ASSESSMENT OF SECONDARY SCHOOL STUDENTS' CONCEPTION OF SELECTED MATHEMATICS CONCEPTS IN DELTA CENTRAL SENATORIAL DISTRICT

ERAVWOKE, Erhijere

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CERTIFICATION

We certify that **ERAVWOKE, ERHIJERE**in the department of Curriculum and Integrated Science, Faculty of Education, Delta State University, Abraka, Delta State

Dr. T.E Agboghoroma **Date**

Supervisor

Prof. Emperor Kpangban **Date**

Head of Department

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CHAPTER ONE

INTRODUCTION

Background to the Study

Mathematics is one of the compulsory subjects studied in both primary and secondary schools as recommended by the National Policy on Education (FRN,2004). This compulsory status given to mathematics was as a result of the importance of its knowledge in our day to day activities as human beings weather educated or not. To secondary school students who wish to further their education, mathematics is required for the understanding of concepts studied in other fields. For this reason, a minimum of credit pass in mathematics is a requirement for admission into tertiary institutions to study any course. It is a known fact that many candidates are denied admission into higher institutions whether their choices of study are related to mathematics or not because of lack of credit pass in mathematics. This shows that all professionals in life require the knowledge of Mathematics to live, as Mathematics is the language of Physical sciences, Technology and the Social sciences.

Mathematics reveals hidden patterns that help us understand the world around us. Now much more than arithmetic and geometry, mathematics today is a diverse discipline that deals with data, measurements, and observations from science; with inference, deduction, and proof; and with mathematical models of natural phenomena, of human behaviour, and of social systems.

The knowledge of mathematics leads to national development because it prepares its graduate for self-reliance which is one of the aims and objectives of Nigerian education, as stipulated in the National Policy on Education (FRN 2004), which stresses the development of a self-reliant nation. According to Jimo (2009) Science Technology and Mathematics (STM) education should prepare individuals for self-reliance. This according to Matazu (2010), can be achieved by delivering STM education practically in such a way that it enables individuals acquire necessary and vital skills for self employment. It should be noted that achieving self-reliance which is a prelude to self sufficiency and employment generation can best be achieved in Nigeria when STM Education is taught as hands-on and minds-on practical activities in our public schools. This is because the way a subject is taught affects students' conception.

Conception refers to the knowledge or understanding a student has about a taught or learnt concept. If this knowledge or understanding is in line with the universally accepted one, it is known as the right conception but if it is in contrast with it, it becomes a misconception. When one has the right conception of a particular concept, it shows that conceptual understanding has taken place.

Students demonstrate conceptual understanding in mathematics when they provide evidence that they can recognize, label, and generate examples of concepts; use and interrelate models, diagrams, identify and apply principles; know and apply facts and definitions; compare, contrast, and integrate related concepts and principles; recognize, interpret, and apply the signs, symbols, and terms used to represent concepts. Conceptual understanding reflects a student's ability to reason in settings involving the careful application of concept definitions, relations, or representations (NCTM, 2000). When students are able to this, they will perform well in mathematics examinations.

Studies have shown that students' conception of mathematics ranges from the narrowest view as a focus on calculations with numbers, through a notion of mathematics as a focus on models or abstract structures, to the broadest view of mathematics as an approach to life and a way of thinking (Peter, Ray, Leigh, Geoff, Glyn, Ansie, Johann, Ken, Joel, and Gillian,2006). In addition, the study by Egodawatte (2011) on students' conception on algebra indicated a number of errors and that some errors emanated from misconceptions. Then the work of Idehen (2011) indicated that minority of the students have right conception and majority has significant alternative conception of mathematics concepts and these are influenced by sex, school type and location.

In addition, in most Nigerian cultures, the counting of market days is done using base four i.e market days are observed within the interval of four days between the last market days. However, in the organized school setting, mathematics problems are solved in base ten. Such conflicts may affect students' learning of mathematics because these students come into the classroom with this prior knowledge (base four) in contrast with the teachers' knowledge of base ten.

These (number base, number and numeration, etec) concepts are often misconceived by students of mathematics which shows that students may not have had the right conceptions of some basic mathematics concepts. This suggests that students' conceptions of Mathematics concepts are at variance with conventionally accepted Mathematics knowledge by mathematicians and mathematics teachers. In the same vein, Nigerian students may have these misconceptions or alternative conceptions of basic Mathematics ideas or concepts. This study therefore seeks to assess secondary school students' conceptions of some basic Mathematics concepts.

Literature reviewed showed that studies on conception are few, while some of the studies looked at teachers and students conception of mathematics (Peter et al, 2011), others looked at teachers’ mathematical conceptions and pedagogical content knowledge in mathematics as it affects learning and achievement, (Hsin- Mei (n.d) , Heather, Brian. & Deborah, (n.d),others looked at secondary school students’ misconceptions in algebra (Egodawatte , 2011), learners' errors and misconceptions associated with fractions and calculus (Mdaka , 2011, Jonatan & Peter (2012) and the only work in Nigeria looked at students' conception of some selected mathematics concepts in Edo State (Idehen, 2010). The findings of the study showed that students had misconceptions in 22 of the test items out of 30 items used for the study.

Review of literature showed that there is a dearth of empirical studies that focused on students' conception in mathematics. As a result of this, the researcher intends to assess students' conception in some mathematical concepts in Delta Central Senatorial District.

Statement of the Problem

Over the years, there has been persistent increase in poor performance of students in external examinations in mathematics. This poor performances has led to different researches on the determination of the effect of different teaching methods on students' performance but the problem still remains.

Since educational psychologist and curriculum theorists have stated that students come into the classroom with some ideas about concepts to be taught, it becomes imperative to determine the type of ideas they have. This is because, these ideas known as prior knowledge or pre-conception would either hinder effective learning of the concept taught or fosters it. If these pre- conceptions are at variance with the acceptable conception and are not dealt with during the teaching-learning process, it may affects performance negatively. Based on this, the problem of this study is: what conception of mathematics' concepts will secondary school students hold on the selected mathematics concepts?

Research Questions

The following research questions are raised to guide the study:

1. What conceptions will students hold of Mathematics concepts under study?
2. What percentage of students will hold the right conception of Mathematics concepts under study?

3. Will there be any difference in the proportion of students who hold the right conceptions and those who hold the wrong conceptions of mathematics concepts under study?

4. Will there be any difference between male and female students in their conception on the mathematics concepts under study?

5. Will there be any difference between mixed and single sex school students' conceptions of the mathematics concepts under study?

Hypotheses

Research questions 1 and 2 will only be answered while 4-5 were hypothesized and will be tested at the 0.05 level of significance:

H_{01}: There will be no significant difference in the proportion of students who hold the right conception and those who hold the wrong conception mathematics of concepts under study

H_{02}: There will be no significant difference between male and female students conceptions of the mathematics concepts under study?

H_{03}: There will be no significant difference between mixed and single sex school students in their conception of the mathematics concepts under study?

Purpose of the study

The major purpose of this study is to determine the conception of secondary school students of some basic mathematics concepts. The specific purposes are to assess:

- the types of conceptions held by secondary school students of some basic mathematics concepts;

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- the proportion of students who hold the right conception and those who hold the wrong conception of the mathematics concepts under study.
- the male and female students' conception of the mathematics concepts under study.
- the conception of mixed and single sex school students of the mathematics concepts under study.

Significance of the Study

It is hoped that this study may be significant to different groups, bodies and organizations in various ways, as follows:

- To the mathematics educators, the findings of this study may be very important. This is because the findings may help in providing information on the type of conception students hold of the concepts understudy after being taught and if their conceptions are at variance with the acceptable conception, this will enable the educators look for better teaching methods that will help student have better conceptions of the concepts.

- The research findings may help educational administrators, planners and strategists observe clearly the teaching methods that could be used in teaching mathematics concepts for conceptual understanding to occur.

- To the future researchers in the same field, the findings of this study may be a source of appropriate design, method, procedure and references. It could serve as a guide for carrying out a similar research.

Scope and Delimitation of the Study

The contents to be covered will be Number and Numerations: number base, number representation place value,even numbers, multiple and percentages, Concepts assessed under Measurement are: length, area, time, weight, money, and for Geometry, the concepts includes line, line segment, triangle, Lam, uniform cross —section, and cube. Also assessed are six concepts in Statistics: histogram, pie-chart, mean, median, mode, and outcomes

This study will be confined to public secondary schools in Delta Central Senatorial District. Specifically only Junior Secondary Class two (JSS II) students will be used for this study. To this end, six sampled schools from the senatorial district will be used for the study. The six sampled schools will be selected from six randomly selected Local Government Areas.

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Operational Definition of Terms

The following terms used in the study are operationally defined as follows:

Assessment: The process of investigating to determine the status of the mathematics conceptions held by secondary school students with reference to conventionally accepted mathematics knowledge and ideas.

Alternative Conception /Misconception: Students' conception which is different from conventionally accepted mathematics knowledge

Conception: The knowledge conceived and provided by students that counts as explanation or support for mathematics ideas or concepts which could be a misconception, alternate conception or right conception.

Right Conception: Having the right answer and the corresponding correct reason.

School Type : This could be Boys only, Girls only or mixed school

Sex : The state of being a male or female.

