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COMPARATIVE EFFECTIVENESS OF LECTURE AND MATERIAL-BASED INTERACTIVE METHODS ON SELF-CONCEPT, TEST ANXIETY AND ACHIEVEMENT IN MATHEMATICS IN LAGOS STATE

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ABSTRACT

This study was carried out with the aim of investigating the effect of three instructional methods and gender on achievement, test anxiety and self-concept in mathematics of NCE year one Business Education Students. The design used was a 3 × 2 pre-test/post-test quasi-experimental design.

A sample of 165 first year NCE Business Education Students comprising 71 males and 94 females, with mean age of 22.96 years, was used in this study. The subjects were all full-time students from two colleges of Education in Lagos State who registered for the 1992/93 session.

A total of nine hypotheses were tested with respect to the interactive effect of instructional method and gender on each of the three dependent variables. The instructional methods occurred at three levels as follows: Interactive learning with individual use of materials, interactive learning with group use of material and the lecture method. The materials were prepared from the second semester business mathematics course outline.Five instruments were used for data

collection. They were:

1. A multiple choice test in mathematics to test pre-requisite skills.
2. A multiple choice post achievement test in mathematics covering the course objectives of the second semester business mathematics course.
3. The Inventory of Test Anxiety in Mathematics (ITAM) by Osterhouse,.
4. A mathematics self-concept scale.
5. A learning package.

Analysis of covariance was done for each of the three dependent variables. Where significant interaction was found the hypothesis on main effect was not tested. Rather, Scheffe multiple Range Test was used to identify the source of variation. In case of no interaction, Multiple
Classification Analysis was used to determine the magnitude and direction of the effect as well as the amount of variation accounted for by each variable.

The result showed significant interactive effect of gender and treatment on mathematics achievement. Interactive learning with individual use of materials

favoured females while interactive learning with group use of materials favoured males. There was no interactive effect of gender and instructional method on the other two dependent variables. However, with test anxiety as the dependent variable, it was found that instructional method had significant effect, with students exposed to the lecture method having the highest anxiety level when compared with others. The hypothesis on self-concept showed that gender had significant effect, favouring females. Instructional method and gender accounted for a total variance of 24.3% in mathematics test anxiety and 22.8% in self concept in mathematics.

Recommendations are made as to how interactive learning could be used to meet students individual needs in the teaching of tertiary mathematics.

DEDICATION

TO MY LATE FATHER PA SAMUEL ADEBIYI OLALEMI

Who desired to witness the completion of this study

and

N M A M I ,

My darling mother, whose encouragement contributed to the success of this work.

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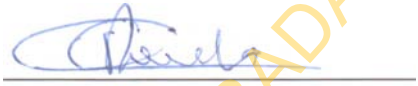
CERTIFICATION

I certify that this study was carried out by Mrs. Oluranti Adenrele Adedayo at the International Centre for Educational Evaluation, Institute of Education, University of Ibadan.



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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE PROBLEM

Knowledge of mathematics is basic to science and technology. It serves the unique purpose of being the foundation upon which all forms of scientific knowledge are built. History shows that most of the scientific and technological discoverers are found to be mathematically well-equipped.

However, the need for sound knowledge of mathematics is no longer restricted to mathematicians, engineers and physicists. The biologists find statistics and biomathematics very useful in such topics as mendelian genetics. In the field of Geography, the use of mathematics includes map projections, statistics of settlement patterns of villages and towns, analysis of surfaces, shapes and network as well as prediction of population. Mathematics has also been recognised as being useful in the humanities. The study of law makes use of Logic which involves mathematical reasoning. In linguistics, mathematics cannot be avoided. For example the linguists use Chomsky's mathematical theory of

languages in order to enhance their knowledge of modern languages. Ethnographers are not left out. They need mathematical knowledge to create mathematical models of primitive society. Holt and Majoram (1973) asserted that even in Christian Religious study, biblical analysts invariably employed mathematical techniques to assign authorship to disputed passages. The use of mathematics in Business Studies is very vast. High aptitude in knowledge and use of the various aspects of Business mathematics will enhance effective business transactions. A nation having students with good mathematical knowledge will have improved technological development and higher standard of living. Ibiejugba (1990) sums it all in his theory of optimization. As a subject of intellectual reasoning the theory is mathematical in nature and helps in the art of selecting the best possible decision in any circumstances including decisions on business transactions. The theory involves identifying what quantity to maximise or minimise and mathematical knowledge is needed for this. Thus, the study of mathematics is emphasised in the Nigerian educational system.

In Business Education, it is recognised that modern business needs sound background of mathematical knowledge to solve a variety of everyday problems. Although calculating devices are available there is need for the business students to be exposed to sound knowledge of basic mathematical procedures in order to use the calculating tools intelligently and efficiently. A sound background in mathematics is essential for effective solution of mathematical problems encountered in business and everyday life. It will also lead to the students being adequately equipped to pursue more advanced mathematics in statistics, econometrics etc. when the student is exposed to university education. Hamburger (1972) emphasized the importance of mathematics in Business when he commented that:

> "It takes the conquest of mathematics to master each Business subject and the knowledge of Business subject to conquer mathematics. Successful operation in any line of Business calls for the ability to comprehend and solve its particular and specialised problems: problems that invariably involve mathematical

concepts".

Thus, mathematics and business subjects are not mutually exclusive in terms of useability.

The NCE level is an important aspect of tertiary education in the Nigerian educational system. As Fafunwa (1990) said, "the NCE will ultimately become the minimum basic qualification for entrance into the teaching profession in Nigeria". Graduates of the various colleges of education are being trained to teach in the primary and secondary schools in Nigeria within the context of the National Policy on Education as ammended in 1981. Among the NCE program is a vocational course on Business Education whose philosophy and objectives are as follows:

1. To make the business educators understand the concept and philosophy of the National Policy on Education as regards Business Education and the importance of Business Education in National Development.
2. To produce NCE Business teachers who will be able to inculcate the vocational aspect of Business

Education into the society.

3. To produce NCE Business teachers who will start the so much desired revolution of vocational development right through Primary and secondary schools.

4. To prepare students in Business Education with necessary competencies to qualify them for a two year

post-NCE degree programme in Business Education in Nigeria.

The inclusion of Business Education in our educational system especially at the secondary level is very crucial because of the usefulness of Business Education in the society which includes making students became very adept in marketable skills. Harms and Stehr (1965) also opined that it "creates an awareness of the need of certain business learning to properly conduct personal business effect". For the teacher to effectively groom students in Business Education, he needs to be mathematical competent.

Coyle (1976) described mathematics in Business as

a way of visualising problems and exploring structures in order to make effective decisions in business. Thus, for effective and rational decision in Business and everyday life, one needs, a sound knowledge in basic mathematics.

It is in recognition of the importance of mathematics in Business Education that the National Commission for Colleges of Education (NCCE) makes it compulsory for all first year NCE students in Business Education to obtain at least a pass in Business mathematics as one of the conditions for the award of the National Certificate of Education. It has been observed, though not empirically, that many of these students have problems with their Business mathematics courses. The high number of students with weak passes and carry-overs in the courses points to the urgent need for intervention programmes to improve the situation.

A number of factors interfere with the learning of any subject and as such, business mathematics is no exception. One of the factors that has been identified as affecting performance in mathematics is mathematics test anxiety (Clute, 1984). This stems from mathophobia,

that is, the fear of mathematics. Majority of the students in the school of Business Education barely managed to scale through their O' Level mathematics. They are aversive to the subject which they view as a thorn in the flesh. They exhibit fear of mathematics test and examination. This may be due to lack of preparations on their part and lack of confidence on their ability to pass the mathematics course. Cronbach (1970) asserts that although test anxiety is common among all kinds of pupils, it is more common among the low achievers. The outcome of this that students go to all extent to be involved in various forms of examination malpractices in order to pass mathematics test or examination.

The Business Education students especially the low achievers in mathematics have low self-concept about their mathematical ability. This has been observed by the researcher through verbal discourse with these students. Results of various research studies have consistently shown significant negative relationship between academic self concept and achievement (Hansfort and Hattie, 1982; Bryne, 1984; Marsh, 1992). A student

who wants to achieve well in mathematics must also have high self concept of his ability. Unfortunately, this is not the case with these students who tend to have low self concept about their mathematical competence.

The problem of negative effect of test anxiety and low self concept which various studies have shown as having relationship with mathematics achievement needs urgent attention. The students need to be encouraged to develop a positive attitude towards mathematics. There is an urgent need to address the issue of low achievement and related variables like mathematics self concept and test anxiety.

One way of looking at this problem is to examine the instructional strategies used in the Colleges of Education. The lecture method appears to be the conventional method of instruction used in the tertiary institutions worldwide, Nigeria inclusive. Costin (1972) confirms this in his statement that "of all methods in college teaching, lecturing is the most widespread". Lecturing involve verbal presentation of facts from the instructor to the students whose participation in the

proceed involves intense concentration and taking down of notes. This method has been criticised by Akin-Aina (1989) as for being teacher-centred, monotonous and failing to permit active learning".

Studies have been carried out pointing out the inadequacies of the lecture method when compared with some teaching methods such as discussion method (Bloom, 1953); group study method (Ward,1956); use of audio tape (Harding et al,1981), guided discovery method (Clute, 1984). All these obtained significant superiority of each of the methods over the lecture method. Although the lecture method is widely used, the constructive criticisms and disbelief about its usefulness and effectiveness point to the need for finding alternatives to this method.

Modern research advocates the need for an active mode of teaching whereby students are given opportunity for active engagement in learning. Collier (1980) in his study of higher education found that tertiary level students were successful in developing higher skills when understanding of course contents was combined with active involvement of students. While investigating the

effect of individualized method as opposed to the traditional lecture method in tertiary mathematics, Wine and Olan (1983) found significant effect between the two methods for students with weak mathematics background in favour of the individualized method. File (1984) advocated that learning difficulties experienced by students could be overcome once these difficulties were recognised and once effort and time were devoted to overcoming them. The question that arises is: can the learning difficulties experienced by students in business mathematics be overcome if instructional techniques which are quite different from the prevailing "teacher-centred" lecture method is adopted?. Although Nickson and Smith (1973) found no clear differences in the various teaching methods employed in teaching mathematics to students of economics at tertiary level, the effectiveness of the methods found by later research poses a challenge of investigating with Nigerian students especially as Robinson and Mansour (1991) found the interactive method to have more successful impact on cognitive variables.

Most of the studies on mathematics test anxiety and

self concepts are correlational in nature. For example, Alpert and Haber (1960) found test anxiety to be negatively related to academic achievement while Hansford and Hattie (1982) found academic achievement to be more highly correlated with academic measures of self concept than with generalised measures of self concept. Few research aim at finding the impact of teaching methods on these psychological measures. The only research work identified by the researcher was that of Georgewill (1990) who
advocated the need for sequential teaching on order to reduce test anxiety in secondary school students.

On the issue of gender effect on achievement in mathematics, Marshall and Smith (1987) found that boys had better understanding of problem structure than girls. Earlier, Benbow and Stanley (1980) confirmed that gender was a significant predictor of high school mathematics. However, Feingold (1992) pointed out a decrease in gender related differences in cognitive variables. It will be interesting to find out if gender has significant effect on performance of NCE business education students.

Research on gender differences on the two psychological measures i.e. on mathematics test anxiety and mathematics self concept, showed that females scored higher in test anxiety (Benbow and Stanley, 1980) while boys had higher self concept in mathematics than girls (Marsh and Smith, 1990; Marsh 1989).

This study hopes to make a comparison between the effects of the interactive learning strategy and lecture methods on achievement in mathematics, test anxiety and self concept of Business Education students. Gender issue
is also included in order to study its effect and interaction with teaching methods.

1.2 STATEMENT OF PROBLEM

The issue of alternatives to lecture poses a problem of educational research. In the normal mathematics lecture room student's role is inactive. The students are presented with so much factual material in an attempt by the lecturer to "cover the syllabus". According to Hubbard (1990) this usually results in students losing trend of the mathematical arguments

especially if the pace is too fast. They may omit some crucial points or write incorrect statements, thereby creating problem of revision.

The poor performance in mathematics by non mathematics majors at tertiary level poses a problem of finding appropriate instructional strategies to enhance students' achievement and mathematics self concept and reduce their test anxiety.

This study will thus attempt to evaluate the effect of material-based instructional strategy (treatment) as well as gender on mathematics self-concept, mathematics test
anxiety and achievement in mathematics of NCE Business Education students.

1.3 RESEARCH QUESTIONS

The study aims at providing answers to the following questions:

1. Is there any difference in mathematics achievement between NCE business education students exposed to material-based instructional methods and those not exposed?

exposed.

9. Is there any difference in mathematics self-concept between male and female NCE business education students?

1.4 STATEMENT OF HYPOTHESES

Based on the research questions, the hypotheses in this study will be tested under the following subheadings:

1.4.1 Achievement as the dependent variable

1. There is no significant main effect of instructional methods on NCE business education students mathematics achievement.
2. There is no significant interactive effect of instructional methods and gender on NCE business education student's achievement in mathematics.
3. There is no significant main effect of gender on NCE business education student's achievement in mathematics.

1.4.2 Mathematics Test anxiety as the dependent variable

4. There is no significant main effect of

instructional methods on NCE business education student's mathematics test anxiety.

5. There is no significant interactive effect of instructional methods and gender on NCE business education student's mathematics test anxiety.
6. There is no significant main effect of gender on NCE business education student's mathematics test anxiety.

1.4.3 Mathematics Self-Concept as the dependent variable

7. There is no significant main effect of instructional method on NCE business education student's mathematics self-concept.
8. There is no significant main effect of gender on NCE business education student's mathematics self-concept.
9. There is no significant interactive effect of instructional methods and gender on NCE business education student's mathematics self concept.

1.5 SIGNIFICANCE OF THE STUDY

Research findings have consistently emphasised

correlational studies involving mathematics test anxiety, mathematics self-concept and achievement in mathematics. For example, Baya'a (1990) conducted a correlational study on mathematics anxiety, achievement, gender and socio-economic status among Arab students and found substantial relationship between the variables. No study known to this present researcher has investigated the combined effects of gender and instructional strategies on the afore-mentioned variables. This lapse emphasises the need for this study.

The issue of high mathematics test anxiety and low self-concept in mathematics is an educational problem in mathematics education. Research has shown that these two variables have effects on mathematics achievement. The application of experimental method to this educational problem is of high significant value and it is in line with the editorial comment of the 1991 edition of the Journal for Educational Psychology which stated that "there is need to stimulate interest in the progress of experimental pedagogy: For we believe that the time is ripe for the study of school room problem in the school room itself and by the use of experimental method". This

experimental study, conducted in the classroom situation, is an answer to this clarion call for experimental research to study educational problems.

The inadequacies of the traditional lecture method, especially, in mathematics and science has been the focus of many educational researchers. Clement and Wrights (1983) rightly observed that:

"particularly in the scientific and technical areas, the use of lectures as a mechanism in the transferance of materials from the notes of the lecturer to the note pads of the students without any critical involvement or significant intellectual efforts on the parts of either has been seen to be a misuse of capabilities of staff and students".

There is need for alternative methods of teaching students at tertiary level in order to effect adequate transfer of mathematical knowledge. Instructional techniques need to be evolved that can optimize students involvement in the learning process. This study is of significant value since it attempts to take up this challenge.

The sample used in this study are students at the tertiary level. Literature points to a lot of research on higher studies but based on non-Nigerian samples. There is therefore the need to combat the issue of scanty studies on higher education in Nigeria and this study aims at meeting this need.

The prevailing economic situation in Nigeria is such that textbooks are extremely costly and beyond the reach of most students at tertiary level. If available, most are outdated and foreign-based. Nigerian authors are making efforts to combat this problem. However, publishers favour academic materials for primary and secondary level since this will sell faster. The new learning package developed in this study will be of significant use to help the students offering a first year Business mathematics course at NCE level.

1.6 SCOPE OF STUDY

The subject used in this study were students at tertiary level. This limits the scope of this study to higher education. Furthermore, the students used were non-mathematics majors. They were those who were

compelled to undertake a course in mathematics as a condition for their graduation. The scope in not widened to include mathematics majors who are likely to have low mathematics test anxiety and high mathematics self-concept.

It should also be noted that the study does not aim at examining the inter-relationship between achievement in mathematics, mathematics test anxiety and mathematics self-concept. Rather, it compares the effectiveness of some attribute and active variables on the three dependent variables mentioned earlier.

1.7 DEFINITION OF TERMS

This section deals with definitions of some important terms used in this study. Examples are given, where necessary, in order to clarify the definitions.

(i) Independent variable: This is a variable which is not affected by changes in the other variables. In this study gender and teaching methods are the independent variables.

(ii) Dependent variable: This is the variable that is affected by changes in the independent

affected by changes in the independent variable. It is the "presumed effect" of the independent variable. Achievement test in mathematics, mathematics test anxiety and mathematics self concept are the three dependent variables studied.

(iii) Active variables: These are variables that can be manipulated. The methods of teaching are the active variables in this study.

(iv) Attribute variables: These are variable that can not be manipulated. The example used in the study is gender. Both the active and attribute variables are the independent variables used in this study.

(v) Target sample: This consists of all NCE students offering a first year course in Business mathematics.

(vi) Achieved sample: This consist of all the students used in this study.

(vii) Achievement in mathematics: This is a measure used to obtain firm responses of students on a carefully constructed and validated objective test in mathematics.

(viii) Mathematics Test Anxiety: This deals with scores obtained by students on a mathematics test anxiety

scale which contains items describing test anxiety situations.

(ix) Mathematics Self-Concept: These are the scores of students' responses on a questionnaire that describes students' self-perceived ability in mathematics.

(x) Lecture method: This is a teacher-directed mode of teaching at tertiary level and it involves oral presentation of mathematical facts with little or no active participation by students.

(xi) Interactive method: This is a students-centred type of cooperative learning in which students work interactively with little assistance from the teacher.

(xii) Materials: These are structured instructional package based on the syllabus of the NCE Business mathematics course.

(xiii) Pre-tests: These are tests given before the commencement of the treatments.

(xiv) Post-tests: These are tests given at the conclusion of the experiment.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 INTRODUCTION

The review of relevant literature to the study is presented in this chapter. The purpose of the study as well as the variables involved in the study have been taken into consideration in the review. Thus the literature review is presented under four major headings: the lecture method; mathematics achievement, instructional techniques and gender; mathematics test anxiety and mathematics self concept.

A summary of findings is given at the end of the review. This summary include appraisal of the reviewed literature.

2.2 THE LECTURE METHOD

The lecture method is the typical instructional strategy used at tertiary level in most subjects, mathematics inclusive. This was confirmed by Hoover (1981) that "the lecture is currently the most widely used instructional method in colleges and universities". Robinson (1991) gave a vivid illustration of this method when he described it as "more or less a continuous oral

presentation of information and ideas by instructors with little or no participation by the students". This method has been regarded by students as being unfavourable (McLeish, 1968). According to File (1984) 31% of students at undergraduate level sampled by him, claimed lecturers assumed more knowledge on part of students during lectures than they actually possessed. Unfortunately, lecturers on their part hardly realise just how little of what they say is understood by students (Abercombie, 1971). The lecture method, described by Marris (1962) as being "most universal and most impersonal method of post secondary instruction" often involves large group with limited scope for interaction.

The strengths and weaknesses of the lecture method have been identified by Gregory (1975). Among the strengths of the lecture method identified by him were: Coverage of more factual materials, uniform transformation of information, usefulness to large group, economic use of instructor's time and a relatively easy instructional technique to adopt. The weaknesses included: not being able to cater for

individual differences of learners, little or no active participation by students, and development of few high intellectual skills. To be effective, the instructor needs careful preparation and presentation on his part while the student needs increasing concentration in order to imbibe the concepts taught. As an impersonal method of teaching, it inhibits feedback and promotes covert rather than overt engagement in learning tasks.

This method is widely used in tertiary mathematics instruction. At this level, the lecture method is used as a mechanism in the transference of materials from the notes of the lecturer to the note pads of the students, without any critical involvement or significant effort on part of either the instructor or the learner (Clements and Wrights, 1983). Making wrong assumptions about the mathematical level, experience and competence of their students, the mathematics lecturer goes straight to confusing definitions, theorems and proofs while the student's inactive role is to copy these concepts from the board. Lecturers need to be aware that little of what they teach during lectures is understood by the students. Morgan(1990), while expressing concern

about the general poor level of mathematical competence of some selected engineering students in tertiary education, found out that the development of mathematical ability was not being achieved since students could not generate solutions to basic problems of the important concepts involved in mathematics.

Hubbard (1990) opined that must lecturers of tertiary mathematics adopted the lecture method because it was the method used in instructing them while they too were students at tertiary institutions. The feeling was that since they were taught that way and succeeded, their own students must succeed if taught in the same way. The fact that using different methods might imply more successful learning of the taught mathematics concept and reduce the drop-out rate in mathematics is not often considered. Furthermore, in an attempt to "cover the syllabus" students are presented with too many factual materials with lecturing done at a fast pace. This fast pace, coupled with the sequential nature of mathematics make many of the students get lost and the longer the mathematics lecture, the more serious the student's incapability to absorb what is being taught.

Students may omit crucial statements, copy down incorrect or incomplete statement thereby getting more confused about concepts.

Although lecturing in mathematics provides a fast way of reaching a large audience (Flexer, 1978), how effective is the individual in the audience being reached? This made November (1976) to comment that the lecture method, "while it is a good method for one person to transmit information to many, it is a very poor method for individual to receive learning". A good mathematics instructor at any level of the educational system, must not just be a transmitter of knowledge, but a manager of knowledge.

In most tertiary institutions in Nigeria, lecturing is supplemented with tutorials organised for the students. The problem is, how effective are these tutorials, if at all they exist in a given institution, in helping the low achievers in mathematics. In most of these tutorials post graduate students or high achievers among the students solve some problems on the board. Little or no pain is taken to ensure good understanding by the students (Adedayo,1994). Attendance at these

tutorials are not encouraging. Some lecturers just give out tutorial questions to students to practise without making any attempt to assist them in their areas of difficulty.

Researchers involved in studies at high educational level have persistently shown concern about the inadequacies of the lecture method and hence have been involved in carrying out studies comparing the lecture method against other methods of instruction some of which are cited here.

2.2.1 The lecture method versus other methods of instruction

The studies comparing the lecture method with other strategies are very interesting. While many of the studies found significant differences when compared with the lecture methods, some did not find any difference. The other methods include lecture combined with tutorials, guided reading, learning packages, laboratory strategies and other methods.

(i) Lecture versus lecture with tutorials

Tutorials, if well organised, are good avenues of

identifying and overcoming students learning difficulties in mathematics. These learning difficulties can be overcome once they are recognised rather than ignored and once time and efforts are devoted to overcoming them (File, 1984). The aims of tutorial classes as outlined by Searl (1979) are:

(i) making personal contacts with students.

(ii) Clearing up difficulties of lecture notes.

(iii) Solving problems.

(iv) meeting with fellow students.

(v) providing feedback to effectiveness of lectures.

(vi) Returning and correcting assignments

(vii) Ensuring that class is keeping up with tutorial sheets.

(viii) Problem solving by students to give experience and confidence.

Tutorial classes when held as supplements to lecture enhance learning. Hubbard (1990) investigated other teaching alternatives different from the normal lecture with first year undergraduates offering courses in mathematics and emerged with a format involving more active participation by students. The procedure involved

provision of study guides for students on weekly basis containing extra explanations, in formal languages, for known areas of difficulties as well as exercises for testing students understanding. Tutorials were held in groups of 15-20 since a large class was involved. Frequent testing was also done with feedback and the outcome was an improvement in students attitude and achievement in mathematics.

Goldschmid and Goldschmid (1976) combined lecturing tutorials and students working in pairs on written materials in tertiary instruction and found this teaching method to be very effective. Wood (1991) examined the effect of computer laboratory tutorials when combined with cooperative learning on mathematics achievement, retention rate, mathematics anxiety, mathematics confidence and success in future mathematics among some tertiary students. This combined tutorial method was compared with the traditional lecture method which served as the control group. The control group showed greater increases in post-course confidence ratings than the experimental group. They also showed greater reductions in anxiety ratings than the

experimental group. However, 69% of the experimental group received a course grade of A, B or C as compared with 52% of the control group while 87.5% of the control group students were successful in the subsequent mathematics course compared to 80% of the experimental group students.

One of the advantages of tutorials is providing feedback of students' errors and correcting these errors. Boonruangratana (1980) observed that testing and subsequent discussion focusing on particular problem identified by the testing has significant effect in the maximum achievement of the class. Students showed positive reaction when provided with corrective testing, which comes up during tutorials especially students with high test anxiety (Arkin et al, 1984). Also, Lyte and Kulhavy (1989) observed that undergraduates who received repeated feedback showed the greatest probability of correcting instructional errors. Johnson (1990) while investigating the effect of frequent testing on the learning of mathematics found that short tests improved students achievement in final examinations. So if short tests are given and correction of errors done during

tutorials, students will be made to work hard on a continuous basis instead of cramming when examination draws near.

(ii) **Lecture versus use of learning materials**

Studies have also compared the lecture method with methods that involve use of learning materials. The results of these studies have been quite interesting.

November (1978) used a tutorial tape learning package as compared with the traditional lecture method. He was not able to prove quantitatively that the learning package produced better result than the lecture method although students using the learning package had a higher mean score. He attributed this high mean score to either light marking on part of the instructor or the package making the subject inherently more interesting. Harding et al (1981) also compared tape slide teaching with normal lecture and found no observable differences between the two groups taught.

