group obtained a mean grade value of 3.73 representing grade C, the 1999 year group obtained a mean grade value of 2.06 representing grade E, the 2000 year group obtained a mean grade value of 1.94 representing grade E and lastly, the 2001 year group obtained a mean grade value of 2.49 representing grade E.

The trend in the performance of science students in elective Mathematics from 1996-2001 depicted that the 1998 year group performed well followed by the 1997, 2001, 1996, 1999, and the 2000 year groups respectively as shown in figure 4. The performance showed a downward trend after 1998.

The general trend in the performance of science students in elective Mathematics in the SSSCE between 1996-2001 showed a downward trend.

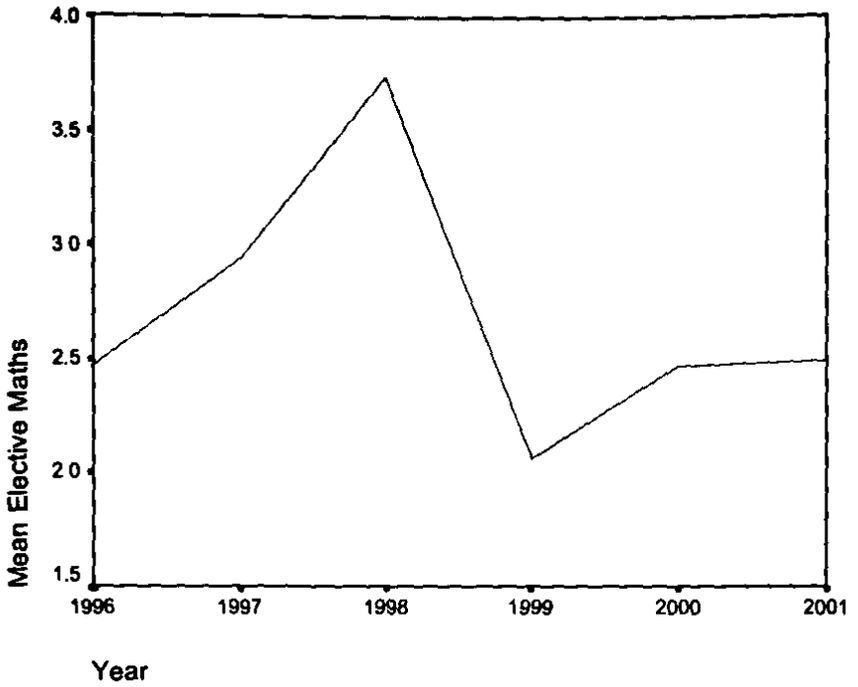

Figure 4. Performance of Elective Mathematics students in SSSCE from 1996- 2001.

Summary

This chapter covered the results of research questions posed by the researcher. The statistical procedures used in the analysis of the data collected included the mean, Kendall's tau-b and a t-test. These statistical procedures were used in analysing the trend in performance of students in their various elective subjects, namely, Physics, Chemistry, Biology and elective Mathematics in the SSSCE. In the research question formulated to find the difference in the performance of students from the basic public and private schools in the SSSCE, the results depicted that there was no difference in their performances. Considering the relationship between the performances of science students

in the BECE in relation to their performance in the SSSCE, the results depicted a very low correlation.

As regards science students' performance in their elective subjects, it was found out from the studies that the 1997 year-group performed better in Physics, the 1997 year group performed better in Biology and the 1998 year group performed better in Chemistry and Elective Mathematics.

In general, the performance of science students in their elective subjects, namely Physics, Chemistry, Biology and Elective Mathematics in the SSSCE between 1996-2001 showed a downward trend.

Tables and graphs were used to further explain the results obtained from the analysis of the data.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This study was designed to determine the trend in the performances of science students in the senior secondary school certificate examination (SSSCE) in Kumasi High School from 1996 to 2001.

The introduction of the new educational reform brought about wrangling among parents and teachers whose responsibility it is to teach these students about the enormous content of the senior secondary school programme and the relatively short period of the time as compared to the old system of education. These problems coupled with lack of the required textbooks, workshops, and inadequate science resource centers for the schools, made teachers and parents to advocate for the increase in the number years in the senior secondary school programme. These problems motivated the researcher to undertake the study. The descriptive survey research was used. Six (6) research questions were formulated and subsequently answered. Various statistical procedures were used in analyzing the data. These procedures included the mean, Kendall's tau-b and a t-test. Line graphs were also used to show the trends.

Summary of the findings

The t-test conducted on the type of basic school (private and public) students attended and their performance in the SSSCE from 1996-2001 indicated that there was no statistically significant difference between their performances.

