CHAPTER ONE

Introduction

Background to the Study

Mathematics can be defined as the reaction of the human mind to his environment in terms of weight, time, space, distance and so on, in our daily life. Mathematics plays a vital role in every single human activity in our homes, at school, at work places, at market places, and in fact, every human endeavour.

As a logical body of knowledge, mathematics can be used as a guide for arriving at results in a systematic way. It is a way of thinking not only working but also the way the individual plans his activities or schedules. In all, mathematics is a means of sharpening the individual's mind, shaping his reasoning ability and developing his personality hence it's immense contributions to the general and basic education of the people of the world. The basic operations form the basis upon which higher mathematics is developed. Therefore, every aspect of mathematics has an amount of addition and subtraction embodied in it. Calculators and computers, which are now a help to the present generation and advancement of the world today depends largely on the basic operations in mathematics.

Despite the meaningful learning of Browbell (1928) and insightful psychological and learning theories of Piaget (1958), Bruner (1966), Dienes and Golding (1971), Gagne (1968) and Skemp (1979), the learning of mathematics is still far from satisfactory. It is unfortunate to find out that our schools in recent times have turned out several graduates without good mathematical background. All well–meaning parents or guardians are extremely concerned about the academic performance of their wards just because they consider education as an investment in human resources. Many people assess the effectiveness of the educational system conventionally by analyzing the results of the products of the system over the years. The poor performance of the pupils or students in Basic Education Certificate Examinations (BECE) and the Senior Secondary School Certificate Examinations (SSSCE) respectively give parents of guardians cause to complain with a view to identify and rectify lapses in the educational system. Schools with poor performance are denigrated, in the sense that parents or guardians shy away from enrolling their wards in such schools whiles those with good academic performance are generally held in high esteem. For instance in the 1999, Senior Secondary School admission, most parents or guardians rushed their wards to the so called first class schools (academically excellent schools) leaving a huge number of schools recognized as "mushroom schools" unfilled (Daily graphic, January 14, 1999).

The poor performance in mathematics in Ghana came to light in 1992 when a criterion reference Test (CRT) that was conducted for pupils in Basic Schools throughout the country showed that their competence in numeracy was low. However, the poor performance in mathematics at the basic level in Ghana started as far back as 1980s when many teachers in search of greener pastures left the country for Nigeria and some West African countries (Journal of the mathematical Association of Ghana vol. 12. 2000).

It is important to note that, no country can advance without a sound scientific base and mathematics forms the root of science. There is therefore the need to design and adopt strategies that will make the teaching and learning of mathematics, especially the basic operations, interesting at the basic school level of education in Ghana. The researcher who is into the effectiveness of the use of Cuisenaire rods practices at King's Presbyterian Primary School.

The King's Presbyterian Primary is a school in Jasikan in the Jasikan District of the Volta Region of Ghana. The school is situated at the north western part of the town precisely 200 metre from the Jasikan college of Education, JASICO E.Tthe people of Jasikan are known as the "Buem" while their local dialect is known as Lelemi although they learn Twi and Ewe at school. Economically, some of the people are government workers, some engage in commercial activities while the rest take to farming as their main occupation.

Religiously some are Christians, others traditionalist or Muslim, the three major religions in the area.   . Most of the farmers and commercial workers do involve their wards in their respective trades.

Statement of the Problem

The problem of not using effective and learning materials has been identified at the researcher's school of attachment during the out segment of the "In – In – Out" programme, when the Presbyterian School find it difficult to do simple operations such as addition and subtraction. The researcher believes that manipulatines and for that matter Cuisenaire rods when used in teaching and learning of operations would make easier the grasping of the concept by pupil and further enhance their understanding of concept.

Purpose of the Study

The purpose of the study is to examine the effectiveness of the use of Cuisenaire rods in the teaching and learning of mathematics.

Research Questions.

For the purpose of the study is to be established, relevant answers will be sought to the following questions.

(1) What accounts for not using Cuisenaire rods to teach basic operations on whole numbers in king's Presbyterian Primary school?

(2) What are the negative effects of not using Cuisenaire rods to teach basic operations on whole numbers in King's Presbyterian Primary School?

(3) How will the effective use of Cuisenaire rods help improve upon the teaching of basic operation on whole numbers?

Research Hypothesis

This research work will be based on the hypothesis that there will be no significant difference between the mean scores of the pupils in the controlled and uncontrolled.