Romberg (1969) used programmed instructional materials and investigated its effect on low-achievers. Although no significant difference in achievement was found, those exposed to the learning materials had

better retention. With respect to its usage, Jones (1989) advocated the use of programmed instruction in cooperative groups in Science teaching as being very effective in promoting achievement. Wine and Olan (1983) compared the effect of the traditional method of instruction with individual type involving the use of programmed instruction for year one students in a tertiary mathematics course. His technique comprised 15-30 minute of lecture followed by individual use of supplementary text.

The use of the individual material was more effective in improving the performance of low achievers than the traditional method. Even for the handicapped, Slavin (1982) found that an instructional method making use of individualized learning in mathematics compared with the traditional method of instruction was more effective in increasing the sociometric status of main streamed academically handicapped student and the individualized learning involved use of materials.

Clements and Wright (1983) found guided reading very

effective in engineering mathematics degree course. Students were guided through the reading and study of a particular textbook or several textbooks by a set of rules provided by the instructors and also supplemented with a series of discussion and tutorial classes run by the lecturers.

The use of new learning materials in improving students achievement was also investigated by Cohen and Ben-Zvi (1992). They found the new learning materials to be very effective in improving students' achievements.

(iii) **Lecture method versus guided discovery**

The guided discovery method, another approach to teaching, has been defined as a unique individual experience by which concepts evolve in the mind of the learner than being transmitted ready-made. It is evident from the ideas of Gagne (1966) that the discovery approach does not imply students just sitting down and paying attention but rather involves the process of searching and selection. Bruner (1960) identified some of the advantages of the discovery method as:

1. resulting in better retention since no memorisation of isolated information takes place. Rather, discovery of principles connecting the information is got.
2. It enhances motivation, interest, and satisfaction. If the student is satisfied there is tendency for competency.
3. It enhances the development of intellectual capacities, information and problem solving skills.
4. A general heuristics of discovery enables students to solve problems in new contexts and hence increase transfer of learning.

A lot of work has been done on its effect on learning of subject especially mathematics and science at various levels of the educational system. When carefully used, it has also been found to have positive effect on tertiary mathematics.

Flexer (1978) used this mode of teaching that enabled pre- service teachers to discover mathematical concept through exploration with manipulative materials such as dice, blocks and abacus. This laboratory strategy (as he chose to call it since it took place in the mathematics

laboratory) was found to be very effective in achieving the desired goal. Clute (1984) compared a lecture method with a guided discovery method comprising of questioning sequences that guided tertiary mathematics students to discover mathematical principles in one of the mathematics course to which they were exposed. The result obtained showed that the discovery approach was of great benefit to students with low mathematics anxiety. The lecture or exposition method favoured students with high mathematics anxiety.

(iv) **Lecture versus Interactive method**

Recent findings lend support to a student-centred model of teaching (as opposed to the teacher-centred lecture method) which involves active engagement of students in learning task. Unlike the normal lecture which limits students to covert participation, this mode of teaching encourages pupil-pupil interactions as well as teacher-pupil interactions. Wanskowski (1982) asserts that "human interaction is most important in assisting students in learning how to learn." Peer teaching, group discussion and cooperative learning are some of the techniques used in the interactive learning processes.

Cooperative learning has been advocated as promoting enhanced understanding and providing guidance for teachers in higher education (Todd, 1981). There is need to increase the involvements of and participation of students in the teaching - learning processes as well as give the control over the learning processes as advocated by Stephens (1981) and Castro (1991). Robinson (1991) emphasised the need for this model of learning by saying that "perhaps the most acceptable indirect method for the post-secondary instructor may be discussion or interactive instruction". Interactive instruction combines components of discussion, group interaction and a defined problem. The main aim is to maximize students involvement while the instructor minimizes his involvement by briefly presenting a topic, engaging students in class activity which generally involves group work or individual work with materials. Feedback must be given on the students' work so that students' involvement in the learning process is thus optimized. Bossert (1988) opined that cooperative learning method promotes students achievement that is at least as high and often higher as in traditional classroom. From the

views of Conwell et al (1993) cooperative learning can be seen as implying shared leadership where there is not just one leader but each member of the group is a leader. A leader thus demonstrates academic as well as collaborative skills in helping the group achieve its goal.

Interactive learning involves small groups of students doing some peer teaching. Channon and Walker (1984) found that most lecturers at tertiary level agreed with small group teaching but made excuse of not doing so because of the large number of students they had to face. However, they advised that with proper planning it could be fully implemented with larger groups. The interactive technique is applicable to all age levels (Davidson,1989).

Small group interactive learning provides an alternative to both the traditional teacher-centred expository instruction and individual instruction systems (Davidson, 1990). Mavarech et al (1991) in an experimental study of learning computers in small group used ANCOVA to arrive at the conclusion that students who used computer assisted instruction for drill and

practice in pairs performed better than students who used the program on individual basis.

The realistic, practical strategies for using small groups in mathematics teaching and learning for all age levels, curricula levels and mathematical topic areas include: problem solving and exploration with manipulative materials in groups of four, team learning approaches based on individual accountability and team recognition, procedure, for problem solving and inquiry in algebra, geometry and trigonometry, free explorations and guided discovery in cooperative groups. Factors affecting the implementation of these learning strategies among others have been extensively discussed by Davidson (1990).

Good et al (1990) sum up the advantages of this method of learning. According to them, the active learners are more motivated and enthusiastic about mathematics than those exposed to traditional techniques. However, well prepared materials are needed for its effective implementation. This interactive strategy has been greatly explored at various studies on the teaching of mathematics at all level of the

educational system.

Nickson and Smith (1973) investigated alternative methods of teaching elementary mathematics to students of economics at first year level in Cambridge University. Three methods were compared, namely:

(i) Self instructional learning packages written specially for the course.

(ii) a lecture course together with classes involving use of computers and

(iii) a straight lecture course.

The results obtained showed no clear differences in effectiveness between teaching methods.

Collier (1980) combined understanding of course content with a student directed learning group and concluded that peer group teaching, which is an interactive technique, is a good technique even at tertiary level. Todd (1981) used a method he called collaborative learning. As an interactive strategy, it involved small groups of students working on learning assignment independent of tutor. The tutor put in his advice from time to time but left student to work alone. The result was very successful and he was

able to conclude that this technique improved learning.

Goldberg (1981) investigated problem solving in small groups comprising four or five members among students in tertiary institution offering courses on algebra, logic, calculus and number theory. He found that this technique promoted more understanding and greater incentives for the students to do their assignment. They were to work individually but were allowed to seek help from their colleagues.

Sherman (1986) used secondary school students as her sample. One of her three studies involved comparison of the interactive cooperative technique with the individualistic method. The result favoured the cooperative group who demonstrated significantly higher post test achievement scores than the individualistic group. The second study involved cooperative learning in remedial mathematics for ninth grade students. One class used a modified team approach (interactive), while the other used the individualistic goal structure including class lecture, seat work and home work. The mean post-test group scores was high for the cooperative group. The third study was done with a biology class and no

difference was obtained.

Phelps and Damon (1989) assessed the effects of collaborative (an interactive method) on spatial reasoning. They found the technique to be effective for tasks requiring reasoning but not effective for those tasks that require rote learning or copying. The group used were also secondary school students.

Brickie and Woodrow (1990) investigated problem solving skills of "at risk" high School mathematics Students through cooperative work groups and computer assisted instruction. For a period of three months, computer manipulative, cooperative groups and Socratic questioning in the mathematics classroom were used to address a variety of learning preferences. No measurable differences could be noted from the pre- and post-test interest responses. However, improved performance and documented increases in class attendance made them conclude that the design of mathematics instruction to accommodate differences in students learning preferences must be an effective strategy for addressing the unique needs of the at-risk alternatives high School Student.

Pratt et al (1990) investigated the effect of

cooperative learning as compared with the traditional approach among low ability fifth - graders. The achievement tests given included topics on mathematics. Students in the cooperative learning class scored higher than those in the traditional class with statistical significant differences occuring in favour of those in the cooperatives learning class on mathematics and total battery Scores.

Back to study on tertiary level mathematics, Dees (1991) used a group of students in a college remedial mathematics course to find out if the cooperative technique would improve their problem solving skills in mathematics and found cooperative learning to be effective in solving worded problems in algebra and geometry. Cooperative learning at tertiary level has not only been effective in mathematics. Cohen and Ben-Zvi (1992) tried it an a chemistry class and found that students involvements in the learning process were optimized.

Urion (1992) tried the small group interactive techniques on groups cutting across secondary and tertiary students in mathematics. The results showed

that in all the levels compared there was no single case of the small group students performing poorly than those exposed to traditional technique. Thus we have seen that majority of the studies in interactive or cooperative or collaborative or group study or peer teaching reviewed, on the average, the interactive technique, when used in tertiary mathematics is quite rewarding.

2.3 MATHEMATICS ACHIEVEMENT, INSTRUCTIONAL TECHNIQUES AND GENDER

Mathematics achievement deals primarily with the performance of students on either teacher made test or standardized achievement test administered by researchers and by examination bodies.

It is generally believed that students' love, interest and achievement in mathematics at all levels of the educational system are not encouraging. Hatred for and poor achievement in mathematics increase with age as cited by Carpenter et al (1980).

Here in Nigeria, we are constantly confronted with statistics that show general low performance in mathematics, when compared with other subjects, at the

National Common Entrance level, the Junior Secondary Mathematics level, as well as the Senior School Certificate mathematics examination level (Adedayo, 1994). The situation at the tertiary level is not any better. The high number of students with weak passes and carry overs in mathematics at the polytechnics, Universities and Colleges of Education show that students are not achieving high enough in mathematics.

Research have focused on both teachers and students in an attempt to find out if improvement in mathematics learning and achievement can be attained by manipulating some of the alterable variables such as teaching methods, time on task e.t.c. The studies on the teachers, among others, concentrate on instructional techniques being employed. As reviewed earlier in this chapter, various teaching strategies such as peer teaching, individualized method of instruction, guided discovery method, in which students play more active role, have been of great use in improving students achievement in mathematics. Frequent testing with corrective feedback measures has also been proved effective in improving students achievement in

mathematics (Keats, 1972; Lyte and Kulhavy, 1987).

The use of humour in teaching has been advocated by Boughman (1979) as a means of promoting understanding and hence achievement in any academic subject, mathematics inclusive. Humour in teaching increases students attention and retention and interest and reinforce what is taught.

Concerning the issue of gender and achievement in mathematics, the general belief is that boys are superior than girls (Muscio, 1962). Research results available show two sides of the coin - sometimes favouring males and sometimes females. Benbow and Stanley (1980) emphasised that gender differences in mathematics achievement is "huge and remarkable" with boys showing superior ability than girls. Later research conducted by these two researchers in 1982 and 1983 using different samples confirmed this assertion. To support this finding, Marshall and Smith (1987) found that boys had better understanding than girls in mathematics. Mills et al (1993) also found that boys performed better than girls on tasks requiring

mathematical concepts. For students at tertiary level, Boli et al (1988) found undergraduate males to be superior only in a calculus course. Bridgement et al (1991) however found that in a given mathematics course at the university level, the average grades of women were about equal or slightly higher than men's average grades. Kimball (1989) found no gender differences in most university courses and that where differences occur, there was female superiority. On the Nigerian scene Uka (1966) found no sex difference while Obioma and Ohuche, (1980) obtained results which showed male superiority over females. However, Onibokun (1979) asserted that male superiority in numerical ability during the early year might be a myth after all. Adedayo (1982) found no significant difference between the scores of male and female students in standardised mathematics tests. Meta-analytic studies carried out on gender differences in mathematics achievement (Feingold, 1988, Friedman, 1989) conclude that simple generalizations concerning superiority of either sex are impossible. Fennema and Sherman (1974) asserted that sex-related differences in mathematics were not as

prevalent as had been believed. Rather, they found mathematics achievement to be age related. Fennema and Sherman (1977) also showed that universal sex related differences did not exist in mathematics. However, Hyde (1990) emphasised that age, type of task and other factors determine gender differences and these factors should be taken into consideration in the issue of gender differences in achievement in mathematics.

Halton and Gosta (1974) investigated sex type interest as possible causes of difference in mathematics achievement between the sexes in different grades. They found no significant difference between the sexes up to grades 5, but after grade 5 the boys achieved higher than the girls. They cited the earlier results of Tyler, Anastasi, and Maccooby who surveyed sex differences in achievement of boys and girls and concluded that boys did better in numerical and spatial tests and tests of arithmetic reasoning. Wolleat et al (1980) also found that females have lower confidence and ability in mathematics than males. The concern about the gender issue is very essential and should be the focus of researchers (Jackline, 1989).

At tertiary level, Betterly and Clarke (1974) carried out their study using undergraduate students in mathematics. The conclusion reached was that there was no evidence existing to show that members of either sex obtained better results. Deboer (1984) confirmed that fewer women took Science and mathematics courses than men but when they did they performed at a higher level in both high school and colleges.

Using Arab students in an Israeli secondary schools Baya'a (1990) found gender to be a significant predictor for course plans for high school students in mathematics and also that differences between males and females depended on their socio-economic status.

2.4 MATHEMATICS TEST ANXIETY

Anxiety describes the individuals level of emotionality. The behaviourist employ the terminology "anxiety" as a short hand label for complex pattern of responses which may be self-reports, physiological or somatic-motor in nature. Psychologists have pointed out that anxiety could affect the cognitive aspect of a human being. This implies it could affect performance in

tests, especially mathematics tests.

Mathematics test anxiety is a measure of students responses to items invoking anxiety related conditions in testing situations. Scales have been designed to measure this test anxiety. A popular test by Richardson and Suin (1972) is the Mathematics Anxiety Rating Scale (MARS) which has been used extensively in America and other parts of the world. Fenneman (1977) modified this Scale to produce the Mathematics Anxiety Scale. Cronbach (1970) confirmed the prominence of testing anxiety in general among dull students.

Anxiety can be grouped into two main divisions: the high-anxious or those are mainly tense and worried and the low-anxious or those who are cool. According to Dececco et al (1974), low anxious students perform better when challenged by a given task in which their performance will be assessed while high anxious students perform worse under the same condition and perform better when they are not threatened with evaluation and faced with a challenging or difficult task. Hallworth (1964) emphasized that the anxiety experienced by a person when taking test or examination could play an

important factor in his success or failure. Over-anxiety could lead to being too confused to put in his best, while not being anxious at all could lead to poor performance due to insufficient effort. He defined general anxiety in terms of typical symptoms recognised by clinicians and concluded that general anxiety of which test anxiety is a subset, correlated highly with anxiety specifically related to tests and examinations.

It is generally believed that anxiety could perform dual role which is either positive or negative in nature. Test anxiety could be an aid to achievement. A student who is anxious about an impending test could be so eager to perform well that anxiety will stimulate him into putting more efforts into his preparation. The positive outcome is that he would do better than if he had not been anxious. This anxiety has a limited level after which it will have negative side effect: being too anxious will make the student so nervous as to forget some facts which he already knows. Alpert and Haber (1960) worked in line with this theory. They believed that anxiety would not always lead to poor performance. It could have a positive effect on performance up to a

certain level after which it could impede performance. This led them to constructing and validating the facilitating and debilitating anxiety scales. The facilitating scale makes the student report how anxiety improves his performance while the debilitating anxiety scale measures how anxiety interferes with test performance.

A recent theory based on the interference model asserts that anxiety produce test irrelevant responses that divert attention from test relevant thoughts and hinders retrieval of information needed to properly answer questions (Tyne, 1980). The high test anxious student occupies himself with task-irrelevant responses such as worry and do not devote attention to test-taking tasks.

Culler and Holahan (1980) gave alternative meaning to the interference model as follows:

(i) Test anxiety represents a problem of broader behaviourial scope and the test anxiety relation-ship is at least partially a function of differential study related behaviours between high and low test anxious individuals.

(ii) Their assertion attests to the fact that study habit has a part to play in test anxiety since it could occur as a result of inadequate test preparation on part of the students. In fact their views are that high test anxiety is caused by inadequate test preparation.

Since poor study habits has been traced to high test anxiety, researchers such as Allen (1991), Mitchell (1972) have recommended study counselling and desensitization therapy in the treatment of test anxiety among students. Quite recently Moshe (1991) made a comparison of training programs for students who have been identified as being test anxious. Desensitization or study skills training were given to different groups of this set of high test-anxious students. He found desensitization to be more useful for those with retrieval problem while the study skills training was more beneficial to those with problem in all stages of information processing. Eddy (1985) has a lot of suggestion to offer on effective treatment of mathematics test anxiety.

2.4.1 Mathematics test anxiety and achievement

Sarason et al (1959) investigated the relationship between anxiety and performance on the 11+ examination in Britain. They predicted that the 11+examination would increase test anxiety scores of incumbent testees and that children with low test anxiety would perform more effectively on the examination than those with high test-anxiety. They reasoned that the freer a child is from anxiety the less his intellectual functioning would be impaired by the disabling effects of anxiety. The result they obtained was contrary to their predictions and they were able to give reasons for the discrepancies. Alpert and Haber (1960) found that test anxiety scales had greater negative correlations with college entrance examination than general anxiety scale and that they made a good contribution to academic knowledge. Turnbull (1965) also used primary school student in his research on test anxiety and achievement. He found that test anxiety could be associated with certain impairment in performance and that such anxiety lessened after the test. The conclusion is that there is

tendency for anxiety about test to have adverse effects on the performance of able students.

Szeteta (1973) while studying the effects of test anxiety and success-failure in mathematics performance and mathematics anxiety among eighth grade students hypothesized that the performance of the high anxiety students would be inferior to those in the low-anxiety group. However his results showed that "the question of the effects of test anxiety on learning of mathematics still remains cloudy".

Ohlson and Mea (1977) used the State Trait Anxiety Inventory (STAI) to measure anxiety levels of mathematics and non mathematics majors who were undergraduates. Using multiple linear regression model they confirmed that mathematics majors were no more or less anxious than non mathematics majors. They also found that being in a mathematics class did not lead to more anxiety than being in a non mathematics class.

Here in Nigeria, Abadom (1980) used students from Ibadan Grammar school and found that performance in mathematics was not independent of anxiety towards mathematics. The low anxious students performed

significantly better than other students. There was no significant difference between the mathematics performance of those rated high or moderate in anxiety towards mathematics: rather both group had tendency to fail.

Clute (1984) using a sample of American students found that students with high level of mathematics test anxiety had significantly lower achievement than students with low level of anxiety. Druva (1984) while investigating problem solving by mathematics anxious and non-mathematics anxious students enrolled in college mathematics course in the U.S found that high mathematics anxious students did better in computational visual type problems than did non-mathematics anxious students. Wigfield and Eccles (1989) showed test anxiety to be negatively related to achievement at the Primary and Secondary levels.

Baya'a (1990) found significant correlation between mathematics test anxiety and achievement.

2.4.4 Test Anxiety and Instructional Strategy

Different instructional strategies have been employed in studies on mathematics test anxiety. Clute

(1984) compared the effect of the lecture method and a method based on questioning sequences that guided students to discover mathematics principles on test anxiety and achievement. The results showed that students with mathematics anxiety had significantly lower achievement. Students with high test anxiety benefited more from the lecture method while those with low anxiety benefited more from the discovery approach. Lipsett et al (1988) investigated the effects of two instructional interventions on achievement of students at tertiary level. The two levels of anxiety used were high and low and the instructional techniques were the experiencing mathematics instructional method and expository method. The conclusion was that either of the two instructional interventions could be used to improve achievement. Georgewill (1990) advocated sequential teaching of mathematics in order to reduce mathematics test anxiety and fear of mathematics.

The cooperative method of instruction has been found to be favourable in reducing anxiety. Blum-Anderson (1992) described 10 teaching strategies that gave attention to affective variables in mathematics and

among the affective variables was mathematics anxiety. Also Wood (1992) used the traditional lecture method and cooperative learning to investigate their effects on test anxiety. The result showed greater reductions in anxiety ratings of those exposed to the lecture method.

2.4.3 Gender and mathematics test anxiety

Two main group of results are evident from past students on gender differences in mathematics test anxiety. One of this is that boys tend to have low mathematics test anxiety than girls. Sarason et al (1952) obtained results which showed that boys got lower anxiety scores than girls in mathematics test anxiety. The result was explained as being probably due to the fact that it was harder for the boys to admit anxiety than for girls because a greater defensiveness could be aroused in boys in the process of answering questions than for the girls. Szetela (1973) treating mathematics anxiety as a quadratic function of test anxiety found significant interaction between test anxiety and gender due to the tendency of girls being more test anxious than boys at the highest test anxiety level.

Baya'a (1990) found that females scored higher in the

mathematics anxiety rating scale and can thus be said to be more test-anxious than males. However, Turnbull (1965) did not obtain any significant difference in the mathematics anxiety levels of the university students he used. Ohlson (1977) also confirmed this. His data analysis led to his concluding that males and females "do not differ in anxiety levels".

2.5 MATHEMATICS SELF CONCEPT

In this section attempt will be made to explain the concept of academic self concept and especially mathematics self concept. This self concept will also be discussed with respect to academic achievement and also with respect to teaching methods. Finally, gender differences in mathematics self concept will be examined.

Self concept, in general has been defined by Helmke (1994) as "the relatively stable picture people have of themselves and their attributes". It is a desirable educational goal that acts as a mediating variable facilitating the attainment of desired outcomes such as academic achievement. Cooley (1902) as cited by Helmke

(1994) said that a person's self concept is in large part the result of interaction with significant others". Thus a person's self concept is influenced by the opinion others have of him.

Self concept deals with a person's belief or idea about his ability or feeling towards the items on the self concept scale and researchers have claimed some elements of biasness in terms of this self perception. This has raised some questions on the stability of self-concept measures.

Some researchers advocate that self concept is totally directed by situational influences and so is only stable as long as the situations themselves are stable. Other school of thought view it as a highly stable personality trait and that right from its inception in infancy, self concept becomes increasingly stable.

Rosenberg (1986) asserts that a state of destabilization is found during adolescence. Young children tend to over estimate their own ability when measured against test of academic achievement.

An unrealistically high measure of self concept or

perceived ability has been found in many areas of competence especially those relating to academic achievement. Marsh (1990) identifies two theoretical approaches to academic self concept. The approaches are the skill development approach and the self enhancement model. The skill development approach regards self concept as primarily the result of past achievement rather than a cause of subsequent achievement while the self-enhancement model views it as a cause rather than an effect of academic achievement. Thus academic self concept more or less reflects past achievement related successes and failures. The conclusion is thus that self concept of ability must be viewed as both a cause and a consequent of achievement. High self concept ability can be obtained if there is increase in intrinsic motivation and decrease in test anxiety.

Of importance in educational research is the specific self-concept known as academic self-concept rather than the global self-concept. Such academic self-concept, of which mathematics self-concept is an example, are known as evaluative self concepts and they have uni-dimensional constructs according to Coopersmith

(1967). Academic self-concept, according to Marsh (1990) is subject specific and so when investigation is to be done an academic self-concept one must chose scales which are specific to those subject areas.

How accurate are the responses given by students on specific self-concept scales? Accuracy of academic self-concept deals with the agreement between self-assessment of academic ability and an independent criteria such as teachers rating or performance in a test. Two views are held by research results: the view regarding self assessment of child and youth as realistic description of academic ability and school performance, and the second view that says self concept can only be better understood in terms of systematic bias of students involved. Shraughter and Osberg (1981) observed that "self-ratings of academic ability consist of quite accurate description of actual academic performance".

Academic self concept scales have been developed in most subject areas and items on these domain-specific self-evaluation could be negative or positive. In summing up a child's self concept the nature of the

items are considered in the scoring procedures.

2.5.1 Academic Self-concept and Achievement

Review of literature predominantly point to the existence of significant correlations between carefully constructed measures of academic self-concept and achievement in the relevant subject area although a few reported no significant correlations. The general view is that high achievers are more accurate in their self-perceived ability and that students tend to rate themselves above class average than below it.

Marsh (1988) used High School students and found that mathematics and English self-concepts were uncorrelated despite a substantial correlation between mathematics and English test scores and that these self concepts were negatively affected by school-average achievement. Furthermore, a student's self-concept in a particular academic subject area is formed in relation to performances by other students in the same subject (external frame of reference) and in relation to the performance by the same student in other academic subject area (internal frame of reference).

Chambers et al (1991) investigated the relationship

between team learning outcomes, achievement and other measures of which academic self concept was one, and found that team outcome was related to achievement as well as academic self concept.

Yohanna and Kurman (1991) compared academic self concept of 287 elementary school pupils with teachers ratings of their academic ability and school performance. Using regression and path analyses they were able to establish that accuracy of perceived ability had an independent unique effect on academic attainments beyond the effects of academic self-concept.

Kruger et al (1992) investigated self-concepts of 95 special needs students in grades 3 through 12 who received mathematics instruction in special education classes. The relationship between the Piers-Harris self-concept scale scores and mathematics achievement was significantly stronger for the elementary students than for Secondary students. The percentage of school day spent in special education however had negative relationship to general self concept scores although the relationship between the period had positive relationship to mathematics self-concept scores.

Quite recently Marsh (1992) found academic self concept scale to be related to school achievement in 8 school subjects. The correlation between matching areas of achievement obtained in this study was higher than those in his past studies. High correlation was obtained for self concept scales reflecting academic subject areas rather than non academic subject areas.

Some research findings have found results contrary to those discussed thus far. For example, Hansford and Hatlie (1982) found no substantial relationship between self-concept and achievement although academic achievement correlated more with measures of academic self-concept than generalised measures of self concept. Bryne (1984) supported this view in his finding that general or global self-concept was uncorrelated with achievement. Using a sample of students at tertiary level, Perney and Ravid (1990) found that academic performance in a statistic course was not related to mathematics self-concept. Low mathematics self concept has also been identified as one of the correlates of test anxiety (Eddy, 1985).