Chapter Two

Review of Related Literature

In this chapter, review of related literature to the study was done under the following sub-topics.

- Theoretical Framework

- Mathematics concept
- Process of acquiring mathematical knowledge
- Teachers’ mathematics Conceptions
- Problem Solving Conceptions in Mathematics
- Empirical Studies on Conception of Mathematics
- Appraisal of Reviewed Literature

Theoretical Framework

Specifically, this study is hinged on cognitive theory of David Ausubel (Assimilation Theory) who stressed the importance of prior knowledge in being able to learn a new concept. The fundamental idea in the Ausubel’s cognitive theory of learning is that learning takes place by the assimilation of new concepts and propositions into the existing conceptual framework held by the learner. The first concepts are acquired by students during the ages of birth to three years, when they recognize regularities (Mac namara, 1982). This is a phenomenal ability that is part of the evolutionary heritage of all normal human beings. After age 3,new concepts and propositional learning are mediated heavily by language and take place primarily by a reception learning process, where new meanings are obtained by asking questions and getting clarifications of relationships between old concepts and propositions and new concepts and propositions. This acquisition is mediated in a very important way when concrete experiences or props are available; hence the importance of “hands on” activity for science learning with young children, but this is also true with learners of any age and in any subject matter domain.

The Ausubel's Assimilation theory is a constructivist theory and in it is the tenet of constructivism. Constructivism is a view of learning, suggesting that learners create (construct) their own understanding of the topics they study, rather than having understanding delivered to them by teachers or written materials. In the theory of instruction with constructivist perspective, students are actively involved throughout the lesson with their partners and in the whole class discussion. This active participation could be done through questioning and these questions are to be distributed to a variety of students and be promoted where appropriate. From the constructivist perspective of learning, it is widely believed that learners create their own understanding of the topic they study (Mayer, 1998). And the term used to describe this process of creative understanding is constructivism. A view of learning in which learners use their own experiences to create understanding that make sense to them rather than having understanding delivered to them in already organized forms (Eggen & Kauchak, 2001).

In order to enable learner construct knowledge, teachers must ask them a large number of questions because their answers will reveal their current understanding. When their answers indicate that their understanding is incomplete or invalid, teachers must intervene with additional questions and examples to try and help them construct more complete and valid ideas. The process of individual creating their own personal meaning is the core of constructivism. The characteristic features of constructivism include: Learners construct their own understanding, new learning depends on current understanding, social interaction increases learning and authentic task promote understanding. One of the most important factors in promoting learning is the way teachers represent the topics they teach. From the constructivist way of learning, as a framework, content representations are important. This is because in an ideal world, learners will be able to use natural processes to construct functional understanding of their world and this is not realistic and does not always occur in the classroom, so teachers can capitalize on these same processes by bringing representations of the world into the classroom for students to understand.

In doing this, teachers begin with a problem or question that must be solved or answered; the lesson must be focused on the solution to the problem or questions and as the explanation and answers come from the learners and not from the teachers, there is no direct link from the teachers to answers or questions; explanations and answers are derived from content representations and social interaction while teachers help the student construct their understanding by guiding the social interaction and providing the content representation.

Constructivist perspective of learning are grounded on the theories of instruction of Piaget, Vygotsky, Gestalt psychology, Bartleet, Brunner and John Dewey, etc. some constructivist theories such as Vygotsky emphasizes the shared and social construction of knowledge while others like Piaget sees this as less important.

In addition to the distinction between the discovery learning process where the attributes of concepts are identified autonomously by the learner and the reception learning process where attributes of concepts are described using language and transmitted to the learners, Ausubel made a very important distinction between rote learning and meaningful learning. For meaningful learning to take place, three conditions must be met;

- The material to be learned must be conceptually clear and presented with language and examples relatable to the learners prior knowledge. Concept maps can be helpful to meet this conditions both by identifying large general concepts prior to instruction in more specific concepts and by assisting the sequencing of learning tasks through progressively more explicit knowledge that can be anchored in developing conceptual framework.
- The learner must posses' relevant prior knowledge. This condition is easily met after age 3 for virtually any domain of subject matter, but it is necessary to be careful and explicit in building conceptual framework if one hopes to present detailed specific knowledge in any field in subsequent lessons.
- The learner must choose to learn meaningfully. The teacher or mentor only has indirect control over learners by motivating them to choose to learn by attempting to incorporate new meanings into their prior knowledge rather than simply memorizing concept definitions or propositional statement or computational procedures.

The above theory is related to this study because the type of conception held by the students is determined by their prior knowledge and how they were taught the concepts under study.

Mathematics Concepts

According to Idehen (2010), mathematicians accept a generalization about a mathematical idea or concept as an approved knowledge by developing hypotheses based on personal observation that requires proof based upon a logical scheme of deduction. From properties that characterize his system, the mathematician sets to prove that his conclusions are true or have some probability value (Johnson and Rising, 1972). Once a mathematician has done this, the deduction or conclusion is always true when the conditions fit his properties, which are built upon ideas or concepts. A mathematical concept is therefore defined by Johnson and Rising “as a mental abstraction of common properties of a set of experiences or phenomena”. The elements of the sets may involve objects (set concept), actions (operational concepts), comparison (relational concepts), or organizations (structural concepts) (Idehen 2010).

In another development according to Dienes (n.d) there are three types of concepts in relation to mathematics: pure mathematical concepts, notational concepts and applied concepts. Pure mathematical concepts (e.g. concepts of a square number) deal with number alone, or with relationship between numbers, and are independent of the manner in which the numbers are expressed. Notational concepts (e.g. concept of place value in a number), deal with those properties of number that arise as direct consequence of methods of expressing the number. Applied concept (e.g. concept of area) expresses particular facets of reality through the usage of already formed mathematical concept. A notational concept, Bart explains further, will be formed after its related pure concept is formed, an applied concept will be developed after both its related pure and notational concepts are formed. To a certain extent, this psychological hierarchy of concept will determine the set of teaching and learning experiences for both the teachers and students.

(i) Formation of Concepts

According to Idehen (2010), the use of concepts involves the interpretation of everyday mathematical phenomena or experiences in terms of abstraction. A mathematical concept as a mental construct is essentially abstracted from the object or objects themselves. For example, in the case of the set concept, the concept "five" is abstracted from the common properties of many sets. The idea of 5 has to be acquired. No one has even seen five (5) as it is an abstract concept — the idea is extracted from many experiences of say 5 objects, 5 people, 5 dinners, 5 dolls and 5 specimens. According to

Kalnger (1973), “a concept expresses an abstraction formed by generalization from particulars” Therefore, the formation of concepts is done by classification of objects or their properties by the process of abstraction (National Teachers Institute, 1990).

In summary concepts could be formed by the process shown in fig.1 below:

PERCEPTION	DIFFERENCIATION	ABSTRACTION	INTEGRATION	DEDUCTION
Sensory	Result from perception of the elements of the experience or structure	Depending on identification of common elements, relationship and structure.	Result in the generalization which applies to the objects, events or ideas involved	The generalization can be established by a deductive proof.

Fig.1 concept formation flow chart (Johnson & Rising, 1972)

National Teachers Institute is based on the above process of concept formation, clarify the following that:

i. Perception involves the use of the sensory and motor organs as well as experiences;

ii. Differentiation is the stage at which the learner gets awareness of possible relationships, and differences which exists among ideas or events;

iii. Abstraction is the stage during which the learner obtains a mental pattern that brings out the relationships among ideas to form a single idea;

iv. Integration occurs when the learner draws some conclusion which can be used to describe the pattern of events or ideas involved;

v. Deduction is made when specific instances are drawn out of general instances.

In Conclusion, mathematical concepts are learnt in the following ways as noted by Johnson and Rising (1972):

i. Sorting of objects, events, or ideas into classes or categories;

ii. Becoming aware of relationships within the classes or categories;

iii. Finding a pattern which suggests relationships or structure;

iv. Formulating a conclusion which seems to describe the pattern of events or idea involved;

v. Establishing the generalization by a deduction proof.

Misconceptionsin mathematics

Misconceptions happen when a person believes in a concept that is objectively false. Due to the subjective nature of being human it can be assumed that everyone has some kind of misconception. If a concept cannot be proven to be either true or false then it cannot be claimed that disbelievers have a misconception of the concept by believers no matter how much the believers want a concept to be true and vice versa. Misrepresentation of a concept is not a misconception but may produce a misconception (WWW.Dictionary/Thesaurus, 2011)

The persistent increase in the failure rate of students in science courses both in internal and external examinations led to the study of the ideas which students come into classroom with. From 1980 till date, various studies have shown that students come into classes with ideas which are not in agreement with the current understanding of natural sciences (Ivowi 1984, 1985, Abiobola 1984, Soyibo 1983,Omoifo & Irogbele 2007 and Idehen 2011). These ideas are called misconceptions, pre-instructional conceptions or alternate conceptions. Misconception in its simplest form is an idea that is not in agreement with our current understanding of natural science. Pre-instructional conceptions, which differ from those held by community of scientists, are called misconceptions or alternative conceptions (Omoifo and Irogbele, 2007). According to Okoli (2012), more studies have shown that students from different ages have a wide spectrum of alternative conceptions in a variety of science topics. For example in rounding up of numbers, to answer this question what is 14 489 to the nearest 1000?To obtain the answer, round to the nearest 10, 100 and then 1000; thus: 14 489 to the nearest 10 is 14 490, 14 490 to the nearest 100 is 14 500, 14 500 to the nearest 1000 is 15 000. Hence: the misconception leads to the incorrect answer, 15 000

Misconceptions have their root from innate knowledge, personal experiences, language, culture, etc and these influence the way students actually think, thus affecting their performances in the science subjects. These misconceptions are resistant to change if not properly dealt with because they form students' mental framework, scaffolding on which they build all subsequent knowledge unless they are distinguished, confronted and replaced or reconstructed in line with modern scientific thinking. New information and ideas which students receive is reinterpreted and rearranged to fit within this scaffolding. Concept formation is not an isolated event but rather a result of repeated observation coupled with how individual constructs their own view of the world from those observations. While some might be based on personal experiences, "intuitive" responses seem to go even somewhat deeper.