On the relationship between the performance of science students in the BECE and their performance in the SSSCE, the results depicted a low but significant relationship. Computation on the trend in the performance of science students in their elective subjects namely, Physics, Chemistry, Biology and Elective Mathematics revealed a downward trend over the years under review.

Interpretation of the findings

On the t-test conducted, a critical study of the students' BECE results' slips indicated that about 90% of students admitted to study science in Kumasi High school over the years under review came from less endowed public schools and up and coming private schools in and around the communities where Kumasi High School is located, namely, Ahensan, Atonsu, Kaase, Gyinyase and Chirapatre. Personal investigations conducted by the researcher in some of the JSS in these communities indicated that most of the private schools whose students selected Kumasi High School for their SSS programme had untrained teachers and holders of the Senior Secondary School Certificate, with some awaiting their SSSCE results. Such 'teachers', it was found out, could not prepare their weekly forecast and lesson notes adequately but selected topics depending on the past BECE questions to teach.

It was also found out through personal investigations that most of these private schools had their proprietors as the schools' directors or head teachers and ensured that teachers attended school regularly and did not take any excuses for absenteeism. Such stringent measures in these private schools resulted in the regular exit of teachers and therefore inconsistencies in teaching methods, which affected students' performance negatively.

Personal investigations also conducted into public schools whose students selected Kumasi High School for their SSS programme indicated that such schools had qualified trained teachers with a minimum qualification of a 3-year post-secondary certificate. But there was laxity in supervision by some of the heads and class sizes were too large for teachers to handle effectively. These findings from the public and private schools where the study was conducted were in consonance with similar studies conducted by Hallak (1977) and Southworth (1995). Hallak's study was on the determinant of students' academic achievement. He emphasised that the quality of the educational system depended on the quality of teachers.

This statement connotes that before a student could perform well in higher educational level, he must have been groomed or cushioned by the availability of qualified teachers in his elementary school days, which he uses as a springboard. Southworth (1995) on the other hand argued that the whole success of a school is to a large extent shaped by the manner in which the headteacher perceives and performs his role in the school. The study revealed that the headteacher of an effectively managed school involved teachers and pupils in the administration of the school. Duties were assigned to teachers and pupils towards the attainment of the overall objectives of the school.

The researcher also found through personal investigations that students from the basic private and public schools within the communities in which Kumasi High school is situated had parents of low socio-economic backgrounds. Personal also investigations revealed that these are predominantly a low income earning communities, as most of the inhabitants are petty traders and casual labourers in the timber factories at Kaase and Ahensan. Such students, it was found out, invariably lacked enough emotional and social contact with both parents as most parents leave home for days just to make ends meet. Most parents it was also found out, could not monitor their wards' performance, neither do

they help them with their homework as they leave home early in the morning and returned late in the night. The findings of socio-economic background and the academic performance of students from the basic public and private schools lent support to some studies conducted by Bloom (1980), Anderson (1988) and Opare (1981).

Bloom (1980) explained that the socio-economic variable is very complex and includes income level, parental education, parental occupation, neighbourhood, home environment and others. He further explained the home environment on students' academic performance in two ways. First, at the early stage of development, a child is born to a family and grows up within the scope and characteristics of his / her environment. The child at this stage acquires the initial social behaviour and manners. He argued that the child's intellectual potentialities for success in school education depended on the initial efforts of the parents in cultivating this potentiality and thereby establishing a good functional relationship with teachers. Secondly, after school hours children spend the rest of the time in their homes and some parents may show interest in helping their children in their studies while at home, while others may not.

Anderson (1988) also found out that in both developed and developing countries children who come from poor families do not enroll in school. Because parents' occupational status is generally low, they are poor. Children of such parents normally drop out of school as compared to children who come from better-off families. He argued that poverty compels children from poor families to drop out of school or perform poorly academically because there are school related expenses apart from school fees which most parents could afford. These are uniforms, stationery, furniture, school building fund, money for science and agricultural materials and tools, examination fees, daily pocket money for transportation and food at school.

He concluded that if the parents are of low socio-economic status with limited resources, the child's effort may be thwarted and this may predispose the child to stop schooling or perform poorly. The literature suggests that the educational level of parents become a challenge to the children who compete to equal or go beyond the level of their parent's education.