2.5.2 Academic self-concept and Instructional method

Studies reviewed earlier show evidence that increase in achievement will also bring about an increase in academic self concept. Thus, the studies on appropriate strategy for enhancing achievement in mathematics will also bring about enhanced academic (mathematics) self concept. Very scanty literature specifically focused on instructional strategy and self concept per se. In the few studies identified, achievement is somehow brought in. Skilful teaching in a diagnostic sense will bring about better achievement and improved and healthier self-concept. Schurer and Kraut (1979) attempted to increase educational achievement via self concept change. The desired objective was not attained probably due to the weak design, smallness of the sample and lack of multi-dimensional instruments with adequate construct, validity. Marsh and Richards (1988) however found that instructions that made frequent use of praise and performance feedback greatly enhanced students self-concept.

Lawal (1987) using a sample of Nigerian students investigated the effect of participation in small groups

on academic self concept of students. He found that this interactive instructional strategy increased the students self-concept as well as his achievement in the subject area used.

2.5.3 Self concept and gender

The studies reviewed on gender differences point out that boys tend to have higher self concept in mathematics than girls. Marsh and Smith (1987) confirmed that apart from boys having better understanding of problem structure than girls they also tended to have higher mathematics self-concept than girls. Maqsud et al (1991) investigated the relationship of some factors which included mathematics self concept on mathematics achievement of secondary and university students in Bophuthatswana. The findings indicated that boys scored significantly higher than girls on the self concept as well as achievement measures.

Dickens et al (1990) examined parental influence on mathematics self-concept of 165 high achieving adolescent girls. The research assessed, among other things, the degree of parent-child identification on the girls' own mathematics concepts. A series of analysis

showed that parent mathematics self concept had little direct effect on daughter's mathematics self concept. Yee (1986) also found that parents strongly influenced their children's mathematics attitude and mathematics self-concept. The available scanty literature points to the need for more investigation by researchers in education on issue of gender and mathematics self-concept.

2.6 SUMMARY

This chapter has reviewed some studies that are relevant to the variables in the study.

The lecture method was examined in terms of its advantages and disadvantages. Studies comparing its effect with respect to other techniques of teaching at tertiary level were also reviewed. The trend is that the lecture method is too teacher centred and does not promote active involvement of students. The need for the use of interactive learning which is a type of cooperative learning was discussed.

Mathematics achievement has been discussed with respect to different instructional techniques and

gender. The teaching method employed either at primary or secondary or even tertiary level plays a part on student's achievement. When gender is considered some studies found significant difference between males and females while some did not find any difference.

Test anxiety and the theory behind it has also been discussed in this chapter. The trend is that test anxiety is negatively related to achievement and females tend to have higher test anxiety especially at the primary level than males, although some studies at tertiary level do not indicate any significant difference.

From the general self-concept theory, academic self-concept is identified as student's self-perceived ability in the particular subject area. As a personality trait some researchers have complained about self concept measures not being accurate because of it being subject to bias on the part of the respondent to the given self-concept scale. Studies show that results are stable while some do not agree on its stability. Some studies found a strong relationship between academic self concept and achievement in the particular subject

area while some did not find substantial significant correlation. Marsh, who has researched extensively on self concept, advised that in investigating self-concept and achievement one must not use the global self concept scale but the specific scale. Not many studies have focused directly on teaching methods and gender but the few that did pointed out that any teaching method that improved academic achievement would also improve academic self-concept. Sequential teaching of subjects and arrangement of problems from easy to difficult would boost up the self concept of a students since success at tackling easier problems could increase his confidence. High academic self concept has been associated more with male students than with females. Furthermore, some studies have linked high academic self concept with low test anxiety.

The review of literature has shown evidence of research efforts being made to improve students achievement in mathematics not only at the primary and secondary level, but also at the tertiary level. However most of the studies revealed that the efforts on exploring alternatives to the lecture method have been

done outside the Nigeria setting. No study in Nigeria, to the knowledge of this researcher, has been undertaken with students at tertiary level. This points to the need to investigate other appropriate methods to be used in helping students undertaking one mathematics course or the other at tertiary level.

When the two psychological measures in this study (i.e. mathematics test anxiety and mathematics self-concept) are considered, the review points to the dearth of literature on how appropriate instructional strategies could be employed to promote the psychological effects of these variables. Most of the studies reviewed are correlational in nature. This calls for the need for an experimental research involving these variables. Also, the review has pointed out the need to investigative how gender affects both the psychological and cognitive variables as well as to study the interactive effect of gender and instructional technique on these variables since literature in this aspect is very scanty. This inadequacy has led to the purpose of carrying out this study.

Chapter three

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter gives a detailed description of the design and procedures used in this study.

The chapter is divided into five main sections as follows:

(i) **Research Design**

This section describes the design adopted in this study. Included are the types of variables used in the study as well as the issues of sensitivity and internal and external validity.

(ii) **Population and Sample**

The population and sample used in the study are described in this section.

(iii) **Instrumentation**

The instruments used in the study are listed here. The procedures employed in constructing and validating the instruments are also described.

(iv) **Procedures for data Collection**

This describes how the data for the study was

collected.

(v) **Procedures for data analysis**

This section gives a description of the statistical techniques used in the analysis of the data collected in the study.

3.2 RESEARCH DESIGN

A 3 × 2 non randomised control pre-test/post-test quasi-experimental factorial design was used for this study. In experimental research, the subjects used should ideally be randomly assigned to different groups. However, in most experimental research in education in which the classroom is the formal setting, it is not easy to disturb the existing classroom setting and intact classes are used as suggested by Lovell and Lawson (1970) and Van Dalen (1973). Thus, the quasi experimental design was employed in this study. The design was such that instructional strategy (Treatment) was crossed with students' gender (male, female). The choice of this design is based in its distinctive advantages which are:

1. It provides opportunity for the researcher to study the interactive effect of gender and method of instruction on each of the dependent variables.

2. It permits the disentangling of the independent variables that are intertwined naturally and to establish a causal link between each of the independent variables and the dependent variable.

3. It is much more economical (in terms of energy time and number of subjects) than corresponding multiple single factor experiments.

The design is illustrated on table 3.1.

Table 3.1

Design of the study

GENDER

	MALE	FEMALE
INSTRUCTIONAL STRATEGY Expt. 1		
Expt. 2		
Control		

This design can also be represented in symbolic form as follows:

Group	Pre-test	Treatment	Post-test
Experiment 1	m_{11}	T_1	M_{11}
Experiment 2	m_{21}	T_2	M_{21}
Control	m_{31}	T_3	M_{31}

where m_{11}, m_{21} and m_{31} represent pre-tests T_1, T_2, T_3 represent the treatment and M_{11}, M_{21}, M_{31} represent post-tests.

3.2.1 Variables in the Study

As is the case with experimental research, there are two types of variables involved: namely the independent variables and the dependent variables.

3.2.1.1 INDEPENDENT VARIABLES

There are two independent variables used in this study. They consist of an active variable and attribute variable. They are as follows:

1. **TREATMENT**

This is the variable that was manipulated and it is

thus the active variable. Treatment occurred at three levels: Experimental group 1 [T_1] experimental group 2 [T_2] and control [T_3].

In the experimental group 1, the subjects were exposed to interactive learning plus individual "hand-on-experience" with learning materials. In the experimental group 2, the subjects were exposed to interactive learning plus group "hand-on-experience" with learning materials. In the control group the subjects were exposed to the conventional lecture method. The investigator conducted the lessons in the three treatment groups. The treatment lasted for 10 weeks at the rate of two hours per week.

2. **GENDER**

Naturally, this attribute variable occurred at two levels: male and female.

3.2.1.2 Dependent Variables

The three dependent variables used in this study were achievement in mathematics, mathematics test anxiety and mathematics self-concept.

3.2.2 Sensitivity, internal and external validity

Sensitivity, according to Lipsey (1990) refers to the likelihood that an effect, if present will be detected. Sensitivity is based upon what is "true" but unknown state of affairs in a population and that state as observed by the researcher. A design is thus said to be sensitive to the extent that the researcher's conclusion mirrors the "true" state. If the difference between the "true" and experimental state (known as error) is reduced, the sensitivity will thus be increased (Lawson, 1994).

The researcher adopted two strategies to ensure systematic differences in the treatment conditions. First, a large sample size (N = 165) was used with the hope of increasing the size of the obtained F (Keppel and Sanfley, 1980). The use of a large sample increases the number of degree of freedom for the denominator which leads to a smaller critical value of F (Cox, 1958).

The sensitivity of the experiment was also increased by ensuring the existence of within groups homogeneity

among the experimental lectures to be received by each treatment group. The investigator undertook the provision of treatment across the groups and ensured that the mode of the treatment that characterized each group was maintained within the group. It was thus possible for the study to ensure a good measure of intra-lecturer reliability which, if not maintained, could be a potential source of experimental error (Lovell and Lawson, 1970; Fricks. 1978).

Internal validity deals with the extent to which the observed changes or findings are attributed to the manipulation or treatment. It is concerned with the confidence that can be placed on the assertion that the treatment was solely responsible for the effect that was observed. The factorial design and the analysis of covariance technique adopted in this study were expected to have depreciating effects on internal validity threats.

Compte and Goetz (1982) emphasized the fact that the concept of external validity "focuses on generalizability, comparability and translability" of research results.

This present study attempted to satisfy all these conditions through the use of all Business Education students as well as the use of highly reliable and valid instruments as suggested by Cook and Campbell (1979). It is thus expected that within the limitations of this present study its findings could be extrapolated to other similar educational settings.

3.3 POPULATION AND SAMPLE

The target population consists of all students offering Business Education in Colleges of Education in Lagos state.

The sample used were all first year full time students of Business Education in Colleges of Education in Lagos State. At the time the study took place, there were only two Colleges of Education in Lagos State offering full time courses leading to the National Certificate of Education (NCE) in Business Education. The institutions were: The Federal College of Education (Tech), Akoka and the Lagos State College of Education Ijanikin. The Business Education students in these Colleges offered the same courses in Business

mathematics as stipulated in the NCCE syllabus. The first year students in the two institutions in Business Education were admitted through the Joint Admission and Matriculation Board examination for Polytechnics and Colleges of Education and the requirements for admission to the two Colleges of Education were similar. Both Colleges had links with University of Lagos which was responsible for moderation of their examination papers.

At Akoka the Business Education students are admitted into the departments of accounting and secretarial education and each set of students receives lecture as intact classes on departmental basis. These two groups of students offer the same courses throughout their first and second year. At Ijanikin the division into the departments is done in their third year. This was the condition that
existed during the experimental period and still exists today.

The students in accounting department formed Experimental 1 while the students in the Secretarial group comprised the Experimental 2 by random assignment of groups. Thus experimental one and two were from

Akoka. All the year 1 Business Education students at Ijanikin comprised the control group.

Table 3.2 shows the distribution of the sample.

Table 3.2

Number of Business Education in the achieved sample

	Experimental Group 1	Experimental Group 2	Control Group	Total
Male	39	10	22	71
Female	24	44	26	94
Total	63	54	48	165

These 165 students consisted of 71 Males and 94 Females and had mean age of 22.96 years.

Excluded in the sample were all students in year 2 and year 3 with carry-over in year one Business Mathematics since this group of students were not regular at lectures.

Ijanikin and Akoka are far apart. This arrangement ensured that there was no contamination between the experimental and control groups.

3.4 INSTRUMENTATION

The following are the instruments used in this study.

1. Pre-test: A test of pre-requisite skills in mathematics. This is a 30 item objective test based on the syllabus of the course done by all the students in the semester preceding the commencement of the study. As the pre-test of the study, it measured the initial ability of the students and thus served as the covariate.
2. Post-test: A 28 item post achievement test covering the course content of the Business Mathematics course to which all the students were exposed during this study.
   This test was constructed and validated by the researcher.
3. Structured learning materials on the topics in the syllabus carefully developed by the researcher and
   whose content validity was ensured with the help of experienced mathematics lecturers and evaluators.

4. A mathematics test anxiety questionnaire known as the Inventory of Test Anxiety in mathematics (ITAM) by Osterhouse, Obe (1981) validated this on a group of Nigerian secondary school students. The instrument consists of 16 items describing anxiety situations to which the respondents react as to the degree of their agreement. All the items describe how anxiety hinders their performance. It is thus a debilitating scale. The maximum Score on this scale is 80 while the minimum is 16.

5. A mathematics self-concept scale constructed and validated by the researcher on NCE Business Education students. It consists of 17 items expressing students feeling about their perceived ability in mathematics. The responses are scored on likert five points scale with options ranging from strongly agree to strongly Disagree. The first part of the questionnaire contains background information of the respondents while the second part contains the statements of self-concept. The validation

procedure for all the instruments is described later in this chapter.

The instruments can be found in the appendices at the end of this thesis.

3.5 PROCEDURES

This study took place in two parts namely

1. The construction and validation of the instruments
2. The main study itself.

3.5.1 Construction and Validation of the Instruments

This section deals with construction of the instruments, where necessary, and the validation procedure used.

(i) THE ACHIEVEMENT TESTS

The two achievement tests used in the study are both multiple choice objective tests and were constructed in line with the principles of test construction.

A good test instrument must possess three basic attributes which are validity, reliability and useability according to Lyman (1963). Validity of a test deals with its ability to measure what it is expected to measure while reliability deals with obtaining

dependable or consistent scores and useability is concerned with practical factors such as ease of scoring, practicality of time and all these three attributes were borne in mind by the researcher while constructing the achievement tests.

The first step taken was to determine the objectives of instruction and items included in the test were drawn from the objectives of instruction of the respective courses. Content validity is related to how adequately the test sample the domain about which inferences are made (Mehrens and Lehman, 1975). A good table of specification of course content by objectives ensures adequate content validity. Thus a table of specification was constructed for each of the two tests in other to ensure that the tests measured the learning outcomes and content in a balanced manner as suggested by Ali (1989). The table of specification or test, blue print was then given to experienced mathematics teachers and evaluators and modifications done based on their advice. Tables 3.3 and 3.4 show the tables of specification for the two tests.About total of 80 items were written for each of the tests and face validity was ensured with the help of

the experts mentioned earlier. The items were then pilot-tested on seventy-five NCE Business Education Students who have already covered the course and were typical of those for whom the test is built. This pilot testing is very essential in the validation of achievement tests as it helps in item analysis and item

Table 3.3

Table of specification of the pre-test in mathematics

LEVEL OF OBJECTIVE	KNOWLEDGE	COMPREHENSION	APPLICATION
CONTENT AREA	item no	item no	item no
1. Indices	-	3	28
2. Logarithm	5	4	
3.Descriptive statistics	2, 19, 29	1, 7	16, 21
4. Fraction	22, 27	20, 10, 17, 26	25
5. Decimals	8, 9, 14, 23	-	24
6. Percentage	11, 15	18	12, 13
7. Algebra	6	30	
Total (percentage)	13 (43.3%)	10 (33.3%)	7 (23.3%)

Table 3.4

Table of specification of the post-test achievement test in mathematics

LEVEL OF OBJECTIVE	KNOWLEDGE	COMPREHENSION	APPLICATION
CONTENT AREA	(item no)	(item no)	(item no)
1. Fraction and decimals	8	1, 2	7
2. Percentages Profit and loss	13, 14	20, 11	3, 12,19
3. Simple interest	5, 21	6	16
4. Compound interest Depreciation	22	23	24
5. Ratio and Proportion Partnership	-	17, 18	-
6. Rates and Tax	25	4	10
7. Stocks and shares	27	28	-
8. Payroll computation	-	9, 15	26
Total (percentage of total)	8 (28.6%)	12 (42.8%)	8 (28.6%)

selection procedure (Ohuche and Akeju, 1977). A scoring stencil was used in scoring the items. The tests have four options with numerical options written in ascending

order. The tests were scored and item analysis was done on the best $\frac{1}{3}$ and the worst $\frac{1}{3}$ of the testees as suggested by Ali (1989). The item analysis was done with respect to

(a) the difficulty level of each item

(b) the discriminating power of each item

(c) and the functioning of the distractors. The difficulty level dealt with the percentage of students who correctly answered the given test item.

Although Educational Testing services (ETS) recommends that item difficulty level of 0.30 to 0.80 is good, the researcher decided to select items with difficulty level of between 0.3 to 0.7 as suggested by Ali (1989).

The discriminating power was also investigated. According to Ahmann (1962), a test item possesses adequate discriminating power when it is capable of differentiating between superior and inferior students. He recommended D values greater than +0.4 as being good while those between + 0.4 and + 0.2 are satisfactory and anything below 0.2 as being poor. The researcher decided

to select only items whose discriminating power was greater than 0.2.

The analysis of the distractor was also done to determine its functionality and also its different attractiveness. The functioning distractors showed greater attractiveness to the lower than to the upper group and those who did not were either modified or discarded.

The result of the item analysis led to the emergence of 30 items in the pre-test and twenty eight in the post test. A full detail of the item analysis can be found in the appendix at the end of this report.

The two achievement tests were not speeded tests and so estimation of reliability through the method of internal consistency was appropriate as advocated by Mehrens and Lehman (1975).

Table 3.5 gives the psychometric properties of the two tests.

Table 3.5

Psychometric Properties of the

Achievement Tests

Psychometric measure	Pre-test	Post-test
Range of discriminating power (D)	0.40 - 0.72	0.40 - 0.64
Item Difficulty Range (P)	0.32 - 0.70	0.30 - 0.70
Coefficient of internal consistency	0.87	0.88

(ii) **THE MATHEMATICS TEST ANXIETY SCALE**

The Inventory of Test Anxiety in mathematics as modified and adapted by Obe (1981) was administered to the seventy-five NCE Business Education Students. The scores for each item ranged from 1 to 5 with a maximum score of 80. Students with scores of 16 - 37 are classified as low test anxious while those with

scores between 38 - 59 have moderate test anxiety and those with 60 and above are high anxiety students. Four weeks later, the same instrument was administered to the same set of students and the estimate of coefficient of stability was obtained. The coefficient of internal consistency as measured by Cronbach α was 0.87.

The coefficient of stability was 0.85 while the criterion validity with mathematics test scores as the criterion yielded 0.63.

(iii) **THE SELF-CONCEPT SCALE**

This scale was constructed by the researcher. Thirty items were written describing self concepts in mathematics. The items were content validated by specialists in mathematics education, evaluators and two educational psychologists for review. This review was done in order to determined the item to be retained, reframed or rejected. The review led to the emergence of seventeen items. The aim was to ensure face and content validity.

The final form of the questionnaire was then administered to the sample of Business Education

Students used in the pilot study.

Likert five point scale with options ranging from strongly agree to strongly disagree was used to obtain the responses. The items were scored by weighting positive items from 5 for strongly agree to 1 for strongly disagree. The weights were reversed for negative items. The respondents score was the sum of the weighted options selected by him. A maximum of 85 and a minimum of 17 is expected from the instrument. Scores under 40 depict low mathematics self concept while those between 41 - 63 depict moderate self concept and 64 and above shows high self concept.

Reliability of an instrument deals with the consistency of the results obtained by using the instrument while validity deals with the extent to which the measuring device measures what it is expected to measure. Validity and reliability estimates were computed for this instrument. The coefficient of stability was computed by the test-retest method. A coefficient of 0.75 was obtained. Correlation between a particular score and a

criterion score gives rise to validity index (Lyman, 1963). The scores on this instrument were correlated with their scores in Business mathematics. A validity coefficient of 0.68 was obtained. This is quite in order since Cronbach (1970) has confirmed that it is unusual for validity coefficient to rise above 0.6 and that any positive correlation is an indication of the accuracy of the instrument. Thus the fairly high validity coefficient of this instrument is highly significant in pointing out its criterion related validity.

Construct validity is the extent to which test performance can be interpreted in terms of certain psychological constructs. One of the methods identified by Gronlund (1976) of establishing construct validity of a test is to relate the test with other known test of that ability. To this end, the researcher computed the correlation between this mathematics self-concept scale and one of the mathematics self-concept scale used by Eshel and Kurman (1991). A correlation of 0.82 was obtained.

The factorial validity (Lyman, 1963) was also

established through the use of factor analysis. The items in this test were factor analyzed with those of the Inventory of Test Anxiety in Mathematics (ITAM). Literature has shown that this has negative relationship with mathematics self-concept. This test anxiety scale was thus expected to measure different constructs. The purpose of doing this was to give evidence of divergence of indicators as advocated by Cronbach (1970). This method, employed in the factor analysis was the Principal Component Analysis with iteration. An initial number of eight factors were extracted. Using the Kaiser normalisation criteria of eigenvalues greater than 1, only two factors were obtained when the eight factors were subjected to orthogonal varimax rotation. The final statistics showed that the self-concept items were generally positively heavily loaded on factor 1 while the test anxiety was heavily positively loaded on factor 2. The self-concept items all have positive loadings on factor 1 and negative loadings on factor 2 while ITAM had negative loadings on factor 1 and positive loadings

on factor 2. Thus factor 1 deals with self-concept while factor 2 deals with test anxiety. This, coupled with the high coefficients of internal consistency obtained in the two tests ensures that the factorial validity is established. The results are in appendices 13 and 14 at the end of this report.

Cronbach alpha was also computed for the self concept scale.

The SPSS programmed was used in the validation process. Table 3.6 gives a summary of the psychometric properties of the inventory for Test Anxiety in mathematics and the self-concept scale.

Table 3.6

Psychometric properties of the psychological tests

Psychometric measure	Magnitude: Test Anxiety	Magnitude: Self concept
Standardized item α	0.87	0.90
Cronbach α	0.87	0.90
Validity Coefficient	0.63	0.68
Coefficient of stability	0.85	0.75

(iv) **The learning materials**

The materials used were structured learning units covering topics in the syllabus of the second semester Business mathematics for year 1 students as stipulated by the NCCE syllabus. Each unit starts with the objectives for that topic and contains some explanation of the lectures. There are questions at the end of each unit which students were expected to attempt. Face and content validation of the 10 unit materials were done with the helpful contributions of two experienced mathematics lecturers in the course and two educational evaluators.

The learning material can be found in appendix 15.

3.5.2 PROCEDURES FOR THE MAIN STUDY

Before the commencement of the main study official permission was sought from the authorities of the two institutions.

At the beginning of the second semester, the mathematics test anxiety scale and self concept questionnaires were administered to the groups of students before the achievement pre-test to prevent the inflation of the scores by the pre-test results and then

the treatment commenced. The time table was so arranged that the Akoka students were taught on mondays while the Ijanikin students had their lectures on wednesdays. Efforts were made to prevent contamination by ensuring that the two groups at Akoka had the lectures almost one after the other. At the time of research the distance between Akoka and Ijanikin was not easy to cover in less than two hours. The students in the three groups were tested after each lecture. Thus chances of contamination was controlled. Attendance was kept on each students. At the end of the treatment a post test was administered on each of the following.

(i) the Inventory of Test Anxiety in mathematics

(ii) the mathematics self concept scale

(iii) the mathematics test on topics taught.

DESCRIPTION OF THE INSTRUCTIONAL PROCEDURES

1. The lecture method: This usually began with a summary of the previous lesson and introduction of the topic for the day (5 minutes). This was then followed by gradual and systematic presentation of the topic for the lesson, with illustrative examples

by the lecturer (1 hours, 30 minutes). During this period students were allowed to ask questions. The responses to these questions were supplied by the instructor alone. The lecture method thus involved more of oral presentation by the lecturer. The lecture was followed by a short fifteen minutes test. The summary of the lesson and the corrections of the test usually ended the lecture for the day (10 minutes).

2. Interactive learning: The students involvement was maximised by this type of strategy. The instructor started by reviewing previous lessons through asking of questions (5 minutes).Efforts were made to involve non volunteer students. Correct answers were acknowledged while partially correct and incorrect responses were tackled with cues and probes and help from other students. The instruction for the day was then delivered with active contribution from the students until the concept was well understood (1 hour 15 minutes).

During this period students were encouraged to solve problems on the board. This was followed by

distribution of the materials which the students were expected to work upon either on individually or an group basis (30 minutes). The materials contained some exercises which the students attempted and submitted. The lecture concluded with a summary and correction of the assignments (10 minutes).

Experimental 1

Students in this group worked individually on the learning materials. The seating arrangement while working on this material was such as to minimise contacts with other students. They were not allowed to seek help from their mates. The assignments were scored on individual basis.

Experimental 2

Students sat in groups of five as suggested by Goldberg (1981) and Channon and Walker (1984) who advocated for groups of four or five for problem solving if cooperative

learning was to be initiated at tertiary level. Each group contained at least one of each gender. A leader

who was noted for having high achievement in mathematics as evident from the pre-test was included in each group. Conwell et al (1993) advocated that in small group learning each group should have a leader with strong academic as well as collaborative skills in helping the group achieve a goal. This was taken into consideration in allocating leaders into each group. Each group thus contained high, low and moderate achievers. The materials were used by students in their various groups. Every member of each group was given opportunity to contribute his idea to the problem as well as to seek clarification from his colleagues within the group. The test at the end of the material for each lecture was done on group basis and feedback was also done on group basis.

The whole treatment lasted for a period of ten weeks after which post-tests on each of the dependent variable were administered.