According to Omoifo (2012), literature has categorized misconceptions as follows:

- Preconceived notions (or preconceptions): These have their roots from everyday experiences.

- Non scientific beliefs: Views learnt by students from other sources outside scientific Education.

- Conceptual misunderstanding: This arises when students are taught in a way that does not challenge their own preconceived notion and non sci entific belief.

- Factual misconception: False ideas learnt from early stage and retained unchallenged into adulthood.

- Vernacular misconception: They arises from the use of words that means different things in everyday life and scientific context.

The nature of misconceptions

Students do not come to the classroom as "blank slates" (Resnick, 1983). Instead, they come with theories constructed from their everyday experiences. They have actively constructed these theories, an activity crucial to all successful learning. Some of the theories that students use to make sense of the world are, however, incomplete half-truths (Mestre, 1987). They are "misconceptions."

According to Jose (1989) misconceptions are a problem for two reasons. First, they interfere with learning when students use them to interpret new experiences. Second, students are emotionally and intellectually attached to their misconceptions, because they have actively constructed them. Hence, students give up their misconceptions, which can have such a harmful effect on learning, only with great reluctance.

What do these findings mean? They show teachers that their students almost always come to class with complex ideas about the subject at hand. Further, they suggest that repeating a lesson or making it clearer will not help students who base their reasoning on strongly held misconceptions (Champagne, Klopfer & Gunstone, 1982; McDermott, 1984; Resnick, 1983). In fact, students who overcome a misconception after ordinary instruction often return to it only a short time later.

Some Misconceptions in Mathematics

According to Askew and Wiliam (1995), One of the most important findings of mathematics education research carried out in Britain over the last twenty years has been that all pupils constantly 'invent' rules to explain the patterns they see around them. While many of these invented rules are correct, they may only apply in a limited domain. When pupils systematically use incorrect rules, or use correct rules beyond their proper domain of application, we have a misconception. For example, many pupils learn early on that a short way to multiply by ten is to ‘add a zero’. But what happens to this rule, and to a child’s understanding, when s/he is required multiply fractions and decimals by ten? Askew and William note that.

> It seems that to teach in a way that avoid pupils creating any misconceptions ... is not possible, and that we have to accept that pupils will make some generalizations that are not correct and many of these misconceptions will remain hidden unless the teacher makes specific efforts to uncover them.

Misconceptions in Fraction

The followings are some identified misconceptions. Scott (1981) noted that a renaissance mathematician John Wallis used a naïve method of induction as follows:

He knew that: $^1/_5 < ^1/_4 < ^1/_3 < ^1/_2 < ^1/_1$.

He also knew the concept of ordinal number. So he (miss) applied this to all unitary fractions to obtain: $^1/_5 < ^1/_4 < ^1/_3 < ^1/_2 < ^1/_1 < ^1/_0 < ^1/_{-1} < ^1/_{-2} < ^1/_{-3}$.

Misconception in Addition

Scott (1981) identified another misconception which he called failure to carry number as shown in the example below:

$$\begin{array}{cccc} & 2 & 3 & 8 \\ + & & & \\ & \underline{1} & \underline{4} & \underline{7} \\ & 3 & 7 & 15 \end{array}$$

The circled number above is the number placed in answer instead of being carried.

Misconception in Multiplication of Fraction

The pupil has transferred algorithm for multiplying fractions to adding fractions thus:

$$^{3}/_{5} + {^{2}/_{3}} = {^{5}/_{8}}$$

The student has misapplied place value to interpret the conjunction of a number and a letter in algebra thus:

If $x = 5$, $2x$ has been interpreted to be 25.

When $x = 5$, work out the value of the expression below:

$2x + 13 = 38$

$5x - 5 = 50$

$3 + 6x = 68$

This is frequently observed.

Example 3:

Peter's height is 0.9m. Lucy is 0.3m taller than Peter. What is Lucy's height? The pupils have a good understanding of addition of whole numbers and may find it easy to add these figures to become 0.12m but have misapplied it with the respect to the addition of decimal numbers. This application is observed repeatedly.

Example 4:

The inverse of equating all number is finding its square root. For example:

$\sqrt{144} = 12$ because $12 \times 12 = 144$

Also, $-12 \times -12 = 144$. So the square root of 144 is also 12. Thus it is written as $\sqrt{144} = 12$ or -12 or $\sqrt{144} = \pm 12$. This is another misconception.

The Inversion Misconception

This is common misconception with people working with concrete object in primary school. The pupil is aware that if you have 2 apples, you cannot take

6 apples from it. Thus, doing subtraction in the tense column. They are presumed that they must remove lesser numbers from higher numbers as shown in the example below:

$$\begin{array}{rccc} & 3 & 2 & 4 \\ - & & & \\ & \underline{1} & \underline{6} & \underline{2} \\ & 2 & 4 & 2 \end{array}$$

The pupil presumed that since you cannot remove 6 from 2, 2 should be removed from 6.

Misconception with Decimal

Here the pupil has a correct interpretation and representation for $^{1}/_{10}$: It is intended 0.10. However, the pupil here probably has misapplied the conversion for fractions. E.g., $6^{1}/_{2}$ means 6 + $1^{1}/_{2}$. So the pupil views 6 tenth to mean 6 + a tenth.

Write the following as decimals:

Six tenth = 06.10

Sixteen tenth = 16.10

Misconceptions in Fraction Addition

When multiplying fractions that numerators are multiplied as denominators. Here the pupil has misapplied the rule to the addition of fractions.

e.g., $^{2}/_{3}$ + $^{3}/_{4}$ = $^{5}/_{7}$

Misconception in Ordering Fractions

Write these fractions in order of size from smallest to the largest:

	$^{1}/_{2}$	$^{3}/_{8}$	$^{5}/_{16}$	$^{5}/_{8}$	$^{1}/_{4}$
Answer:	$\underline{^{5}/_{16}}$	$^{3}/_{8}$	$^{5}/_{8}$	$^{14}/_{4}$	$\underline{^{1}/_{2}}$

Smallest Largest

Reason:

This is because $^{5}/_{16}$ is much smaller than $^{1}/_{2}$ if youcut the fraction out of a cake, there would be a lot of 15 small pieces instead of two large ones. The pupil has the misconception that the larger the denominator, the smaller the fraction. There is no acknowledgement of the role of numerator. Secondly, the pupil grouped them according to the denominator then orders them in those 4 sets. Note that $^{3}/_{8}$ and $^{5}/_{8}$ are correctly placed relative to each other.

Misconception in Rounding up of Numbers.

Q. Round up 15, 473 to the nearest 1000 Ans: 16,000

The pupil answer looks like a mistake, there may be an underlying misconception that rounding is associative. The pupil may have rounded up 15,743 to the nearest ten to obtain 15, 410. Then, may have rounded 15, 410 to the nearest hundred to obtain 15, 500, finally, may have rounded 15, 500 to the nearest 1000 to obtain 16,000.

Misconceptions in Percentages

Q. A bank offers two service schemes that last for two years.

1. 10% interest in one year followed by 20% in two years

2. 20% interest in one year followed by 10% in two years

Which scheme is better? Ans: scheme A.

This misconception is not just related to school children but also to both adults.

The first scheme is chosen because of this persuasive misconception that 20% on a larger amount in year two will yield more money. This misconception is encountered by demonstrating that multiplication is a commutative

$$1.1 \times 1.2 = 1.2 \times 1.1$$

Misconception in Algebra

x is a variable misconception

Q. A piece of rope 5m long is cut into 2 pieces. 1 piece is x meter long, how long is the other piece n? Ans: 2.5m

Q. There are 24hrs in 1 day, how many hours are in y days?

Ans: $y = 3 = 72$hrs

Here, x and y are intended unknown variables. The pupil decided that as such he/she can make them each equal to a convenient number.

Cancelling/Deletion Misconception

The unknown x in the ratio 1:2 and the pupil misapplies simplifying ratio into the domain, he/she devices the co-efficient of x by 3 as shown below:

Q. solve $3x + 3 = 6x + 1$.

Ans: $3x + 3 = 6x + 1$

$= x = 3 = 2x + 1$

$= 2 = x$

This misconception is also evident in this simplification:

$$\frac{\cancel{6}^{3}x + 3}{\cancel{2}x + 1}$$

$$= \frac{3x + 3}{x + 1}$$

Equating Misconception

Q. solve $x^2 - 4x + 3 = 12$

Ans: $x^2 - 4x + 3 = 12$

$(x-3)(x-1) = 12$

$(x-3) = 12$ or $(x-1) = 12$

$x = 15$ or $= 13$.