Significance of the Study

Cuisenaire rods which have been used in teaching the basic operations on whole numbers are almost new to many trained teachers. It is therefore an opportunity for the users of this research to know and have an idea of the simple and attractive material. How to identify the various colours and assign values for the activities that have been explained. In the primary schools each teacher has the tendency of teaching in any other class. Therefore, the use of Cuisenaire rods in teaching the operations will be of immense benefit to the teachers and they will find their task of delivering the lessons on the topic easier, interesting and simpler.

Since the teachers are exposed to the material they will find it easier to assign their own to help the pupils.

Delimitation of the Study

In this work the researcher limits herself to the use of Cuisenaire rods only because these materials are among the most suitable materials for teaching the basic operations on whole numbers. The pupils are familiar with lengths and engage in comparison of lengths of object Moreso, the colours used for the various rods are attractive and can easily draw pupils' attention. The topic of the research covers primary class five.

Limitations

The researcher decided to choose primary class five of Kings Presbyterian an Primary School because the researcher does her attachment in that class and knows the weakness of the pupils.

Organization of the Study

Chapter one of the study presents a brief introduction of the literature, which forms the background information to the organization of the study. It state the problem, the purpose of the study and the research question to be addressed. It also includes the significance of the study, delimitation of the study.

Chapter two focuses on the review of related literature on the proposed area of research.

Chapter three comprises the description of the methodology, type of research, reasons for action research, the materials used in collecting data and the result of the pilot test. It also talks about the data collection processes and procedures used in the study.

Chapter four presents the discussion of interview results, problems from the uncontrolled and controlled administration, intervention of uncontrolled, the analysis of data collected in chapter three and results interpretation.

Chapter five deals with conclusion and recommendations. In this same chapter, the researcher presents the designed controlled questions and uncontrolled questions and suggestions.

CHAPTER TWO

Literature Review

The Basic Operations

According to Macmillan English Dictionary for Advanced learners (2002) basic means forming the main or the most important part of something without which it cannot really exist. Operation is about the way something such as a role or an idea is used. In mathematics, basic operations are ideas or skills that one must know or learn in order to understand or do some calculations.

Crockcroft (1991) reported in his book “Mathematics counts” that the skills of mental and written computation are found on the basic concepts, which need to be developed through the use of structural apparatus and many other activities. The basic concept he identified including the meaning of the operation addition and subtraction are very important when it comes to place values. Reys (1993) observed that a variety of arithmetic properties are to simplify the problem. Reys gave an example as follow. “A pupil described his strategy to multiply 8 by 45 as doubling 45 three times”.

Parling (1985) stated that operations form large part of mathematics and children in Primary Schools spend many hours and even each day dealing with simple operations. This implies that children need to understand the ideas underlying operations. Parling stressed therefore that, it is important to realize that all the simple operations with numbers are based on operations with objects manipulative. Burn (1987) indicated that, children spend their mathematics instructional time on the arithmetic skills of addition and subtraction with emphasis on their mastery of those computational skills

Addition as Mathematical Operation

Bennett and Nelson (2001) stated that children learn addition at an early age by using objects. If 2 bottle tops are put together with 3 bottle tops, the total number of bottle tops is the sum 2+3. The idea of putting sets together, or taking their union, is often used to define addition. Addition is such a natural operation, which is one of the first mathematical concepts taught to children. According to Gerber (1982), in elementary school, examples of simple addition are usually simplistic but mankind must consider them first.

Skemp (1989) also pointed out that there are two different meanings to 'adding' which are physical and mental actions. Skemp illustrated it as follows "when we talk about 'adding' an egg adding to stamp collections we are talking about physical actions with physical objects. When we are talking about 'adding seven'and adding eight – two we are talking about mental action on numbers"

Biggs (1989) said “adding symbol ‘+’ should be understood as putting sets together and saying how many are there together”. Marling (1995) added that children would need much practice in addition before they develop subtractions concepts.

The Basic Addition Facts

Pupils must have acquired the following basic skills before learning the addition algorithms sums of the two one – digit whole numbers up to 9 for example (9 +9 = 18) and sums of three one – digit whole number for example 3+2+4 = 9. With the fundamentals, pupils will now be able to find the sum of any two numbers of two digit and later more numbers of several digit (Kalejaiye 1990).

A few fundamental properties for operations on whole numbers are so important that they are given special names. Here, four properties of addition are introduced.