3.6 ANALYSIS

The experimental and control groups constituted the units of observation. The analysis thus focused on the

group mean scores in mathematics test anxiety, mathematics self concept and achievement in mathematics. The three groups were compared on each of the three dependent variables. The scores of individual student formed the unit of analysis. Data analysis was done using SPSS sub-programme (Nie et al, 1975) on analysis of covariance with the pre-tests as covariates. The ANCOVA was expected to correct for any initial differences in the dependent variables and other extraneous factors that could compound treatment effect (Lovell and Lawson, 1970).

Each of the hypotheses was examined. In the case of no significant interactive effect, Multiple Classification Analysis (MCA) was used to determine the magnitude and direction of the effect as well as the amount of variation due to each independent variable. Where an interaction was significant, Scheffe Multiple Range test was used to identify the source of the interaction.

Chapter four

RESULTS AND DISCUSSION

The results obtained from the analysis of the collected data are discussed in this chapter.

The descriptive statistics of the data are first discussed followed by the testing of the various hypotheses. Once the presence of interaction was established in the various results of analysis of covariance the main effects were not tested since the two independent variables jointly affect the dependent variables under focus as suggested by Kim and Kohout (1988). This is to prevent the risk of erroneous or misleading interpretation of results (Wright, 1976). The post test mean scores for measures with significant interaction were examined carefully by studying the simple effects of the independent variable with significant interaction. The cell means of the variables were also plotted in order to give more visual impact.

4.1 DESCRIPTIVE STATISTICS OF THE DATA

Table 4.1 gives some descriptive statistics of the data in terms of the mean, standard deviation, Kurtosis and Skewness.

Table 4.1

Descriptive Statistics of the Overall data.

	PRE-TESTS			POST-TESTS		
DESCRIPTIVE STATISTICS	ACHIEVE -MENT	TEST ANXIETY	SELF CONCEPT	ACHIEVE -MENT	TEST ANXIETY	SELF CONCEPT
MEAN	48.339	34.648	43.921	55.370	29.091	49.728
STANDARD DEVIATION	14.189	10.903	7.924	12.573	11.051	6.581
STANDARD ERROR OF MEAN	1.105	0.849	0.617	0.979	0.860	0.517
KURTOSIS	-.338	-0.133	0.408	0.877	0.310	-0.081
SKEWNESS	.427	0.615	0.115	-0.277	0.977	-0.389
S.E. KURT	.376	0.378	0.376	0.376	0.376	0.379
S. E. SKEW	.189	0.189	0.189	0.189	0.189	0.191

It is evident that the experiment has resulted in an

increase in general level of mathematics achievement from 48.339 to 55.370. Both tests were converted to percentages prior to analysis for ease of comparison. There has also been a reduction in the debilitating anxiety level of the subjects. The self concept has also improved as anticipated. However the result of the hypothesis testing would prove to be of statistical significance than the general descriptive statistics. The negative values of Skewness obtained showed that the means of these values were lower than their respective medians.

Kurtosis deals with the degree of peakness of a distribution. The variables with positive values of Kurtosis have relatively high peaks and are known as leptokurtic distribution while those with negative values have flat-topped peaks and are called platykurtic.

Tables 4.2, 4.3 and 4.4 also show the average composite scores for each of the three variables namely achievement in mathematics, mathematics test anxiety and mathematics self-concept. The scores on each table has been divided by the three categories of treatment and

two categories of gender.

Table 4.2

Group means of post-test mathematics achievement scores

GENDER	Experimental 1	Experimental 2	Control	Grand total
MALE	54.85	63.50	52.23	55.25
FEMALE	56.38	56.18	53.38	55.46
TOTAL	55.43	57.54	52.85	55.37

The students exposed to interactive learning with use of materials in group had the highest scores in the achievement test (57.54) while those exposed to only lectures had the lowest (52.85). The females had a slightly higher mean score of 55.46 than the males (55.25). Males in experimental 2 had the highest mean score (63.50) when compared with other males while females in experimental one had the highest mean score (56.38) when compared with females in the other groups.

Table 4.3

Group means of post test anxiety scores

Gender	Experimental 1	Experimental 2	Control	Grand mean
Male	29.36	32.76	31.55	30.51
Female	25.46	29.18	28.42	28.02
Total	27.87	29.83	29.85	29.09

Those exposed to lecture method alone had the highest test anxiety scores (29.85). Males had higher test anxiety mean score (30.51) although the significance of this will be discussed under hypothesis testing. Also, both males and females in experimental 2 obtained the highest test anxiety score when compared with those in other groups.

Table 4.4

Group means of post-test self-concept scores.

GENDER	EXPERIMENTAL 1	EXPERIMENTAL 2	CONTROL	GRAND TOTAL
MALE	50.56	47.40	46.43	48.87
FEMALE	50.25	49.41	52.29	50.38
TOTAL	50.44	49.04	49.56	49.73

Students exposed to interactive learning with individual use of material had the highest self concept score (50.44). Contrary to expectation those exposed to the group use of material had the lowest mean (49.04). Females had higher self concept (50.38) than males (48.87). Males in group one had the highest self concept score (50.56) when compared with other males in the three groups. The female students in the lecture group (the control group) had the highest self concept score when comparison is made among the females in each of the three groups.

The section on hypothesis testing which deals with inferential rather than descriptive statistics will enable

appropriate decisions to be taken with respect to the significance of the observed differences.

4.2 HYPOTHESES TESTING

Altogether nine hypotheses were formulated and tested using ANCOVA for each of the three dependent variables. The first column of each of the ANCOVA table lists the sources of variation. The second column deals with the sum of squares attributable to each of the components. The "explained" sum of squares is the total sum of squares for the covariates, the main effects and interaction terms in the model. The degrees of freedom, listed in the third column of each table, are one fewer than the number of categories. Thus gender has one degree of freedom while the three levels of treatment lead to two degrees of freedom. The degree of freedom for the interaction is the product of these two. The degrees of freedom for the residual are
N - 1 - K where K is the degree of freedom for the explained sum of squares. The mean squares in column 4 are obtained by dividing each sum of squares by its degrees of freedom. The ratios of the mean squares of

each source of variation to the mean square for the residual gives the F ratios upon which hypothesis tests are based. The level of significance used in testing each of the hypothesis is 0.05.

4.2.1 ACHIEVEMENT AS THE DEPENDENT VARIABLE

Hypotheses 1-3 deal with the tests of hypotheses with achievement as the dependent variable. These three hypotheses are based on the main effect of each of gender and treatment as well as the interactive effect of the two.

Table 4.5 shows the output of the ANCOVA test on these three hypothesis. The table shows a significant interactive effect of treatment and gender on students achievement in mathematics ($F(1, 158) = 3.166$, $P < 0.05$).

Table 4.5

ANCOVA Table for Achievement in mathematics

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F
COVARIATES (PRE-TEST)	2587.714	1	2587.714	19.525
MAIN EFFECTS	1559.522	3	519.841	3.922
INSTRUCTIONAL METHODS (V2)	1422.705	2	711.353	5.367
GENDER (V3)	.284	1	.284	.002
2- WAY INTERACTIONS	839.263	2	419.632	3.166
V 2 × V 3	839.263	2	419.632	3.166
EXPLAINED	4986.500	6	831.083	6.271
RESIDUAL	20939.949	158	132.531	
TOTAL	25926.448	164	158.088	

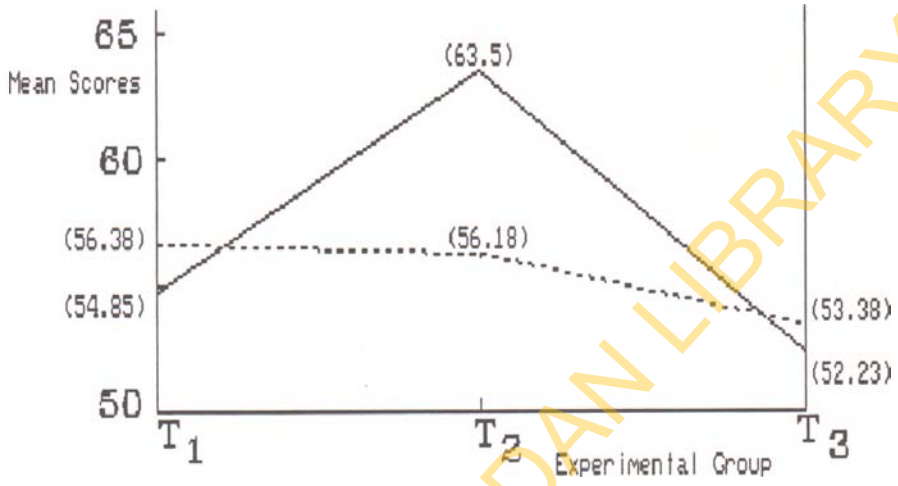
Thus the hypothesis that "there is no significant interactive effect of instructional methods and gender on NCE Business Education Students achievement in mathematics" was rejected since a significant effect was found. Although the main effect on treatment was significant [$F = 5.367$, $P < 0.05$] while that of gender was not significant

[$F = 0.002$, $P > 0.05$] the fact that interactive effect was significant implies that the other two hypotheses need not be tested since the two variables jointly affect achievement in mathematics. The small F value associated with gender does not necessarily imply

that achievement was unaffected by gender, since gender was included in the significant interaction terms. Rather, it showed that if the scores were averaged over treatment levels, the two gender category means were not significantly different.

According to Kerlinger (1973) it is also possible, and often very profitable to graph interactions. This will give a visual impact on the result obtained. By plotting on the horizontal axis treatment positions (T_1, T_2, T_3) and the mean values in the cell means table (Table 4.2) at the levels of the other independent variable (i.e. male, female) as suggested by Kerlinger (1973), a graph of the interaction was obtained. The horizontal axis denotes the treatment level while the vertical axis shows the mean scores. The mean score for each of the gender was plotted with respect to the treatment level. Figure 4.1 shows the graph of the interaction.

INTERACTION OF TREATMENT AND GENDER ON STUDENTS ACHIEVEMENT IN MATHEMATICS.



T_1 = Experimental Group 1
T_2 = Experimental Group 2
T_3 = Control
_____ = male
- - - = female

Figure 4.1

From the diagram it is obvious that the mean scores did not only relate to the treatment group and the gender of the student, but also to the combination of the values of the variables. The males in Experimental group 2 obtained the highest scores (63.50) while the females in experimental 1 had the highest scores (56.38). Thus, the scores for each level of treatment depend on the gender variable. If there was no interaction the plot for the males and females would never cross.

In order to explore the significance of interaction of instructional method and gender, a post hoc test, the Scheffe Multiple Range Comparison test, was performed separately for the males and females on the three instructional methods. The results are displayed on tables 4.5a and 4.5b.

For the males, the interactive method with group use of material was significantly better than the other two methods and the pairwise difference between the group use of materials and the individual use of materials as well as the difference between the group use of materials and the lecture method were significant. For the females the source of variation was due to the superiority of the individual use of material over the lecture method since the test gave evidence of significant pairwise difference between these two methods.

Table 4.5a

Scheffe mulitiple Range Comparison Test on Achievement in mathematics of MALES in the three instructional groups.

		G r p 1	G r p 2	G r p 3
Mean	Group			
54.85	Grp 1			
63.50	Grp 2	*		*
52.23	Grp 3			

Group 1 = Interactive with individual use of materials.

Group 2 = Interactive with group use of materials.

Group 3 = Lecture method.

* Pairs of groups significantly different at 0.05 level.

Table 4.5b

Scheffe Multiple Range Comparison Test om Achievement in Mathematics of FEMALES in the instructional groups.

Mean	Group	G r p 1	G r p 2	G r p 3
56.30	Grp 1			*
56.18	Grp 2			
53.38	Grp 3.			

Group 1 = Interactive with individual use of materials.

Group 2 = Interactive with group use of materials.

Group 3 = Lecture method.

* Pairs of groups significantly different at 0.05 level.

The fact that individual use of material was more favourable to the female students while the group use of material was more favourable to the male students in terms of achievement could be explained. The females in experimental group 1 were fewer in number than the males. Similarly the males in group 2 were fewer than the females. This could result in their putting in their best in order boost up their sex ego. During group work females tend to chip in some irrelevant discussion which might be a hinderance to their

performance. In the experimental group 2 only one male was attached to each group because of the fact that they were few in number. The male ego of wanting to put in one's best in the midst of the opposite sex may account for the higher performance of the males in this group. On the other hand, individual use of materials would favour the females more since there will not be time for non academic activities as they would be compelled to face their studies.

Furthermore the result confirmed the finding of Li and Georgina (1992) that boys preferred both the individualistic and competitive styles in mathematics while females preferred the individualistic styles. Although the sample used by these two was based on gifted secondary school pupils this study has shown that it could hold for NCE students.

4.2.2 TEST ANXIETY AS THE DEPENDENT VARIABLE

(HYPOTHESIS 4 - 6)

Hypothesis 4: There is no significant interactive effect of instructional methods and gender on the test anxiety of NCE Business Education Students.

Table 4.6

ANCOVA summary table for mathematics test anxiety

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F
COVARIATES (PRE-TEST)	3951.685	1	3951.685	41.277
MAIN EFFECTS	915.884	3	305.295	3.189
INSTRUCTIONAL METHODS (V 2)	691.959	2	345.980	3.614
GENDER (V3)	273.456	1	273.456	2.856
2 WAY INTERACTIONS	35.662	2	17.831	.186
V 2 × V3	35.662	2	17.831	.186
EXPLAINED	4903.231	6	817.205	8.536
RESIDUAL	15126.405	158	95.737	
TOTAL	20029.636	164	122.132	

Table 4.6 shows the results of all the tests of hypothesis based on test anxiety as the dependent variable. In order to test for significant interactive effect between gender and treatment the F value of the 2 way interaction was examined. The obtained F of 0.186 showed that there was no significant interaction. Thus the above hypothesis was not rejected.

This shows that the two independent variables, treatment and gender do not interact significantly with mathematics test anxiety with mathematics test anxiety. So the treatment does not affect mathematics test anxiety differentially at different facets of gender.

Hypothesis 5: There is no significant main effect of instructional methods on NCE Business Education student's mathematics test anxiety. As the table shows, the F value for the effect of instructional method is 3.614 which has significant effect. Thus the hypothesis of no significant main effect of instructional methods was rejected. Instructional method used had effect on mathematics test anxiety. This supports Clute's (1984) findings that the instructional method does have an effect on mathematics test anxiety.

In order to understand this result fully, there was need to carry out a multiple classification analysis. This is because there was no interactive effect of treatment and gender. The multiple classification analysis table,

according to Kim and Cohort (1988) is of interest only when no interactive terms are significant.Table 4.7

shows the

output of the multiple classification Analysis on the Test Anxiety Scores.

Table 4.7

Multiple Classification Analysis (MCA) on Mathematics test anxiety.

GRAND MEAN = 29.091

VARIABLE + CATEGORY	N	UNADJUSTED DEVIATION	ETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEVIATION	BETA
INSTRUCTIONAL METHODS					
EXPERIMENTAL 1	63	-1.22		-2.15	
EXPERIMENTAL 2	54	0.74		-0.20	
CONTROL	48	0.76		3.04	
			.09		0.19
GENDER					
MALE	71	1.42		1.60	
FEMALE	94	-1.07		-1.21	
			.11		0.13
MULTIPLE R^2					0.243
MULTIPLE R					0.493

The table consists of the grand mean of the test anxiety

scale, a table of deviation from the grand mean for each factor level and some measures of association.

The fact that the treatment (instructional methods) was significant only showed that the mean of at least one category of the instructional methods was different from the grand mean, after appropriate adjustments have been made. Hence it is very important to examine the pattern of the relationship of the instructional methods to the test anxiety variable. The first column of the table shows a description of the independent variables and their categories. The next column shows the means of each category expressed as deviation from the grand mean. No
adjustment of covariates or other independents was made for in calculating these values.

From the table it can be seen that treatment accounted for 3.6% $(0.19)^2$ of the variation in test anxiety. The adjusted post test mean score for any of the category was obtained by addition of the grand mean and the adjusted mean. The result showed that the control group had the highest adjusted post test mean

score of 32.131 followed by Experimental 2 with 28.89 and Experimental 1 with 26.94. Thus, students exposed to the lecture method had the highest anxiety and so obtained significantly higher anxiety than those exposed to interactive learning. The multiple R of 0.493 at the bottom of table indicates the overall relationship between mathematics test anxiety and the two independent variables. A value of $R^2 = 0.243$ was obtained which showed the proportion of variation in mathematics test anxiety students as explained by the additive effect of all factors and covariates.

That students exposed to the interactive methods did not score highest in the mathematics test anxiety is quite expected. Artzi and Newman (1990) suggested that the interactive methods make students enthusiastic about mathematics since they enjoy discussing mathematical problems with other students and benefit from their interaction with colleagues and instructors. This enthusiasm could reduce their fear of mathematics and hence bring about lower anxiety than those exposed to the lecture method. Lipsett (1988) found that different

instructional strategies, favouring group work could be used to reduce anxiety and this result has confirmed this although the result obtained by Wood (1992) contradicts this and implies that lecture method aids greater reduction in anxiety.

Hypothesis 6: There is no significant main effect of gender on NCE Business Education Students mathematics test anxiety. The result on table 4.6 showed that the F value of 2.856 was not statistically significant at the level of 0.05. Hence the above hypothesis was not rejected the conclusion is that gender has no significant effect on students mathematics test anxiety.

The multiple classification Analysis showed an initial difference of 2.49 between males and females in anxiety scores. When the confounding effects of covariates and treatments were controlled for the difference between males and females increased slightly to 2.81. Gender accounted for 1.69% (0.13^2) of the variation in test anxiety scores.

4.2.3 SELF CONCEPT AS THE DEPENDENT VARIABLE

Three hypothesis 7, 8 and 9 were tested here. Table 4.8 shows the output of the ANCOVA.

Hypothesis 7. There is no significant interactive effect of instructional methods and gender on NCE Business Education Students mathematics self concept.

A study of table 4.8 showed that there was no significant interactive effect of treatment and gender on the students mathematics self concept since an F value of 1.569 at $P > 0.05$ was obtained. Thus the above hypothesis was not rejected. This shows that gender and instructional methods do not have joint effects on the mathematics self concept of students. The type of instructional method to which a boy or girl is exposed does not have any effect on his or her self concept.

Since no interaction was found the multiple classification Analysis was done and proved useful in studying the pattern of the changes of the effects of each of the two independent variables as more variables are introduced as control. This analysis can be found on Table 4.9.

Table 4.8

Ancova table for mathematics self-concept

SOURCE OF VARIATION	SUM OF SQUARES	DF	MAIN SQUARE	F
COVARIATES (PRE-TEST)	1275.867	1	1275.867	37.478
MAIN EFFECTS	312.749	3	104.250	3.062
INSTRUCTIONAL METHODS (V 2)	33.664	2	16.832	.494
GENDER (V 3)	311.465	1	311.465	9.146
2-WAY INTERACTIONS	106.795	2	53.398	1.569
V 2 × V 3	106.795	2	53.398	1.569
EXPLAINED	1695.412	6	282.569	8.300
RESIDUAL	5276.638	155	34.043	
TOTAL	6972.049	161	43.305	

$P < 0.05$

Table 4.9

Multiple Classification Analysis (MCA) on mathematics self-concept.

GRAND MEAN = 49.728

A VARIABLE + CATEGORY	N	UNADJUSTED DEVIATION	ETA	ADJUSTED FOR INDEPENDENT + COVARIATES DEVIATION	BETA
INSTRUCTIONAL METHODS					
EXPERIMENTAL 1	63	0.72		0.55	
EXPERIMENTAL 2	54	-0.69		-0.62	
CONTROL	45	-0.17		-0.03	
			0.09		0.08
GENDER					
MALE	70	-0.86		-1.73	
FEMALE	92	0.65		1.31	
			0.11		0.23
MULTIPLE R^2					0.228
MULTIPLE R					0.477

Hypothesis 8. There is no significant main effect of instructional methods on NCE Business Education Students mathematics self concept.

The F value of 0.494 showed that the above hypothesis was not rejected. This implies that the type of instructional method used had no significant effect on the students mathematics self-concept. The MCA table (See Table 4.9) shows that the percentage of variation accounted for by the instructional methods was too low $(0.08)^2$ i.e. 0.64% . This backs up the result that there was no significant effect of treatments group on the student's self-concept. The type of instructional strategy adopted thus had no effect on the students self concept.

That instructional method had no effect on student's self concept is contrary to the findings of Wood (1992) who found that traditional lecture method made students have post confidence ratings in mathematics than the group method. We know that self concept deals with a student's self perceived ability in the particular subjects area. The higher the level of confidence a

student has about his mathematics ability the higher his level of self-concept. One expects that interactive learning would boost up students activity in mathematics and hence result in increased mathematics self concept. This study, however did not show this expected prediction. The reason may be that as matured students they had already made up their minds as to their perceived ability in mathematics and no amount of variation in instructional method could affect their self concept. This may not be case with younger students.

Hypothesis 9. There is no significant main effect of gender on NCE Business Education Students mathematics self-concept.

The F value obtained on table 4.8 was 9.149 and this was significant at $p < 0.05$. Thus the above hypothesis was rejected and it could be concluded that gender does have effect on the student's self concept.

The multiple classification Analysis on Table 4.9 throws more light to this result. As initial difference of 1.51 between males and females increased to 3.04 as more variables (treatment and covariates) were

introduced as controls. The adjusted post mean score of 50.38 for the females as against 48.87 for the males showed that the females had significantly higher mean scores than the males as far as self- concept is concerned. Furthermore gender accounted for 5.3% of the variation in mathematics self concept. The multiple R of 0.477 at the bottom of the output showed the overall relationship between self concept and the two independent variables. The value of R^2 = 0.228 showed the proportion of variance in self concept "accounted for" by all factors, covariates and interaction terms.

Unlike the treatment factor, the partial beta for the gender factor increased from 0.11 to 0.23. (That of treatment decreased from 0.09 to 0.08) as other controls

were introduced. Thus the variance proportion explained by gender increased as more controls were being introduced.

The findings that females had higher self concept, which was even significant, than males contradicts the findings of Marsh and Smith (1990) who found that boys

had higher self concept in mathematics than girls. However the sample was obtained with students in secondary school. Self concept, has been defined as the relatively stable picture people have of themselves and of their own academic ability when the focus of attention is mathematics ability. Self concept theorists have advocated that a phase of destabilisation of self concept is found during adolescents. The sample used by Marsh and Smith were adolescents. The sample used in the study were matured students with mean age of approximately 23 years. They are more likely to be stable in their self perceived ability or self concept in mathematics. The skill developmental approach to the theory of self-concept advocates that self concept is primarily the result of past achievement rather than a cause of subsequent achievements. The females in this sample have higher achievement in mathematics as evident from the means of their achievement test scores than the males. Thus since achievement has been found to be related to self concept it can be argued the finding is not contrary to expectations as far as this sample is concerned.

Chapter five

5.0 SUMMARY OF FINDINGS, EDUCATIONAL IMPLICATIONS AND RECOMMENDATIONS

This chapter contains summary of the findings of the study, the educational implications, the limitations and recommendations, as well as suggestions for further research.

5.1 SUMMARY OF FINDINGS

Over the years there has been an increase in emphasis on the study of mathematics at all levels of the educational system. At primary and secondary levels in Nigeria and other parts of the world, mathematics is compulsory for all the students and it is one of the core subjects offered at the end of their final examinations. Its impact is also felt in almost all courses taken at tertiary level. At the tertiary level, it is no longer in the sciences that mathematics is intensely studied as a pre-requisite for graduation. For courses in social sciences and in the humanities, mathematics is being made compulsory for the students.

In Business studies in particular, its impact in areas of business decisions is indisputable. Thus, mathematics, is one of the courses offered in tertiary institutions offering courses in Business studies. At NCE level in Nigeria, a look at the stipulated minimum standards of NCE education shows that mathematics is compulsory for all students in Business Education.

Despite this emphasis on the teaching of mathematics at all levels, the cognitive and affective outcomes of the study of mathematics by students have not been encouraging. In terms of popularity, mathematics is generally not liked by students. The poor performance in mathematics at primary and secondary level is well known and well documented in research reports by the various testing organisations, researchers in mathematics education and even the mass media. At the tertiary level, the low passes in mathematics courses and the high number of students with carry over in the mathematics courses is a pointer to poor performance in mathematics. Reports on the affective aspect vary from lack of interest towards mathematics to hatred, fear and anxiety about mathematics. Most students will readily

admit having poor self perception about their ability in mathematics. This poor outcome of cognitive and affective variables, as far as mathematics is concerned, has engaged the attention of most researchers in mathematics education over the years. Attempts have been made at how some identified alterable variables, especially teaching methods, can be manipulated in order to bring about a favourable increase in both cognitive and affective outcomes. The effect of some innate attribute variables such as gender have also been examined. However, most of these studies have focused on the primary and secondary levels. The study at tertiary level has received least attention than that at primary and secondary levels. The studies on tertiary level need to be increased since this area has been neglected. This is because some of the products of the tertiary level end up as teachers of students at the lower level of the educational system and their cognitive and affective outcomes in mathematics will in one way or the other affect the students they have to teach and also affect their own progress in everyday challenges requiring mathematical competence.

Thus the researcher was motivated to carry out this study in order to see the impact of the popular instructional strategy, the lecture method, and an attribute variable, gender, on students' cognitive outcome
(achievement in mathematics), and selected effective outcomes (mathematics test anxiety and self-concept).

The two institutions in Lagos State offering full-time courses in NCE Business Education were used in this study.The first year Business Education Students on full time NCE studies in these two institutions were assigned to three groups comprising two experimental and one control groups. The final sample was 165 students consisting of 71 males and 94 females.