The pupil was initially introduced to quadratic equation by investigating equations such as: $x^2 - 4x + 3 = 0$.

Solvable in this manner:

$x^2 - 4x + 3 = 0$

$(x-3)(x-1) = 0$

$(x-3) = 0$ or $(x-1) = 0$

So, $x = 15$ or $= 13$.

The pupil misapplied the method of quadratic equation not equals to 0. The reason why (1) leads to (2) needs to be clearly understood to avoid this misconception.

Sources of misconception in mathematics

The following are some of the sources of misconceptions

- **Teaching methods**

Observation and experience have shown that most of the methods used in the teaching of mathematics in our classrooms are devoid of investigation of learner's prior knowledge. For effective learning and understanding of mathematics to take place, teachers must identify learners' prior knowledge before teaching. This is to determine if it is the right conception or misconception. When this is done, appropriate teaching methodology that could reduce or eliminate misconception and facilitate conceptual understanding would be used. But this is contrary to what happens in our mathematics classrooms today. According to Luneta and Makonye (2010), the teaching and learning of Mathematics is seen to be difficult and ineffective that poor performances of students is correlated with their errors and misconceptions which result from this teaching methodologies.

- **Learners' construction of knowledge**

Learners' construction of knowledge is largely dependent on their cognitive structures. Learners do not come into the classroom blank. They have some existing pre-instructional ideas which affect the way they process information in the classroom either positively or negatively depending on the type of pre instructional conception. According to Battista (2001) the way in which learners construct knowledge is dependent on the cognitive structures learners have previously developed. This means that there are conceptions and preconceptions that learners of different ages and backgrounds bring with them to Mathematics classrooms, and if preconceptions are misconceptions, teachers need knowledge of strategies most likely to be fruitful in reorganizing the learners' understanding. In the same vein, Shulman (1986) argues that the ability to identify learners' misconceptions is based on teacher pedagogical skills or teacher competence. In other words, the teacher's main focus is not mainly on classroom management, preparing good lessons and presenting well-structured tasks, but also on the quality of questions about the content of lesson, and explanations given to learners.

- **Nature of the learner**

In mathematics classroom, there exist learners of varying cognitive abilities and this has a lot to do with the way they reason and process information. The findings of Higgins, Ryan, Swam, and Williams (2002) showed that possible causes of mistakes learners make may be due to lapses in concentration, hasty reasoning, memory overloaded or failure to notice important features of a problem which may lead to misconception. According to Bell (1993), the main cause for many students' misconception is that they appear to understand a concept at the end of a unit, but do not retain it after a few months. In another way, they lack long term learning. In contrast, students with long term learning do not forget the acquired knowledge, and are able to apply it in real life situations. To Askew and William (1995), diagnostic teaching strategy can help promote long-term learning and transfer from the immediate topic to wider situations. In his own view, Bell (1993) argues that students see scores and not weaknesses, because they often want to know if their answer is correct or what score they got on a test, but don’t want to go beyond scores to look into why they got the score they did. Yet paradoxically, this is one of the many ways to improve scores and acquire new knowledge. This view is supported by Skemp (1976) who sees learners as being more dependent on instrumental understanding which is the following of mathematical rules and procedure without understanding, as compared to relational understanding which is knowing what to do in Mathematics and the reasons behind that.

- **Teachers' Assumptions**

According to Adler and Setati (2001), misconceptions arise when a teacher thinks a learner is familiar with a concept whereas the learner in fact lacks an understanding of certain aspects of it. For instance, a learner may be using fractions and obtaining the correct answers but not aware that fractions are numbers.

Why Consideration of Misconception Important

Students construct meaning internally by accommodating new concept within the existing mental frameworks. Thus, unless there is intervention, there is likelihood that pupil's conception will deviate from the intended one. Pupils are known to misapply algorithms and rules in domains where they are inapplicable and a surprisingly large proportion of students share the same misconceptions (Scott, 1981).

Process of acquiring mathematical knowledge

Mathematics is the science of patterns and relationships. As a theoretical discipline, mathematics explores the possible relationships among abstractions without concern for whether those abstractions have counterparts in the real world. The abstractions can be anything from strings of numbers to geometric figures to sets of equations. Mathematics relies on logic and creativity, and it is pursued both for a variety of practical purposes and for its intrinsic interest. For some people, and not only professional mathematicians, the essence of mathematics lies in its beauty and its intellectual challenge. For others, including many scientists and engineers, the chief value of mathematics is how it applies to their own work. Because mathematics plays such a central role in modern culture, some basic understanding of the nature of mathematics is requisite for scientific literacy. To achieve this, students need to perceive mathematics as part of the scientific endeavour, comprehend the nature of mathematical thinking, and become familiar with key mathematical ideas and skills (Science for all American). This shows that mathematics is highly conceptual and appropriate mathematical skills are needed to acquire mathematical knowledge to avoid mistakes. In agreement with this, Higgins et.al (2002) argue that mistakes made in acquiring mathematical knowledge, may indicate alternative ways of reasoning, and that such mistakes should not be dismissed as "wrong thinking" but be seen as necessary stages of conceptual development. According to Piaget (1972) development comprises of four stages: that is, the sensory-motor, pre-operational, concrete operation, and formal operations stages. He argues that it is through these operational stages that we can understand the development of knowledge. For instance, the formal operation stage shows that learners can also reason on hypothesis and not only on objects. In contrast to Piaget view, Vygotsky (1978) indicates that the essential feature of learning is that it creates the zone of proximal development, that is, learning awakens a variety of internal development processes that are able to operate only when the child is interacting with people in his/her environment and in cooperation with peers. According to Piaget, the three developmental processes of how children progress conceptually from one stage to another include: assimilation referring the manner in which learners transform incoming information so that it fits within their way of thinking, accommodation as a stage where a learner receives new information which is quite different from the existing knowledge which s/he then tries to re-construct and re-organise ideas, and lastly, equilibration referring to the keystone of developmental change between the learner's cognitive system and the external world. In other words, equilibration is the stage in which learners begin to realize the errors and misconceptions they have developed and further use these mistakes to restructure their existing knowledge.

Conceptions of Mathematics by Teachers

Mathematics is believed to be a difficult, hard, abstract and complex subject. On this note, everyone including the mathematics teacher and students come to the mathematics classroom with some pre-instructional or alternative conceptions about mathematics and it's teaching/learning. When there are differences between these pre-instructional conceptions and those held by mathematicians and mathematics educators about a concept, they are called misconceptions. Students' common sense knowledge or students framework (Erickson, 1983); aversions, (Harbor - Peters 2001); or alternative conceptions (Omoifo and Irogbele, 2007).These ideas which may either be misconception or right conception are influenced or predicted by a combination of teachers' beliefs about the subject or the contents. According to Telese (1997), a combination of beliefs may be described as belief system, which is restricted, as individuals reflect on their beliefs. Individual teachers possess particular beliefs of varying degrees of conviction that develop into personal perspectives of the subject. The belief system is organized in to teachers' conception of mathematics whose components consist of conscious or subconscious beliefs, concepts, meaning, rules, mental images, and preferences concerning the discipline of mathematics (Thompson, 1992). Ernest (1988) believes that the teachers' subject conception resides in their belief system by indicating that the key belief components of the mathematics teacher is the teacher's conception of the nature of mathematics and his or her belief system concerning the nature of mathematics as a whole.

On the significance of the teachers' conception of mathematics, he also argues that although knowledge is important, it is not sufficient by itself to account for the differences between mathematics teachers. For example, two teachers can have similar knowledge: one has the traditional conception of mathematics, emphasizing "…the mastery of symbols and procedures, largely ignoring the processes of mathematics and the fact that mathematical knowledge often emerges from dealing with problem situations" (*Standards* NCTM, 1995) and the other has the non-traditional conception of mathematics, emphasizing "the continually expanding field of human creation and invention" (Ernest, 1988 in Golafshani, n.d).

Associated with teachers' conceptions of mathematics are beliefs aligned with the traditional absolutist view and a non-traditional constructivist view of mathematics (Roulet, 1998). Among other views about mathematics, absolutist and constructivist views are distinguished here because of their observed occurrence in the teaching of mathematics (Thompson 1984), as well as in the evidenced teachers' conceptions of mathematics and science (Ernest, 1988).