1. Closure property for addition – if one is able to select any two whole numbers their sum will be another unique whole number. This fact is expressed by saying that the whole numbers are closed for addition. The word unique means one and only one, and is an important condition because it guarantees that there is only one sum for any two whole numbers. The word close indicates that when an operation is performed on two numbers for a given set , the result is also in the set rather than outside the set. The idea of closure property for addition is not closed. For example if we select any two numbers from the set of odd numbers {1,3,5,7…}, their sum is not another odd number. So the set of odd numbers is not closed for addition. For instance 5+7 = 12.

2. Identity property – among the whole numbers is a very special number zero. Zero is called identity for addition because when it is added to another there is no change in the

result. That is adding number to any number leaves the identity of the number unchanged. For example 0 + 9 = 9, 17 + 0 = 17, 0 + 0 = 0 etc.

3. In any sum of three numbers the middle numbers may be added to (associated with) the first or the last two numbers and yet the total remain the same. For example (9 + 8)+ 7 = 9 + (8 + 7). This property is called the associative property for addition.

4. Communicative property for addition – when two numbers are added, the numbers may be interchanged without affecting the sum. For example 10+2 = 2+10 =12, For the sum of 9+15 =24.

Subtraction as a Mathematical Operation.

According to Macmillan English Dictionary for Advanced Learners (2002), subtraction is the process of removing one number or amount from another. That is, taking a number or amount from another number or amount. The symbol for this is "---" and is called a minus sign (to take away part of something). Subtraction is usually explain as the taking away of a subset of objects from a given set. Subtract literally means to draw away from under. The process of taking away or subtraction may be thought of as the opposite of the process of putting together or addition. Because of this dual relationship subtraction and addition are called inverse operations. This relationship is used to define subtraction in terms of addition (Bennett and Nelson 2001).

According to Kalejaiye (1990), subtraction of numbers can be illustrated by the removal of number of object from a group of objects. He illustrated it with the following statements:

1. There are ten (10) birds, five (5) run away, how many are left?
2. There are 13 bottles, and one is broken, how many are not broken?

Basic Subtraction Facts

The definition of subtraction says that we can calculate the difference 17 – 5 by determining the missing addend, which is, finding the number that must be added to 5 to give 17. Subtraction arises from three distinct sets of actions which occur in problems. Each of these situations is solved using the operation of subtraction (Martin, 1995 and Bennett and Nelson, 2001). Bennett and Nelson (2001) illustrated the three concepts as follows:

1. Take away concept: Suppose that these are five oranges and given away, how many oranges will be left?
2. Comparison concept: Suppose that you have 12 oranges and someone else have 7 oranges. How many more oranges do you have than the other person? In this case, we compare one collection to another to determine the difference.
3. Missing Addend Concept: Suppose that you have 7 oranges and you need to obtain 12 oranges. How many more oranges are needed? In this case we count up from 7 to 12 to determine the missing addend. After developing the idea of subtraction through varied experienced, pupils should be given practice on doing subtraction and recording their results in symbols. Kalejaiye (1990) stated that these results of

addition problems should be related to the result of addition problems in other to assist pupil learn the subtraction facts easily. For instance, the addition and subtraction facts which relayed to 3, 5 and 8 are:

3 +5=8	8-5 = 3
5 + 3 8	8-3 = 5

Parling (1985) recommends planned activities to help pupils to understand and use the two operations (addition and subtraction). The two stages, he suggests are:

1. Addition with totals up to 10 with subtraction which bring in numbers from 11 to 18 may involve the idea of place value but no techniques such as "carrying" or the use of "decomposition" or "equal" addition are necessary. These become necessary only when operations involving numbers from 20 onwards are introduced.

Teaching – Learning Material in Mathematics

Teaching and learning materials contribute a lot to pupils understanding of mathematics. All educators recognize the need of sensory materials in mathematics learning (Felor and Philips, 1972). In the handbook of suggestions for teachers published in 1937 by the Board of Education and quoted in the book "Mathematics Counts". It is stated, "the use of teaching and learning materials by way of introduction should come practical and oral to give meaning to, and create interest in the view of arithmetical conception of the child. In his own experience he gains confidence in dealing with it, by establishing in his mind correct notions about the numerical and quantitative relation involved in the operation.

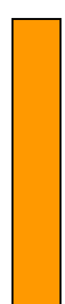
Grossinckle (1983) and Carpenter (1993) added encouragement to the use of approaches to mathematics based on practical experience by stating that children must be given the opportunity to work with manipulative hands on materials in mathematics lessons. Some of the manipulative materials for mathematics teaching; listed include place value chart, based on ten block and Cuisenaire rods.

