THE RELATIONSHIP OF STUDENTS' ACADEMIC ACHIEVEMENT IN SECONDARY MATHEMATICS, SCIENCE, ENGLISH AND ACADEMIC ACHIEVEMENTS IN GEOLOGY TECHNOLOGY AT THE COLLEGE OF SCIENCE AND TECHNOLOGY CALABAR, NIGERIA

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CHAPTER I

INTRODUCTION

As technology grows, job opportunities also increase. Technicians needed to fill these jobs must possess the ability to use both mind and hand in analysis, problem solving, and repair. As Alfred North Whitehead (1, p. 3), a British educator, puts it: "Technical education should turn out the pupil with something he knows well and something he can do well. This intimate union of practice and theory aids both." The College of Science and Technology (COST) in Calabar, Nigeria, has been striving to provide such technicians for industry, business, and schools. However, many factors must be considered before the institution can produce the needed technicians. One such factor is the student's enrollment into a proper program that he or she has sufficient prerequisite skills and potentials. A student in a geology technology program, for example, needs a strong background in mathematics, science, and English.

The proper placement of a new student into a selected geology program in technical education coursework has been a crucial task for academic advisers. Allowing a student to enroll in a geology program, if his/her academic background is weak in mathematics, science, and English language, could result in the student's failure to successfully complete the course. Hence, a comprehensive analysis of the beginning student's ability in mathematics, science, and English may be needed by

the adviser to recommend appropriate courseworks for the student.

Statement of the Problem

Students with varied backgrounds in mathematics, science, and English have enrolled in the geology technology department at the College of Science and Technology, Calabar, Nigeria. The department of geology needs to be properly informed as to the importance of a student's academic achievement in secondary school (high school) mathematics, science, and English skills as they relate to his/her academic achievement in a geology program. Without sufficient information as to the probable success of the student within a geology program, among other things, the student might enroll in a program and, being unable to complete it due to a deficiency in mathematics, science, and English language, be forced to withdraw from the college.

Purpose of the Study

The purpose of this study was to study the relationship of student's academic achievement in secondary school mathematics, science, English and academic achievement in a geology technology program at the College of Science and Technology, Calabar, Nigeria.

Hypotheses of the Study

The hypotheses tested in this study, stated in the null form, are as follows:

Ho (1) There is no significant relationship between secondary school mathematics and a student's academic achievement in a geology program;

Ho (2) There is no significant relationship between secondary school science and a student's academic achievement in a geology program;

Ho (3) There is no significant relationship between secondary school English and a student's academic achievement in a geology program;

Ho (4) There are no significant relationships among secondary school mathematics, science, English skills, and a student's academic achievement in a geology program. These hypotheses lead to the research question of the study: Are there significant correlations between a student's academic achievement in secondary school mathematics, sicnece, and English and his/her academic achievement in a geology program?

Limitation of the Study

The study was limited to the graduates of 1979, in a geology program at the College of Science and Technology, Calabar, Nigeria.

Supporting information and data were also obtained from related research works in the United States, especially from Oklahoma State University, Stillwater.

Assumptions

For the purpose of this study the following assumptions were made:

1. That the grading system used by each instructor at the College of Science and Technology, Calabar, is fundamentally the same.

2. That each student who failed to complete his/her course after having entered the College of Science and Technology contsituted a loss

to the individual, the college, and to society, unless the student had transferred to another field that is more suitable to his/her abilities and interests.

Definition of Terms

The following terms are defined based upon the meaning and context of the study:

Curriculum: Is a course of study in a school or university.

National Technical Programs: A national technical program is offered at a number of Polytechnics and College of Technology leading to a Nigerian Certificate of Education (NCE).

Education: Is a process of providing an individual student with knowledge, skill, competence, and desirable qualities of character and values for his benefit and for the benefit of mankind.

Secondary School: Is defined as a school which is recongized by the Ministry of Education as providing instruction in an approved curriculum and which complies with the Rules for Secondary Schools made by the Ministry.

Technical Institute: Technical institute is a post-secondary school institution offering training for occupations in which emphasis is placed on the application of the functional aspects of mathematics and physical sciences, or an officially designated, separately organized technical institute division of a four-year institution. The primary purpose of a technical institute is training for an objective other than the Bachelor's degree (2).

Technical Education: Is a planned sequence of classroom and laboratory experiences at the post-secondary level designed to prepare

persons for a cluster of job opportunities in a specialized field of technology. The program of instruction normally includes the study of the underlying sciences and supporting mathematics inherent in a technology; and of the methods, skills, materials, and processes commonly used by the services performed in the technology. A planned sequence of study and extensive knowledge in a field of specialization is required in technical education, including competency in the basic communication skills and related general education. Technical education prepares for the occupational area between the skilled craftsman and the professional person (3).

The College of Science and Technology Grading System: The College of Science and Technology grading system is to be understood to mean the actual grades (scores) for all mathematics, science, and English courses taken during the academic year in the College of Science and Technology. For the purpose of this study, mathematics, science, and English grading was quantified as follows:

A (Excellent)	4.00
B (Very good)	3.00
C (Average)	2.00
D (Poor pass)	1.00
F (Failure)	0.00

West African School Certificate: The West African School Certificate means a certificate awarded by the West African Examination Council.

School Certificate: School Certificate is another name for the West African School Certificate. The certificate is awarded upon the successful completion of class-five-school and in passing the West

African School Certificate Examination.

Technical Training: Is provided through part-time and full-time courses which vary in length according to the subject.

Academic Achievement: Will refer to the grade point average (GPA) of the students based on a four-point scale: A = 4.0; B = 3.0; C = 2.0; D = 1.0; F = 0.0.

Communication Skill: Is defined here as the ability to have good command of oral and written English.

COST: Is used here to mean the College of Science and Technology.

Entry Level GPA: In this study, entry level GPA grade point average means the admission grade point average obtained in the West African School Certificate Examination used for admission purpose into the geology program at the College of Science and Technology, Calabar. Mathematics, science, and English scores are the variables used in this study.

Science: Includes biology, chemistry, and physics.

Geology Technology Program: Is referred here to mean the technical coursework in which geology is the core subject area.

Null Hypothesis: Is a statement that there is no significant difference between the variables under analysis.

T-test: Means test difference among means of two or several groups.

"R"-test: Means a test of multiple correlation.

Fisher's t-test: Means test difference between several variables developed by A. R. Fisher.

Correlation: Measure of the relationship among variables.

Multiple Correlation: Is test differences among means of two or

more groups with one dependent and two or more independent variables.

Scattergram: Here is used to mean a scattered diagram showing correlation.

Sample: Means a (smaller) group of carefully selected units from a defined larger group.

CHAPTER II

REVIEW OF LITERATURE

Recent studies in technical education in the United States indicate that mathematics and communication skills are among the top ten areas of studies that college graduates need improvement. Hence, educational experts believe that no technical specialty program (curriculum) is effectively planned without substantial breadth in mathematics, science, and general education. These courses are important because mathematics and science are regarded as the foundation for specialty courses in any technical discipline. In addition, mathematics and science promotes and supports further education of the individual technician.

Mathematics and Science

Several studies have been conducted concerning the relationship between selected subjects, such as mathematics and electronics, reading ability and mechanical ability, but no studies have been found by the researcher concerning the relationship of mathematics, science, English and a geology program.

Braden and Roney (4, p. 6) in stating the specifics to describe a formal program of occupational studies at the associate degree level cited that mathematics and sciences are integral part of earth science programs.

Ulam (5, p. 4) indicated "that the development and use of mathematical tools were a prerequisite to the development of present-day technology."

Venables (6, p. 439) explores the necessity for a variety of levels of mathematics courses within a technical college.

According to Briggs (7, p. 4) "a technician of any category requires a certain level of mathematics. Certainly not the highest level, but a substantial level is required."

Roney (8) stated that

> One of the arguments advanced for using existing courses rather than designing new ones is based on the taint of specialization. Courses must be pure. Mathematics must be algebra, trigonometry, or calculus; physics must be traditional physics, not applied mechanics; and chemistry must be general chemistry rather than industrial chemistry (p. 79).

A professor at Princeton University once wrote: "No one can prevent mathematics from being occasionally applied" (9, p. 38). His concept here does not attempt to contradict Roney's concept of applying "pure" mathematics and science within a technical program, but he supports that if mathematics is used within a technical curriculum, it should be put to practical use during the learning process and, to some extent, on-the-job process of the technician.