The second task of the study was to find the relationship between the performances of science students in the Basic Education Certificate Examination (BECE) and their performance in the Senior Secondary School Certificate examination (SSSCE) and the Kendall's tau-b statistics was used. The result obtained from this procedure was .247 depicting a low relationship between the two examinations. To this end, since majority of teachers at the basic level are 3-year Post Secondary Teacher trainees, the researcher conducted a critical study of the Teacher Training colleges' science syllabus in relation to that of the JSS. The study of the two syllabi revealed a relationship between them, that is, what the teacher trainees were taught had bearing on the JSS syllabus. The broad aim of the science syllabus for the 3-year Post Secondary Teacher Training Colleges is to provide the students with the basic science education so as to enable them understand and to some extent, exercise control over the environment in which they live. A critical study of the JSS syllabus also revealed similar aim as that of the Teacher trainees. But it was also found out from the JSS syllabus that JSS schools needed to be provided with science laboratories, as they needed to keep some equipment required for their practical. For instance, according to the JSS syllabus, students were supposed to have science equipment like Bunsen burners, test tubes, dissecting kits, hand lenses etc., and chemicals like ammonia, calcium hydroxide, hydrochloric acid, nitric acid etc. for their practicals as stated in the syllabus.

The researcher found out that the JSS in the communities whose students attended Kumasi High school lacked these science laboratories and as such teachers concentrated on the theoretical aspects of science teaching; meanwhile the JSS syllabus encourages science teachers to make their teaching activity-oriented by providing a variety of activities. This requires the science teacher to ensure that sufficient and relevant materials are provided. Further investigations conducted by the researcher also revealed that many of these basic schools lacked trained science teachers and therefore the students covered not much of the JSS syllabus.

These findings on the relationship between the performance of students in the BECE and the SSSCE lent support to a study conducted by the Ministry of Education (M O E, 1996a) on the trends of school – going population at the basic level of education in Ghana. The study revealed that the government of Ghana recognized basic education as the fundamental block of the nation. The quality of teaching and learning was observed to be very low. According to the study, evidence from assessments indicated that increased funding of education at the basic level has not contributed in any way to an improvement in the literacy and cognitive abilities of pupils (MOE, 1996a). It was found out that the quality of the present basic education in many schools is insufficient to impart sustainable literacy and knowledge skills and habits required for full social and economic participation in society.

As part of the intervention design by the MOE to improve the quality of teaching and learning, the study suggested that the basic schools should be provided with the necessary teaching/learning materials, which the research findings found to be lacking in basic schools in the study areas, new teachers should be trained and old ones should also receive in-service training in a re-structured system of training. It was the expectation of the study that progress towards the achievement of the above stated goals would be

evaluated on a yearly basis to ascertain whether teacher quality and teaching materials in the basic schools have improved.

The findings by the researcher on the performance of students at the basic level in relation to their performance in the SSSCE are also consistent with Owolabi's (1984) study on the trend analysis of Ghana's school-going population. His study showed that teacher supply at the basic school affected the school going population and academic achievement. It revealed that the number of teachers in both primary and JSS in Ghana fluctuated over the study years, that is, from 1988 to1995 maintaining a steady increase only in the last three years. The study by Owolabi depicted that about two-thirds of the teachers in the primary schools were trained, while about three quarters of those in the JSS were trained. To improve the quality of education imparted and to acquaint teachers with new methods and re-orient them towards the objectives of the new FCUBE (Free and Compulsory Universal Basic Education) programme, it was necessary to train new teachers and retrain existing ones through seminars, workshops and short in-service courses.

The third task was to find the trend in the performance of science students in their elective subjects, namely, Physics, Chemistry, Biology and elective Mathematics. Analysis of students' performance in the four elective subjects depicted a downward trend.

Science students have attributed various reasons to such dismal performance over the years. Unstructured interviews with science teachers and students revealed that majority of the students who opted for science during their selection of programmes at the basic level came to the senior secondary school to find the science programme much more difficult than they had envisaged. Many of them had to change programmes, with some moving from Science to the General Arts and Business programmes where they found respite.

Some of the science teachers explained that some of the students could not grapple with the various scientific concepts, and had to change programmes after a term's work and others after a year's work to repeat and change programme. Observations revealed that the science laboratories, namely Physics, Chemistry and Biology were ill equipped. The Parent Teacher Association (PTA) of Kumasi High school in 2001 renovated the Chemistry and Physics laboratories but without equipment and chemicals for practicals. The Biology laboratory has been in a dilapidated state since 1994 and it is yet to be renovated. Science teachers therefore complained about their inability to organize enough practical work for the students.