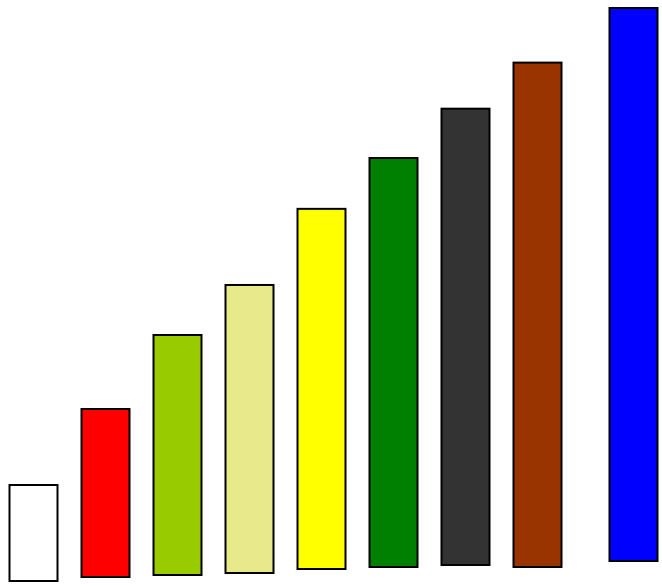
Cockcroft (1991) reported that, mathematics teaching based on practical experience has a beneficial effect both in improving children's attitudes towards mathematics, and also in laying the foundations of better understanding and helping to attain a secure and rapid recall of basic concepts.

John (1958) and Martin (1995) stressed that for effective work in mathematics, teachers need to draw upon a variety of resources for their lesson "On the whole then most children find it not too difficult to connect together the concrete situations and pictures that go with the language and symbols of operation" (Haylock and Cork, 1989)

Cuisenaire Rods

Cuisenaire rods are collection of rectangular rods, each of a different colour and size. The smallest rod is 1cm long and the longest rod is 10cm long. They are made of wooden or plastic rods. The colours are White, Red, Light Green, Purple, Yellow, Dark - Green, Black, Brown, Blue and Orange. The rods showing their lengths and colours are shown below.





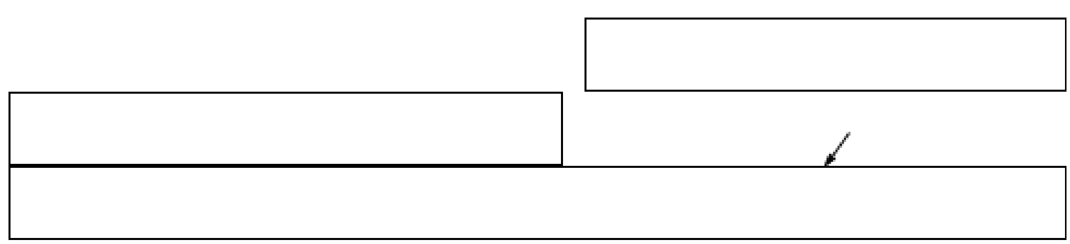
Cuisenaire rods were compiled or developed by Doug Brumbaugh college of education, University of Central Florida, Orlando: Activities will help us become familiar with the Cuisenaire rods. The study of mathematics should begin by observing and discovering relationships. This implies that physical objects are manipulated to some level, which is what we will do with the rods. Most of these examples will not be defined by grade because the basic activities are necessary as an introduction to the rods regardless of the grade in which they are introduced. The transaction from these activities to the abstractions and algorithms is a slow process that should be considered carefully. Here we deal with concrete things. The objectives of developing the Cuisenaire rods are numerated below. Pupils will:-

1. Be able to correctly identify the numerical value of each rod assuming the white rod is considered the unit.
2. Be able to correctly show the basic operations (addition and subtraction) on whole numbers with the rods.

3. Be able to demonstrate the rod comparisons for both proper and improper fractions where white may not be the unit.
4. Correctly show the basic operations on rational numbers with the rods where white may or may not be the unit.
5. Do some geometry related activities with the rods and
6. Do some number theory activities with the rods.

According to Martin (1995) Cuisenaire rods are useful for developing the concept of addition. Pupils learn to associate the colours of the rods with her numbers much more quickly than adults and surprisingly some pupils actually find adding with the rods easier and quicker than adding with sets.

Gerber (1982) observed that, putting a train of rods along another train of rods that they match at one end could perform subtraction using Cuisenaire rods. Train of rods that fit along the remaining section of the longer can be found. This train of rods represents the difference as shown below.