Greenwood (10, pp. 107-108) made an investigation to predict the academic success in the Technical Curricula of three Community Colleges in New York, and the result of his study indicated that: "An adequate mathematical background is an important factor in academic success in technician curricula."

Greenwood further stated: "However, just what constitutes an adequate mathematical background, and how important a factor it is will be

found to vary in different curricula and in different colleges"(108).

Brown (11, p. 8) indicated that high school (secondary school) grades correlate with success about as well as any other variables being examined. The evidence further shows that for success in the college of engineering, aptitude in the science and mathematics is necessary.

Brown further stated that: "These results may not necessarily apply to technical institute students. Their aims are different from those of engineering freshmen. Their educational program is also different" (p. 9).

Both science and mathematics have personal reflection upon the life of individual learner. Rauff (12) puts it in a different dimension in citing the importance of physical sciences and mathematics on the average life attainment of the student

> Every so-called course must be a blend of mathematics and sciences. We should expect the mathematics teacher to present the rudiments of logic, the biologist to illustrate the rudiments of algebra and combinational analysis, the geologist to have the knowledge of mathematics, physics, chemistry and biology. As mathematics and science instructors, we have the personal responsibility to see that these skills are taught vigorously and continuously by the educational community in order to reflect upon the life of individual learner (p. 2).

Applications of geology in the practice of engineering are developing so rapidly and, in general geological applications and techniques require academic mathematics, biology, physics, and chemistry. The development of conceptual mathematics could not ruin the students' ability in a geology program. Academic mathematics could include the following categories: real arithmetic with particular emphasis on the order of operations; basic algebra of polynomials and first degree

linear equations; use of formulas; formulation of algebraic sentences to solve applications, and mensuration. Chemistry is an essential tool for the study of the earth's chemistry, geochemistry. Goldschmidt (13) described geochemistry in the following terms

> The primary purpose of geochemistry is on one hand to determine quantitatively the composition of the earth and its parts, and on the other to discover the laws which control the distribution of the individual elements. To solve these problems the geochemist requires a comprehensive collection of analytical data on terrestrial materials such as rocks, water, and the atmosphere; he also uses analyses of meteorites, astrophysical data on the composition of other cosmic bodies, and geophysical data on the nature of the earth's interior. Physics, chemistry, biology, and mathematics in fact play a major role in his geological studies (p. 1).

Bruner (14, p. 31) is widely known for his statement of the hypothesis, "any subject can be taught effectively in some intellectually honest form to any child at any stage of development." Some curriculum designers believe that mathematics and sciences should be waived in certain fields of technician education. However, this concept might result in poorer academic achievement in a geology program.

As Sand (15, p. 3) pointed out: "The fact that very young children can learn relatively difficult aspects of science, mathematics, and other subjects provides at best an incomplete answer to the question of whether they should learn them."

Harris (16, p. 27) in his study, hypothesized that "the success in a two year technical program (college of technology equivalent) is dependent upon the number of secondary school mathematics and science courses." The results indicated that two characteristics were accepted as significant indicators of two-year technical program preference. Of these two, one of the characteristics that was accepted as a significant indicator was secondary school (high school) mathematics

and science courses taken in secondary school. Harris shows that the mathematics and science background showed a clear indication to deviate from the expected values in the manner predicted, that is, the fewer the number of mathematics and science courses the greater the probability of two-year technical program selected.

The Wilson Examination Panel in Science and Mathematics (17) stated

> One solution used to improve students' ability in their coursework due to an inadequate background in mathematics, science and communications is to offer pre-technology programs. These programs are designed to prepare secondary school students to meet their entrance requirement of the college of technology programs. The existence of these pre-technology programs is viewed by the fact that too many students entering geology programs in the college of technology were ill-prepared for the demands and rigors of these programs. They were extremely weak in mathematics, sciences, and most of all, in their ability to express themselves, both orally and in written communications (p. 2).

Tinnell (18) also shows concern with the area of realizing that mathematics is essential for success within a technical program. His study "examined the relationship between selected student entry parameters and achievement in an electromechanical technology program at Oklahoma State University" (p. 22).

Tinnell (18) concluded that

> On the basis of these results one could conclude that high school background in mathematics would offer the most promise as a tool for identifying potentially successful students for electromechanical technology (p. 22).

Heller and Roy (19) concluded that

> For some time now, there has been talk of the new physics, the new chemistry, the new biology, and the new mathematics, and curriculum reform in these fields is beginning to have far-reaching effects on education in his country (p. 5).

What else could be done if the college of technology would find

it difficult to determine the students' ability in geology programs based upon the students ill-prepared previous knowledge of mathematics, science, and English skills as an integral part of the program. According to Francis Chase (20) of the University of Chicago

> No one can follow the evolution of the curriculum project in biology, physics, mathematics, and chemistry without becoming aware of the fact that, taken as a whole, these studies incorporate philosophical concepts that have radical applications for educational objectives, curriculum theory, the practice of teaching, and organization and administration of schools (pp. 15-17).

The studies of the relationship between mathematics, sciences, and the students' ability in a geology program could reflect emerging, though not yet clearly enunciated, concepts of the nature of students and how they learn, and of the nature of knowledge and its uses. These concepts of relationships between science, mathematics and geology programs would lead into another important concept: the relationship between geology and its related fields of study. In the planning and development of the "geology" technical curriculum, planners have attempted to emphasize the underlying unity and the unbroken interrelationships of the earth sciences with even other areas which are non-sciences. Geology relates to astronomy, meterorology, oceanography and physical geography. Chemical and physical properties and processes, and mathematical relationships were considered to be basic in familiarizing the student with the natural processes which play important roles upon <u>life itself</u>.

Reynolds and his committee (21, p. 6) believe that "science is a basic and important aspect of man's intellectual endeavor." They further indicated

> It is also the basic underlying our technology as well as our increasingly frequent biological manipulations. Educa-

> tion in science cannot, therefore, be apart from the social and cultural turbulences which seem certain to be the characteristics of the next few decades. Accommodations with these forces and the continuing self-development of science programs will demand new designs for progress in science education (pp. 7-9).

Margolis (22) remarked

> Of all the educational subsystems in Nigeria, technical/vocational is the most difficult to translate into American terms because it may be very hard to convert the program into academic equivalencies. This is true because the intent of this training is to meet the ever-shifting manpower needs in Nigeria. Basically, there are two levels of technical education. Both levels have the goal of preparing students for certificates showing that they have met external qualifications. Nigeria has to set up an inquiry panel for recommendations and improvement of its educational system with emphasis on technology, probing the relationship between mathematics, science, and oral and written communication skills (pp. 49-52).

The government of Nigeria has sponsored a survey of the Nigerian educational system in conjunction with the Reference Committees on Secondary School Education, Teacher Training, and Technical Education, and a report entitled, Investment in Education: Report of the Commission of Post-secondary School Certificate and Higher Education in Nigeria, was issued in 1960 (23). The approach to developmental task of the Committee was based on the concept that by 1980 Nigeria would be

> . . . a nation of some 82 million people, with industries, oil, and a well-developed agriculture; intimately associated with other free African countries on either sides of its borders; a voice to be listened to in the Christian and the Moslem worlds; with its traditions in art preserved and fostered and with the beginnings of its own literature; a nation which is taking its place in technological civilization, with its own airways, its organs of mass communication, its research institutes (pp.52-53).

Another report, Federal and Regional Manpower Needs, sponsored by the Federal Government and undertaken by the Federal Advisory Committee on Technical Education and National Technical Programs, was

issued in 1962. Aa s result of this report, the network of vocational and technical training programs were developed, consisting of post-primary trade schools, technical institutes, and colleges of technology. The courses in technical schools have been extended from two to three years, and an additional half year has been required in areas (for example, laboratory technician, radiology technician, and nursing technician). The committee concluded that "mathematics, science, and English could be the center force for success in a technical program."

The Report of the Commission on Post-school Certificate and Higher Education (25) entitled, Investment in Education (Federal Ministry of Education, Lagos, 1960), stated

> In deciding on the pattern of technical education we have been guided by the following principles: (1) It must produce enough children with post-secondary education to satisfy the nation's needs for high-level manpower. (2) It must be properly balanced as between primary, secondary and post-secondary education. (3) It must narrow the gap between educational opportunities in the North and the South, without producing an unbalanced education system in the North. It must include adequate areas of science, mathematics, and English skills (p. 12).