Teachers' with absolutist conception of mathematics describe the mathematics subject as a vast collection of fixed and infallible concepts and skills (Romberg, 1992) and a useful but unrelated collection of facts and rules (Ernest, 1989). The teachers adhere to the belief that mathematics is an unrelated collection of facts and mathematical knowledge becomes certain and absolute truths. It represents "the unique realm of certain knowledge" (Ernest, 1991). Finally, Ernest (1996), summarizes teachers' absolutist views about mathematics by saying:

> Absolutist views of mathematics are not concerned to 'describe' mathematics or mathematical knowledge…Thus mathematical knowledge is timeless…it is superhuman…it is pure isolated which happens to be useful because of its universal validity; it is value-free and culture-free, for the same reason. (p. 2)

Another promoted or more "fashionable and fruitful" according to Golafshani, (n.d) conception of mathematics among teachers is constructivism: "the image of mathematics, which is growing in popularity among mathematics educators" (Roulet, 1998). Even the reforms proposed by both the NCTM (1989) and The Ontario Association for Mathematics Education [OAME] (1993) are rooted in constructivism and they support the transition of teachers' mathematics conceptions from the traditional absolutist view to a non-traditional constructivist view (Roulet, 1998). Constructivism is one alternative view to traditional instruction that NCTM promotes (Sandhotz, Ringstaff, and Dwyer 1997; Brooks and Brooks 1993). Furthermore, Hersh (1986) lists three main properties of mathematical activity or mathematical knowledge which adhere to constructivist view of mathematics and challenge the basic assumption that mathematical knowledge is infallible. These properties are:

1. Mathematical objects are invented or created by humans.

2. They are created, not arbitrarily, but arise from activity with already existing mathematical objects, and from the needs of science and daily life.

3. Once created, mathematical objects have properties that are well-determined, and we may have great difficulty discovering, yet they are possessed independently of our knowledge of them.

From these properties, it seems Hersh advocates the idea of practical mathematics and challenges the assumption that mathematics is absolute and certain. The constructivist view emphasizes the practice of mathematics and the reconstruction of mathematical knowledge. Teachers holding the constructivist view of mathematics take the subject as a language developed by humans to describe their observations of the world. The teachers see mathematics as continually growing, changing and being revised, as solutions to new problems are explored by the learners with the teachers as “facilitators”. (Golafshani, n.d)

Mathematics teachers may not be able to describe their personal conceptions of the subject in terms of absolutist or constructivist view of mathematics. However, the importance for teaching of such views of subject matter has been noted both across a range of subjects, and for mathematics in particular (Thom, 1973).

Conception of Mathematics by students

According to Crawford, Gordon, Nicholas, & Prosser (1998), students' mathematics conception can be grouped into the following categories.

1. Math is numbers, rules, and formulas.
2. Math is numbers, rules, and formulas which can be applied to solve problems.
3. Math is a complex logical system; a way of thinking.
4. Math is a complex logical system which can be used to solve complex problems.

5. Math is a complex logical system which can be used to solve complex problems and provides new insights used for understanding the world.

According to him, the first two categories represent a student view of mathematics that is termed “fragmented” while the last three categories present a more “cohesive” view of mathematics. Note that the terms *fragmented* and *cohesive* are well-used throughout the international body research. The categories above, form a hierarchical list, with each one building on the one above it.

Students' learning of mathematics can equally be categorized into the followings:

1. Learning by rote memorization, with an intention to reproduce knowledge and procedures.
2. Learning by doing lots of examples, with an intention to reproduce knowledge and procedures.
3. Learning by doing lots of examples with an intention of gaining a relational understanding of the theory and concepts.
4. Learning by doing difficult problems, with an intention of gaining a relational understanding of the entire theory, and seeing its relationship with existing knowledge.

5. Learning with the intention of gaining a relational understanding of the theory and looking for situations where the theory will apply.

Again, these five categories were grouped, this time according to intention, into two general categories: reproduction and understanding. In the first two approaches to learning math, students simply try to reproduce the math using rote memorization and by doing lots of examples. In the last three categories, students do try to understand the math, by doing examples, by doing difficult problems, and by applying theory. Other researchers in this community have seen similar results on both general surveys of student learning and on subject-specific surveys and have termed this to be *surface approach* and *deep approach* to learning (Marton, 1988 in Crawfold et al, 1998).

According to Peter, Anna, Leigh, Geoff, Glyn, Ansie, Johann, Ken, Joel and Gillian (2006), students' conception of mathematics is classified under the following five qualitatively different categories:

Number

In this conception, students consider mathematics to be connected with numbers and calculations. Mathematics is manipulation with numbers with no essential advance beyond elementary arithmetic. People mention numbers, calculations, sums and basic operations. Mathematics is numbers being processed and calculations. Mathematics is a subject that involves counting.

Components

Here, mathematics is viewed as a toolbox to be dipped into when necessary to solve a problem. It may also be viewed as a collection of isolated techniques unrelated to real-world applications. Students mention formulas, equations and laws. Using formulas and numbers to work out equations. Solving of equations, sums, algebra, trig, indices, etc. Maths is a selection of theorems and laws, which help solve equations and problems. Maths is a "tool" that can be applied in various disciplines.

Modelling

This conception links mathematics to the physical world. Indeed, the students who hold this conception make strong connections between mathematics and the physical world, which can be described, perhaps imperfectly, by mathematics. There may be an underlying assumption that mathematics is a human endeavour invented to describe the world. Quantifying and studying in a logical manner the physical world. It is a human endeavour to logically write predictions about systems of interest. The attempt to explain the physical laws and patterns of the physical world by algebraic and numerical means. Mathematics, and especially actuarial mathematics, is the model set up to analyse and predict real world events.

Abstract

The emphasis here is on mathematics as a logical system or structure, perhaps even a kind of game of the mind. Applications and modelling techniques may be recognised, but are regarded as secondary to the structure of the mathematics. Mathematics is the "other", somehow pure and abstract..

Life

In this conception, students view mathematics as an integral part of life and a way of thinking. They believe that reality can be represented in mathematical terms, but in a more comprehensive way than the modelling conception. Their way of thinking about reality is mediated by mathematics. They may make a strong personal connection between mathematics and their own lives.

Mathematics is a way to approach life in an analytical manner so as to support and formalise natural processes. In a sense, it is a way to understand how life works. Mathematics relates, and can be used in every aspect of everything, the uses are endless. Mathematics is the language of nature. It is the way in which nature is ruled by God.

The narrowest conception is Number, followed by Components, then Modelling and Abstract, and finally the broadest conception, Life. They regarded the conceptions of Modelling and Abstract to be at a similar hierarchical level: one describes modelling applied to the real world, while the other refers to abstract (mathematical) structures and ideas. It can be seen that the conceptions are consistent with those of Reid, Petocz, Smith, Wood. & Dortins. (2003) augmented by the narrower conception identified in Reid and Petocz (2002) (renamed as Number rather than Techniques). Furthermore, the present analysis identified two aspects of the previous mathematics as models conception which are represented by the present Modelling and Abstract conceptions. This distinction was suggested by our earlier explorations of the first-phase interview data, but not pursued due to lack of evidence from the interview transcripts.

Problem -Solving Conceptions in Mathematics

According to Nunokawa, (2005), a common definition given to mathematical problem is that a mathematical problem presents an objective or goal with no immediate or obvious solution or solution process. In summarising the work of Schrock (2000) and Wilson, Fernandez, & Hadaway, (1993), it is suggested that a mathematical problem must meet at least three criteria; individuals must accept an engagement with the problem, they must encounter a block and see no immediate solution process, and they must actively explore a variety of approaches to the problem.

According to Chapman (1997) problem solving means different things to different people, having been viewed as a goal, process, basic skill, mode of inquiry, mathematical thinking and teaching approach. However, most research in the area seems to regard problem solving as the process of achieving a solution (Blum &Niss, 1991; Boekaerts, Seegers & Vermeer, 1995; Franke & Carey, 1997; Hart, 1993). Famously, Polya (1981) described it as a means of "finding a way out of difficulty, a way around an obstacle, attaining an aim which was not immediately attainable" and it is on this conception that we focus our work.

Many writers, including Polya (1945), have developed frameworks for analyzing the problem solving process. Polya's model comprises the four phases of understanding the problem, devising a plan, carrying out the plan, looking back. Other models, frequently based on Polya's, include Kapa's (2001) six phase and as Mason, Burton, & Stacey (1985) three phase. The latter suggest that problem solving comprises entry, attack and review. However, space prevents a lengthy discussion on the details of these models and their similarities and differences, although it is our view that their resonance with Polya's is close and not difficult to discern.

Empirical Studies on Conception of Mathematics

A study was carried out by Peter et al (2006) on undergraduate students' conceptions of mathematics. Almost 1,200 students in five countries completed the short survey including three open-ended questions asking about their views of mathematics and its role in their future studies and planned professions. Responses were analysed starting from a previously-developed phenomenographic framework (Reid et al., 2003) which required only minor modification. Their findings showed that students' conceptions of mathematics ranged from the narrowest view as a focus on calculations with numbers, through a notion of mathematics as a focus on models or abstract structures, to the broadest view of mathematics as an approach to life and a way of thinking. Broader conceptions of mathematics were more likely to be found in later-year students (p G 0.001) and there were significant differences between universities (p G 0.001). The information obtained from the study not only confirms previous research, but also provides a basis for future development of a monitoring questionnaire.

Also, Hsin- Mei (n.d) carried out a study to investigating of teachers' mathematical conceptions andpedagogical content knowledge in mathematics. This study examined relationships within primary school teachers' knowledge of school mathematics, cognition about children's learning, and knowledge of instructional practice among fifth and sixth grades teachers. Teachers (N=201) completed structured questionnaires which evaluated their cognition about children's learning difficulties, knowledge of instructional practice, and mathematical concepts in the fifth and sixth grades mathematics curriculum. Results indicated that the prominent children are learning difficulty was in understanding abstract mathematical concepts. The primary knowledge of instructional practice that was suggested from teachers was to engage in problem solving in cooperative small groups. However, the teacher's mathematical knowledge did not significantly affect their cognition of children's learning difficulties and knowledge of instructional practice. Providing more in-service education for teachers to develop more understanding of mathematical knowledge and epistemology is needed for further research.