Personal observation also revealed that science teachers employed to teach science in the school did not stay long enough as they left the teaching service to find greener pastures elsewhere. Such movement by science teachers had contributed to the inconsistencies of students' performance in their elective subjects from 1996 to 2001. Responses from unstructured interviews with some science teachers who were on the staff from 1996 to 2001 revealed that the non-availability of science textbooks, scientific calculators and the high cost of available ones and lack of the required science equipment contributed to students' dismal performance in their elective subjects as majority of them could not afford to buy more of such books. Again some of the students complained about the attitude of some of the science teachers. They said that some teachers tended to concentrate more on the organization of extra classes for them and other private candidates at a fee to the neglect of the normal classroom teaching and not all of them could afford the fee. They also complained about the upsurge of educational pamphlets purported to help them at a cost. A student's inability to buy some of these pamphlets put them in a disadvantaged position.

A related study, conducted by Crentsil (1996), showed low performance of students in Physics, Chemistry and Biology. His study revealed that the number of students who applied to study Physics at Ghanaian Universities have been persistently low since the inception of the senior secondary programme in 1993. His study, which covered around six educationally renowned secondary schools in the Cape Coast municipality in the Central Region of Ghana, showed that the results of Physics and other science subjects, notably, Biology and Chemistry were consistently poor in almost all the schools The results were compiled from the report of the senior secondary school examination conducted by the West African Examination Council (WAEC) in 1993. The study revealed that, one of the factors contributing to this trend could be poor understanding of the scientific concepts by pupils (Nelson, 1992). Also, most students already consider Physics to be the most difficult, most boring and hence the most disliked subject with the sciences (Nachtigall, 1995)

Djangmah (1988) highlighted that the method used in teaching scientific and especially Physics concept is not in consonance with the child's cognitive and affective development. Another factor could be attributed to the findings that students hold alternate ideas about scientific phenomenon which are taught in schools and that these alternate views persist and often interfere with correct scientific explanations in the course of the academic studies (Pope and Gilbert 1983; Driver 1989; Erickson, 1979; Osborne and Gilbert; 1980).

For instance, the response to a problem on the Newton's law of motion posed by the researcher to students showed that most students think wrongly that force always causes motion. In other words, most students have the notion that motion always implies an external force causing it or vice versa. This notion also made the students choose incorrect responses to explain that if a body continues to move without any visible or

applied external force then the initial impelling force must have been transferred from one system to another.

Crentsil's (1996) study revealed that students' misconception could stem from the wrong or the literal interpretation of Newton's first and second laws of motion that force is always responsible for motion. This idea or the interpretation the study revealed, would be acceptable if only students were thinking of force causing change of motion or state of rest. Crentsil further explained that external forces acting on a body do not necessarily cause change in the state of rest or motion unless when they do not balance. He explained that only a resulting unbalanced force could cause change in the state of rest or motion. In an interview conducted for the study, it was observed that none of the students could make complete statements of the Newton's first law of motion. The students had forgotten the correct statement of the law. They could not comprehend the law but rather committed it to memory, hence, making it easy to forget. On the other hand, a few students could guess that forces could still act on a body at rest. However, they were not able to apply the law to explain the question as to how a body at rest could still have external forces acting and yet not move. In the same study on the misconceptions in Physics by Crentsil, analysis of the data from students in SSS1, SSS2 and SSS3 of Mfantsipim School in the Central Region showed that similar misconceptions of force and friction exist among the students. This result confirms those reported by Osborne and Gilbert (1980) and Nelson (1992) that misconceptions are prevalent among students at all academic levels of education.

Alani (2000) revealed that concerns have been expressed about the failure of a large number of students in the science subjects in the SSSCE each year. He explained that a number of happenings in secondary schools provide evidence that all is not well with the senior secondary system. He mentioned inadequate funding, lack of qualified teachers,

equipment, teaching materials and workshops (for the vocational and technical subjects) as some of the factors that have contributed to the high failure rate of students in the SSSCE.

Educational implications of the findings

A number of educational implications could be drawn from the findings of the study.

The general impression derived from the study suggested that private and public schools in the communities where Kumasi High school is situated, namely, Kaase, Ahensan, Atonsu, Chirapatre, and Gyinyase lacked infrastructure and equipment for science thereby warranting their dismal performance at the senior secondary schools.

Drawing inferences from this situation, it is plausible to say that science students from the public and private schools in these communities will continue to perform poorly in science at the senior secondary schools, because science poorly taught and badly learnt is little more than burdening the mind with dead information and it could degenerate into a new superstition. The irony of the situation is that Ghana's sweeping educational reforms theoretically lay greater emphasis on the hands – on education. Considering the objects of the reforms, one would have expected the government to supply adequate and appropriate science equipment and materials to all levels of education. Unfortunately, this expectation has not been met.