But there is another consideration to be noted and that is stated thus by Oyelese (26)

> Africa has been rather fortunate to have the Entebbe workshops. We are in the forefront of the experiments going on in various parts of the world in the teaching of the "New Mathematics." In the past our ideas for the development of education came to us through Britain; and although developments are being made in Great Britain at the present time, it would normally have taken several years for these ideas to reach the English-speaking countries in Africa. Now we do not need to lag behind; we can move forward together, and to advance in technology, the relationship between mathematics and science must be strongly developed and followed up (pp. 93-94).

The committee concluded that science and mathematics should be

strengthened, modernized and better adopted to the needs of students who show special ability or aptitude in science, and that two new courses be developed, one in biological science and one in physical science, for students whose needs are not well served by existing courses but whom the values of science, and mathematics as parts of general education, should not be neglected.

At present the technical schools in Nigeria are considering technical education as integral parts of the total education process; it "reconstructs" the country. It is observed that the science learned is very much up-to-date laboratory science and related to Nigeria's environment and keeping with modern scientific knowledge considering the Nigeria's local apparatuses and mathematics as their basis.

Taiwo (27) indicates that

> Every African ethnic group has its own peculiar materials that await scholars who may wish to study any kind of education in African society. Yoruba mathematics and Ibibio "ritual" science are good examples. Local science and mathematics materials are practical and unlimited in scope. In technology simple rules could be formulated to suit the technical application of modern civilization based upon local materials in Nigeria (p. 8).

The Fayetteville Technical Institute (28) in North Carolina has found that

> Recruitment of qualified students with adequate background in mathematics, science, and communication skills is becoming an increasingly difficult task. Great numbers of students are applying for entrance into the fields of technology; but after carefully testing and counseling many of them fail to meet the minimum admissions requirements established by the college and accreditation agencies (pp. TE 1-3).

Boudreau (28, pp. TE 1-3) indicates that "there is nothing sacred about finishing an associate degree curriculum in two years, if it takes three years or if it takes four years to complete this require-

ment" this does not matter as long as the end result is that the student succeeds in his chosen field.

Not only has the concern for the technicians' background in mathematics, science, and communication skills been of primary importance in both secondary school and technical institute remedial courses or even during the geology coursework itself, but this concern continues even beyond graduation when the technician is working in industry or business.

Because mathematics and science in any technical institute are the nucleus of the program, "genuine" curriculum must be considered in terms of its relationship in the curriculum and position with mathematics, science, auxiliary, and general education. According to Roney (8), six basic rules must be followed if any program-curriculum is to meet the demanding and enthusiastic interest of the students.

The development of curriculum does not only depend upon the needs of the individual student, but also on the need of the individual school and society. The central academic loads of mathematics, science, and English vary in accordance with a particular program.

In Roney's (8) rules

> The curriculum should have at least 30 credit hours of specialized course work in the field of specialization and from 15 to 20 credit hours of mathematics and science. The technical speciality should be introduced in the first term by one or two major courses. Mathematics and science courses should be coordinated with technical courses whenever possible, to introduce concepts as they are needed. Auxiliary technical courses should be included to broaden the students' understanding of the technology. Provision should be made for either individual or small group problem work during the final term to promote independent thinking and to test each individual's comprehension of the total curriculum content. The total class and laboratory load for students

> should not exceed 30 hours per week and should not include more than 5 courses requiring extensive outside preparation (p. 12).

Roney's curriculum design concept is widely accepted and used in many accredited and non-accredited schools in the United States and even in other countries including Nigeria, but precaution should be taken in order that the curriculum satisfies both the technician and society needs.

Briggs (7) indicates that

> Mathematics for the student of modern technology, therefore, is not an end in itself but rather a means to a desired goal. It is taught principally for its contributive value to the student, rather than to support the intrinsic beauty of mathematics itself (p. 5).

If these basic rules are properly followed at the College of Science and Technology, the curriculum will be improved along with the proper allocation of mathematics, sciences, and communication within the curriculum.

Geology and its Auxiliary Courses

Tomikel (29) states

> Earth science should not be ignored for its interrelationship with biology, chemistry, and physics. Today the big three still dominate the science curriculum and perhaps they should since these are basic studies for all scientists regardless of narrow discipline.
>
> Since earth science is an interdisciplinary subject and since it is taught at an intermediate level in high school the teacher must somehow see that his students get instruction and experience in the tool subjects of earth science. Chemistry cannot be ignored since it cannot be separated from astronomy, the origin of minerals, composition of rocks, the earth's interior, weathering, the atmosphere, fresh water, and oceanography.
>
> Physics and the laws of physics are inseparable from geologic processes. The general topics usually included in detail in earth science textbooks are geology, physical geology, astronomy, meteorology, and oceanography.

> Mathematics, physics, and chemistry are treated as tools of the earth scientist (p. 45).

Cessac (30) stated

> Although the study of mathematics is absolutely essential to the acquisition of a true scientific training and although at the same time, the study of physics and chemistry calls for a sound training in mathematics, the experts taking part in the Abidjan meeting decided to discuss only the problems raised by the teaching of physics, chemistry, and biology, since the organization and development of mathematics teaching raise no special problems (p. 51).

Richardson (31) indicated

> Traditionally physics and chemistry have been considered as desirable, even essential, courses for students who planned to study science in college; there is currently considerable effort to identify early those students who have a high level of ability and to encourage them toward scientific careers such as earth sciences (p. 2).

There are many who maintain that the fields of physics and chemistry do make a significant contribution to general education of the student. Those courses that place a heavy emphasis upon preparation for college seem to discourage many students and, as a result, are not elected by a very large percentage of them. Thus the contributions to general education are limited, and there is a growing suspicion that much potential talent is being lost through poorly taught courses in physics, biology, chemistry which lead to the study of geology as a field of specialization.

Communication Skills

As English is the language of instruction at the College of Science and Technology, Calabar, Nigeria, the ability to function well in oral, written, and spoken English is necessary. Proficiency in English is one of the prime factors in a geology program at the

college. Students who have been using English as a second language in instruction for less than the number of years required to complete the program may encounter a language problem in technical courses, geology in particular, depends upon a rapid increase in reading, writing, and comprehension skills.

Does reading have an educative value then? Quoting from F. W. Parker (32)

> Reading in itself has no educative value, it does not give rise to a succession of educative acts any more than does seeing, hearing, or touching, the value of reading in education depends entirely upon the educative subject presented, and upon the intensity of the conscious acts. The educative value of reading, then, depends upon what is read and upon how it is read (p. 3).

Alfred S. Lewernz (33) a statistician in the Educational Research Division of the Los Angeles City Schools, makes the following statement

> I am convinced that a lot of failure in high and post-secondary schools is due to sheer lack of attainment of proper levels of reading comprehension on the parts of students. I believe it is important to know what grade level of reading comprehension attainment is necessary on the part of students in order to study successfully accepted texts in science, math, and other subjects which involve reading (pp. 54-55).

The relevance of education for employment arises, therefore, from better educated labor and a technology that requires it. The educational skills of spoken and written communication, analytical techniques, knowledge of society and one's role in it and skill in human relations are all vital as skills of particular occupations. Hence culture and vocation are inseparable aspects of humanity.

A number of educators have designated success in English as prerequisite to the study of physical science, geological science and mathematics.

Turse (34) said that

> General English marks may give a clue to the effective use of language in business education like in other program's transcription, but they do not give much clue to the pupils' potential resourcefulness in learning, recording, interpreting geological symbols or data. Therein, probably lies the chief weakness of English skill as a predictive instrument (p. 21).

In support of Turse's concept of "combined factors" as a predictive measure of a student's success in any program, one could conclude that the importance of motivation, application, and academic interest is hereby emphasized in contrast with measures of so-called intelligent parameters including mathematics, science, and communication skills.

Recent studies of Michigan State University indicated that three out of four students were unable to recount the structure and major content of a well-organized lecture. This and other studies for the same intent indicate that students generally have a lack of listening skills. In addition, a majority of students in college lack the ability to express themselves grammatically, literately, and precisely for greater effectiveness, personal confidence and social awareness. The study further showed that writing, reading, speaking and listening are inseparable parameters which are necessary to develop and deepen knowledge of purpose, objectives, and function of learning (35, p. 9).