The independent variables were instructional strategies and gender. The instructional strategies occurred at three levels namely: interactive learning with individual use of materials (Experimental 1), interactive learning with group use of materials (Experimental 2) and the lecture method (control). Gender occurred naturally at two levels, male and female. Thus the study was a 3 × 2 non-randomised

control group pre-test/post-test quasi-experimental design.

Two achievement tests, two psychological tests and instructional materials were the instruments used. The achievement tests comprised an objective pre test of pre-requisite skills and an objective post test based on the syllabus of the second semester Business mathematics course for year 1 NCE Business Education Students. The two psychological tests were the Inventory of Test Anxiety in Mathematics (ITAM) by Osterhouse and a 17-item mathematics self concept scale constructed by the researcher. A total of nine (9) hypotheses were tested consisting of three hypothesis on each of the three dependent variables namely achievement in mathematics, mathematics self-concept and mathematics test anxiety. The whole study took place for a period of ten weeks.

The 3 × 2 Analysis of Covariance (ANCOVA), with pre-test scores on each of the dependent variables as Covariates, was employed in the analysis of the data. Where there was no significant interactive effect, multiple classification Analysis (MCA) was done to find the magnitude of the effect of each factor level of the

independent variable. Where there was a significant interactive effect the main effects were not tested. Rather the post test mean scores were carefully examined by studying the effects of the variables having significant interaction.

The findings in this study were as follows:

1. There was significant interactive effect of treatment and gender on mathematics achievement of these NCE students.
2. There was no significant interactive effect of instructional method and gender on students mathematics test anxiety.
3. There was no significant interactive effect of instructional method and gender on students mathematics self concept.
4. Post test mean score of students exposed to interactive learning with group use of materials was higher than those in the other two groups. The students exposed to the lecture method alone had the lowest post test mean achievement score.
5. Students exposed to the lecture method had

significantly higher test anxiety scores than those exposed to interactive learning.

6. Post test self concept mean score of females was significantly higher than that of males.
7. The interactive learning with individual use of materials favoured females while interactive learning with group use of materials favoured the males.
8. Treatment and gender accounted for a total variance of 24.3% in mathematics test anxiety and 22.8% in mathematics self concept.
9. Instructional method (Treatment) accounted for 3.61% of the variation in test anxiety and 0.6% in mathematics self concept.
10. Gender accounted for 1.69% of the variation in mathematics test anxiety and 5.29% in mathematics self concept.

5.2 EDUCATIONAL IMPLICATIONS AND RECOMMENDATIONS

The results obtained in this study have some implications for the educational system especially at tertiary level. The result obtained from the testing of

hypothesis with achievement in mathematics as the dependent variable pointed out the superiority of the interactive method of teaching over the lecture method. Students exposed to the lecture method had the lowest post test mean score in mathematics achievement while those exposed to the group use of materials had the highest. This calls for the urgent need for teachers of tertiary mathematics to look into the inadequacy of the lecture method as the sole means of instruction at tertiary level. Experts on Nigerian educational practices in mathematics have constantly pointed out the inefficiency of this method at secondary level. Ali (1980) advised that:

> "It will help if we vary our teaching methodology or better still use activity teaching methodology to determine whether mathematics achievement in schools can improve. The use of lecture approach is a mundane teaching technique; this effort, in the Nigerian experience has continued to translate into very poor achievement in secondary school mathematics education programmes".

This study has shown that this advice is not only for

secondary school mathematics but also affects mathematics at tertiary level. The interactive method of learning, which is not a new method (Ajose, 1990), could be explored further and its implementation in tertiary mathematics imbibed. To this end, it is recommended that workshops and seminars be held for teachers of tertiary mathematics as to how interactive and cooperative learning could be inculcated in the teaching of mathematics in order to promote students achievement in mathematics at tertiary level. Research grants should be made available to those who wish to explore the practicability of this in the tertiary institutions.

The obtained significant interaction of instructional method and gender on mathematics achievement of the students points out the possibility of differential method of instruction to cater for the male and female students whenever interactive method with use of materials is being adopted. The fact that individual use of materials favoured the females while the group use favoured the males could be examined further. While not advocating that males and females should be separated for instructional purposes at

tertiary mathematics, the researcher would recommend the technique of individual use of materials in institutions that are strictly for females. Here in Nigeria we have a Federal College of Education for girls at Gusau in the Northern part of the country. In institutions such as this, the use of both individual and group of materials should be tried out to find out the extent to which achievement in mathematics of females could be improved.

This study also showed those exposed to the lecture method as having higher mathematics test anxiety than those exposed to interactive learning when the significant of treatment on mathematics test anxiety obtained was more closely examined. This also implies that instructional method not only affects the cognitive aspect of the student at level tertiary but also the affective aspect especially that dealing with the debilitating aspect of mathematics test anxiety. This further strengthens the need for adopting the interactive method of learning at tertiary level.

There is evidence that this technique has been practised in some tertiary institution outside Nigeria (Hong and Neil, 1992; Cohen and Ben-Zvi, 1992) with some

measure of success. We need to incorporate this in the Nigerian educational system at all levels.

The interactive learning used in this study involved the use of materials. The implication of this for the educational system is that teachers at tertiary level need to introduce the use of instructional materials at this level. Text books are costly and the few available for Business mathematics and other courses are foreign inclined. There is need for workshops and avenues for teachers of tertiary mathematics to develop instructional materials that could be used by students.

That gender had an effect on self concept with females having higher self concept than males showed that females could be encouraged to participate more in mathematics related courses at tertiary level. It is well known that fewer females than males opt for mathematics courses. With proper counselling, their self-perceived ability about mathematics could be influenced positively and thus they will be encouraged to have a more favourable attitude towards mathematics. This will remove the myth of mathematics being a "male" subject.

5.3 LIMITATIONS OF THE STUDY

In this study, intact classes were used in order not to disrupt the academic practices of the two institutions used. This poses a limitation of complete randomisation of subjects as expected in pure experimental research.

Although all the full time students in the institutions formed the initial sample in this study, the final sample was less because some of the students were dropped due to a number of reasons including sickness, missing of final examination and inadequate information of the questionnaires and withdrawal from the institutions. This reduction in sample poses a limitation to the study.

The scope was limited to students at NCE institutions in Lagos State. The fact that other states in Nigeria were not involved could pose a limitation to the generalizability of the result.

5.4 SUGGESTIONS FOR FURTHER STUDIES

The sample used in this study comprise Business Education Students who are not majoring in mathematics.

It would be interesting if the study is replicated using sample of mathematics majors at tertiary level. The sample could also be varied to comprise non mathematics majors at Polytechnics, Universities and Colleges of Education.

The dependent variables could be varied. In this study, achievement in mathematics was the only cognitive variable. This could be varied to include other variables such as cognitive styles and retention. Similarly, the affective measures could be varied to see the effect of the independent variable on these affective measures.

The design of the experiment could be altered to include more dependent measures such as locus of control.

This will give the opportunity to examine more interactive effects among the variables.

The study could also be carried out in many institutions of learning and the results pooled together in order to obtain a more global effect. However those to be involved in the treatment must be trained as to the three methods of instruction.

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APPENDIX 1

PRE-TEST ACHIEVEMENT TEST IN MATHEMATICS

1. The median of the numbers 8,5,11,6,8,13,6, is

   A. 13 B. 8 C. 7 D. 6

2. The mean of the number 2,4,6,8, is

   A. 2 B. 4 C. 5 D. 6

3. Simplify $2^{0} + 2^{-1}$

   A. 0 B. 1 C. $1\frac{1}{2}$ D. 2

4. What is $\log_{6} 36$?

   A. 36 B. 6 C. 2 D. 1

5. Simplify $\log 4 + \log 3$

   A. $\log \frac{4}{3}$ B. $\log \frac{3}{4}$ C. log 12 D. log 1

6. At what points does $(x - 1)(x + 2)$ cut the x-axis.

   A. x = 1 and 2 B. x = 1 and -2

   C. x = -1 and 2 D. x = 1 and -2

7. Which of the following is a measure of central tendency?

   A. variance B. mode C. Range D. Mean deviation

8. Subtract 2.02 from 20.2

   A. 1.782 B. 16.82 C. 17.82 D. 18.18

9. Express $\frac{4}{5}$ as a percentage.

   A. 40% B. 45% C. 50% D. 80%.

10. What is a third of one quarter of 48?

    A. 16 B. 12 C. 4 D. $\frac{1}{4}$

11. Express $72\frac{1}{4}\%$ in decimal

    A. 0.724 B. 0.7225 C. 0.0724 D. 0.07225

12. A workman had 5k deducted from every naira he earned in 1977. By the end of the year he had paid a total tax of ₦86.25. How much did he earn during the period?

    A. ₦1725.00 B. ₦862.50 C. ₦431.25 D. ₦345.00.

13. A second hand car dealer sold a volkswagen car for ₦16,800 at a loss of 20%. What did he pay for the car?

    A. ₦3360 B. ₦12,000 C. ₦13,440 D. ₦21,000

14. What is the difference between 75 and 0.75?

    A. 75.75 B. 74.25 C. 74.15 D. 0.7425

15. Express $\frac{9}{20}$ as a percentage

    A. 9% B. 18% C. 45% D. 90%.

16. The mean age of the three children in a family is $7\frac{1}{2}$ years. If Bola is 10 and Kike is 8, how old is Kemi?

A. $2\frac{1}{2}$ years B. $4\frac{1}{2}$ years C. $8\frac{1}{2}$ years

D. $22\frac{1}{2}$ years.

17. If seven - tenths of a number is 2.10. What is the number

A. 1.47 B. 3 C. 7 D. 147.

18. An amount of money earned ₦24 in four years at a rate of 5% per annum simple interest. What was the amount of money?

A. ₦1.20 B. ₦4.80 C. ₦120.00 D. ₦240.

19. Find the mean of 30,25,20,70,96,75 and 55.

A. 55.8 B. 53 C. 50 D. 45.

20. Express 0.6 as a fraction in its lowest terms.

A. $1\frac{1}{5}$ B. $\frac{3}{5}$ C. $\frac{2}{5}$ D. $\frac{3}{10}$

21. A man pays a total of ₦5,430 as wages to his workmen each month. If the number of workmen is 12, what is the mean monthly wage of the workmen?

A.₦142.50 B. ₦447.50 C. ₦450 D. ₦452.50

22. $\frac{9}{0.3}$ is equal to

A. $\frac{1}{9}$ B. $\frac{1}{3}$ C. 3 D. 30.

23. Express 0.0067368 to three significant figures
A.0.00673 B. 0.00674 C. 0.007 D.0.0674

24. If 6 oranges cost 30 kobo, then the cost of x oranges is

A. x kobo B. 5x kobo C. 5 kobo D. $\frac{5}{x}$ kobo.

25. By how much would you multiply 36 to make the product equal the sum of 36 and 72?

A. $\frac{4}{9}$ B. $2\frac{1}{2}$ C. $2\frac{3}{4}$ D. 3.

26. If my pocket money were cut by half I should have 24 naira a week. How much do I get now?

A. ₦12 B. ₦24 C. ₦48 D. ₦96.

27. Simplify $3\frac{1}{3} \times 10\frac{1}{2} \div 1\frac{3}{4}$

A. $\frac{1}{20}$ B. $\frac{1}{18}$ C. 20 D. 30.

28. Find x if $\frac{4^{2x}}{4^{3x}} = 2$

A. -2 B. $-\frac{1}{2}$ C. $\frac{1}{2}$ D. 2.

29. If the scores of 3 students are 5,6 and 7. Find the variance.

A. $\frac{2}{3}$ B. $\frac{2}{3}\sqrt{3}$ C. $\frac{\sqrt{2}}{3}$ D. $\frac{\sqrt{3}}{2}$

30. $x + y = 5$ $x - y = 1$

A. $x = 2, y = 3$ B. $x = -2, y = -3$
C. $x = 3, y = 2$ D. $x = 4, y = 1$.

APPENDIX 2

POST-TEST IN MATHEMATICS

1. Express 0.09 as a percentage
   A. 90% B. 9% C. 0.09% D. 0.0009%.

2. Express $37\frac{1}{2}\%$ as a fraction

   A. $\frac{1}{75}$ B. $\frac{1}{37}$ C. $\frac{3}{16}$ D. $\frac{3}{8}$

3. A salesman, working on 15% commission sold ₦240,000 worth of services for his company in May. Find his commission for the month of May.

   A. ₦3,000 B. ₦3,600 C. ₦30,000 D. ₦36,000

4. A man pays ₦1,625 monthly for rent. His rate are $\frac{2}{5}$ the amount of his rent. How much will he pay half yearly for rates.

   A. ₦325 B. ₦650 C. ₦3,900 D. ₦7,800.

5. Find the simple interest on ₦780,000 for 6 years at 10%.
   A. ₦39.000 B. ₦78,000 C. ₦108,000 D. ₦468,000

6. How much will ₦15,000 amount to is 2 years at 5% simple interest?

   A. 15,150 B. ₦16,5000 C. ₦156,000 D.₦165,000

7. A worker spends $\frac{1}{5}$ of his income on housing, $\frac{1}{2}$ of it on food and $\frac{1}{4}$ on transport. How much does he have left?
   A. $\frac{1}{20}$ B. $\frac{3}{4}$ C. $\frac{4}{5}$ D. $\frac{19}{20}$.

8. Add $\frac{2}{3}$ to the difference between $3\frac{1}{2}$ and $1\frac{1}{6}$

A. $3\frac{5}{6}$ B. 3 C. $2\frac{5}{6}$ D. $2\frac{1}{3}$

A man's monthly salary is ₦1,200; he does not pay tax on the first ₦600 of his salary. For the remaining, he pays 10k on every naira. Use this information to answer question 9 and 10.

9. How much tax does he pay every month?

A. ₦60 B. ₦120 C. ₦600 D. 1,080.

10. What percentage of his salary goes on tax?

A. 2.5% B. 5% C. 10% D. 50%.

11. An article costing ₦90 was increased by 10%. If the increased price was later reduced by 10%, find the new price.

A. ₦89 B. ₦90 C. ₦99 D. ₦100.

12. After deducting 10% from a certain amount of money ₦1,620 is left. How much is the money?

A. ₦1,458 B. ₦1,610 C. ₦1,782 D. ₦1,800.

13. A man bought a car for ₦30,000 and later sold it at ₦72,000, what was his percentage profit?

A. 41.7% B. 58.3% C. 71.4% D. 140%.

14. Potatoes are bought at ₦15 per kilo and sold at ₦21 per kilo. What is the profit per cent?

A. 28.6% B. 40% C. 60% D. 71.4%.

15. Find the net pay of a man who pays a tax of $2\frac{1}{2}\%$ on his salary of ₦4,000.

A. ₦1,000 B. ₦3,000 C. ₦3,890 D. ₦3,900.

16. A man borrowed ₦20,000 and agreed to pay an interest of 10 k per naira for month. How much did he pay back if he paid the loan and interest two months after taking it?

A. ₦20,000 B. ₦22,000 C. ₦24,000 D. ₦44,000

17. ₦60,000 is to be shared between two people in the ratio 2:3. Find the smaller share.

A. ₦20,000 B. ₦24,000 C. ₦36,000 D. ₦40,000.

18. If A:B = 3:4 and B:C = 5:6. Find A:B:C.

A. 3:20:6 B. 3:9:6 C. 15:20:24 D. 12:20:30.

19. The market price of a refrigerator is ₦8,400. If the buyer is given 15% cash discount. Find the cash price.

A. ₦1,260 B. ₦6,900 C. ₦7,140 D. ₦8,385

20. A man paid ₦1,400 for a suit after 5 k in the naira had been deduced from the market price. Find the market price.

A. ₦1,330 B. ₦1,333 C. ₦1,405 D. ₦1,474

21. The sum on which interest is payable is known as.

A. Amount B. Balance C. Principal D. Interest.

22. A loss in value is known as:

A. Discount B. Depreciation
C.Demotion D. Appreciation.

23. Find the compound interest on ₦500 for 2 years at 10% per annum.

A. ₦50 B. ₦55 C. ₦100 D. ₦105.

24. A manufacturer bought a machine for ₦50,000 and wrote off 10% depreciation at the end of each year. What was its book value after two years?

A. ₦30,000 B. ₦40,000 C. ₦40,500 D. ₦45,000

25. Income tax is an example of :-

A. Indirect tax B. Tax free pay
C. direct tax D. Taxable pay.

26. A man's basic monthly salary is ₦2,500. He pays 5% tax on this and his non taxable payment is ₦2,000, find his take home pay.

A. ₦4,275 B. ₦4,375 C. ₦4,400 D. ₦4,500.

27. A payment of apportioned profits to stock holders is known as :-

A. Dividend B. Stocks
C. Shares D. Brokerage.

28. How much Stock at $62\frac{1}{2}$k can be bought for ₦5,000?

A. ₦2,625 B. ₦3,125 C. ₦8,000 D. ₦8,125.

APPENDIX 3

CORRECT OPTIONS FOR PRE-TEST IN MATHEMATICS

1. B	2. C
3. C	4. C
5. C	6. B
7. B	8. D
9. D	10. C
11. B	12. A
13. D	14. B
15. C	16. B
17. B	18. C
19. B	20. B
21. D	22. D
23. B	24. B
25. D	26. C
27. C	28. B
29. A	30.C

APPENDIX 4

CORRECT OPTIONS FOR POST TEST IN MATHEMATICS

1. B	2. D
3. D	4. A
5. D	6. B
7. A	8. B
9. A	10. B
11. A	12. D
13. D	14. B
15. D	16. C
17. B	18. C
19. C	20. D
21. C	22. B
23. D	24. C
25. C	26. B
27. A	28. C.

APPENDIX 5

ITEM ANALYSIS OF PRE-TEST IN MATHEMATICS

FUNCTIONS OF DISTRACTORS

	HIGH GROUP					LOW GROUP				
Item No.	A	B*	C	D	Omits	A	B	C	D	Omits
1	-	22*	-	3	-	2	12*	3	7	1
2	1	1	22*	1	-	2	7	12*	4	-
3	-	1	22*	1	1	3	6	11*	5	-
4	1	4	19*	1	-	3	11	7*	2	2
5	-	1	23*	1	-	5	1	12*	3	4
6	1	20*	2	1	1	4	3*	12	3	3
7	-	30*	-	12	-	2	3*	2	17	1
8	-	1	1	23*	-	5	2	6	11*	1
9	1	1	1	21*	1	4	4	5	11*	1
10	7	3	15*	-	-	10	6	4*	1	4
11	2	17*	2	2	2	6	5*	8	4	2
12	15*	3	4	1	2	5*	6	6	4	4
13	-	-	1	23*	1	3	2	4	12*	4
14	1	21*	1	1	1	3	11*	5	2	4
15	-	1	14*	10	-	1	6	3	15	-
16	1	18*	5	1	-	6	5*	10	2	2
17	2	18*	3	1	1	6	3*	9	5	2
18	2	5	16*	2	-	6	10	5*	4	-
19	-	24*	-	1	-	3	11*	5	4	2
20	1	24*	-	-	-	5	7*	7	5	1
21	1	1	2	20*	1	4	6	5	9*	1

Item No.	A	B*	C	D	Omits	A	B	C	D	Omits
22	-	-	3	22*	-	2	3	2	4*	4
23	1	19*	2	3	-	2	9*	5	7	2
24	1	15*	7	2	-	4	5*	12	4	-
25	1	1	1	22*	-	5	6	8	5*	1
26	2	2	19*	1	1	7	7	6*	3	2
27	1	-	21*	1	2	5	6	7*	4	3
28	2	16*	2	4	1	3	6*	8	8	-
29	14*	1	9	1	-	5*	4	14	2	-
30	2	2	20*	1	-	4	3	10*	8	-

(ii) DISCRIMINATING POWER AND DIFFICULTY LEVEL OF PRE-TEST

MATHEMATICS.

Item No	Difficulty Level (P)	Discriminating Power (D)	Item No	Difficulty level (p)	Discriminating Power (D)
1	.68	.40	16	.46	.52
2	.68	.40	17	.42	.60
3	.66	.44	18	.42	.44
4	.52	.48	19	.70	.52
5	.70	.44	20	.62	.68
6	.46	.68	21	.58	.44
7	.32	.40	22	.52	.72
8	.68	.48	23	.56	.40
9	.64	.40	24	.40	.40
10	.38	.44	25	.54	.68
11	.44	.48	26	.50	.52
12	.40	.40	27	.56	.56
13	0.34	.44	28	.44	.40
14	0.70	0.44	29	.36	.40
15	0.64	0.40	30	.60	.40

APPENDIX 6

ITEM ANALYSIS OF POST TEST IN MATHEMATICS:

(i) **FUNCTIONS OF THE DISTRACTORS**

HIGH GROUP						LOW GROUP					
Item No	A	B	C	D	O	Item No	A	B	C	D	O
1	2	20*	-	3	-	1	4	10*	2	7	2
2	1	-	3	21*	-	2	6	5	8	5*	1
3	-	1	2	22*	-	3	3	5	3	11*	3
4	15*	4	5	1	-	4	5*	7	9	3	1
5	4	1	1	19*	-	5	10	3	3	9*	-
6	1	20*	3	1	-	6	3	9*	6	7	-
7	15*	3	3	4	-	7	5*	4	5	11	-
8	1	20*	2	2	-	8	5	6*	7	5	2
9	18*	7	-	-	-	9	7*	10	4	4	-
10	1	16*	-	8	-	10	3	5*	3	14	-
11	16*	8	-	1	-	11	4*	18	2	1	-
12	1	2	3	18*	1	12	7	6	7	2*	1
13	4	-	2	19*	-	13	7	5	5	7*	1
14	1	19*	2	2	1	14	6	7*	6	4	2
15	4	3	-	18*	-	15	9	7	4	4*	1
16	4	2	17*	2	-	16	8	5	6*	4	2
17	2	22*	-	1	-	17	5	12*	5	3	-
18	-	7	16*	1	1	18	3	10	6*	4	2
19	4	-	20*	1	-	19	8	4	7*	5	1
20	-	-	12	13*	-	20	3	8	10	2*	2
21	1	1	22*	1	-	21	5	5	11*	3	1
22	-	25*	-	-	-	22	3	10*	4	4	4
23	-	1	9	15*	-	23	3	6	11	5	-
24	1	9	14*	1	-	24	4	14	4*	2	1

HIGH GROUP						LOW GROUP					
25	1	-	21*	3	-	25	5	3	11*	5	1
26	-	22*	1	-	2	26	4	7*	12	1	1
27	24*	-	1	-	-	27	11*	3	5	4	2
28	2	3	16*	3	1	28	3	8	6*	8	-

(ii) **DISCRIMINATING POWER AND DIFFICULTY LEVEL OF POST MATHEMATICS ITEM**

Item No	Difficulty level (p)	Discriminating Power (D)	Item No	Difficulty level (p)	Discriminating Power (D)
1	.60	.40	16	.46	.44
2	.52	.64	17	.68	.40
3	.66	.44	18	.44	.40
4	.40	.40	19	.54	52
5	.56	.40	20	.30	.44
6	.58	.44	21	.65	.44
7	.40	.40	22	.70	.60
8	.52	.56	23	.40	.40
9	.50	.44	24	.36	.40
10	.42	.44	25	.69	.40
11	.40	.48	26	.58	.60
12	.40	.64	27	.70	.52
13	.52	.48	28	.44	0.44
14	.52	.48			
15	.44	.56			

APPENDIX 7

Formulae for Item Analysis and Reliability.

The difficulty level can be calculated for each item with the formula

$$P = \frac{R}{T} \times \frac{100\%}{1}$$

where R = no of students who got the item right and

T = total number of one third of the candidates.

The popular formula used to obtain the discriminating power was

$$D = \frac{U - L}{N}$$

where U = number of students in upper one third group who answered items correctly

L = number in lower one third group who answered the item correctly and

N = number of students in each group.

The coefficient of internal consistency can be computed with the formula

$$KR_{21} = \frac{n}{n-1}\left[1 - \frac{\overline{X}(n - \overline{X})}{n S_x^2}\right]$$

where n = number of items in the test.

$\overline{X}$ = mean of test scores and

S_x^2 = variance of test scores.

Cronbach alpha can be obtained using the formula.

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\text{Sum } S^2X_i}{S^2X_t}\right)$$

where n = number of items

S^2X_i = variance of part scores and

S^2X_t = variance of the sum of n part scores.

APPENDIX 8

NCCE SYLLABUS. **BED 122.**

BUSINESS MATHEMATICS

Percentages and their application to discount, depreciation
etc.

Ratio and proportion.

Simple and compound interest up to partnership, hire purchase, and annuities. Payroll Computation and application to PAYE

Shares and Stocks.

APPENDIX 9

INVENTORY OF TEST ANXIETY IN MATHEMATICS (ITAM)

Direction: *Read each of the following statements carefully.*
In the space in front of each, write the letter corresponding to the way you actually felt during your mathematics examination. Use the following scale for your answers.

a. The statement did not describe my feeling or condition.

b. The feeling or condition was barely noticeable.

c. The feeling or condition was moderately intense.

d. The feeling or condition was strong.

e. The feeling or condition was very strong.

1. I felt terrified while taking this examination.____

2. I felt during this examination that I wouldn't be able to finish the examination on time. _____

3. My mouth got dry during this examination. _____

4. Prior to taking this examination, I felt that other students were better prepared for this examination than I was. _____

5. My mind went blank at the beginning of this examination. It took me a few minutes to recover. _____

6. I feel that I disappointed myself and other persons by my poor performance on third examination. _____

7. I felt my heart beating fast during this examination.

8. I found myself worrying about a low mark before this examination. _____

9. During this examination, I found myself thinking about the consequences of failure. _____

10. I got so tense during this examination that my stomach became upset. _____

11. After finishing this examination, I feel that I could have done better than I actually did. _____

12. I got a headache during this examination. _____

13. While taking this examination, I found myself thinking of how much brighter other students are than I am _____

14. My hands were sweating during this examination.___

15. I did not feel very confident of my performance before I took this examination that I forgot facts which I really knew. _____

16. I got so nervous during this examination that I forgot facts which I really knew.

APPENDIX 10
MATHEMATICS SELF-CONCEPT ITEMS

Instructions: The following are statements. Concerning your feelings about mathematics.