The finding that students from the basic private and public schools within the communities in which Kumasi High school is situated had parents of low socio-economic background is not surprising since the socio-economic class in which parents find themselves, their income and the prohibitive cost of the science programme contribute significantly to shaping decisions about the science programme. The implication is that where parents find themselves in petty trading and less paid jobs which attract meager

Lastly, on the question of the difference in the performance of pupils from the basic public and private schools in the SSSCE, it was shown from the study that there was no statistically significant difference between the achievement of science students from the basic public and private schools in the SSSCE.

From the foregoing, it is evident that although government has been making spirited efforts to develop science education in this country, the overall results has been less satisfactory. Therefore much remains to be done if the country is to develop scientifically and technologically.

Recommendations

Based on the findings of the study and conclusions drawn from them, the following recommendations are made to government and other stakeholders to improve students' performance in science elective subjects:

1. Educational authorities, especially the Kumasi Metropolitan Educational office should intensify its supervisory work in the public schools to check laxity on the part of some head teachers and large class sizes which make class management difficult for classroom teachers.

2. In the case of private schools, the Kumasi Metropolitan education office must ensure that proprietors of these schools employ qualified science teachers to teach or arrange in-service training courses in the teaching of science for their teachers regularly. Again, proprietors of private schools should improve the condition of service of their teachers to enable them stay and teach for longer period of time.

3. Parents and guardians should take interest in their wards' education as well as choice of subjects and monitoring of their school attendance.

4. The Ministry of Education should establish a science resource center for the five communities, namely, Ahinsan, Kaase, Atonsu, Chirapatre and Gyinyase and qualified laboratory technician employed to organize science practicals for the various schools, both public and private.

5. The school authorities must ensure through the head of the science department that science teachers cover their scheme of work as required of them during normal teaching period so that students who cannot afford extra classes are not disadvantaged.

6. School authorities must encourage students to report any teacher who tends to absent himself regularly from class thereby dragging them behind with respect to the coverage of the syllabus and warranting the organisation of extra classes.

7. The Ministry of Education should initiate a special best teachers' award for science teachers.

Suggestions for Future Research

This study on the trends in the performance of science students in the Senior Secondary School Certificate Examination was conducted in Kumasi High School in the Ashanti Region of Ghana, which has a peculiar socio-cultural and economic background reinforced by long years of formal education, with many well established institutions. It would therefore be worthwhile undertaking a similar study in other schools in Ashanti Region for purposes of comparison.

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APPENDICES

APPENDIX A

Performance in aggregate of science students in the BECE and the SSSCE from 1996-2001.

Year	No. of students	BECE AGG.	SSSCE AGG.
1996	1	13	33
	2	09	29
	3	09	24
	4	13	28
	5	10	31
	6	12	36
	7	08	32
	8	12	33
	9	12	22
	10	13	34
	11	10	30
	12	08	23
	13	07	21
	14	13	31
	15	07	24
	16	13	32
	17	08	34
	18	12	25

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1996	19	08	23
	20	06	21
	21	10	10
	22	06	27
	23	09	20
	24	09	36
	25	12	30
	26	12	25
	27	06	23
	28	08	33
	29	13	28
	30	10	26
	31	10	20
	32	10	34
	33	07	26
	34	10	31
	35	11	35
	36	07	23
	37	08	29
	38	11	27
	39	07	27
	40	08	32

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG
1996	41	09	30
	42	08	26
	43	10	27
	45	07	25
	46	09	28
	47	06	16
1997	1	06	13
	2	09	26
	3	07	29
	4	06	18
	5	07	30
	6	08	28
	7	08	33
	8	06	09
	9	06	19
	10	08	27
	11	06	26
	12	06	13
	13	06	30
	14	07	23
	15	12	24

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1997	16	06	25
	17	11	20
	18	07	28
	19	08	20
	20	08	18
	21	08	31
	22	07	21
	23	08	24
	24	06	12
	25	06	18
	26	06	23
	27	07	24
	28	07	25
	29	15	36
	30	09	19
	31	07	31
	32	07	13
	33	06	14
	34	06	24
	35	10	21
	36	11	26

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1997	37	07	19
	38	09	25
	39	08	20
	40	06	24
	41	06	18
	42	06	24
	43	06	24
	44	07	21
	45	08	29
	46	07	23
	47	08	24
	48	09	30
	49	06	25
	50	06	18
	51	08	23
	52	06	24
1998	1	06	26
	2	06	14
	3	14	16
	4	08	23
	5	06	14
	6	08	18