The Wilson Examination Panel in Science and Mathematics sub-committee (17) conducted a study designed to identify the relationship existing between English language skill and scholastic achievement. Findings of the study revealed that English ability and scholastic achievement are highly interrelated.

The committee further reported that they found that English language skills made in any academic program are significant and that

they tend to become the medium of communication in any program.

The Wilson Science and Mathematics Committee (17) in their 1974 Report to the College of Science and Technology, Calabar, Nigeria, remarked

> If 'sound' and 'adequate' correlation between science, mathematics, and communication skills are established within a geology program, the department of geology will be able to produce the needed number of technicians needed for the State (p. 6).

Summary

From the review of the literature, one must conclude that there is evidence that academic ability, as measured by the previous background in selected subject areas (mathematics, science, and communication skills) may predict achievement in geology even though the need can be seen that mathematics, science, and English skills do play an important part in the role of a technician. This research will study the relationship between the students' background in mathematics, science, English, and their overall success within the geology program offered at the College of Science and Technology, Calabar, Nigeria, and will also attempt to determine (by correlation) if a weak background in mathematics, science, and English will affect the academic performance of a student.

CHAPTER III

METHODOLOGY

This chapter will consider the methods used to determine the relationship between the selected subject matter areas, mathematics, science, and English and academic achievement in a geology program at the College of Science and Technology, Calabar.

Data for seventy-two students were collected to be used in this study. These students represented all graduates for the year 1979.

Only those students whose transcripts included grades in mathematics, science, and English language and had completed all geology course work at the College of Science and Technology were selected for this study. The usual population was composed of fifty-four students, and these represented members which not only had considerable background in mathematics, science, and English, but also had little or no background in mathematics, science, and English before they were admitted into the geology program at the COST, Calabar. Of the fifty-four students, twenty-seven had considerable background in mathematics, science, and English. Another group of twenty-seven students at the same level in the geology technology program was selected to represent those students who had less background in mathematics, science, and English but were admitted probationally into the same program.

Statistical Method

As mentioned in the introduction, the data was made up of 54 graduates of the College of Science and Technology, Calabar, Nigeria, but information on "technical" and statistical method was derived from resource literature from Oklahoma State University, Stillwater, Oklahoma.

It must be remembered that all statistical data are affected by a multiplicity of factors which may obscure the meaning of the relationship among observed variables. Karl J. Holsinger (36) for example, found that the correlation between secondary (high) school and college (university) grades was .612, as a result doubtless due in part to the mentality of the student. However, many other factors such as age, interest, sex, ambition, health, perseverance, attendance, and internal drive contribute also to the observed correlation. Ability as measured by grades is thus a variable made up of a larger number of other variables, and the correlation found is sometimes doubtful meaning so far as causes are concerned.

In analyzing the variables to determine their relationship one could run analysis of variance to determine the difference in the whole group before the t-test could be run to determine where the existing difference, if any, lies within the variables. Another possible method could be to run a t-test using two variables at a time to determine the existing difference among them. Rather the study took a simplier method: to use the multiple correlation method to determine the relationship between the variables. By this technique a coefficient (R) was computed as shown in Table VII. It should be recalled that before the multiple correlation was successfully achieved the r

(single correlation coefficient) was established and since the geology program variable was held constant, the analysis was approached using the following groups:

1. Mathematics/geology program relationship;
2. Science/geology program relationship;
3. English/geology program relationship;
4. Mathematics, science, English/geology program relationship.

For the purpose of this study, the Pearson product-moment correlation designated r, was used to provide information regarding the relationship between each group, for instance, the relationship between mathematics and geology was determined first, followed by science and geology, English and geology, finally, mathematics, science, English, and geology. The "multiple correlation" parameter was used to determine the relationship among the whole group.

In this study, the values of r and R were calculated using the following formulas:

$$r_{xy} = \frac{\Sigma XY - \frac{(\Sigma X)(\Sigma Y)}{n}}{\sqrt{\left(\Sigma X^2 - \frac{(\Sigma X)^2}{n}\right)\left(\Sigma Y^2 - \frac{(\Sigma Y)^2}{n}\right)}}$$

where r_{xy} = correlation coefficient between X and Y

X represents mathematics or science or English grades

xy = sum of cross products of deviation for X and Y

n = number of observed samples, n = 27 in each group

Y' represents the whole group, considered as one whole

$$R_{y.x_1x_2x_3} = \sqrt{\frac{r^2_{yx_1} + r^2_{yx_2} + r^2_{yx_3} - 3(r_{yx_1})(r_{yx_2})(r_{yx_3})}{1 - r^2_{x_1x_2x_3}}}$$

where $R_{y.x_1x_2x_3}$ = coefficient of multiple correlation between Y and a combination of X_1, X_2, and X_3

r_{yx_1} = the product-moment correlation coefficient between Y and X_1

r_{yx_2} = the product-moment correlation coefficient between Y and X_2

r_{yx_3} = the product-moment correlation coefficient between Y and X_3

$r_{x_1x_2x_3}$ = the product-moment correlation coefficient between X_1, X_2, and X_3

As it is shown in Table VII, a correlation of .4930 is, of course, an index of a strong relationship among the three variables, mathematics, science, and English, even though their relationship and strength of correlation to each other are not all the same.

The null hypothesis was rejected if the calculated value of r was greater than the table value at the .01 level. Table VII of Chapter IV shows the values of r and R as related to each group. If the calculated value of r was statistically significant between the .01 and .05 levels with degree of freedom (d.f) = N - 1 in each level then the hypothesis was or was not rejected depending upon the value of r and the significance level. Fisher t-test was used to test the null hypothesis.

Tables I to VI were used to compute the six quantities, X, Y, Y^2, XY and Y'Y, needed in order to calculate r and R.

TABLE I

SECONDARY SCHOOL GPA IN MATHEMATICS, SCIENCE, ENGLISH AND GPA IN GEOLOGY TECHNOLOGY PROGRAM

Number of Students	Geology	Mathematics	Science	English
1	2.99	1.50	1.55	1.50
2	2.33	2.23	2.30	2.23
3	2.27	2.15	2.10	2.15
4	2.88	1.00	1.50	1.67
5	3.23	1.65	1.65	1.65
6	2.30	1.65	1.00	1.65
7	2.72	2.00	2.00	2.00
8	2.50	1.65	1.00	2.65
9	2.16	1.65	1.00	1.65
10	2.50	2.00	2.00	2.50
11	2.52	1.00	1.50	1.00
12	2.56	1.50	1.00	1.50
13	2.33	2.50	1.00	2.00
14	2.58	2.50	2.50	2.50
15	3.28	1.65	1.00	1.00
16	3.44	2.00	2.10	1.05
17	2.06	1.50	1.30	1.50
18	2.78	2.00	2.15	1.00
19	3.73	2.50	1.00	1.50
20	2.43	2.65	2.65	2.65
21	2.00	2.00	2.00	2.00
22	1.31	2.00	2.00	1.00
23	2.69	1.50	1.40	1.50
24	3.49	1.00	1.00	1.00
25	3.22	1.50	1.00	1.50
26	1.82	1.00	1.50	1.00
27	2.40	2.50	2.00	2.50
28	2.10	1.00	--	2.65

TABLE I (Continued)

Number of Students	Geology	Mathematics	Science	English
29	2.00	1.13	--	1.34
30	2.51	2.43	2.12	--
31	3.00	--	1.50	1.00
32	2.70	2.00	--	1.65
33	3.10	2.41	1.99	--
34	2.50	--	1.44	2.00
35	1.55	1.52	--	1.52
36	--	2.00	1.53	1.71