Please write strongly Agree, Agree, "Disagree or Strongly disagree according to your feeling.

1. I always scores high marks in mathematics _____
2. I can never pass mathematics no matter how hard I try _____
3. I answer correctly most questions asked by my mathematics lecturer _____
4. Most of the time I cannot work a single problem in mathematics without seeking for help _____
5. I am confident enough to volunteer to solve problems on the black board _____
6. My colleagues recognise me as a good mathematics student _____
7. I enjoy practising mathematics problems _____
8. I like taking mathematics test _____
9. During mathematics examination I believe I would fail even before the results are out _____
10. I believe I am competent to understand any

mathematics topic _____

11. I can never be good at solving mathematics problems _____

12. I believe I am specially gifted in mathematics____

13. Everybody regards me as a poor student in mathematics _____

14. Mathematics is only good for the gifted students and not for people like me _____

15. I always struggle to pass mathematics examination ____

16. Which of the following would describe your ability in maths.

    A. Outstanding B. Good C. Average

    D. Highly below average E. Not sure.

17. How would you rate your general performance in mathematics.

    A. 70 - above B. 60-69 C. 50-60 D. 40-49

    E. Below 40.

APPENDIX 11

Reliability Analysis of ITAM

CORRELATION MATRIX

	ITEM 1	ITEM 2	ITEM 3	ITEM 4	ITEM 5
ITEM 1	1.0000	.5718	.3165	.1345	.3475
ITEM 2	.5718	1.0000	.3554	.13078	.2871
ITEM 3	.3165	.3554	1.0000	.2173	.4987
ITEM 4	.1345	.3078	.2173	1.0000	.3220
ITEM 5	.3475	.2871	.4987	.3220	1.0000
ITEM 6	.4266	.4477	.2030	.3208	.4243
ITEM 7	.3021	.2636	.3320	.2816	.3966
ITEM 8	.2651	.2955	.1726	.5663	.2108
ITEM 9	.2771	.1485	.2400	.2509	.3981
ITEM 10	.2570	.2682	.1149	.1575	.2938
ITEM 11	.0170	.3140	.3363	.5314	.1716
ITEM 12	.1568	.0702	.1344	.1202	.5618
ITEM 13	.3089	.4619	.4467	.3470	.6537
ITEM 14	.0015	-.0092	.2235	.2804	.3036
ITEM 15	.0848	.2108	.3103	.2092	.4609
ITEM 16	.3532	.3912	.4986	.2311	.4922

	ITEM 6	ITEM 7	ITEM 8	ITEM 9	ITEM 10
ITEM 6	1.0000	.1888	.4691	.2219	.6178
ITEM 7	.1888	1.0000	.2864	.4856	.3087
ITEM 8	.4691	.2864	1.0000	.4732	.4235
ITEM 9	.2219	.4856	.4732	1.0000	.4248
ITEM 10	.6178	.3087	.4235	.4248	1.0000
ITEM 11	.0809	.2318	.1014	.0955	-.0318
ITEM 12	.4549	.2793	.1187	.2650	.4312
ITEM 13	.2959	.2524	.2499	.3448	.3135
ITEM 14	.0898	.1173	.0409	.2614	.1774
ITEM 15	.3389	.3300	.1788	.3240	.5744
ITEM 16	.3609	.3610	-.0388	.2970	.3277

	ITEM 11	ITEM 12	ITEM 13	ITEM 14	ITEM 15	ITEM 16
ITEM 11	1.0000	-.0277	.3835	.2123	.2083	.3219
ITEM 12	-.0277	1.0000	.3837	.3544	.4653	.2740
ITEM 13	.3835	.3537	1.0000	.2630	.4446	.4215
ITEM 14	.2123	.3544	.2630	1.0000	.2685	.3395
ITEM 15	.2083	.4653	.4446	.2685	1.0000	.3435
ITEM 16	.3219	.2740	.4215	.3395	.3435	1.000

ITEM TOTAL STATISTICS

	SCALE MEAN IF ITEM DELETED	SCALE VARIANCE IF ITEM DELETED	CORRECTION ITEM TOTAL CORRELATION	SQUARED MULTIPLE CORRELATION	ALPHA IF ITEM DELETED
ITEM 1	31.4464	132.3971	.4334	.4791	.8628
ITEM 2	31.5357	131.0896	.5135	.5538	.8589
ITEM 3	31.7857	132.0623	.5129	.4756	.8590
ITEM 4	31.3393	130.4828	.4961	.6393	.8598
ITEM 5	31.8214	128.0039	.6741	.6993	.8519
ITEM 6	31.8393	130.6828	.5616	.6739	.8568
ITEM 7	31.6071	131.9156	.5067	.4324	.8592
ITEM 8	31.6786	134.1130	.4323	.7109	.8625
ITEM 9	31.6071	130.8610	.5110	.5191	.8590
ITEM 10	31.8214	132.2221	.5228	.6735	.8586
ITEM 11	30.9821	134.1633	.3413	.5260	.8680
ITEM 12	32.0536	136.0516	.4457	.5431	.8620
ITEM 13	31.5893	126.1010	.6448	.6183	.8523
ITEM 14	31.9286	137.2312	.3276	.3345	.8670
ITEM 15	31.5536	131.6698	.5371	.5274	.8579
ITEM 16	31.3929	127.0792	.5747	.5957	.8558

ALPHA = .8672 STANDARDIZED ITEM ALPHA = .8687

APPENDIX 12

RELIABILITY ANALYSIS OF THE SELF-CONCEPT QUESTIONNAIRE

CORRELATION MATRIX

	ITEM 1	ITEM 2	ITEM 3	ITEM 4	ITEM 5
ITEM 1	1.0000	.5904	.5368	.5125	.7086
ITEM 2	.5904	1.0000	.4868	.6006	.6289
ITEM 3	.5368	.4868	1.0000	.3760	.4324
ITEM 4	.5125	.6006	.3760	1.0000	.5935
ITEM 5	.7806	.6289	.4324	.5935	1.0000
ITEM 6	.5733	.5336	.4236	.4302	.5523
ITEM 7	.5506	.4400	.3331	.3038	.6387
ITEM 8	.6229	.5329	.4201	.4712	.7028
ITEM 9	.3099	.6018	.1954	.3608	.4403
ITEM 10	.2435	.4392	.2027	.2465	.3199
ITEM 11	.1880	.4775	.21107	.2178	.3205
ITEM 12	.4041	.0363	.2042	.1715	.3596
ITEM 13	.4467	.5494	.3665	.3007	.5398
ITEM 14	.3322	.6652	.3304	.4902	.4671
ITEM 15	.2900	.0926	.0710	.1476	.3022
ITEM 16	.3964	.4086	.1861	.4012	.5422
ITEM 17	.5019	.4344	.2861	.3750	.5969

	ITEM 6	ITEM 7	ITEM 8	ITEM 9	ITEM 10
ITEM 6	1.0000	.6039	.4250	.3271	.2758
ITEM 7	.6039	1.0000	.4964	.2728	.3390
ITEM 8	.4250	.4964	1.0000	.4331	.3204
ITEM 9	.3271	.2728	.4331	1.0000	.3215
ITEM 10	.2758	.3390	.3204	.3215	1.0000
ITEM 11	.2428	.1449	.3712	.6027	.2926
ITEM 12	.3150	.1848	.3923	.2071	.1628
ITEM 13	.4327	.3855	.5054	.6094	.1782
ITEM 14	.3518	.2114	.5682	.6329	.2046
ITEM 15	.2277	.3442	.2793	.1287	.2427
ITEM 16	.3063	.3212	.4196	.4188	.2367
ITEM 17	.3959	.5091	.4320	.2974	.1348

	ITEM 11	ITEM 12	ITEM 13	ITEM 14	ITEM 15
ITEM 11	1.0000	.1357	.4523	.5718	.0340
ITEM 12	.1357	1.0000	.4793	.0171	.3594
ITEM 13	.4523	.4793	1.0000	.5008	.1356
ITEM 14	.5718	.0171	.5008	1.0000	.0013
ITEM 15	.0340	.3594	.1356	.0013	1.0000
ITEM 16	.2497	.3957	.4352	.2765	.2735
ITEM 17	.1344	.3758	.3397	.2125	.2427

	ITEM 16	ITEM 17
ITEM 16	1.0000	.4299
ITEM 17	.4299	1.0000

ITEM - TOTAL STATISTICS

	SCALE MEAN IF ITEM DELETED	SCALE VARIANCE IF ITEM DELETED	CORRECTION ITEM-TOTAL CORRELATION	SQUARED MULTIPLE CORRELATION	ALPHA IF ITEM DELETED
ITEM 1	46.5357	72.3987	.7218	.7378	.8879
ITEM 2	45.8393	71.2282	.7136	.7793	.8872
ITEM 3	46.4107	75.5919	.4782	.3869	.8948
ITEM 4	46.2857	72.8623	.5992	.5322	.8910
ITEM 5	46.4464	70.1062	.8247	.7903	.8838
ITEM 6	46.7857	72.4987	.6268	.5488	.8901
ITEM 7	46.2500	72.0455	.6019	.6544	.8908
ITEM 8	46.2321	72.4360	.7298	.6513	.8877
ITEM 9	45.6786	74.6584	.5977	.6311	.8919
ITEM 10	46.2143	75.9896	.4034	.3861	.8669
ITEM 11	45.9286	74.5766	.4261	.4766	.8967
ITEM 12	46.6964	75.0153	.4183	.6537	.8968
ITEM 13	45.9286	73.9948	.6667	.6749	.8902
ITEM 14	45.9286	73.7766	.5429	.6902	.8928
ITEM 15	46.9821	73.6906	.3110	.2700	.9058
ITEM 16	46.2500	69.5727	5615	.4231	.8934
ITEM 17	45.8929	70.8247	.5543	.4681	.8930

APPENDIX 13

FACTOR ANALYSIS OF THE SELF CONCEPT SCALE

(i) CORRELATION MATRIX OF SELF CONCEPT AND ITAM

SELF CONCEPT	ITEM 1	ITEM 2	ITEM 3	ITEM 4	ITEM 5	ITEM 6	ITEM 7
ITEM 1	1.00000	.59043	.53671	.51247	.78044	.57327	.55058
ITEM 2	.48677	1.00000	.148677	.60058	.62893	.53363	.43999
ITEM 3	.53677	.48677	1.00000	.37599	.43240	.42356	.33309
ITEM 4	.51247	.60058	.37599	1.00000	.59352	.43023	.30576
ITEM 5	.78064	.62893	.43240	.59352	1.00000	.55225	.63874
ITEM 6	.57327	.53363	.42356	.43023	.55225	1.00000	60395
ITEM 7	.55058	.43999	.33309	.30376	.63874	.60395	1.00000
ITEM 8	.62294	.53294	.42010	.47119	.70279	.42495	.49635
ITEM 9	.30992	.60176	.19537	.36078	.44026	.32711	.27276
ITEM 10	.24346	.43919	.20267	.24653	.31992	.27578	.33902
ITEM 11	.18804	.47751	.21075	.21781	.32046	.24281	.14486
ITEM 12	.40415	.03633	.20424	.17149	.35963	.31502	.18475
ITEM 13	.44667	.54937	.36648	.50073	.35984	.43267	.38548
ITEM 14	.33222	.66524	.33036	.49021	.46706	.35185	.21141
ITEM 15	.29004	.09259	.07099	.14755	.30217	.22769	.34422
ITEM 16	.39636	.40865	.18613	.40118	.54222	.30631	.32115
ITEM 17	.50193	.34443	.28613	.37503	.59690	.39587	.50907

ITAM	ITEM 1	ITEM 2	ITEM 3	ITEM 4	ITEM 5	ITEM 6	ITEM 7
ITEM 1	-.41840	-.41737	-.21558	-.57811	-.59310	-.37341	.-.35258
ITEM 2	-.50036	-.43512	-.23580	-.45911	-.52045	-.36705	-.30590
ITEM 3	-.22140	-.47257	-.32648	-.46715	-.23143	-.35226	-.16821
ITEM 4	-.37693	-.35255	-.38857	-.24977	-.38850	-.21827	-.29979
ITEM 5	-.30035	-.57426	-.27927	-.40689	-.51805	-.30836	-.43826
ITEM 6	-.48007	-.45533	-.15669	-.42044	-.46148	-.26183	-.22168
ITEM 7	-.296-8	-.29325	-.42839	-.52052	-.45528	-.33834	-.22796
ITEM 8	-.407-1	-.34341	-.20826	-.30707	-.39147	-.26339	-.22040
ITEM 9	-.391.5	-.26197	-.31023	-.42800	-.49872	-.25515	-.26181
ITEM 10	-.283-6	-.24122	-.04957	-.28488	-.39560	-.20330	-.07581
ITEM 11	-.188.1	-.31437	-.45787	-.24897	-.25619	-.14645	-.00675
ITEM 12	-.139-4	-.23402	-.16388	-.13508	-.30151	-.00881	-.20712
ITEM 13	-.298-9	-.47411	-.23723	-.42400	-.44142	-.34507	-.33687
ITEM 14	.05305	-.09875	-.06087	-.11616	-.13156	-.05429	-.05180
ITEM 15	-.26289	-.23092	-.27946	-.29744	-.32699	-.18975	-.19741
ITEM 16	-.31157	-.33710	-.29651	-.42434	-.41430	-.23682	-.24848

	ITEM 8	ITEM 9	ITEM 10	ITEM 11	ITEM 12	ITEM 13	ITEM 14
ITEM 8	1.00000	.43312	.32044	.37120	.39232	.50538	.56818
ITEM 9	.43312	1.00000	.32152	.60269	.20705	.60939	.63293
ITEM 10	.32044	.32152	1.00000	.29255	.16277	.17819	.20457
ITEM 11	.37120	.60269	.29255	1.00000	13566	.45234	.57179
ITEM 12	.39232	.20705	.16277	.13566	1.00000	.47929	.01711
ITEM 13	.50538	.60939	.17819	.45234	.47929	1.00000	.50081
ITEM 14	.56818	.63293	.20457	.57179	.01711	.50081	1.00000
ITEM 15	.27928	.12866	.24272	.03393	.35940	.13561	.00130
ITEM 16	41961	.41884	.23670	.24972	.39565	43519	.27648

(ii) **FINAL STATISTICS**

VARIABLE SELF CONCEPT	COMMUNALITY	ITAM	COMUNALITY
ITEM 1	.69154	ITEM 1	.46319
ITEM 2	.57529	ITEM 2	.45392
ITEM 3	.29194	ITEM 3	.36809
ITEM 4	.49331	ITEM 4	.27225
ITEM 5	.76804	ITEM 5	.57390
ITEM 6	.49342	ITEM 6	.41784
ITEM 7	.50182	ITEM 7	.30369
ITEM 8	.58766	ITEM 8	.24444
ITEM 9	.48758	ITEM 9	.31026
ITEM 10	.19877	ITEM 10	.38808
ITEM 11	.39418	ITEM 11	.18210
ITEM 12	.39778	ITEM 12	.30904
ITEM 13	.58745	ITEM 13	.49471
ITEM 14	.52205	ITEM 14	.32744
ITEM 15	.19659	ITEM 15	.41953
ITEM 16	.40436	ITEM 16	.40994
ITEM 17	.46744		

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	11.45304	34.7	34.7
2	2.44459	7.4	42.1

Varimax Rotation 1, Extraction 1, Analysis 2- Kaiser Normalization.
Varimax converged in 3 iterations.

Rotated Factor Matrix:

SELF CONCEPT	FACTOR 1	FACTOR 2
ITEM 1	.81153	-.18152
ITEM 2	.55028	-.52199
ITEM 3	.44842	-.30143
ITEM 4	.54503	-.44300
ITEM 5	.78821	-.38310
ITEM 6	.68118	-.17152

Varimax Rotation 1, Extraction 1, Analysis 2 - Kaiser Normalization.
Varimax converged in 3 iterations. Rotated Factor Matrix:

SELF CONCEPT	FACTOR 1	FACTOR 2
ITEM 1	.81153	-.18152
ITEM 2	.55028	-.52199
ITEM 3	.44842	-.30143
ITEM 4	.54503	-.44300
ITEM 5	.78821	-.38310
ITEM 6	.68118	-.17152
ITEM 7	.70120	-.10068
ITEM 8	.64075	-.42084
ITEM 9	.34830	-.60520
ITEM 10	.41929	-.15155
ITEM 11	.15825	-.60757
ITEM 12	.54485	-.03045
ITEM 13	.49076	-.58873
ITEM 14	.31437	-.65055
ITEM 15	.44133	.04268
ITEM 16	.55580	-,30894
ITEM 17	.67475	-.11025
ITAM TEST ANXIETY ITEM 1	-.61911	.28267
ITEM 2	-.60042	.30564
ITEM 3	-.25908	.54861
ITEM 4	-.28282	.43848
ITEM 5	-.31691	.68809
ITEM 6	-.41814	.49295
ITEM 7	-.29415	.46601
ITEM 8	-.34425	.35486
ITEM 9	-.32390	.45315
ITEM 10	-.10809	.61351
ITEM 11	-.09083	.41696

SELF CONCEPT	FACTOR 1	FACTOR 2
ITEM 12	-.04910	.55374
ITEM 13	-.25753	.65451
ITEM 14	-.18918	.54004
ITEM 15	-.03936	.64651
ITEM 16	-.25021	.58935

Factor Transformation Matrix:

	FACTOR 1	FACTOR 2
FACTOR 1	.71341	-.70075
FACTOR 2	.70075	.71341

Factor Score Coefficient Matrix:

SELF CONCEPT	FACTOR 1	FACTOR 2
ITEM 1	.16988	.08496
ITEM 2	.05103	-.04254
ITEM 3	.06152	-.00355
ITEM 4	.06245	-.02355
ITEM 5	.13173	.03060
ITEM 6	.13951	.06651
ITEM 7	.15582	.08751
ITEM 8	.08949	-.00260
ITEM 9	-.01191	-.09592
ITEM 10	.07848	.02939
ITEM 11	-.05891	.12709
ITEM 12	.12876	.07999
ITEM 13	.02569	-.06887
ITEM 14	-.02752	-.11277
ITEM 15	.11513	.08170
ITEM 16	.08665	.01184
ITEM 17	.14779	.08085
ITAM ITEM 1	-.10641	-.02861
ITEM 2	-.09813	-.01984
ITEM 3	.02469	.09606
ITEM 4	.00115	.06460
ITEM 5	.03294	.12178
ITEM 6	-.02328	.05651
ITEM 7	.00280	.06996
ITEM 8	-.02737	.03372
ITEM 9	-.00657	.06167
ITEM 10	.07217	.13665
ITEM 11	.04479	.09008

SELF CONCEPT	FACTOR 1	FACTOR 2
ITEM 12	.07703	.13113
ITEM 13	.04210	.12290
ITEM 14	.13328	.16602
ITEM 15	.09434	.15599
ITEM 16	.03342	.10772

Covariance Matrix for Estimated Regression Factor Scores:

	FACTOR 1	FACTOR 2
FACTOR 1	1.00000	
FACTOR 2	.00000	1.00000

APPENDIX 14
LETTER TO PROVOST

International Centre For Educational Evaluation

Institute of Education,
University of Ibadan,
25th April 1993.

The Provost,
Lagos State College of Education,
Ijanikin,
Lagos.

Application For Permission To Use NCE Year One Business For Research Purpose.

I hereby apply for permission to use all the NCE year one Business Education Students for research study of my PHD thesis.

The study involves the use of all NCE students at the two colleges of Education in Lagos State to collect data on my research design. It consists of lecturing in business mathematics (BED 122) as well as administering some tests and questionnaires.

Enclosed is a summary of my research proposal and a letter of introduction from my university.

Thank you for your anticipated co-operation.

Yours Faithfully,
O. A. Adedayo.

APPENDIX 15

LEARNING MATERIALS

UNIT 1 FRACTIONS

A. **OBJECTIVES.**

Students will be to recall how to

1. Add, subtract, multiply and divide given fractions.
2. Use the concept of BODMAS.
3. Apply fractions in solving practical problems.

B. **INTRODUCTION**

A fraction is part of a whole number. Examples of fractions are $\frac{5}{9}$, $\frac{7}{10}$, $\frac{13}{17}$ etc. Thus, a fraction is of the form $\frac{p}{q}$ where p and q do not have any factor in common. P is the NUMERATOR while q is the DENOMINATOR. In the fraction $\frac{12}{19}$, 12 is the numerator while 19 is the denominator.

Exercise 1.1

Given fraction $\frac{5}{41}$, (a) the numerator is _____

(b) the denominator is _____

C. **ADDITION AND SUBTRACTION OF FRACTION.**

The important point note is the need to find the LCM of the denominator.

For example, to find $\frac{2}{3} + \frac{4}{5}$, one needs to find the L.C.M of the denominators i.e. the L.C.M of 3 and 5. Their LCM is 15. You then obtain the addition by bring the two fractions to a common denominator

i.e. $\frac{2}{3} + \frac{4}{5} = \frac{10 + 12}{15} = \frac{22}{15} = 1\frac{7}{15}$.

Now, try this problem:

$$\frac{2}{3} + \frac{3}{4} + \frac{2}{5} + \frac{7}{12}.$$

1. What is your L.C.M?
2. Did you obtain 60?
3. The sum of the numerators should be

   $40 + 45 + 24 + 35 = 144$.

4. The addition is thus $\frac{144}{60} = 2\frac{2}{5}$.

For subtraction, the principle is the same with addition.

e.g. $\frac{5}{7} - \frac{2}{9}$.

Your LCM is _____?

Your numerator should be 45 - 14.

Thus the final answer is $\frac{31}{63}$.

For mixed numbers, the procedure is the same. You only need to deal with the whole numbers first.

e.g. $2\frac{3}{5} + 1\frac{4}{6} - 1\frac{2}{3}$. $= (2 + 1 - 1) +$

$$\frac{18 + 20 - 20}{30}$$

$$= 2\frac{18}{30} = 2\frac{3}{5}$$

D. MULTIPLICATION AND DIVISION OF FRACTIONS.

For multiplication, if the fraction is a proper fraction, you only need to cancel out the common factors in the numerator and denominator.

e.g. $\frac{4}{9} \times \frac{3}{5} \times \frac{1}{2} = \frac{2}{15}$.

In case of mixed fraction, first convert to improper fraction and then cancel out common factors.

e.g. $3\frac{1}{3} \times \frac{12}{25} \times 1\frac{1}{4} = \frac{10}{3} \times \frac{12}{25} \times \frac{5}{4}$

Exercise 1.2

If you cancel out common factors, you will obtain _____ .

For division, the rule is:"invert and multiply"

e.g. $2\frac{2}{3} \div \frac{5}{6} = \frac{8}{3} \times \frac{6}{5} = \frac{16}{5} = 3\frac{1}{5}$.

Exercise 1.3

Now try these:

(a) $4\frac{3}{4} \times \frac{4}{7}$ The answer is _____

(b) $15\frac{1}{2} \div 2\frac{1}{4}$ The answer is _____

E. BODMAS.

For problems involving mixed operations, the concept of BODMAS comes in very useful. It tells you which operation to perform first.

Recall that it means Bracket comes before Of, Division comes before Multiplication which comes before Addition and Addition comes before Subtraction.

e.g.

$$2\frac{2}{3} + \frac{5}{6} - \frac{4}{15} \text{ of } \frac{5}{8} + \left(1\frac{5}{12} + 2\frac{1}{3}\right) + 1\frac{1}{4}.$$

Exercise 1.4

$$\left(1\frac{5}{12} + 2\frac{1}{3}\right) = \_\_\_?$$

$$\therefore 4\frac{1}{6} + 2\frac{1}{3} + 1\frac{1}{4} = 3.$$

Exercise 1.5

$$\frac{4}{15} \text{ of } \frac{5}{8} = \frac{4}{15} \times \frac{5}{8} = \_\_\_?$$

$\therefore$ the expression becomes

$$2\frac{2}{3} + \frac{5}{6} - \_\_\_\_? + \_\_\_\_?$$

If you simplify correctly you will obtain final solution of

$$6\frac{1}{3}.$$

e.g. $$\left(\frac{4\frac{2}{3} - 2\frac{5}{6}}{6\frac{3}{4} - 5\frac{5}{6}}\right) \div \frac{\left(3\frac{1}{2} - 2\frac{1}{3}\right)}{\left(1\frac{2}{3} + 2\frac{1}{3}\right)}$$

Exercise 1.6

$$4\frac{2}{3} - 2\frac{5}{6} = \_\_\_?$$

Exercise 1.7(i)

$$6\frac{3}{4} - 5\frac{5}{6} = \_\_\_?$$

$$\therefore \frac{4\frac{2}{3} - 2\frac{5}{6}}{6\frac{3}{4} - 5\frac{5}{6}} = 2.$$

Exercise 1.7(ii)

Also $3\frac{1}{2} - 2\frac{1}{3} = \_\_\_\_\_?$

Exercise 1.8

$$1\frac{2}{3} + 2\frac{1}{3} = \_\_\_?$$

$$\therefore \frac{3\frac{1}{2} - 2\frac{1}{3}}{1\frac{2}{3} + 2\frac{1}{3}} = \frac{7}{24}.$$

The expression thus becomes $2 \div \frac{7}{24} = 6\frac{6}{7}$ Ans.