In addition, Egodawatte (2011) carried out a study on secondary school students' misconceptions in algebra. This study investigated secondary school students' errors and misconceptions in algebra with a view to expose the nature and origin of those errors and to make suggestions for classroom teaching. The study used a mixed method research design. An algebra test which was pilot-tested for its validity and reliability was given to a sample of grade 11 students in an urban secondary school in Ontario. The test contained questions from four main areas of algebra: variables, algebraic expressions, equations, and word problems. A rubric containing the observed errors was prepared for each conceptual area. Two weeks after the test, six students were interviewed to identify their misconceptions and their reasoning. In the interview process, students were asked to explain their thinking while they were doing the same problems again. Some prompting questions were asked to facilitate this process and to clarify more about students' claims. The results indicated a number of error categories under each area. Some errors emanated from misconceptions.

In another study carried out by Heather, Brian & Deborah (n.d) to determine the effects of Teachers' Mathematical Knowledge for Teaching on Student Achievement. The aim of the study was to explore whether and how teachers' mathematical knowledge for teaching contributes to gains in students' mathematics achievement. They used linear mixed model methodology in which first (n=1190) and third (n=1773) graders' mathematical achievement gains over a year were nested within teachers (n=334 and n=365), who in turn were nested within schools (n=115). The findings of the study showed that teachers' mathematical knowledge was significantly related to student achievement gains in both first and third grades, controlling for key student and teacher-level covariates. While this result is consonant with findings from the educational production function literature, our result was obtained using a measure of the specialized mathematical knowledge and skills used in teaching mathematics. This result provides support for policy initiatives designed to improve students' mathematics achievement by improving teachers' mathematical knowledge.

In the same vein, Mdaka (2011) carried out a study on learners' errors and misconceptions associated with fractions. The study aimed to explore errors associate with the concept of fractions displayed by grade 5 learners. This aim specifically relates to the additions and subtractions of common fractions. In order to realize the purpose of the study, the following objectives were stated: to identify errors that learners display when adding and subtracting common fractions. The causes which led to the errors were also established. The study was conducted at Dyondzo primary school, Vhenbe district in Lippopo Province. The constructivist's theory of learning was used to help understand how learners construct their meaning of newly acquired knowledge. It was a qualitative study where most of the data and findings were presented with think description using descriptive analysis technique. A group of 49 learners were selected purposively within two classes of grade 5 to write the class work, home work and test on addition and subtraction of fractions. The learners were interviewed and so were two teachers. The five teachers also completed the questionnaire of five questions to supplement the interview. The study found that learners mead a number of errors in the addition and subtraction of fractions including conceptual errors, carelessness errors, procedural errors and application errors.

Moreover, Jonatan & Peter (2012) carried out a study on analysis of errors and misconceptions in the learning of calculus by undergraduate students. The aim of the study going to was to analyze the errors and misconceptions in an undergraduate course in Calculus. The population of the study was 10 B. Ed. mathematics students at Great Zimbabwe University. Data is gathered through use of two exercises on Calculus 1&2.The analysis of the results from the tests showed that a majority of the errors were due to knowledge gaps in basic algebra. It was found that errors and misconceptions in calculus were related to learners' lack of advanced mathematical thinking since concepts in calculus are intertwined.

Also, George, (2011) carried out a study on students' conceptions of mathematics as a discipline**.** The purpose of this study is to categorize college students' various conceptions concerning mathematics as a discipline. Results from this study were used to create a preliminary framework for categorizing student conceptions. The results of this study indicate that the conceptions are numerous and range greatly in complexity. The results also suggest the need for further study to qualify the various student conceptions and the roles they play in students' understanding of and approach to performing mathematics.

Lastly, Idehen (2011) carried out a study to assess secondary students' conceptions of some basic mathematical concepts. The study was a descriptive survey and the survey design employed consisted of four independent variables - gender, school location and school mode. The stratified random sampling technique was used to select 4,332 subjects that adequately represented all the specific groups in the population. The instrument for the study was a two-tier diagonistic instrument for assessing students' conception of mathematics ideas (SCMI). The instrument was validated by experts in mathematics education and measurement and evaluation. The reliability of the instrument was established through the Kuder- Richardson formula 20 and has co-efficient of 0.76, 0.70 and 0.85 were obtained for answers, reasons and answers and reasons respectively. Descriptive statistics (frequency and percentage, inferential statistics, Pearson's chi square, Pearson correlation co-efficient, t-test statistics, one way analysis of variance and two-way analysis of co-variance were used to analysed the data. The hypotheses were tested at 0.05 level of significance. The result showed that only 12 out of the 30 items did at least, 50% of the students have right conception and with 34 significant alternative conceptions identified from 22 out of the 30 items. There are positive and significant relationship between right answers and right conceptions. The proportion of students with right answers is significantly different form that with right conceptions. Furthermore, there is no significant difference between male and female students conception of mathematics. However, there are significant differences between urban and rural, public and private and single sex and mixed school students in their conception of mathematics. Urban, private and single sex school students performed better than rural, public and mixed school students respectively. There are no significant interaction effects of gender and school type, location and school type and of school mode and school type of students' conception of mathematics. From the findings of the study, minority of the students have right conception and majority has significant alternative conception of mathematics concept.

Appraisal of the Review

The theoretical framework of this study is based on the constructivism theory. The constructivism theory state that knowledge is personally constructed but socially mediated. At the heart of this constructivist view is that learners accomplished understanding through the social interaction which occur in and outside the classroom. Through these personal and social interactions, the conceptions held by each individual guide his understanding.

From theoretical framework of the study, it was discovered that the prior knowledge of the child as an important role to play during subsequent learning in the teaching and learning process. Also, the empirical studies, it showed that the Only one study on students conception was carried out in (Idehen, 2011**).** This study was carried out in Edo States. This showed that there is an acute dearth of literature in the field and hence the need for more studies on a similar topic. This is the gap this study intends to fill and it becomes the focus of the study. In order to meet up with this need, this study will will investigate the conceptions of secondary school students on some basic mathematics concepts in Delta Central Senatorial District.

CHAPTER THREE

RESEARCH METHODS AND PROCRDURES

This chapter describes in details the procedures which will be employed in carrying out the study. In this section, the following are discussed:

- Design of the study
- Population of the study
- Sample and Sampling Procedure
- Research Instrument
- Validity of the instrument
- Reliability of the instrument
- Method of Data collection
- Method of Data analysis

Design of the study

The design for the study is a descriptive survey as the study assesses the current situation of the conceptions held by secondary mathematics students of selected basic mathematics concepts. This design will be adopted for this study because there will be no manipulation of any of the variables under study, and findings will only be used for descriptive purpose, not to establish a cause and effect relationship This design is appropriate because authorities in research methods (Wiseman, 1999; Thorndike & Hagen, 1997; Johnson &Christensen, 2000) are of the opinion that researches which involve collection of available data should use survey design. The independent variables is students conception and the dependent variables are students' gender (male and female), and school type (Boys, Girls and mixed schools)

Population of the Study

The population of this study are all public secondary school students in Delta central senatorial District. There are 144 secondary schools in Delta central senatorial District. (See appendix III).

Sample and Sampling Technique

The sample for the study will be nine secondary schools selected from three Local Government Areas in Delta central senatorial District. From the nine schools that will be selected, three will be mixed schools, three girls and three boys schools. All students in intact classes in the schools selected will be used for the study. The basic sampling procedure for the study will be the stratified random sampling. The schools will first of all be grouped into the following strata: based on school type: mixed and single sex schools. (see appendix IV)

Research Instrument

The instrument for the study is a two-tier Diagnostic Instrument titled " Assessing students’ Conceptions of Mathematics ideas (SCMI)". The instrument was adapted from the work of Idenhen (2011) (See appendix 1). The SCMI is a two-tier instrument for the collection of data on conception. It consists of two sections A and B. Section A seeks information on students' bio data: sex and school type. Section B contains 30 items of multiple choices of one correct answer with two wrong ones and one correct reason for choosing any option with two wrong ones. Each question in section B requires two answers to be chosen by respondent. i.e. The right answer for the options chosen and the right reason for choosing the option. The concepts assessed under Number and Numeration include: number bases, number representation place value, even number, multiple, percentage. addition and multiplication operation, subtraction division operation, zero as multiplicand and, addition of fraction and division. Concepts assessed under Measurement are: length, area, time, weight, money, and Assessed under Geometry are concepts of a line, line segment, triangle, Lam, uniform cross —section, and cube. Also assessed are six concepts in Statistics eg: histogram, pie-chart, mean, median, mode, and outcomes. Section B of the SCMI has thirty items. The first part of each item in section B multiple-choice content question having three choices. The second part of each is a set of three possible reasons for the answer to the first part (see Appendix 1)

Validity of Instrument

The design or adapting an appropriate, valid and usable research instrument for any study is very important if the study proposes to arrive at accurate findings and an instrument is valid when it measures what it is supposed to measure. In other words, the items in the instrument should be raised in a way that would facilitate needed responses in answering the research questions/hypotheses and purposes. In order to achieve this, Although the instrument was adapted from the work of Idehen (2010), its face and content validity were determined by three experts. Two from science education and the other from measurement and evaluation they suggested that some of the items should be reframed and some removed. Their suggestions were effected and this made the instrument valid for data collection.