TABLE II

STUDENTS WITH HIGHER GPA IN MATHEMATICS, SCIENCE, ENGLISH AND GPA IN GEOLOGY PROGRAM

Student Number	Geology Program GPA	Mathematics	Science	English	Mathematics, Science, English Average
1	2.99	1.50	1.55	1.50	1.52
2	2.33	2.23	2.30	2.23	2.25
3	2.27	2.15	2.10	2.15	2.13
4	2.88	1.00	1.50	1.67	1.39
5	3.23	1.65	1.65	1.65	;/65
6	2.30	1.65	1.00	1.65	1.43
7	2.72	2.00	2.00	2.00	2.00
8	2.50	1.65	1.00	2.65	1.77
9	2.16	1.65	1.00	1.65	1.43
10	2.50	2.00	2.00	2.50	2.17
11	2.52	1.00	1.50	1.00	1.17
12	2.56	1.50	1.00	1.50	1.33
13	2.33	2.50	1.00	2.00	1.83
14	2.58	2.50	2.50	2.50	2.50
15	3.28	1.65	1.00	1.00	1.22
16	3.44	2.00	2.15	1.00	1.72
17	2.06	1.50	1.30	1.50	1.43
18	2.78	2.00	2.15	1.00	1.72
19	3.73	2.50	1.00	1.50	1.67
20	3.73	2.50	1.00	1.50	1.67
21	2.00	2.00	2.00	2.00	2.00
22	1.31	2.00	2.00	1.00	1.67
23	2.69	1.50	1.40	1.50	1.47
24	3.49	1.00	1.00	1.00	1.00
25	3.22	1.50	1.00	1.50	1.33
26	1.82	1.00	1.50	1.00	1.17
27	2.40	2.50	2.00	2.50	2.33

TABLE III

CALCULATION OF X, Y, XY VALUES
OF MATHEMATICS/GEOLOGY

Number	ΣX_1	ΣX_1^2	ΣY	ΣY^2	$\Sigma X_1 Y$
1		2.2500		7.3610	4.0350
2		2.2500		8.9401	4.4850
3		6.2500		5.7600	6.0000
4		1.0000		8.2944	2.8800
5		2.7225		5.2900	3.7950
6		4.0000		4.0000	4.0000
7		1.0000		3.3124	1.8200
8		4.0000		7.3984	5.4400
9		6.2500		5.4389	5.8250
10		4.0000		6.2500	5.0000
11		2.7225		6.2500	4.1250
12		4.0000		1.7161	2.6200
13		2.2500		6.5536	3.8400
14		1.0000		12.1801	3.4900
15		6.2500		6.6546	6.4500
16		4.9729		5.4307	5.1959
17		2.7225		10.7584	5.4120
18		2.7225		4.6656	3.5640
19		4.6225		5.1529	4.8805
20		1.0000		6.3504	2.5200
21		6.2500		13.9129	9.3250
22		2.7225		10.4329	5.3295
23		4.0000		11.8336	6.8800
24		2.2500		4.2436	3.0900
25		7.0225		5.9049	6.4395
26		4.0000		7.7284	5.5600
27		2.2500		10.3684	4.8300
N = 27	48,7800 ΣX_1	94.4804 ΣX_1^2	70.5200 ΣY	192.0474 ΣY^2	126.8314 $\Sigma X_1 Y$

TABLE IV

CALCULATION OF X, Y, XY VALUES
OF SCIENCE/GEOLOGY

Number	ΣX_2	ΣX_2^2	ΣY	ΣY^2	$\Sigma X_2 Y$
1		1.6900			4.6345
2		2.4025			3.7660
3		2.2500			4.8000
4		2.7225			4.3200
5		4.0000			2.3000
6		1.0000			4.0000
7		2.2500			2.7300
8		4.0000			5.4400
9		1.0000			2.3300
10		1.0000			5.0000
11		4.0000			2.5000
12		2.2500			2.6200
13		1.0000			2.5600
14		4.6225			3.4900
15		6.2500			6.4500
16		4.4100			5.3510
17		1.0000			3.2800
18		4.0000			2.1600
19		4.6225			4.7670
20		1.0000			3.7800
21		1.0000			3.7300
22		7.0225			5.3295
23		1.0000			7.3960
24		5.2900			2.6780
25		1.0000			6.4395
26		4.0000			5.9770
27		1.9600			3.2200
N = 27	43.2500	76.7425	70.5200	192.0474	111.0565
	ΣX_2	ΣX_2^2	ΣY	ΣY^2	$\Sigma X_2 Y$

TABLE V

CALCULATION OF X, Y, XY VALUES OF
ENGLISH/GEOLOGY

Number	ΣX_3	ΣX_3^2	ΣY	ΣX^2	$\Sigma X_2 Y$
1		2.2500			2.6915
2		2.2500			4.4850
3		6.2500			6.0000
4		2.7889			4.8096
5		2.7225			3.7950
6		4.0000			4.0000
7		1.0000			2.8200
8		4.0000			5.4400
9		4.0000			4.6600
10		6.2500			6.2500
11		7.0225			6.6200
12		1.0000			1.3100
13		2.2500			3.8400
14		1.0000			3.4900
15		6.2500			6.4500
16		4.9720			5.1959
17		1.0000			3.2800
18		2.7225			3.5640
19		4.6225			4.8805
20		1.0000			2.5200
21		2.2500			5.5950
22		2.7225			5.3295
23		1.0000			3.4400
24		2.2500			3.0900
25		7.0225			6.4395
26		1.0000			2.7800
27		2.2500			4.8300
N = 27	45.8000 ΣX_3	85.8468 ΣX_3^2	70.5200 ΣY	192.0474 ΣY^2	116.6105 $\Sigma X_3 Y$

TABLE VI

CALCULATION OF Y', Y, Y'Y VALUES OF MATHEMATICS, SCIENCE, ENGLISH/GEOLOGY

Number	$\Sigma Y_1'$	$\Sigma Y'^2$	ΣY	ΣY^2	$\Sigma Y'Y$
1		2.1609			3.9543
2		2.3104			4.5448
3		5.4289			5.5920
4		1.9321			4.0032
5		2.0449			3.2890
6		4.0000			4.0000
7		1.3689			3.4900
8		4.0000			5.4400
9		3.3489			2.1294
10		4.7089			5.9250
11		3.1329			4.4250
12		2.7889			2.1294
13		1.7689			4.2639
14		1.0000			3.4048
15		6.2500			6.4500
16		5.0625			5.2425
17		1.4884			4.0016
18		2.0449			3.0888
19		4.5369			4.8351
20		1.3689			5.9168
21		2.7889			2.1877
22		2.7225			5.3295
23		2.4584			6.2291
24		2.0449			2.9458
25		7.0225			6.4395
26		2.9584			2.1877
27		1.7689			4.2826
N = 27	45.9500 ΣY_1	82.9607 $\Sigma Y'^2$	70.5200 ΣY	192.0474 ΣY^2	118.6404 $\Sigma Y'Y$

CHAPTER IV

FINDINGS

This research studied the relationship of students' academic achievement in secondary school mathematics, science, English, and academic achievement in geology technology at the College of Science and Technology, Calabar, Nigeria, to determine if there was: (1) a statistically significant relationship between secondary school mathematics level GPA and the GPA earned in geology technology courses at the College of Science and Technology (COST), Calabar; (2) a statistically significant relationship between secondary school science level GPA and the GPA earned in geology technology courses at the COST, Calabar; (3) a statistically significant relationship between secondary school English level GPA and the GPA earned in geology technology courses at the COST, Calabar, and (4) a statistically significant relationship among secondary school mathematics, science, English level GPA and the GPA earned in a geology program at the COST, Calabar.

Although there are other methods of determining whether or not the relationship among the aforementioned variables, the Pearson product-moment coefficient of correlation was used. The 'simple' and 'multiple' correlation factors (r, R) respectively were used to determine the relationship of students' academic achievement in secondary school mathematics, science, English and academic achievement in geology technology at the College of Science and Technology, Calabar.

The t test of significance developed by R. A. Fisher, was used to determine whether or not the null hypothesis could be rejected.

The results of the study are shown in Table VII.

TABLE VII

COEFFICIENT OF CORRELATION R-TEST RESULTS OF MATHEMATICS, SCIENCE, ENGLISH/GEOLOGY

Subject Area	r	R	Hypothesis Disposition
Mathematics/Geology	.0572	---	Not Rejected
Science/Geology	.2489	---	Not Rejected
English/Geology	.3762	---	Not Rejected
Mathematics, Science, English/ Geology	.4210	.4930	Not Rejected

In each case the rejection levels were 0.01 and 0.05

Although statistically significant relationship exists among mathematics, science, English and a geology program, it was seen that English, as a single parameter, has a strong relationship in the study of geology. Table VII illustrates the r value which indicates the relationship between two variables, for example, mathematics and geology. As it is shown in the table, mathematics, science, and English combined, show statistically significant relationship with geology, hence the results of the study are summarized as follows:

1. The students' secondary school mathematics grades showed a significant correlation with geology technology at the 1% level, but was insignificant at the 5% level, the hypothesis was not rejected.