E. **PRACTICAL PROBLEMS INVOLVING FRACTIONS.**

e.g. A bath can be filled by three cold water tap in 15 minutes and by the hot water tap in 21 minutes. How long would it take to fill the bath if both taps were turned on together.

Solution

Fraction of bath filled in 1 min by 1st tap = $\frac{1}{15}$

Fraction of bath filled in 1 min by 2nd tap = $\frac{1}{21}$

$$\text{Total} = \frac{1}{15} + \frac{1}{21} = \frac{12}{105}$$

$\therefore$ Total time taken by the two taps if both were turned on together = $1 \div \frac{12}{105}$

$8\frac{3}{4}$.

Now try this:

Exercise 1.9

A bath can be filled by the hot-water pipe in 12 minutes and by the cold water pipes in 15 minutes.

1. How long will it take to fill the bath when both taps are turned on? Ans = $6\frac{2}{3}$ minutes.

2. If the waste pipe can empty the bath in $7\frac{1}{2}$ minutes, how long will it take to fill the bath when both taps are turned on and the waste plug is drawn? Ans = 1 hr.

e.g. A man shared ₦240,000 such that $\frac{1}{4}$ went to his wife, $\frac{2}{3}$ to his sons and the remainder was divided equally between his two daughters. How much did each daughter receive?

Solution

Total fraction for wife and son = $\frac{1}{4} + \frac{2}{3} = \frac{11}{12}$

$\therefore$ Daughter received $1 - \frac{11}{12}$

Exercise 1.10

$= \frac{\quad}{\quad}$

$\therefore$ Each daughter received $\frac{1}{2}$ of the fraction both daughter

$= \frac{1}{24}$

$\therefore$ Amount received by each daughter $= \frac{240,000}{24}$

$= ₦10,000.$

F. **REVISION EXERCISES**

1. Simplify the following:

a. $3\frac{1}{2} + 5\frac{2}{3} + 7\frac{5}{6}$.

b. $4\frac{1}{4} - 2\frac{3}{5}$.

c. $7\frac{1}{3} \times 1\frac{1}{11}$.

d. $1\frac{2}{3} \div \frac{7}{9}$

e. $4\frac{3}{4} + 1\frac{3}{5} \div \frac{12}{25} - \frac{2}{3}$ of $\frac{9}{8}$.

2. If takes a man 6 hours to finish a job and another man 4 hours to finish the job, how low will it take the two man to finish the job if they work together?

3. A man spent $\frac{1}{2}$ of his money and then gave away $\frac{1}{3}$ of the rest. If he had ₦3,600 left, how much had he at first?

4. Three men agreed to pay a bill. The first man paid $\frac{2}{5}$ of it, the second paid $\frac{1}{4}$ of it plus an extra ₦2 while the third paid $\frac{1}{3}$ of it plus an extra ₦3. How much did the first man pay?

5. In an election, there are two candidates and $\frac{4}{25}$ of the people who could have voted did not do so. Of the remainder, $\frac{4}{7}$ voted for the winning candidate who had a majority of 3,696. How many voters were there?

Answers:

1. A. 17 B. $1\frac{13}{20}$ C. 8 D. $.2\frac{1}{7}$ E. $7\frac{1}{3}$

2. $2\frac{2}{5}$ hrs

3. ₦10,800.

4. ₦120.

5. 7,700 voters.

UNIT 2. DECIMALS

A. OBJECTIVES

Students will be able to:

1. Find the place value of any digit in a given number containing decimals.
2. Express a number correct to a specified number of decimal places.
3. Use the balancing rule to evaluate problems involving combination of division and multiplication of decimals.
4. Covert fractions to decimals and vice verse.
5. Solve worded problems involving decimals.

A. PLACE VALUE

To find the place value of a given number containing decimals, recall that each place value increases ten fold as one goes from right to left and decreases by one-tenth from left to right.

	Hundreds	Tens	Units	Tenth	hundredth	thousandth
e.g. 378.429 =	3	7	8	4	2	9

Thus digit 3 actually represent 300.

7 represents 7 tens i.e 70
8 represents 8 units.
4 is four tenth $\left(\frac{4}{10}\right)$
2 is 2 hundredth $\left(\frac{2}{100}\right)$
9 is 9 Thousandth $\left(\frac{9}{1000}\right)$.

e.g. 9451.63.

9 represents 9 thousands

5 represents 5 tens

3 represents 3 hundredths etc.

Exercise 2.1

Find the place value of the number in bracket for each of the

following:

a. 14.058 (5).

b. 127.563 (3).

c. 968.43 (6)

d. 7925.814 (7,1)

B. **Addition and Subtraction of decimals**

This can be easily done with your calculator. If no

calculator is available, the key point to note is correct placement of decimals of the numbers concerned. All decimals must tally!

e.g. 0.92 + 450.007 + 0.0056.

To do this, arrange the numbers in such a way that the position of the decimals with tally.

So above becomes

$$\begin{array}{r} 0.92 \\ +\ 450.007 \\ .0056 \\ \hline 450.9326 \end{array}$$

e.g. Subtract 3.092 from 51.78.

Arrange as follows:

$$\begin{array}{r} 51.780 \\ 3.092 \\ \hline 48.688 \end{array}$$

Now, do the following:

Exercise 2.2

$$0.1305 + 121.0027 + 42.1002 + 0.005.$$

Exercise 2.3

$$9781.0403 - 103.00049.$$

C. **Multiplication and Division**

For multiplication, treat the number as whole then, do long multiplication and then round off to the total number of decimal places. e.g. 53.47 × 0.042.

Use long multiplication to obtain product of 5347 and 42.

Counting from left to right, the total number of decimal places for rounding up is 5.

So,

$$\begin{array}{r} 5\ 3\ 4\ 7 \\ \times \quad 4\ 2 \\ \hline 1\ 0\ 6\ \ 9\ 4 \quad \text{i.e. } 5347 \times 2 \\ 2\ 1\ 3\ 8\ \ 8 \quad \text{i.e. } 5347 \times 4 \\ \hline 2\ 2\ 4\ 5\ \ 7\ 4 \end{array}$$

Ans = 2.24574.

Now try this: Check result with the calculator.

Exercise 2.4

0.00413 × 461.2.

For division, the divisor is changed to a whole number by moving the decimal point to the right, with the divisor being used at the reference point.

e.g. 0.46 ÷ 0.00023.

The divisor, which is 0.00023 needs to be moved 5 points.

Thus 0.46 will have its decimal moved five places. The problem thus transforms to 6000 ÷ 23.

$$\begin{array}{r} 2000 \\ 23\,\overline{)\,46000} \\ \underline{46000} \\ \hphantom{00}0 \end{array}$$

e.g. 0.252 ÷ 3.15 = 25.2 ÷ 315

The long division yields 0.08.

Now do this:

Exercise 2.5

78.678 ÷ 0.00348.

For combination of product and division the "balancing rule" is used. This rule deals will balancing up the decimal places of the given quantities.

$$\text{e.g } \frac{0.168 \times 5.04}{6.3 \times 1.344}$$

The total number of decimal places in the numerator = 5 while that of the denominator = 4. One needs to balance up as follows:

$$\frac{0.168 \times 5.04}{6.30 \times 1.344}.$$

Addition of 0 to either 6.3 or 1.344 balances up the decimal places.

Thus the expression becomes

$$\frac{168 \times 504}{630 \times 1344}$$

which can be easily cancelled to obtain $\frac{1}{10}$ or 0.1

e.g. $\frac{1.21 \times 1.44}{0.022 \times 0.528} = \frac{1.2100 \times 1.44}{0.022 \times 0.528}$.

This has balanced up the decimal places in the numerator and denominator. We now remove the decimals to get

$$\frac{12100 \times 144}{22 \times 528}$$

which can be easily cancelled to obtain 150.
Now do this:

Exercise 2.6

$\frac{0.156 \times 3.36}{8.4 \times 0.0468}$ Ans = $1\frac{1}{3}$ or 1.333

Exercise 2.7

$\frac{0.169 \times 3.43}{0.091 \times 0.637}$ Ans = 10.

D. **Expressing a number to a given number of decimal places:**

When expressing a quantity to x number of decimal places, examine the $(x + 1)^{th}$ digit. If it is more than, 5 add 1 to the xth digit.

e.g. Express 2.7893 to two decimal places. The third digit after decimal is 9 and is more than 5. So add 1 to 8 and obtain 2.79 as answer.

e.g. Express 0.000612 to 5 decimal places. The 6th digit after decimal is 2 and this is less than 5. So the solution is 0.00061.

Now do this:

Exercise 2.8

(a) 561.087 to 2 decimal places.

(b) 9.00305 to 3 decimal places.

E. **Fractions to decimals and vice-versa.**

A fraction can easily be changed to decimal by dividing the numerator by the denominator using long division.

e.g. $\frac{3}{4}$ = 0.75

4 | 30
28
20
20
--

= 0.75

To convert decimals to fraction count the number of decimal places and then covert to fractions by multiplying up and down by the powers of 10 of the number of decimal places.

e.g. Convert 0.025 to fractions. There are 3 decimal

places. So multiply up and down by 10^3

$$\therefore 0.025 = \frac{0.025 \times 1000}{1000}$$

$$= \frac{25}{1000}$$

$$= \frac{1}{40}.$$

$$\text{e.g. } 0.00125 = \frac{0.00125 \times 100000}{100000}$$

$$= \frac{125}{100000}$$

$$= \frac{1}{800}$$

F. **Worded problems involving decimals.**

e.g. A pole is 6.8 metres long. What length will be left after cutting off 8 pieces each 0.58 metres long.

Solution

Total number of length cut off = 8×0.58

$= 4.64.$

$\therefore$ Length left = $6.8 - 4.64 =$ 2.16 m .

Exercise 2.9

What is the greatest number of books 3.5 cm thick can be placed on a shelf 5 metres long. (Hint: Convert metres to centimetres and divide. The whole number obtained is the solution.

Exercise 2.10

(a) Convert 0.00562 to fraction

(b) Convert $\frac{13}{15}$ to decimals.

Revision Exercises

1a. Express 62 ÷ 3 to 3 decimal places

b. Express 0.000842 in standard form.

2a. 1.1816 + 0.00978 + 120.12

b. 81.125 - 79.0064

3. Simplify $\frac{2.31 \times 1.28 \times 0.275}{0.77 \times 0.55 \times 1.6}$ and express your answer as a vulgar fraction.

4. A tank full of spirit lost 0.025 of its content by evaporation. 9 gallons were then drawn off leaving the tank $\frac{3}{4}$ full. How many gallons does the tank hold?

5. Poles at the side of the road are 3.75 m apart and extend for $\frac{3}{4}$ of a kilometre. How many poles are there?

Answers: 1a. 20.667 1b. 8.42×10^{-4}

2a. 121.31138 2b. 2.1186

3. $1\frac{2}{5}$. 4. 40 gallons

5. 201 poles.

UNIT 3 PERCENTAGES

A. **Objectives:**

Students will be able to

1. Know the various ways percentages are used in business.
2. Convert fractions to percentages and vice versa.
3. Convert decimals to percentages and vice versa.
4. Find the value of a percentage of a quantity.

B. **Introduction**

As a student in Business Education you cannot avoid the use of percentages. The next few weeks will express you to some of the various ways in which it is used in business, among which are:

1. Commission paid to a salesman, (which is usually a percentage of good sold).
2. Interest paid by borrower to lender. This is usually a specified percentage for a specified period.
3. Discount, a decrease in price, is also expressed as percentage of price.
4. Depreciation. This deals with reduction in value of an asset and is usually expressed as a percentage of its original value.
5. Population changes are expressed as percentage increase or decrease in population.
6. In insurance, the premium paid to insure against a loss is usually expressed as a percentage of amount insured.

7. Dividend paid to share holder are also expressed as percentage of capital. Thus, percentage is very useful to you as a business students.

C. **Changing fractions to percentages and vice-versa.**
To change a fraction to percentage, one needs to just multiply by 100.

$$\text{e.g. } \frac{3}{4} = \frac{3}{4} \times 100\% = 75\%.$$

Exercise 3.1

Convert $\frac{3}{5}$ to percentage.

To change percentage to fraction, you need to realise that percentage involves the use of a common denominator of 100.
So just divide by 100 and cancel out common factors.

$$\text{e.g. } 55\% = \frac{55}{100} = \frac{11}{20}.$$

Exercise 3.2

Change the following percentages to fractions:

(a) $37\frac{1}{2}\%$ (b) 72% (c) 64%.

D. **Changing decimals to percentages and vice versa.**

To convert a decimal to percentage, one needs to multiply by 100.

$$\text{e.g. } 0.35 = (0.35 \times 100)\%$$

$$= 35\%.$$

$$\text{e.g. } 0.0465 = 0.0465 \times 100$$

$$= 4.65\%.$$

Exercise 3.3

Convert 0.00025 and 0.19 to percentages.

To convert a percentage to decimal you need to divide the given percentage by 100 and obtain your answer in decimals.

$$\text{e.g. } 97\tfrac{1}{2}\% = \frac{97\frac{1}{2}}{100} = \frac{975}{100} = 0.975.$$

Exercise 3.4

Convert the following percentages to decimals.

(a) $2\frac{3}{4}\%$ (b) 45% (c) $48\frac{1}{2}\%$.

E. **To find the percentage of a given quantity**

In order to do this, you will first express the percentage as a fraction and then multiply by the given quantity.

e.g. find 40% of ₦72,000.

This becomes $\frac{40}{100} \times \frac{72000}{1} = ₦28,800.$

e.g. The population of a town was formerly 576, 307 but it showed an increase of 47.65 per 1,000 in the recent census. Find the population at the recent census.

Solution

Increase = 47.65 per 1,000

= 4.765 per 100.

∴ percentage of new population = 104.765%.

$$\text{New rate} = \frac{104.765}{100} \times 57630$$

$$= 603768 \text{ to the nearest whole number.}$$

Now do the following:

Exercise 3.5

In the last census the population of a town was 386,475. This was an increase of 17,453 over the figure for the previous census. Find the increase per 1,000.

If you do it carefully you will obtain 47 per 1,000.

Exercise 3.6

In a school of three departments there were $47\frac{1}{2}\%$ infants,

42 girls and 147 boys.

(a) what percentage of the students was non infants?
(b) How many infants were there.

Did you get 171 infants?

e.g. An oil exporter exported oil this year of the same value as last year but the amount exported was $17\frac{1}{2}\%$ less. By how much per cent was the price per barrel increased?

Solution

$$\text{Increase} = \frac{17\frac{1}{2}}{82\frac{1}{2}}$$

$$= \frac{17\frac{1}{2}}{87\frac{1}{2}} \times 100\%$$

$$= 21.2\%$$

Exercise 3.7

If the amount of oil exported in the last example was $6\frac{3}{4}\%$, by how much was the price per barrel increased?
Ans 7.2%.

The following figures are given by a company:

	1992	1993
Gross receipts	6,758,500	9,860,000
working expenses	5,479,000	6,254,500

Find the percentage increase in the net receipts in 1993.

Solution

Net receipts

Exercise 3.8

1992 = ₦6758500 - ₦5479000 = _____

Exercise 3.9

1993 = ₦9,860,000 - 6,254,500 = _____

∴ Increase = net receipt in 1993 - net receipt in 1992

= ₦2326000

Exercise 3.10

$$\therefore \text{Percentage increase} = \frac{2326000}{?} \times 100\%$$

$$= 181.79\%.$$

F. Revision Exercises

1. Convert to percentages

   (a) $\frac{15}{62}$ (b) 0.0725.

2. Express the following as fractions in its simplest forms:

   (a) $67\frac{1}{2}\%$. (b) $33\frac{3}{4}\%$.

3. In a consignment of tomatoes, 14% are spoilt in transit. If a total of 2322 is left, how many are there in the original consignment?

4. A man bought a crate of 30 eggs at ₦4.50 per egg from a trader. He then paid the trader gave him a change of ₦25. Find the percentage error in the correct change to be given by the trader.

5. The following figures are given by a company.

	1991	1992
Gross receipts	5400000	4800000
working expenses	3828600	3201600

Find (a) the net receipts for 1991 and 1992.
(b) The percentage increase in the net receipts in 1992.

Answers

1a. 24.2% 1b. 7.25%

2a. $\frac{27}{40}$ 2b. $\frac{27}{80}$

3. 2700 4. 66.7%

5a. ₦1571400 and 1598400 5b. 1.7%.

UNIT 4 DISCOUNT - PROFIT - LOSS.

A. **OBJECTIVES**

Students are expected to

1. Know how to find the cash price of an article for which discount is allowed.

2. Calculate profit or loss or cost price or selling price under given conditions.

DISCOUNT

A deduction from a given price is known as discount given for an article. If the customer wishes to pay cash, a cash discount may be given by a trading company. It is the normal practice to express discount as a percentage.

e.g. 1. An article priced at ₦7,000 is subject to a discount of 10% for cash. Find the cash price.

Solution

Discount = 10% of ₦7,000

= ₦700.

∴ Cash price = ₦7000 - 700

= ₦6,300.

e.g. 2. A man paid ₦600,000 for a generator after 10% discount has been deducted from the list price. What was the list price?

Solution

Let the list price be 100%.
∴ Price paid by the man in percentage = (100 - 10)%
= 90%

∴ 90% → 600,000

Exercise 4.1

$100\% \rightarrow \frac{600,000}{90} \times 100 =$ ₦ _____

If a company allows both trade and cash discount, the trade discount is first deducted before deducting the cash discount.

e.g. A wholesaler allows a retailer 25% trade discount and 5% discount for cash. Find the cash price of an article which is priced in the wholesaler's catalogue at ₦480,000.

Solution

The layout is as follows:

	₦
Catalogue	480,000.
Less 25% trade discount	?
	360,000
Less 5% cash discount	18,000
	? Ans.

Exercise 4.2

Exercise 4.3

∴ Cash Price ____?____ Ans.

Now do this on your own:

Exercise 4.4

An article priced at ₦47,750 is subject to a cash of 5%.

Find the cash price.
Did you get ₦45,362.50?

e.g. A fridge is listed in a wholesaler's catalogue as 21,000 subject to a trade discount of $33\frac{1}{3}\%$ and a cash discount of $2\frac{1}{2}\%$. Find the cash price.

	₦
Catalogue	21,000
Example 4.4 Less $33\frac{1}{3}\%$ trade discount	?
Example 4.5 Balance	?
Example 4.6 Less $2\frac{1}{2}\%$ Cash	?

$\therefore$ Cash price = ₦13650 .

C. **PROFIT AND LOSS.**

In business enterprise one can make a profit or a loss. If the cost price is less than the selling price a profit is made, otherwise a loss will be incurred. Profit or loss per cent is usually calculated with respect to the cost price except if otherwise stated.

$$\text{Profit (loss) percent} = \frac{\text{Profit (loss)}}{\text{Cost Price}} \times \frac{100}{1}\%.$$

e.g. The cost price of an article is ₦7,000 and the selling price is ₦8400. Find the profit percent.

The profit = 8400 - 7000

= 1400

$$\therefore \text{Profit } \% = \frac{1400}{7000} \times 100 = 20\%.$$

Exercise 4.7

Find the loss per cent if an article bought for ₦7,500 was sold at ₦6,000.

To find the cost price or selling price it is essential that the cost price is denoted by 100% while the percentage of the selling price is found from the given information.

e.g. An article costing ₦160,000 was sold at a loss of 5%.

Find the selling price.

Solution

Let the price be 100%.

$$SP = (100 - 5)\%$$

$$= 95\%$$

$$\text{So, } S.P = \frac{160,000}{100} \times 95$$

$$= ₦152,000.$$

e.g. By selling an article for ₦75,000, a trade made a gain of 15%. Find the cost price.

Solution

Let C.P = 100%

$$S = 100 + 15$$

$$= 115\%.$$

$$115\% \rightarrow 75,000$$

$$\therefore 100\% \rightarrow \frac{75,000}{115} \times \frac{100}{1} = 65,217.39.$$

Now do the following:

Exercise 4.8

Find the cost price of an item sold for ₦35,000 at a profit of $2\frac{1}{2}\%$. (Ans. = ₦34,146.34)

Exercise 4.9

If the cost price of an article is ₦15,000 and the loss made on it is 8% find the selling price (₦13,800). We now go on to more interesting examples.

e.g. In selling an article to a wholesaler the manufacturer makes a profit of $7\frac{1}{2}\%$ on the actual cost price. The wholesaler sells it to a retailer at a profit of 15% on the wholesale selling price. The retailer sells it to the customer at ₦1250 and makes a profit of 10% on the retail selling price. What was the cost of the article to the manufacturer?

Solution

	₦
Customer pays	1250
Retailer's profit (10%)	125
Retailer pays	1125
Wholesaler' profit (15%)	168.75
Wholesaler pays	956.25.

$$\therefore \text{Manufacturers cost price} = \frac{956.25}{107.5} \times \frac{100}{1}$$

$$= ₦889.53$$

Exercise 4.10

A man bought a bicycle for ₦2,100. The dealer made a profit of 20% on the marked price and the manufacturer makes a profit of $33\frac{1}{3}$ on gross receipts. What was the manufacturing cost of the bicycle?

(Ans: note that dealer pays ₦1680

while manufacturer's gross profit = ₦560

and so manufacturing cost is ₦1,120).

Revision Exercises

1. A man bought a shirt at ₦150 and sold it for ₦120. Find the loss per cent.

2. By selling an article at ₦720 a trader made a profit of 8%. Find the cost price.

3. An article listed in a wholesaler's catalogue at ₦4,800 is subject to a trade discount of 25% and a cash discount of 5%. Find the cash price.

4. A makes an article for ₦200 and sells it to B at a profit of 20%. B sells it to C at a profit of 25% and C sells it to D at a profit of $33\frac{1}{3}$%. How much did D pay for the article?

5. On 50% of the turn over of a firm, there is a profit of 25%, on 35% there is a profit of 10% and on the remaining 15% there is a loss of 5%. Find the rate of profit on the whole turnover.

Answers:

1. 20% 2. ₦666.67 3. ₦3420 4. ₦400

5. $15\frac{1}{4}$%.

UNIT 5 SIMPLE INTEREST

A. OBJECTIVES

Students will be able to know the concept of Simple Interest and also various calculation involving the parameters on Simple Interest.

B. INTRODUCTION

People obtaining loans from individuals, banks or finance houses are made to pay interest of one form or the other.

Similarly, the banks pay a specified interest to depositors. Interest has been defined as a charge for the use of money. There are 2 popular types of interest in business transactions. They are:

1. Simple interest in which the principal is fixed.
2. Compound interest in which the interest is added to the principal at the end of given periods and simple interest is calculated on the sum of the principal and interest of the previous year.
   This unit deals with simple interest while Unit 6 will focus on Compound Interest.

C. SIMPLE INTEREST

You may recall that Simple Interest is calculated using the formula $S.I = \frac{P \times R \times T}{100}$ where P is the principal, R is the rate and is usually expressed in percentage and T is the time in years.

e.g. 1 Find the Simple Interest on ₦500,000 for $3\frac{1}{2}$ years at $1\frac{1}{4}\%$ per cent per annum.

Solution

Principal = 500,000.

Time = $3\frac{1}{2}$ years Rate = $1\frac{1}{4}$%.

So, using the formula we obtain

$$\frac{500{,}000 \times 3\frac{1}{2} \times 1\frac{1}{7}}{100}$$

$$= ₦21{,}875.0$$

Note that if the time is in days or months you will need to convert to years.

e.g. Find the simple interest on ₦20,000 at $1\frac{1}{2}$% p.a for 8 months.

$$\text{Note that time} = \frac{8}{12} \text{ yr}$$

$$\therefore \text{S.I.} = \frac{20{,}000 \times 1\frac{1}{2} \times 8}{100 \times 12}$$

$$= ₦200.$$

Exercise 5.1

What is the simple interest on ₦25,000 at $6\frac{1}{2}$% per annum for 1 year 6 months?

(Ans. ₦2437.5).

When the principal is added to the simple interest we have the amount.

$$A = P + I.$$

Exercise 5.2

What is the amount of the problem in e.g. 1? Ans. 521,875.

Can you find the expressions for

(i) Principal (ii) Rate (iii) Time?

You should obtain: $P = \frac{I \times 100}{R \times T}$.

$$R = \frac{I \times 100}{P \times T}; \quad T = \frac{I \times 100}{P \times R}$$

Note that T is in years and can be converted to months by multiplying by 12 or to days by multiplying by 366.

e.g. In how many days will ₦43,800 amount to ₦44,556 at $4\frac{1}{2}\%$ per annum simple interest?

Exercise 5.3

What is the principal? _____

Exercise 5.4

What is the amount? _____

$\therefore$ Interest = Amount - Principal

= ₦756

$$\therefore T = \frac{750 \times 100}{43800 \times 4\frac{1}{2}} \times 365 \text{ days}$$

Exercise 5.5

= _____ days.

e.g. Find the principal which earns ₦750,750 in 11 years at 7% simple interest.

Exercise 5.6

What is the interest? _____

$$\therefore P = \frac{I \times 100}{P \times T} = ₦975,000$$

e.g. Find the rate per cent annum at which ₦36,000 will earn ₦1,640 in 131 days.

$$\text{Rate} = \frac{I \times 100}{P \times T}$$

Exercise 5.7

Substitute in the values and get Rate = $12\frac{1}{2}\%$

e.g. A man borrows ₦146,000 on the March and on 21st May he repays it, with interest at 11%. How much does the pay altogether to clear the debts?