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1998	7	10	23
	8	10	28
	9	06	26
	10	08	14
	11	08	23
	12	07	18
	13	06	21
	14	06	20
	15	09	25
	16	12	34
	17	09	32
	18	07	24
	19	08	28
	20	07	28
	21	06	21
	22	06	27
	23	07	27
	24	09	28
	25	06	16
	26	14	36
	27	07	17
	28	11	36

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1998	29	09	25
	30	08	26
	31	07	23
	32	08	17
	33	09	26
	34	10	29
	35	06	31
	36	12	31
	37	06	23
	38	15	23
	39	09	25
	40	06	18
	41	09	16
	42	07	18
	43	06	11
	44	06	10
	45	06	24
	46	07	22
	47	10	23
	48	07	32
	49	09	20
	50	10	29

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1998	51	08	21
	52	08	22
	53	12	32
	54	07	21
	55	09	25
	56	06	16
	57	10	27
	58	11	30
	59	09	26
	60	07	33
	61	06	27
	62	06	14
	63	06	16
	64	06	13
	65	08	24
	66	10	32
	67	07	20
	68	10	35
	69	09	28
	70	10	26
	71	08	21
	72	06	12

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1998	51	08	21
	52	08	22
	53	12	32
	54	07	21
	55	09	25
	56	06	16
	57	10	27
	58	11	30
	59	09	26
	60	07	33
	61	06	27
	62	06	14
	63	06	16
	64	06	13
	65	08	24
	66	10	32
	67	07	20
	68	10	35
	69	09	28
	70	10	26
	71	08	21
	72	06	12

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1998	73	09	16
	74	08	13
	75	06	26
	76	07	26
	77	11	32
	78	06	22
	79	09	24
	80	08	21
	81	06	10
	82	06	27
1999	1	08	18
	2	09	23
	3	12	30
	4	07	28
	5	08	33
	6	07	31
	7	10	36
	8	11	36
	9	11	27
	10	10	35
	11	07	12
	12	06	33

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1999	13	06	29
	14	08	34
	15	07	21
	16	06	25
	17	11	32
	18	06	24
	19	07	25
	20	08	31
	21	12	36
	22	09	28
	23	07	26
	24	09	25
	25	09	33
	26	08	25
	27	08	23
	28	06	24
	29	12	32
	30	06	17
	31	11	31
	32	06	16
	33	11	34
	34	08	30

Appendix A continued

Year	No. of students	BFCF AGG	SSSCF AGG
1999	35	06	20
	36	08	22
	37	08	34
	38	12	32
	39	09	32
	40	08	35
	41	13	34
	42	06	19
	43	08	35
	44	06	30
	45	06	30
	46	10	33
	47	06	22
	48	10	34
	49	09	22
	50	10	34
	51	07	16
	52	08	28
	53	08	35
	54	08	22
	55	07	32
	56	08	27

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1999	57	06	?8
	58	09	27
	59	14	24
	60	09	27
	61	07	29
	62	11	17
	63	09	28
	64	07	19
	65	09	30
	66	06	24
	67	06	34
	68	13	35
	69	06	17
	70	08	26
	71	06	27
	72	08	33
	73	09	35
	74	06	17
	75	08	28
	76	07	26
	77	08	28

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1999	78	06	33
	79	06	32
	80	07	21
	81	17	32
	82	07	24
	83	06	26
	84	09	27
	85	09	24
	86	09	34
	87	07	22
	88	11	28
	89	06	23
	90	08	31
	91	06	29
	92	06	26
	93	07	26
	94	09	27
	95	08	24
	96	06	30
	97	07	35
	98	06	16
	99	06	26

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1999	100	06	26
	101	06	23
	102	08	29
	103	11	34
	104	10	26
	105	12	34
	106	12	34
	107	09	27
	108	07	27
	109	06	32
	110	11	32
	111	09	26
	112	12	28
	113	09	30
	114	07	28
	115	06	28
	116	07	31
	117	06	35
	118	09	14
	119	06	34
	120	06	30

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
1999	121	12	25
	122	06	21
	123	11	29
	124	11	34
	125	09	33
	126	07	33
	127	11	35
	128	09	32
	129	10	30
	130	08	36
	131	08	26
	132	08	30
2000	1	10	23
	2	09	25
	3	06	35
	4	06	23
	5	06	22
	6	09	31
	7	11	26
	8	09	22
	9	06	29
	10	07	16

Appendix A continued

Year	No. of students	BECE AGG.	SCCE AGG.
2000	11	06	25
	12	06	15
	13	06	30
	14	06	31
	15	06	18
	16	06	17
	17	07	10
	18	09	18
	19	06	24
	20	06	24
	21	06	28
	22	11	26
	23	11	14
	24	06	30
	25	06	23
	26	06	15
	27	09	27
	28	09	21
	29	06	24
	30	06	25
	31	06	21
	32	06	22