2. The students' secondary school science grades showed a significant correlation with geology technology at both 1% and 5% levels.

3. The students' secondary school English grades showed a significant correlation with geology technology at both 1% and 5% levels.

4. Mathematics, science, and English showed statistically significant correlation with geology technology at both 1% and 5% levels.

Although the correlation coefficient and significance levels are necessary in testing the null hypothesis, they may offer little to educators in actually providing a visual concept of the relationship among the selected subject matter areas, mathematics, science and English. Scattergrams were developed and are presented in Figures 1 through 4 to show how statistically significant the variables are correlated.

In Figure 1 the scattergram shows the correlation between the entry level mathematics GPA and the COST geology GPA. Apart from at a lower level GPA the relationship percentile ranks up to 47%. In Figure 2 the scattergram indicates 56% correlation between the entry level science GPA and the geology GPA. The difference in this case is seen at the two extremes of the GPA of each predictive parameter. In Figure 3 the correlation is significant indicating a stronger (75%) relationship between the entry level English GPA and the COST geology GPA. In Figure 4, the correlation scattergram indicates the highest percentage (85%) correlation. This then should indicate to administrators and faculty at the College of Science and Technology, Calabar,

that a strong background in secondary school mathematics, science, and English is a beneficial parameter in predicting students' academic achievement in geology technology.