Reliability of Instrument

In determining the reliability of the instrument, an instrument validation exercise was carried out. In doing this, the instrument was administered on students of JSS11 who will not be part of the sample to be used for the study after they have been taught the concept. Data were collected and analyzed using Kuder Richardson (k20) formula to determine the reliability value because it is an achievement test. From the analysis of the data collected, it was discovered that the r-value for the achievement was 0.81 and that of the conception was 0.83. this values were high enough for use in the study. (See appendix II).

Method of Data Collection

Before the instrument will be administered on the sampled students, the researcher will first of all take permission from the principals of the sampled schools. After taking permission, the researcher will go round the sampled schools and administer the instrument on the students of the randomly selected classes. At the end of the stipulated time allowed to respond to items in the instrument, the answered instruments will be collected back from the students on the spot by the researcher.

Method of Data Analysis

To analyze the data collected, descriptive and students' independent t-test statistical procedures will be used as follows: All research questions will be answered using descriptive statistics of frequencies, percentages and means. Hypotheses 1-3: will be tested using independent sample t-test statistics.

Scoring of the Items in the Instrument

For the section B part of the instrument, each correct answer given by the students in section B will be scored one (1) while wrong answer will be scored zero (0) and wrong reason will be scored 0 and right reason scored 1. In answering the research questions and testing the hypotheses that deal with conception, both right answers and right scores on reasoning will be used.

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Appendix 1

Assessment of Students' Conception of Some Selected Mathematics Ideas

(SCMI)

Section A.

Instruction: Read the question thoroughly and respond as suitable to you.

Name of student:

____

Name of school:

____

Local

Government____

Sex: Male ☐ Female ☐

MARKING SCHEME

ANSWER		REASON
1	**B**	**A**
2	**B**	**A**
3	**A**	**B**
4	**A**	**B**
5	**A**	**B**
6	**C**	**A**
7	**A**	**B**
8	**C**	**A**

9	**B**	**A**
10	**C**	**A**
11	**A**	**C**
12	**C**	**A**
13	**A**	**A**
14	**C**	**A**
15	**B**	**A**
16	**A**	**C**
17	**B**	**B**
18	**C**	**A**
19	**C**	**A**
20	**B**	**A**
21	**B**	**A**
22	**B**	**A**
23	**B**	**A**
24	**B**	**B**
25	**B**	**A**
26	**B**	**C**
27	**B**	**C**
28	**B**	**C**
29	**C**	**A**
30	**C**	**A**

APPENDIX 3 - RELIABILITY

```
GET
 Data for Reliability.sav'.
DATASET NAME DataSet0 WINDOW=FRONT.
RELIABILITY
  /VARIABLES=q1 q2 q3 q4 q5 q6 q7 q8 q9 q10 q11 q12 q13 q14 q15 q16 q17 q18 q19
q20 q21  q22  q23  q24  q25  q26  q27  q28  q29  q30
  /SCALE('ALL VARIABLES') ALL

  /MODEL=Kunder-Richradson 20.
```

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	**Valid**	**40**	**100.0**
	Excluded[a]	**0**	**.0**
	Total	**40**	**100.0**

a. category = achievement

b. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Kunder-Richardson 20 (KR20)	N of Items
.807	30

a. category = achievement

Category = Conception

Case Processing Summary

		N	%
Cases	Valid	40	100.0
	Excluded[a]	0	.0
	Total	40	100.0

a. category = conception

b. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Kuder-Richardson 20	N of Items
.832	30

Appendix III

POST PRIMARY SCHOOLS IN DELTA CENTRAL

- **ETHIOPE EAST LOCAL GOVERNMENT AREA**

S/N	NAME OF SCHOOLS
1	ABRAKA GRAMMAR SCHOOL, ABRAKA
2	AGBON COLLEGE, OKPARA INLAND
3	AGBON SECONDARY SCHOOL, AGBON
4	BAPTIST HIGH SCHOOL, EKU
5	EGBO COMM. SECONDARY SCHOOL, EGBO-KOKORI
6	EKU GIRL'S SECONDARY SCHOOL, EKU
7	ERHO SECONDARY SCHOOL, ERHO-ABRAKA

8	IBRUVWE SECONDARY SCHOOL, SAMAGIDI-KOKORI
9	IGUN SECONDARY SCHOOL, IGUN
10	KOKORI BOY'S SECONDARY SCHOOL, KOKORI
11	KOKORI GIRLS SECONDARY SCHOOL, KOKORI-INLAND
12	OKPARA BOY'S SECONDARY SCHOOL, OKPARA
13	OKPARA GIRL'S SECONDARY SCHOOL, OKPARA
14	OKUREKPO SECONDARY SCHOOL, OKUREKPO
15	ORHOAKPO SECONDARY SCHOOL, ORHOAKPO
16	OTORHO SECONDARY SCHOOL, OTORHO-ABRAKA
17	OVIORIE SECONDARY SCHOOL, OVIORIE-OVU
18	OVU COLLEGE, URHODO-OVU
19	OVU SECONDARY SCHOOL, OVU-INLAND
20	OWERRE GRAMMAR SCHOOL, OKPARA
21	UMIAGWA SECONDARY SCHOOL, ORIA-ABRAKA
22	URHUOKA SECONDARY SCHOOL. URHUOKA-ABRAKA

- **ETHIOPE WEST LOCAL GOVERNMENT AREA**

S/N	NAME OF SCHOOLS
1	BOBORUKU SECONDARY SCHOOL, B. JESSE
2	IDJERHE GRAMMAR SECONDARY SCHOOL, JESSE
3	IGHOYOTA SECONDARY SCHOOL, UGBOR
4	IHWIGHWWU SECONDARY SCHOOL
5	MOSOGAR SECONDARY SCHOOL, MOSOGAR
6	OGHAREFE SECONDARY SCHOOL, OGHARA
7	OGHAREKI MODEL SECONDARY SCHOOL
8	OGINI GRAMMAR SCHOOL, OGHAREKI
9	ONYOBRU SECONDARY SCHOOL, ONYOBRU
10	OREFE SECONDARY SCHOOL, OGHAREFE
11	OREKI SECONDARY SCHOOL, OGHAREKI
12	OSOGUO SECONDARY SCHOOL, OSOGUO
13	OVADE SECONDARY SCHOOL, OVADE
14	UDUAKA SECONDARY SCHOOL, MOSOGAR
15	UDURHIE SECONDARY SCHOOL, MOSOGAR
16	UGBEVWE SECONDARY SCHOOL
17	UKAVBE SECONDARY SCHOOL, OTEFE

- **OKPE LOCAL GOVERNMENT AREA**

S/N	NAME OF SCHOOLS
1	ADEJE SECONDARY SCHOOL, ADEJE
2	ARHAGBA SECONDARY SCHOOL, ARHAGBA
3	UGBOKODO SECONDARY SCHOOL, UGBOKODO
4	BAPTIST HIGH SCHOOL, OREROKPE
5	ST. PETER CLAVERS MODEL COLLEGE. AGHALOKPE
6	BASIC SCHOOL, JEDDO
7	ERADAJAYE SECONDARY SCHOOL, ADAGBRASA-UGOLO
8	ESEZI SECONDARY SCHOOL, UGHOTON
9	OHA SECONDARY SCHOOL, UGHOTON
10	OKENE MIXED SECONDARY SCHOOL, OKUOKOKO
11	ORHUE SECONDAR'Y SCHOOL, MEREJE
12	OVIRI-OKPE SECONDARY SCHOOL, OVIRI-OKPE

- **SAPELE LOCAL GOVERNMENT AREA**

S/N	NAME OF SCHOOLS
1	BASIC SECONDARY SCHOOL (GANA), SAPELE
2	BASIC SECONDARY SCHOOL (OZUE), OKUOVO SAPELE
3	CHUDE GIRLS MODEL SECONDARY SCHOOL, SAPELE
4	ELUME GRAMMAR, SCHOOL, ELUME
5	ETHIOPE MIXED SECONDARY SCHOOL 1, SAPELE
6	EZIAFA SECONDARY SCHOOL, EZIAFA
7	OGIEDI MIXED SECONDARY SCHOOL, SAPELE
8	OKOTIE-EBOH GRAMMAR SCHOOL, SAPELE
9	OKPE GRAMMAR SCHOOL, SAPELE
10	ORODJE GRAMMAR SCHOOL, SAPELE
11	SAPELE TECHNICAL COLLEGE, SAPELE
12	ST. ITAS GIRL'S MODEL SECONDARY SCHOOL, SAPELE
13	ST. MALACHYS SECONDARY SCHOOL, SAPELE
14	UFUOMA MIXED SECONDARY SCHOOL, SAPELE
15	URHIAPELE MIXED SECONDARY SCHOOL, SAPELE
16	ZIK SECONDARY SCHOOL, SAPELE
17	ADAKA GRAMMAR SCHOOL, UGBORHEN
18	BASIC SCHOOL (ETHIOPE) SAPELE