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
2000	33	07	29
	34	06	28
	35	06	26
	36	08	28
	37	06	10
	38	06	13
	39	06	24
	40	10	20
	41	06	11
	42	06	19
	43	09	25
	44	09	14
	45	06	28
	46	12	33
	47	09	25
	48	06	26
	49	06	26
	50	06	24
	51	07	32
	52	08	26
	53	06	25
	54	06	12

Appendix A continued

Year	No. of students	BECE AGG	SSSCE AGG.
2000	55	08	27
	56	06	22
	57	06	19
	58	06	25
	59	06	33
	60	08	30
	61	06	23
	62	06	33
	63	07	21
	64	08	29
	65	06	34
	66	12	15
	67	08	32
	68	07	07
	69	06	25
	70	07	26
	71	07	23
	72	06	31
	73	10	24
	74	06	29
	75	09	30

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
2000	76	06	27
	77	10	19
	78	10	31
	79	08	09
	80	06	22
	81	13	25
	82	12	22
	83	09	34
	84	06	19
	85	06	22
	86	06	08
	87	10	33
	88	08	28
	89	10	34
	90	09	20
	91	08	34
	92	09	33
2001	1	06	24
	2	07	13
	3	10	32
	4	07	26
	5	09	25

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
2001	6	09	26
	7	06	15
	8	06	28
	9	06	27
	10	08	33
	11	06	30
	12	06	20
	13	06	11
	14	06	29
	15	08	15
	16	07	23
	17	08	24
	18	09	26
	19	06	27
	20	07	25
	21	06	17
	22	08	26
	23	07	31
	24	09	33
	25	08	25
	26	06	29
	27	06	13

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG
2001	28	08	27
	29	14	24
	30	06	25
	31	07	22
	32	07	28
	33	06	18
	34	09	26
	35	08	18
	36	08	31
	37	09	24
	38	07	17
	39	06	21
	40	07	23
	41	06	17
	42	06	26
	43	06	21
	44	07	28
	45	09	20
	46	08	22
	47	10	25
	48	06	24
	49	07	31

Appendix A continued

Year	No. of students	BFCF AGG.	SSSCF AGG.
2001	50	07	32
	51	08	28
	52	08	28
	53	07	27
	54	06	17
	55	12	28
	56	07	21
	57	06	15
	58	08	25
	59	06	08
	60	10	23
	61	08	22
	62	08	34
	63	07	20
	64	09	24
	65	07	27
	66	06	24
	67	07	32
	68	10	30
	69	10	27
	70	16	18

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
2001	71	06	31
	72	06	27
	73	08	22
	74	07	22
	75	10	24
	76	07	24
	77	08	16
	78	06	28
	79	07	27
	80	06	21
	81	06	28
	82	11	26
	83	06	23
	84	09	28
	85	07	26
	86	06	28
	87	09	27
	88	06	22
	89	08	24
	90	07	26
	91	06	19
	92	06	29

Appendix A continued

Year	No. of students	BECE AGG.	SSSCE AGG.
2001	93	06	20
	94	07	22
	95	09	15
	96	06	31
	97	07	21
	98	10	29
	99	06	26
	100	07	17
	101	07	31
	102	12	25
	103	06	24
	104	07	22
	105	06	25
	106	07	24
	107	06	30
	108	08	32
	109	06	15
	110	09	26
	111	13	29
	112	06	30
	113	06	32

Appendix A continued

Year	No. of students	BECE AGG	SSSCE AGG
2001	114	10	23
	115	07	23
	116	06	22
	117	07	24
	118	06	26
	119	06	18
	120	09	29
	121	06	20
	122	06	34
	123	10	06
	124	06	23
	125	06	27
	126	08	32
	127	07	32
	128	10	32
	129	14	25
	130	07	19

APPENDIX B

Performance of science students in Physics between 1996-2001 in Kumasi High school

Year	Grade	Value	Frequency	Mean
1996	A	6	0	1.80
	B	5	0	
	C	4	4	
	D	3	2	
	E	2	22	
	F	1	19	
1997	A	6	1	3.1
	B	5	5	
	C	4	13	
	D	3	13	
	E	2	19	
	F	1	1	

Appendix B continued.