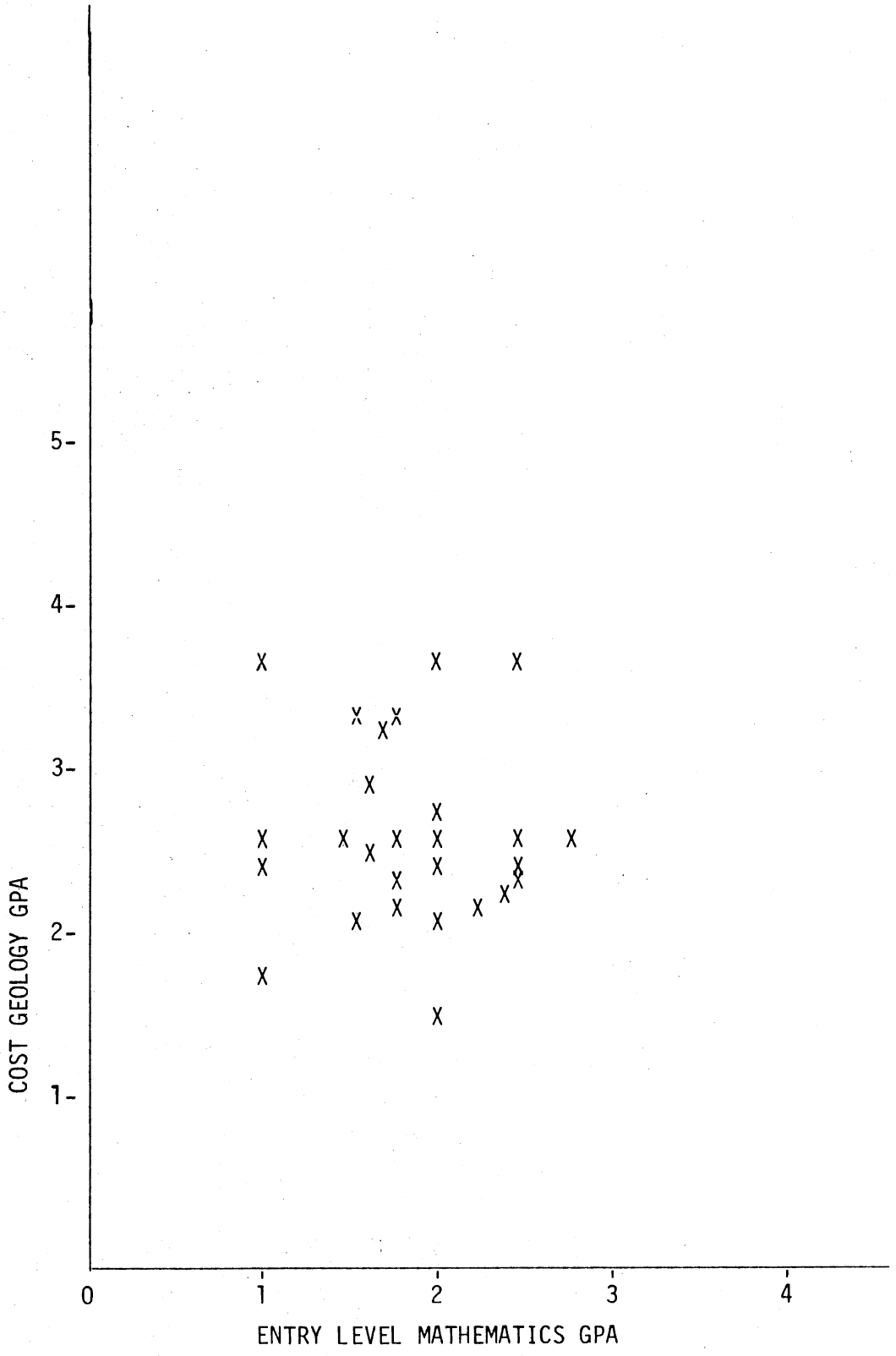

Figure 1. Scattergram of COST Geology GPA Vs Entry Level Mathematics GPA

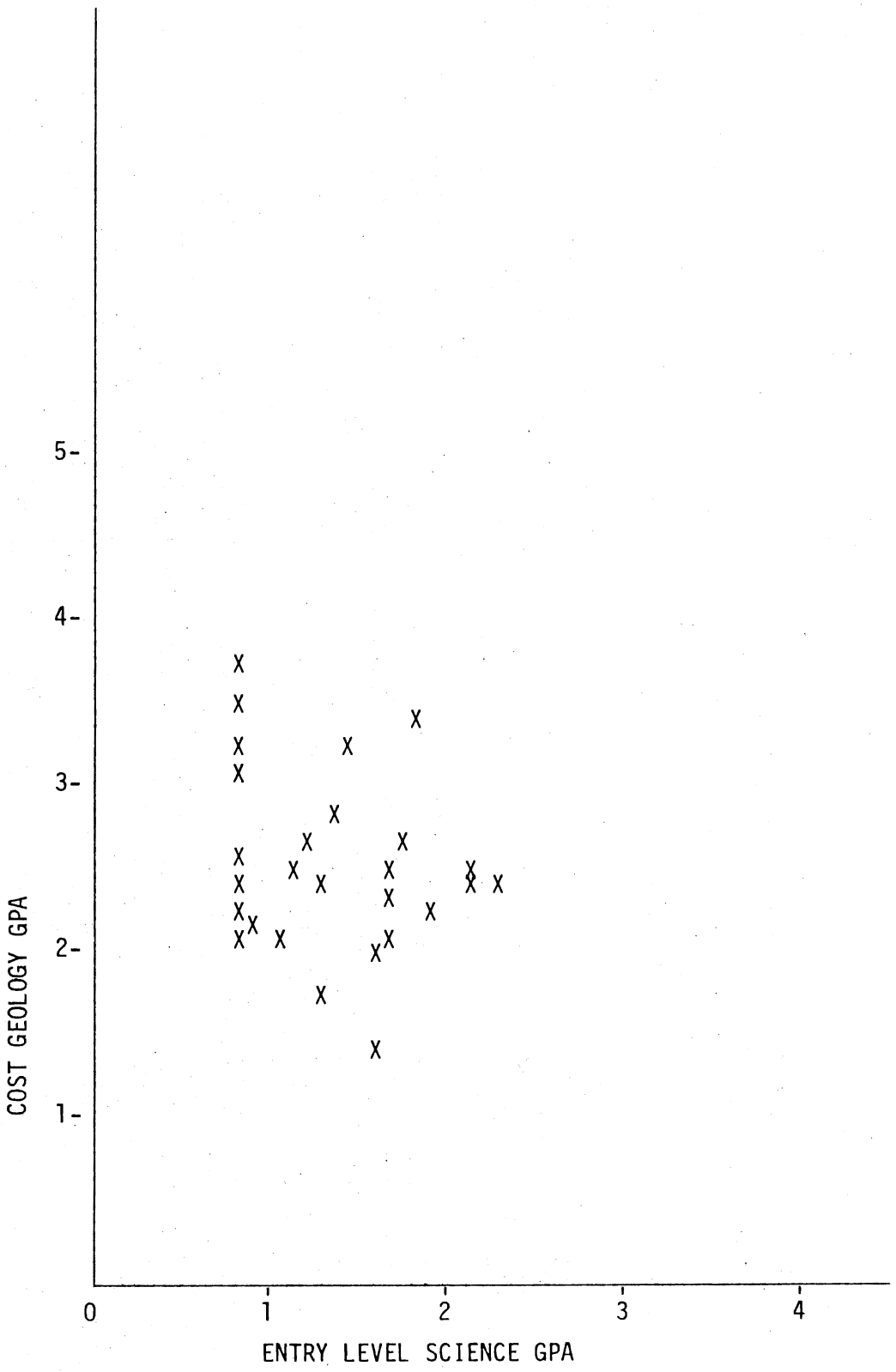

Figure 2. Scattergram of COST Geology GPA Vs Entry Level Science GPA

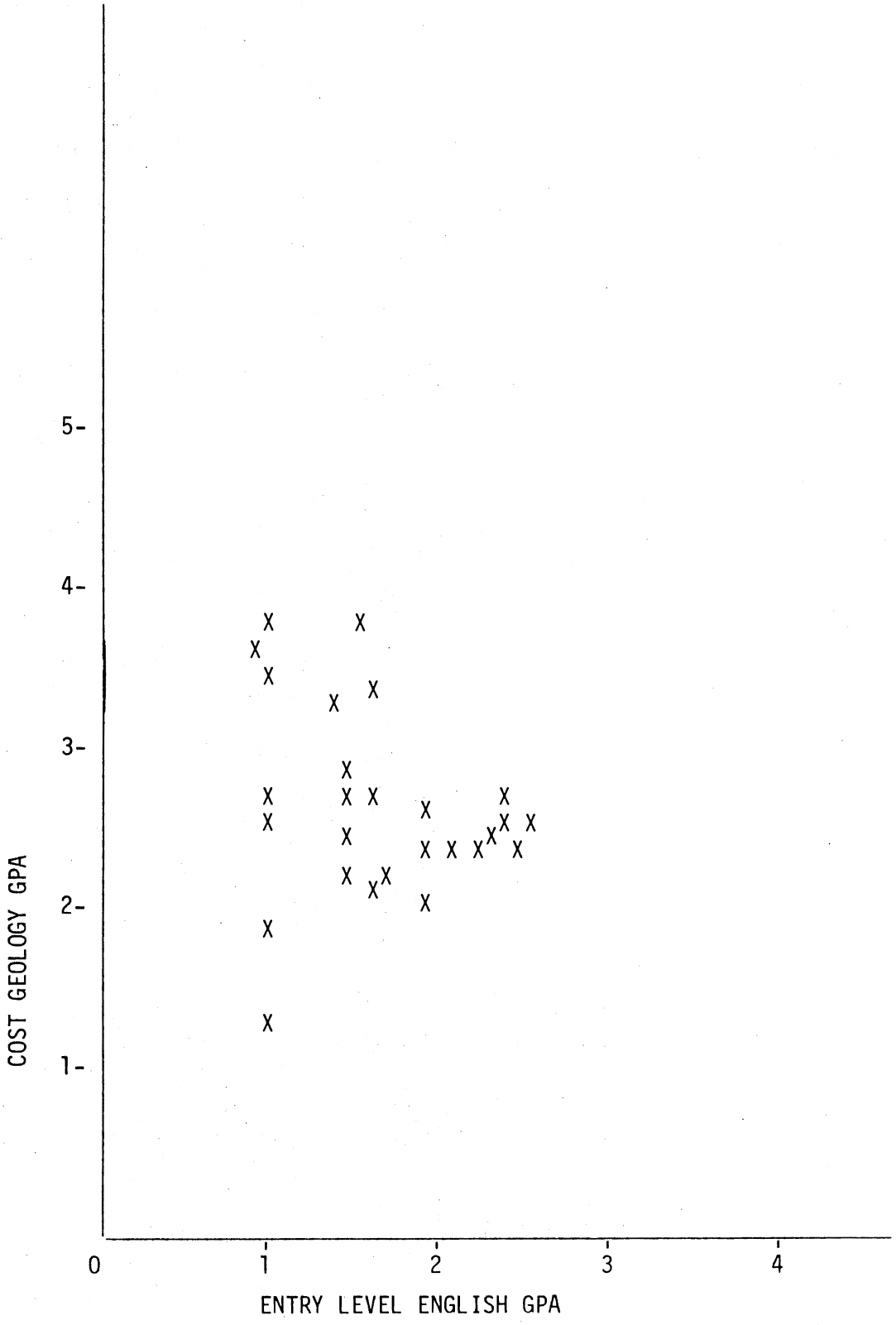

Figure 3. Scattergram of COST Geology GPA Vs Entry Level English GPA

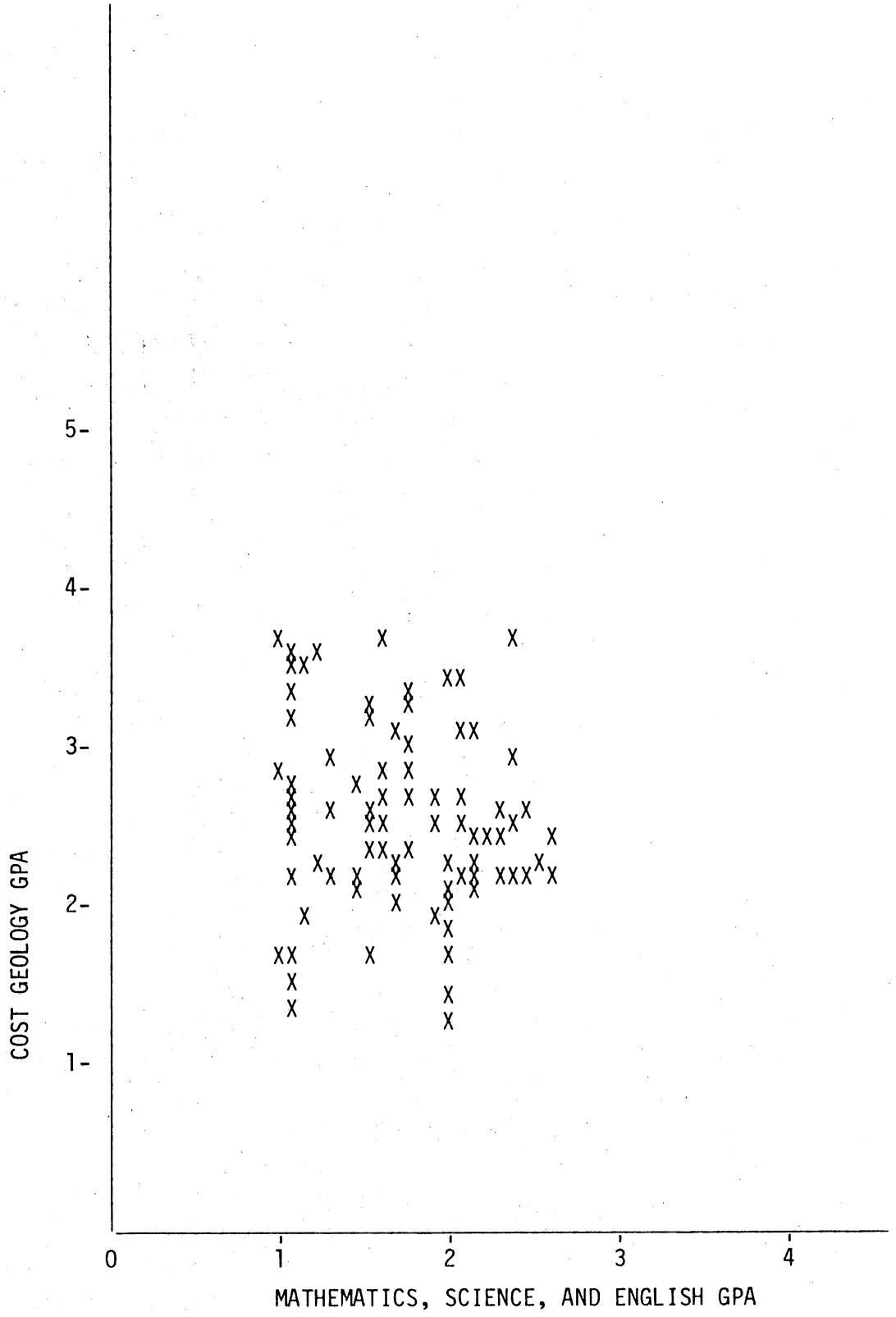

Figure 4. Scattergram of COST Geology Vs Entry Level Mathematics, Science, and English GPA

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The problem with which this study was concerned was that the department of geology at the College of Science and Technology (COST), Calabar, Nigeria, needs to know if there is a statistically significant relationship between a student's background in secondary school (high school) mathematics, science, English and his/her academic achievement in the geology program offered at the COST.