Exercise 5.8

Days in March = _____ ? _____

April = 30

May = 21

Exercise 5.9

Total = _____ ? _____

$$I = \frac{P \times R \times T}{100} = ₦3,300.$$

Exercise 5.10

So altogether he pays A = _____?_____

C. Revision Exercises

1. A sum of money was invested at 8% per annum simple interest. If after 4 years the money amounts to ₦26,400, find the amount originally invested.

2. A customer saved ₦375,000 with a bank and at the end of the year his money amounted to ₦390,000. Find the rate of interest.

3. Find the simple interest on ₦900 for 4 months at 8% per annum.

4. For how long must 1 leave ₦540 in a bank to earn an interest of ₦108, the rate being 12% per annum simple interest?

5. Find the total amount to be paid if ₦52,080 is borrowed on 19 April and repaid on 12 September, of the same year, with interest at 12% per annum.

Answers:

1. ₦20,000
2. 4%
3. ₦24
4. 1 yr 8 months
5. ₦54579.84

UNIT 6 COMPOUND INTEREST AND DEPRECIATION

A. OBJECTIVES

By the end of this unit student will know

1. The concept of compound interest and two method of computing it.

2. How to find the depreciating value of a given asset.

B. Compound Interest

The principal in compound interest is not fixed.

Instead, the interest is added to the principal at end of the stated period and future interest is then calculated on the aggregate of the principal and interest of the previous period. The banks use compound interest in computing interests for customers.

Exercise 6.1

In a given data, which is bigger, simple interest or compound interest?

Answer: _____

e.g. Find the compound interest on ₦400 for 3 years at 10% p.a.

There are two methods of doing this.

Method 1

1st year : Interest in ₦400 at 10% = $\frac{400 \times 10 \times 1}{100}$

= ₦40.

Now add this to the principal and obtain a new principal of ₦440.

2nd year: Interest on ₦440 at 10% p.a. = $\frac{440 \times 10 \times 1}{100}$

= ₦44.

New principal at end of 2nd year = 440 + 44

= ₦484.

Interest at end of 3rd year = $\frac{484 \times 1 \times 10}{100}$

= ₦48.40.

Total interest = ₦(40 + 44 + 48.40)

∴ Compound interest = ₦132.40

Method 2

Formula method. This is a faster method and it involves finding the new amount as follows:

$$\text{Amount} = P\left(1 + \frac{R}{100}\right)^T$$

where P = principal, R = Rate and T is time in years. Thus

compound interest = Amount - Principal.

Thus in the last example,

$$\text{Amount} = 400\left(1 + \frac{10}{100}\right)^3$$

Exercise 6.2

Amount = _____?

Exercise 6.3

Compound Interest = Amount - ₦400 = _____ ?

e.g. Find the compound interest on ₦24,000 for 3 years at 5% per annum, if interest is added half yearly.

Solution

There are 6 - half-yearly periods in 3 years

1st half-year Interest = $\frac{24000 \times 5 \times 1}{100 \times 2}$ = ₦600.

Amount at end of 1st period = 24,600.

Exercise 6.4

2nd half year, interest = _____

Amount at end = ₦25215.

Exercise 6.5

3rd half year, interest = _____

Amount = ₦25845.4.

Exercise 6.6

4th half year interest = ₦646.1

Amount = ₦26491.50

5th half year, interest = ₦662.3

Amount = ₦27153.8

3rd year interest = ₦67.88

Amount = ₦27832.60

$\therefore$ Compound Interest = ₦27832.60 - ₦24,000

= ₦3832.60

To use formula method, note that there are six-$\frac{1}{2}$ years in 3 years, your T = 6.

Also since rate is half yearly, your rate = $\frac{5}{2} = 2\frac{1}{2}\%$.

$$\therefore A = 24000\left(1 + \frac{2\frac{1}{2}}{100}\right)^{6} = ₦27832.6$$

$\therefore$ Compound Interest = 27,832.6 - 24,000 = ₦3832.6.

C. **Depreciation**

Assets or possession decrease in values for various reasons and the decrease in value of called depreciation.

It is usually calculated as a percentage decrease on the cost of asset.

The book value is the value of the depreciated asset at the end of the specified period.

e.g. Assuming that at the end of a year a machine is worth 10% less than at the beginning of that year, find the value after three years use of a machinery bought for ₦20,000.

Solution

	₦
Value	20,000
1st year depreciation	2,000

18,000

2nd year 1,800

16,200

3rd depreciation = 1620

∴value at end of third year = ₦(16200 - 1620)

= 14,580

e.g. A machine costs ₦72,500. It is decided to write off 8% for depreciation at the end of each year. What will be its value at the end of 4 years?

Solution

Depreciation first year = 8% × 72500 = ₦5800

Value at end of 1st year = 72500 - ₦5800 = 66700.

Exercise 6.7

2nd year depreciation = ?

∴ Value at end of 2nd year = 61,364

Exercise 6.8

Depreciation at 3rd year = ?

∴ Value at end of 3rd year = ₦56454.88

Exercise 6.9

Depreciation at end of 4th year = ?

∴ Value at end of 4th

year = ?

If you do this correctly you will obtain ₦51,938.49 as

the book value.

D. **Revision Questions**

1. What sum will amount to ₦3993 in 3 years at 10% per annum compound interest?

2. What is the difference between the simple and compound interest on ₦240 for three years at 5% annum?

3. A man borrows ₦2,000 at 4% compound interest per annum at yearly instalmental repayment of ₦500.00. How much is he still owing at the end of the second year?

4. A capital of ₦15,000 is deposited at a finance institution with an agreement to pay 5% interest rate on the money per annum, calculate the total amount payable to the owner at the end of the 5th year.

5. Calculate the book value of a machine after two years whose after two years price is ₦85,000 and which depreciates by 5% by the end of the year.

Answers:

1. ₦3,000 2. ₦1.83 3. ₦1143.20

4. ₦19,144.22 5. ₦76712.5

UNIT 7 RATIO AND PROPORTION

A. OBJECTIVES

Students will be able to

1. Know the concept of ratio and its application in business.
2. Know the concept of proportion and its application in business.
3. Know how to calculate problems on ratio and proportion.

B. Ratio

When two quantities of the same magnitude are compared, then the relationship which one quantity bears to the other is known as ratio. It can be expressed as fractions.

e.g. If Mr A earns ₦3,600 monthly and Mr B earns ₦5,400 monthly. Then the ratio of A's salary to B's salary is 3600:5400 which when simplifies gives 2:3.

e.g. If 1 man in 15 and 1 woman in 9 failed to pass their driving test, how many of each were tested if 168 men and 104 women passed?

For the men, 1 in 15 failed

$$\therefore \text{ 14 in 15 passed}$$

$$\text{So } \frac{14}{15} \rightarrow 168$$

$$\therefore \text{Total men} = 168 \times \frac{15}{14} = 180 \text{ men.}$$

Similarly for the women, 1 in 9 failed

Exercise 7.1

$\therefore$ _____ in 9 passed

$$\therefore \text{No of women} = 104 \times \frac{9}{8}$$

Exercise 7.2

= _____ women.

e.g. If A:B = 3:5, and B:C = 4:7, find A:B:C.

Solution

Look at the values allocated to B i.e. 5 and 4. Find the LCM which is 20.

$\therefore$ A:B = 12:20 and B:C = 20:35

$\therefore$ A:B:C = 12:20:35.

Now do the following:

Exercise 7.3

If A:B = 5:9 and B:C = 12:13, find A:B:C. (Ans. 20:36:39)

Exercise 7.4

Find the smallest share if 45,000 is to be divided in the ratio 3:5:7. (Ans. ₦9,000)

e.g. A trader allows on the list price of his goods a trade discount of 20% and a cash discount of 5%. What is the ratio of the cash price to the list price?

Solution

Let list price be 100

Trade discount = $\frac{20}{80}$

Cash discount = $\frac{4}{76}$

Cash price =

∴ Ratio is 76:100.

C. **Proportion**

Proportion deals with the equality of ratio

e.g. $\frac{2}{3} = \frac{4}{6}$

and also 2:3 = 4:6

Problems in this section are usually worked by the fractional methods, bearing in mind that ratio can only exist between quantities of the same magnitude.

There are two types of proportion:

1. direct proportion in which the price will be directly proportional to the quantity.

   e.g. If 2 oranges cost 10 k one expects 5 to cost 25k.

2. The second is the inverse proportion in which the change in the ratio of the first quantity is followed by a change in the inverse ratio of the second quantity.

   e.g. If 4 men can do a piece of work in 10 minutes,

20 men will take less time i.e. $\frac{4 \times 10}{20}$ = 2 minutes.

(Note Ratio of men is $\frac{20}{4}$).

e.g. If 3 men take 15 hours to do a piece of work how long will 5 men take?

Exercise 7.5

Ratio of men in fraction is _____

$\therefore$ time take = 15 ÷ ratio = 15 × $\frac{3}{5}$ = 9 hours.

Sometimes a problem may be a mixture of both direct and in direct proportion.

e.g. If x is directly proportional to the square of y and inversely as z and x = 36, when y = 3 and z = 4, find x when y = 5 and z = 2.

Solution

The equation is $x = \frac{ky^2}{z}$

$$\therefore k = \frac{xz}{y^2}.$$

7.6 Substituting the values k = _____?

$$\therefore x = \frac{ky^2}{z}.$$

7.7 Substitute for k, y × z and obtain x = _____?

e.g. If 3:5 = 12:P find P

Solution

$$\frac{3}{5} = \frac{12}{p}$$

$$\therefore 3p = 12 \times 5$$

Exercise 7.8

P = _____?

e.g. Divide ₦ 50 into two parts so that one is two-thirds of the other

Solution

The proportion is $\frac{2}{3}$ i.e. 2:3

Exercise 7.9

One part will be $\frac{2}{5} \times 50$ = _____

Exercise 7.10

The other will be $\frac{3}{5} \times 50$ = _____

Revision Exercises

1. Divide ₦14,000 among A, B and C so that A has twice as much as B and B has twice as much as C.

2. The ratio of men to women in a committee of 33 people is 7:4. How many women must be added so that the ratio will be 7:7?

3. If a:b = 5:8 and x:y = 25:16 find $\frac{a}{x} : \frac{b}{y}$.

4. If x:y = 5:8 and y:z = 3:2 find x:y:z.

5. Find the ratio between the selling price which will give a profit of 20% on the cost price and the selling prices which will give a profit of the 20% on the selling price. The cost price is the same in both cases.

Answers:

1.₦8000, ₦4000, ₦2000 2. 9 3. 2:5

4. 15:24:16 5. 24:25.

UNIT 8 PARTNERSHIPS

A. **OBJECTIVES**

Students will

1. Know the meaning of partnership in business.
2. identity the various ways of sharing profits in partnership.
3. acquire the ability of solving mathematical problems on partnership.

B. **Introduction.**

Whenever two or more people own a business jointly with the purpose of making profits, then they are said to from a partnership. Thus, partnership has been described as "the relation which subsists between persons carrying on a business in common with a view to profit". The profits made in the business are shared periodically according to the agreement made at the time the partnership is formed and a document (deed of partnership) usually gives the conditions governing the sharing of profits or losses. Partners usually specify the agreed proportion for profit sharing and the capital and human input is usually considered in doing this. If partners do not make agreement legally, then the profits must be shared equally. We are more concerned with the mathematics involved in profit sharing in this course.

C. **Solved problems on partnership.**

e.g. A net profit of ₦35,000 is to be shared equally between A and D. What is each person's share?

Solution

All you need to do is to divide 35,000 by 2.

Exercise 8.1

This gives _____

e.g. 2 A profit of ₦32,000 is to be shared between A, B and C in the ratio of their investments. The investments are ₦100,000; ₦200,000 and ₦500,000 respectively. How much will each receive.

Solution

The ratio of their investment is 100,000:200,000:500,000.

When reduced to lowest term the ratio is

Exercise 8.2 _____

∴ **Exercise 8.3**

A's share = $\frac{1}{8} \times 32000$ = _____

Exercise 8.4

B's share = $\frac{2}{8} \times 32000$ = _____

C's share = _____

Please check the addition of the three shares. They should add up to ₦32,000.

e.g. A, B and C are in partnership. It was agreed that A should receive a quarter of the profit, B, $\frac{1}{3}$ and C the remainder. The profit amounted to ₦37,458. What was the share of each?

Solution

Total shared by A and B = $\frac{1}{4} + \frac{1}{3} = \frac{7}{12}$

Exercise 8.5

$\therefore$ Fraction shared by C = _____

$\therefore$ A's shared = $\frac{1}{4} \times 37458$

= ₦9364.5

B's share = $\frac{1}{3} \times 37458$

= ₦12486

Exercise 8.6

C's share = _____

e.g. Davidson, Lee and Daniel's partnership agreement calls for division of half the annual profit in the basis of their original investments and half on the basis of 40% for Davidson, 35% for Lee and 25% for Daniels. The original investments were:

Davidson - ₦24,000; Lee - ₦20,000 and Daniel - ₦12,000.

The net profit of the business is ₦46,200.

What is each person's share in the profit?

Solution

The arithmetic involved in this problem is quite simple!

It boils down to sharing $\frac{46,000}{2}$ (i.e. 23,100) in two ways:

(a) Ratio 40:35:25 i.e. 8:7:5 and

(b) 24000:20000:12,000 i.e. 6:5:3

₦23,100 share in ratio:

	Davidson	Lee	Daniels
	₦	₦	₦
a. 8:7:5	9240	8085	5775
b. 6:5:3	9900	8250	4950
	19140	16335	10725

Now try the following:

Exercise 8.7

Two partners A and B are in business together

A's capital is 40,000 and B's ₦30,000. The profits of the firm are 21,000. How much should each partner receive?

Exercise 8.8

A, B and C are in partnership.It was agreed that A should receive $\frac{1}{3}$ of the profit, B, $\frac{2}{5}$ and C the remainder. If the profits were 14,550. how much should each partner receive?

Exercise 8.9

A and B started business with a capital of ₦17,820. A contributed ₦9,720. and B the rest. If profit of ₦19,492 are shared in the ratio of their capital, how much will each receive?

Exercise 8.10

Share profits of ₦365,172 between two people in the ratio 5:9.

D. **Revision Exercises**

1. Three partners Ade, Abu and Obi are in business will capitals of ₦500,000 ₦400,000 and ₦200,000. The profits amounted to ₦279,576. How much will each person receive?
2. A construction company is owned by two partners P and Q and it is agreed that their profit will be divided in the ratio 3:4. At the end of the year, P received ₦4,000 less that Q. What is the total profit of the company for the year?
3. A, B and C are in partnership. It was agreed that A should receive $\frac{1}{6}$, B $\frac{1}{5}$ and C the remiander. If the profits were ₦290,100 how much should each partner receive?
4. The profits of a firm were ₦127,500. A provided 3 times as much as B and $\frac{2}{3}$ the amount of C's capital. How much should they each receive?
5. Two men Ayo and Akin form a business partnership Ayo provided ₦54,000 capital and Bayo ₦63,000

cappital. It was decided that profit made each year will be divided according to their capital at the begining of that year. In the first year, the total profit was ₦7,800. At the end of the year, Ayo withdraw ₦1600 of his share of the profits and then invested the remainder in the business while Akin invested the whole of his share. If the profit for the second year was ₦9 160.80, how much did each person get?

Answers

1. Ade - ₦127080; ₦101664 for Abu; Obi - ₦50832.
2. ₦2,800.
3. A receives ₦48,350. B receives ₦58,020 C receives ₦183730.
4. A receives ₦45,000 B recieves ₦15,000 C receives ₦67,5000.
5. Ayo ₦4164 Akin ₦4996.8.

UNIT 9 STOCKS AND SHARES

A. **OBJECTIVES**

1. Students will be able to know about stocks and shares and the difference bvetween them.
2. Know about ordinary and preference shares.
3. Solve simple problems on stocks and shares.

B. **Introduction**

A public company issues shares to which the public is invited to subscribe. This helps the company to acquire more capital to be incested in the business. The shares are issued in fixed units of say 50 kobo, ₦1 or ₦2 etc. At the end of the financial year the company then declares a dividend or profit to share holders which is taxable and is in the form of a percentage of the nominal value of the shares. A shareholder can only buy an exact number of shares e.g. 70 - ₦1 share whereas any amount of stock (e.g. ₦98.60 stock) can be purchased. The buying and selling of stock and shares is controlled by the Stock Exchange.

By owning a share in an incorporated company, it means the shareholder is prepared to prosper with the company in good times and also to suffer with it

financially in bad times.

There are many types of shares, but the most common are the ordinary and preference shares. A preference share is issued at a fixed percentage and the payment of the dividend of this type of share is the first to be paid. The dividend is cumulative, unless the shares are expressly issued as non cumulative. If the dividend is not paid when due it must be added to the next dividend. Thus any time profits in a company are shared, the preference share holders are fist satisfied before the ordinary holders are considered.

When stocks are bought or shared at the stock market, the broker receives a commission known as brokerage. When stocks are at sale for a higher than the nominal or face value they are said to be at a premium; when at a lower price they are said to be at a discount and when the market price is the same as the face value they are said to be at par. Speculators buy shares in anticipation of a rise in price when they then sell out the shares at a profit while investors buy stock or shares with the aim of receiving a steady income.

The following are some examples involving stocks and

shares.

C. **Exercises**

e.g. Bata Shoes Company $3\frac{1}{2}\%$ stock is quoted at $47\frac{1}{2}$. What will be the cost of ₦800 stock and what dividend is due on that stock?

Solution

Cost of stock = $\frac{800}{100} \times$ ₦47.50

Exercise 9.1

= ₦ _____

Exercise 9.2

Dividend = $\frac{800}{100} \times 3\frac{1}{2}$ = _____

Now do this:

Exercise 9.3

War loan stock is quoted at $37\frac{1}{2}$. What will be the cost of ₦400 stock and what dividend is due on that stock?

e.g. How much stock at ₦9 $2\frac{1}{2}$ can be bought for ₦555?

Solution

$$\text{Amount} = \frac{555}{92\frac{1}{2}} \times 100$$

= ₦600 nominal value.

Exercise 9.4

How much stock at $87\frac{1}{2}$ can be bought for ₦350?

e.g. How much stock at 110 can be bought with proceeds of the sale of ₦1045 stocks at 95?

Solution

Proceeds of ₦1045 stocks at 95

$$= 1045 \times \frac{95}{100} = ₦992.75.$$

$$\text{Amount of stock at 110} = \frac{992.75}{110} \times 100$$

Exercise 9.5

= ₦ _____

e.g. Standard motor 50 kobo shares are quoted at 75 kobo and a dividend of 15% is declared. How much does it cost me to buy 8000 shares and what dividend do I expect?

Solution

The cost = ₦$(8000 \times \frac{75}{100})$ = ₦6000.

The dividend = 15% of the nominal value

$$= \frac{15}{100} \times ₦4000$$

$$= ₦600.$$

Exercise 9.6

John Holt 50 kobo shares stand at 75 k and declare a dividend of 20%. What does it cost me to buy 8000 shares and what dividend do I expect?

e.g. Find the profit made by buying ₦1000 stock at $82\frac{1}{2}$ and selling at $87\frac{1}{2}$.

Solution

Profit per ₦100 = $87\frac{1}{2} - 82\frac{1}{2}$ = ₦5.

$\therefore$ Profit made = ₦5 $\times \frac{1000}{100}$ = ₦50.

Exercise 9.7

Find the profit made by buying ₦8000 of stock at $87\frac{1}{2}$ and selling at $88\frac{3}{4}$.

e.g. How much stock at 90 can be bought for ₦7290. If the brokerage is $1\frac{1}{4}$ per cent.

Solution

Consideration = $7290 \times \frac{100}{101\frac{1}{4}}$

Exercise 9.8

$= \underline{\qquad\qquad\qquad\qquad ?}$

Exercise 9.9

Stock = $\underline{\qquad\qquad\qquad\qquad} \times \frac{100}{90}$

₦8000 <u>nominal value</u>.

Exercise 9.10

How much stock at can I buy for ₦609. If the brokerage is $1\frac{1}{2}$ per cent?

(Ans. 800 nominal value).

D. **Revision Exercises**

1. PZ $15\frac{1}{2}$% preference shares of ₦1 norminal value are quoted at ₦0.72$\frac{1}{2}$. What will be the cost of 400 shares and what dividend is payable on them?

2. Find the profit made by buying ₦6000 stock at$97\frac{1}{2}$ and selling at $98\frac{3}{4}$.

3. A man sells ₦600 of stock at $82\frac{1}{4}$. The brokerage is$1\frac{1}{4}$ per cent. How much will be receive?

4. A man has ₦8500 invested in $5\frac{1}{2}$% Cumulative Preference Shares. Last year he received a dividend

of ₦320. How much should be receive this year?

5. I buy 6000 shares of norminal value 50 k at 65 k. If the dividend declared is 4% what is the income derived?

Answers

1. ₦290; ₦62. 2. ₦750 3. ₦487.33 4. ₦615
5. ₦120.

UNIT 10 INCOME TAX AND PAY ROLL COMPUTATION

A. OBJECTIVES

Students will be able to

1. Distinguish between direct and indirect tax.
2. Know the procedures for payroll computation.

B. Introduction

Every worker pays tax which is deducted from his salary in pay roll computation. The direct tax paid on a person's income is known as income tax. Other type of direct taxes are licences and death duties. Indirect taxes, on the other hand, are paid at source and later passed on to consumers e.g. excise duties on wines, spirits and beer and custom duties on imported goods.

Every worker is entitled to some allowances set against his income before whatever remains is subject to tax. Exercises of such are children allowance, contribution to pension, life assurance etc. After deducting these allowances, whatever is left is known as TAXABLE INCOME and it is on this income that tax is paid.

In payroll computation, you need to be familiar with some terms:

1. Gross earnings: This comprises basic salary, overtime acting allowances and other taxable income.
2. Taxable Income is the income that is subject to tax after the allowances have been deducted.
3. Non taxable income: This is not subject to tax. Example are housing allowance, transport allowance and learned society allowance.
4. Pay roll deductions comprises income tax and loans or salary advances.
5. Take home pay is what is left after pay roll deductions and addition of allowances are done from the gross earnings.

C. **Worked Problems**

e.g. A man with an annual salary of ₦30,000 has allowances of ₦12,000. If income tax is 35%,how much tax does he pay each year?

Solution

Annual Salary = ₦30,000

Allowances = 12,000

Exercise 10.1

∴ Taxable Income = _____

∴ Annual Income tax = 35% of Taxable income = ₦6,300

e.g. A tax payer is allowed $\frac{1}{8}$ of his income tax - free,

and pays 20% on the remainder. If he pays ₦490 tax, find his income.

Exercise 10.2

What is his taxable income, given that ₦490 represents 20% of his taxable income.

Exercise 10.3

If he is allowed $\frac{1}{8}$ of his income tax free, what fraction of his income is subject to tax.

Exercise 10.4

Equate the fraction in exercise 10.3 to the taxable income in exercise 10.1 and use simple proportion to obtained an income of ₦28,000.

Now try this on your own:

Exercise 10.5

A man with an annual salary of ₦45,000 has allowances of ₦16,000. If income tax is 15% how much does he pay?

e.g. A man having a wife and two children is on a monthly salary of ₦2000. He is allowed ₦200 tax free in

respect of himself, ₦200 tax free in respect of his wife and ₦80 tax free in respect of each child. He pays tax at the rate of 10 k in the ₦ on the first ₦400 of his taxable income and 20 k in the naira on the rest. A loan of ₦208 is deducted from his salary while his monthly non taxable allowances total up to ₦1802. Calculate

1. his taxable income
2. the total deductions in his pay slip.
3. his take home pay.

Exercise 10.6

What is the tax free amount in respect of the two children?

Exercise 10.7

What is the total tax free allowance (i.e. add his own, his wife and the two children's allowances)

Monthly salary = ₦2,000 What then is his taxable income?

His taxable income is ₦1440.

Exercise 10.8

Tax on 1st ₦400 at 10 kobo per naira = _____

Tax on nex 1,040 at 20 kobo per naria = ₦208

∴ Total tax paid = ₦248.

Exercise 10.9

Total deductions = tax plus loan = _____

So take home pay = (salary and allowances - deduction)

= ₦3,346

e.g. A man with an annual salary of ₦37,000 has allowances of ₦9,000. What percentage of his salary does he pay annually as income tax, given that tax is 10% on 1st ₦20,000 and 15% on the next ₦20,000.

Exercise 10.10

What is his income tax? _____

$\therefore$ Percentage = $\frac{\text{Income tax}}{37000} \times 100 = 8.6\%$.

Revision Exercises

1. A man whose salary is ₦200,000 has allowances of ₦50,000. Find the annual tax he pays if the rates are: 33% on the first ₦40,000
   43% on the next ₦40,000
   53% on the next ₦40,000
   63% on any remaining.
2. A science teacher gets a basic salary of ₦2,000 every month and taxable science teacher's allowance of ₦200. Tax is paid at a flat rate of 10%. His housing and transport allowances total up to ₦2,500. What is his take home pay?
3. If the take home pay of a civil servant is ₦2,825 and deductions from his salary are ₦250, while his housing and transport allowances are ₦1,500, what is his basic salary?
4. A man with an annual salary of ₦45,000 has allowances of ₦12,000. If income tax is 25%, how much tax does he pay each year.
5. A man's tax is ₦240 and this is 5% of his gross earnings. What is his gross earning?

Ans: 1. ₦70,500 2. ₦4,480 3. ₦1575 4. ₦ 8250 5. ₦4800.