Year	Grade	Value	Frequency	Mean
1998	A	6	0	2.33
	B	5	8	
	C	4	5	
	D	3	10	
	E	2	42	
	F	1	17	
1999	A	6	0	2.12
	B	5	6	
	C	4	8	
	D	3	24	
	E	2	52	
	F	1	42	
2000	A	6	2	2.33
	B	5	6	
	C	4	8	
	D	3	12	
	E	2	42	
	F	1	22	

Appendix B continued

Year	Grade	Value	Frequency	Mean
2001	A	6	0	1.74
	B	5	1	
	C	4	4	
	D	3	14	
	E	2	52	
	F	1	59	

APPENDIX C

Performance of science students in Chemistry between 1996-2001in SSSCE in Kumasi High school

Year	Grade	Value	Frequency	Mean
1996	A	6	0	1.35
	B	5	0	
	C	4	0	
	D	3	3	
	E	2	20	
	F	1	24	
1997	A	6	0	2.25
	B	5	2	
	C	4	4	
	D	3	11	
	E	2	23	
	F	1	12	

Appendix C continued

Year	Grade	Value	Frequency	Mean
1998	A	6	2	3..`4
	B	5	20	
	C	4	15	
	D	3	20	
	E	2	19	
	F	1	6	
1999	A	6	0	2.25
	B	5	4	
	C	4	6	
	D	3	18	
	E	2	50	
	F	1	54	
2000	A	6	2	2.60
	B	5	10	
	C	4	6	
	D	3	19	
	E	2	40	
	F	1	15	

Appendix C continued

Year	Grade	Value	Frequency	Mean
2001	A	6	1	2.84
	B	5	16	
	C	4	20	
	D	3	30	
	E	2	50	
	F	1	13	

APPENDIX D

Performance of Science students in Biology between 1996-2001 in Kumasi High School

Year	Grade	Value	Frequency	Mean
1996	A	6	0	2.03
	B	5	0	
	C	4	2	
	D	3	4	
	E	2	17	
	F	1	7	
1997	A	6	0	2.47
	B	5	1	
	C	4	4	
	D	3	8	
	E	2	21	
	F	1	2	

Appendix D continued

Year	Grade	Value	Frequency	Mean
2000	A	6	6	1.70
	B	5	2	
	C	4	3	
	D	3	5	
	E	2	37	
	F	1	45	
2001	A	6	6	1.70
	B	5	1	
	C	4	3	
	D	3	11	
	E	2	57	
	F	1	52	

Appendix D continued

Year	Grade	Value	Frequency	Mean
2000	A	6	0	1.70
	B	5	2	
	C	4	3	
	D	3	5	
	E	2	37	
	F	1	45	
2001	A	6	0	1.70
	B	5	1	
	C	4	3	
	D	3	11	
	E	2	57	
	F	1	58	

APPENDIX E

Performance of science students in Elective Mathematics between 1996-2001 in Kumasi High school.

Year	Grade	Value	Frequency	Mean
1996	A	6	0	2.47
	B	5	2	
	C	4	1	
	D	3	5	
	E	2	4	
	F	1	5	
1997	A	6	0	2.94
	B	5	2	
	C	4	3	
	D	3	4	
	E	2	6	
	F	1	1	
1998	A	6	1	3.73
	B	5	9	
	C	4	6	
	D	3	10	
	E	2	3	
	F	1	1	

Appendix E continued

Year	Grade	Value	Frequency	Mean
1999	A	6	2	2.06
	B	5	8	
	C	4	10	
	D	3	17	
	E	2	34	
	F	1	61	
2000	A	6	5	1.94
	B	5	5	
	C	4	12	
	D	3	10	
	E	2	35	
	F	1	25	
2001	A	6	2	2.49
	B	5	8	
	C	4	15	
	D	3	22	
	E	2	63	
	F	1	20	

APPENDIX E

Performance of science students in Elective Mathematics between 1996-2001 in Kumasi High school.

Year	Grade	Value	Frequency	Mean
1996	A	6	0	2.47
	B	5	2	
	C	4	1	
	D	3	5	
	E	2	4	
	F	1	5	
1997	A	6	0	2.94
	B	5	2	
	C	4	3	
	D	3	4	
	E	2	6	
	F	1	1	
1998	A	6	1	3.73
	B	5	9	
	C	4	6	
	D	3	10	
	E	2	3	
	F	1	1	

Appendix E continued

Year	Grade	Value	Frequency	Mean
1999	A	6	2	2.06
	B	5	8	
	C	4	10	
	D	3	17	
	E	2	34	
	F	1	61	
2000	A	6	5	1.94
	B	5	5	
	C	4	12	
	D	3	10	
	E	2	35	
	F	1	25	
2001	A	6	2	2.49
	B	5	8	
	C	4	15	
	D	3	22	
	E	2	63	
	F	1	20	