This chapter includes a summary of the study, conclusions, and recommendations.

Summary

The purpose of this research was to study the relationship of students' academic achievement in secondary school mathematics, science, English, and academic achievement in geology technology at the College of Science and Technology, Calabar, Nigeria.

Data on the seventy-two students were obtained from the personal files in the Principal's Office of the College of Science and Technology, Calabar, Nigeria, but information on "technical" and statistical methods were derived from resource literature at Oklahoma State University, Stillwater, Oklahoma.

In analyzing the variables, mathematics, science, English, and geology, to determine if there was a statistically significant rela-

tionship among them, the Pearson product-moment coefficient of correlation was used. The 'simple' and 'multiple' correlation factors (r, R) respectively were used to determine the relationship of students' academic achievement in secondary school mathematics, science, English, and academic achievement in geology technology at the College of Science and Technology, Calabar, Nigeria.

The t-Test of significance developed by Fisher, was used to determine whether or not the null hypothesis could be rejected.

The result of the study indicates that mathematics, science, and English combined show statistically significant relationship with geology.

Conclusions

The results of this study indicate that the relationship among secondary school mathematics, science, English GPA and geology technology GPA were statistically significant. This relationship was significant at both 1% and 5% levels. The null hypothesis was not rejected. An examination of the scattergram in Figure 4 reveals that these variables are "predictors" in identifying potential and successful students for the geology technology program, because the coefficient of correlation (in comparison) is so distinguished that the conclusion which can be drawn is that there is a statistically significant relationship among mathematics, science, English and academic achievement in a geology technology program at the College of Science and Technology, Calabar, Nigeria. These variables are not good "indicators" of students academic achievement in a geology program, but they are good "predictors." For example, a student with a secondary

school GPA of 2.5 appears to be more successful in terms of geology GPA than the 1.0 GPA student.

The study seemed to show that mathematics, science, and English could effectively be used to predict students' academic success in a geology technology program.

Recommendations

Since the results of this study indicate that strong relationships exist among secondary school mathematics, science, English GPA and the student's achievement in a geology technology program, it is recommended that the Department of Geology Technology at the College of Science and Technology use the findings in this study to advise new and present geology technology students.

Further studies could be conducted concerning some other variables, such as the mode of instruction, use of curriculum materials, the structure of mathematics, science, and the English materials, motivation, interests, and health as they relate to students' academic success in geology technology at the College of Science and Technology, Calabar, Nigeria.

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APPENDIXES

APPENDIX A

LETTER TO THE COLLEGE OF SCIENCE AND TECHNOLOGY CALABAR, NIGERIA, REQUESTING "RAW DATA"

c/o International Student Office
Oklahoma State University
Stillwater, Oklahoma 74074
June 13, 1980

The Secretary
College of Science and Technology
Calabar, Nigeria

Dear Sir/Madam:

I am working on my Master's Degree at Oklahoma State University. As a part of my thesis, I am doing a study of the relationship of students' academic achievement in secondary school mathematics, science, English, and academic achievement in geology technology at the College of Science and Technology, Calabar, Nigeria. Would you please "pull-out" and send to me from the College general result files the 1979 students' grade point average in mathematics, science, English, and geology.

It would be more helpful if two sets of data from your personal files would represent: 1) all your 1979 graduates whose transcripts include grades in mathematics, science, and English, and this group should represent the group which members had considerable background in mathematics, science and English before they were admitted into the geology program at the College of Science and Technology (COST), Calabar, and 2) all your 1979 graduates who had little or no background in mathematics, science, and English but were admitted probationally into the same geology program at the COST.

Thank you for your cooperation.

Sincerely,

Umoren W. Umoren

APPENDIX B

RAW DATA FROM THE COLLEGE OF SCIENCE AND TECHNOLOGY, CALABAR, NIGERIA

College of Science and Technology
Calabar, Nigeria
July 26, 1980

Mr. Umoren W. Umoren
Oklahoma State University
Stillwater, Oklahoma USA

Dear Mr. Umoren:

We are pleased to furnish you with the following data for your research study for your Master's Degree at Oklahoma State University, Stillwater:

No. of Students	Geology	Mathematics*	Science*	English*
1	2.99	1.50	1.55	1.50
2	2.33	2.23	2.30	2.23
3	2.27	2.15	2.10	2.15
4	2.88	1.00	1.50	1.67
5	3.23	1.65	1.65	1.65
6	2.30	1.65	1.00	1.65
7	2.72	2.00	2.00	2.00
8	2.50	1.65	1.00	2.65
9	2.16	1.65	1.00	1.65
10	2.50	2.00	2.00	2.50
11	2.52	1.00	1.50	1.00
12	2.56	1.50	1.00	1.50
13	2.33	2.50	1.00	2.00
14	2.58	2.50	2.50	2.50
15	3.28	1.65	1.00	1.00
16	3.44	2.00	2.10	1.05
17	2.06	1.50	1.30	1.60
18	2.78	2.00	2.15	1.00
19	3.73	2.50	1.00	1.40
20	2.43	2.65	2.65	2.65
21	2.00	2.00	2.00	2.00
22	1.31	2.00	2.00	1.00
23	2.69	1.50	1.40	1.50
24	3.49	1.00	1.00	1.00
25	3.22	1.50	1.00	1.50
26	1.80	1.00	1.50	1.00
27	2.40	2.50	2.00	2.50
28	2.12	1.00	--	2.65
29	2.00	1.13	--	1.34
30	2.51	2.43	2.12	--
31	3.00	--	1.50	1.00
32	2.70	2.00	--	1.65
33	3.10	2.41	1.99	--

No. of Students	Geology	Mathematics*	Science*	English*
34	2.50	--	1.44	2.00
35	1.55	1.52	--	1.52
36	--	2.00	1.53	1.71

*Entry Level GPA.

We hope the data will help you in your research. We wish you good luck.

Truly yours,

Etim J. Okon
(Secretary)

VITA

Umoren Wilson Umoren

Candidate for the Degree of

Master of Science

Thesis: THE RELATIONSHIP OF STUDENTS' ACADEMIC ACHIEVEMENT IN SECONDARY MATHEMATICS, SCIENCE, ENGLISH AND ACADEMIC ACHIEVEMENT IN GEOLOGY TECHNOLOGY AT THE COLLEGE OF SCIENCE AND TECHNOLOGY, CALABAR, NIGERIA

Major Field: Technical Education

Biographical:

Personal Data: Born in ONNA, Nigeria, May 12, 1943, the son of Tity and Wilson Umoren.

Education: Attended Higher School at Saint Augustine's Grammar School, Orlu, in 1965-1966; received the Bachelor of Science in Technical Education Degree from Oklahoma State University, Stillwater, Oklahoma, in December, 1979; completed requirements for the Master of Science degree, major in Technical Education, at Oklahoma State University in December, 1980.

Professional Experience: Employed by the Shell Petroleum Company, as a storekeeper in Cross River State, Nigeria, 1958-1960; Secretary to ONNA Corperative Union, 1967-69; Employed as a Senior Science Teacher at Kano Higher Elementary College, Kano, Nigeria, 1972-1974; Employed as a Graduate Assistant at Oklahoma State University, July 1, 1980 to May 31, 1981.

Member: Science Teacher Association of Nigeria (STAN); Nigerian Union of Teachers (NUT); Nigerian Higher School Association Founder, 1967.