- **UDU LOCAL GOVERNMENT AREA**

S/N	NAME OF SCHOOLS
1	ADADJA SECONDARY SCHOOL
2	ALADJA GRAMMAR SCHOOL, ALADJA
3	EGINI GRAMMAR SCHOOL, EGINI
4	OGBE UDU SECONDARY SCHOOL
5	OGHIOR SECONDARY SCHOOL
6	OKPAKPA SECONDARY SCHOOL
7	ORHUWHORUN HIGH SCHOOL, ORHUWHORUN
8	OTOR-UDU SECONDARY SCHOOL, UDU
9	OVWIAN SECONDARY SCHOOL, OVWIAN
10	OWHRODE MIXED SECONDARY SCHOOL, OWHRODE

UGHELLI NORTH LOCAL GOVERNMENT AREA

S/N	NAME OF SCHOOL
1	ADAGWE GRAMMAR SCHOOL, ERUEMUKOVWO
2	AF1ESERE SECONDARY SCHOOL, UGHELLI
3	AGADAMA SECONDARY SCHOOL, AGADAMA
4	AGBARHO GRAMMAR SCHOOL, AGBARHO
5	ANGLICAN GIRL’S GRAMMAR SCHOOL, UGHELLI
6	ANGLICAN GIRL’S GRAMMAR SCHOOL, UGHELLI
7	ARAGBA SECONDARY SCHOOL, ARAGBA
8	AWIRHE SECONDARY SCHOOL, AWIRHE
9	BASIC SECONDARY SCHOOL, EKREJEBO
10	BASIC SECONDARY SCHOOL, ERHAVWE
11	BASIC SECONDARY SCHOOL, OGUNAME
12	BASIC SECONDARY SCHOOL, OHARISI, UGHELLI
13	EBOR SECONDARY SCHOOL, EBOH-OROGUN
14	EDJEBA SECONDARY SCHOOL, EDJEBA
15	EDJEKOTA SECONDARY SCHOOL, EDJEKOTA
16	EHWERHE GRAMMAR SCHOOL, EHWERRE
17	EKIUGBO SECONDARY SCHOOL, EHWERHE
18	EKIUGBO GRAMMAR SCHOOL, EKIUGBO
19	EKRUOPIA SECONDARY SCHOOL
20	EMONU COMPREHENSIVE HIGH SCHOOL, EMONU
21	ENI GRAMMAR SCHOOL, EVWRENI
22	GIRL’S MODEL SECONDARY SCHOOL, EVWRENI
23	GOVERNMENT COLLEGE, UGHELLI

24	IBRU COLLEGE, AGBARHO
25	IKWEGHWU SECONDARY SCHOOL, IKWEGHWU
26	IMODJE SECONDARY SCHOOL, IMODJE
27	OFUOMA SECONDARY SCHOOL, OFUOMA
28	OGHARA SECONDARY SCHOOL, OGHARA
29	OGOR TECHNICAL COLLEGE, OTO-OGOR
30	OHORO SECONDARY SCHOOL, OHORO-UWHERU
31	OMO SECONDARY SCHOOL, OVARA-OROGUN
32	ORHOEMRHA SECONDARY SCHOOL, UGOWO
33	OROGUN SECONDARY SCHOOL, OROGUN
34	OTOVWODO GRAMMAR SCHOOL, UGHELLI
35	OVIOHU BASIC SECONDARY SCHOOL, OMAVOVWE
36	OWEVWE SECONDARY SCHOOL, OWEVWE
37	ST. THERESA'S GRAMMAR SCHOOL, UGHELLI
38	UNITY SECONDARY SCHOOL, AGBARHO
39	UWHERU GRAMMAR SCHOOL, UWHERU

UGHELLI SOUTH LOCAL GOVERNMENT AREA

S/N	NAME OF SCHOOL
1	ARHAVWARIEN GRAMMAR SCHOOL, ARHAVWARIEN
2	EFFURUN-OTOR SECONDARY SCHOOL, EFFURTJN-OTOR
3	EGBO SECONDARY SCHOOL, EGBO-KOKORI
4	EKAKPAMRE GRAMMAR SCHOOL, EKAKPAMRE
5	EWU GRAMMAR SCHOOL, EWU-URHOBO
6	GBAREGOLOR SECONDARY SCHOOL, GBAREGOLOR
7	OGBAVWENI GRAMMAR SCHOOL, USIEFURUN
8	OGINIBO SECONDARY SCHOOL, OGINIBO
9	OKPARABE SECONDARY SCHOOL
10	OKPARE GRAMMAR SCHOOL, OGINIBO
11	OKUAMA SECONDARY SCHOOL
12	OLOMU SECONDARY SCHOOL, OTORERE-OLOMU
13	OPHQRIGBALA MIXED SECONDARY SCHOOL, OPHORIGBALA
14	ORERE SECONDARY SCHOOL
15	OTOKUTU GRAMMAR SCHOOL, OTOKUTU
16	OTU-JEREMI SECONDARY SCHOOL, OTU-JEREMI
17	OVIRI OLOMU SECONDARY SCHOOL, OVIRI OLOMU
18	OVWOR MIXED SECONDARY SCHOOL, OVWOR,
19	OWAHWA SECONDARY SCHOOL, OTOR-OWAHWA
20	ST. VINCENTS SECONDARY SCHOOL, OKWAGBE

21	UGHEVWEJGHE SECONDARY SCHOOL

UVWIE LOCAL GOVERNMENT AREA

S/N	NAME OF SCHOOL
1	ALEGBO SECONDARY SCHOOL, EFFIJRUN
2	ARMY DAY SECONDARY SCHOOL, EFFURUN
3	BASIC SCHOOL, SEDEKO,
4	BASIC SCHOOL, EKPAN
5	EBRUMEDE SECONDARY SCHOOL, EBRUMEDE
6	EKPAN SECONDARY SCHOOL, EFFURUN
7	OGBE SECONDARY SCHOOL, EFFURUN
8	OHORHE SECONDARY SCHOOL, UVWIE
9	OPETE SECONDARY SCHOOL
10	OUR LADYS MODEL SECONDARY SCHOOL, EFFURIJN
11	UGBOMRO SECONDARY SCHOOL, UGBOMRO
12	UGBORIKOKO SECONDARY SCHOOL, UGBORIKOKO
13	URHOBO MODEL COLLEGE, EFFURUN

Source: Post Primary Board, Asaba. 2011

APPENDIX IV

SAMPLE POPULATION

- **UDU LOCAL GOVERNMENT AREA**

S/N	NAME OF SCHOOLS
1	ADADJA SECONDARY SCHOOL
2	ALADJA GRAMMAR SCHOOL, ALADJA
3	EGINI GRAMMAR SCHOOL, EGINI
4	OGBE UDU SECONDARY SCHOOL
5	OGHIOR SECONDARY SCHOOL
6	OKPAKPA SECONDARY SCHOOL

7	ORHUWHORUN HIGH SCHOOL, ORHUWHORUN
8	OTOR-UDU SECONDARY SCHOOL, UDU
9	OVWIAN SECONDARY SCHOOL, OVWIAN
10	OWHRODE MIXED SECONDARY SCHOOL, OWHRODE

UVWIE LOCAL GOVERNMENT AREA

S/N	NAME OF SCHOOL
1	ALEGBO SECONDARY SCHOOL, EFFIJRUN
2	ARMY DAY SECONDARY SCHOOL, EFFURUN
3	BASIC SCHOOL, SEDEKO,
4	BASIC SCHOOL, EKPAN
5	EBRUMEDE SECONDARY SCHOOL, EBRUMEDE
6	EKPAN SECONDARY SCHOOL, EFFURUN
7	OGBE SECONDARY SCHOOL, EFFURUN
8	OHORHE SECONDARY SCHOOL, UVWIE
9	OPETE SECONDARY SCHOOL
10	OUR LADYS MODEL SECONDARY SCHOOL, EFFURIJN
11	UGBOMRO SECONDARY SCHOOL, UGBOMRO
12	UGBORIKOKO SECONDARY SCHOOL, UGBORIKOKO
13	URHOBO MODEL COLLEGE, EFFURUN

- **OKPE LOCAL GOVERNMENT AREA**

S/N	NAME OF SCHOOLS
1	ADEJE SECONDARY SCHOOL, ADEJE
2	ARHAGBA SECONDARY SCHOOL, ARHAGBA
3	UGBOKODO SECONDARY SCHOOL, UGBOKODO
4	BAPTIST HIGH SCHOOL, OREROKPE
5	ST. PETER CLAVERS MODEL COLLEGE. AGHALOKPE
6	BASIC SCHOOL, JEDDO
7	ERADAJAYE SECONDARY SCHOOL, ADAGBRASA-UGOLO
8	ESEZI SECONDARY SCHOOL, UGHOTON
9	OHA SECONDARY SCHOOL, UGHOTON
10	OKENE MIXED SECONDARY SCHOOL, OKUOKOKO
11	ORHUE SECONDAR'Y SCHOOL, MEREJE
12	OVIRI-OKPE SECONDARY SCHOOL, OVIRI-OKPE