(Orange + Yellow) – Black = Brown that is (10 + 5) = 15 – 7 = 8

Biggs and Sutton (1983) are with the view that Cuisenaire rods can be very useful in helping pupils to understanding the concept of addition. They therefore advised that the rods should be used in the early stages because pupils need first to experience as the addition of sets containing the same number of objects. Martin (1995) again stated that, Cuisenaire rods can be used for representing subtraction as take away but quite so suitable for representing borrowing.

Mathematics Teaching Strategies

Kanchak and Eggen (1989) point out that “Education has always been of the most rewarding professions but at the some time, it continues to be one of the most difficult in which to perform well. An effective teacher combines the best of human relations institution sound judgment, knowledge of subject matter and knowledge of how pupils learn : - all in one simultaneous act. Teaching as we know, is a profession and we may describe it as an art or a science. As a profession, one of it’s main characteristics is the possession of a body of knowledge and ability to apply the knowledge in the classroom.

For effective teaching and learning of mathematics at most levels particularly at primary school level for better understanding of concepts. Harling (1991) suggestion and outlined the following:

1. Problem solving including the application of mathematics of everyday situation. Problem is a challenging question or statement presented in such a way that learners accept the change. Problem solving therefore is the process of accepting a challenge and striving to resolve it in the mathematics classroom to assess pupils understanding of the topic taught.

2. Consolidation and practice of fundamental skills and routines.
3. Appropriate practical work.
4. Investigation work.
5. Discussion between teacher and pupil.
6. Exposition by the teacher.

In this chapter, the literature review has pointed out the appropriateness of the Cuisenaire rods for development of basic concepts on whole numbers and the uniqueness of basic operation on whole numbers at the primary level. The approaches have been exposed for effective teaching and learning of mathematics in the primary schools. Emphasis is also laid on understanding and relationship rather than on facts. The areas, which normally pose problems to pupils understanding, have been indicated.

CHAPTER THREE

Methodology

This chapter contains the research techniques and methods used in the study. It also deals with the sampling measures, research design and the instruments used in collecting data (controlled and uncontrolled)

Research Designing

The researcher adopted two designs:- the experimental design, (controlled and uncontrolled) and interview guide to interview the class teachers.

Sample

The accessibility population in this research work is primary five a class of twenty pupils, nine (9) girls and eleven (11) boys whose ages were between ten and twelve years. The researcher used purposeful sampling which was all the pupils in the class. Ten pupils for uncontrolled and ten pupils for controlled.

Uncontrolled

The uncontrolled aimed at finding out the behaviour or the ability of the pupils in the terms of their understanding of the basic operations on whole numbers. Since the project covers the upper primary class five and has a specific objective ten (10) general problems or questions that could be answered by the pupils were written on the chalkboard for the pupils to provide answers to.

The test was administered to the class of 10 pupils. The class teacher assisted in the arrangement of the pupils' tables and chairs and the distribution of the answer sheets provided by the researcher. Each pupils had his / her own table and chair to avoid talking to and copying from each other. The test items were explained to pupils before they started. Sufficient working time was allowed to enable each pupils to complete his or her work after which they had finished was collected for marking and recording of scores.

Preamble

During the preparation of the lesson notes, references were made to the Teacher's handbook. Mathematics syllabus for primary schools and pupil's textbook five (Primary Mathematics series) Cuisenaire rods were the only structured apparatus used.

Week One

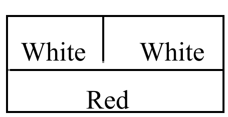
As an introduction, the researcher and the classteacher distributed the Cuisenaire rods to pupils in groups. The researcher guided the pupils to identify the various rods, their lengths, colours and unit values through the following steps:

Sept 1.

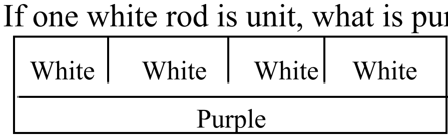
Free play: the researcher asked the pupils to play with the rods, build towers, arrange the rods to represent letters and explore the relationships between the rods.

Step 2.

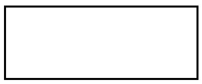
Beginning formal work: the researcher asked pupils form a train of two or more rods, not necessarily the same colour, placed them end – to – end in a straight line. If white rod is the unit, what does red rod represent? How would you show this? The researcher guided pupils to make a train out of two white rods and show this train is the same length as a red as shown below.



If one white rod is unit, what is purple?

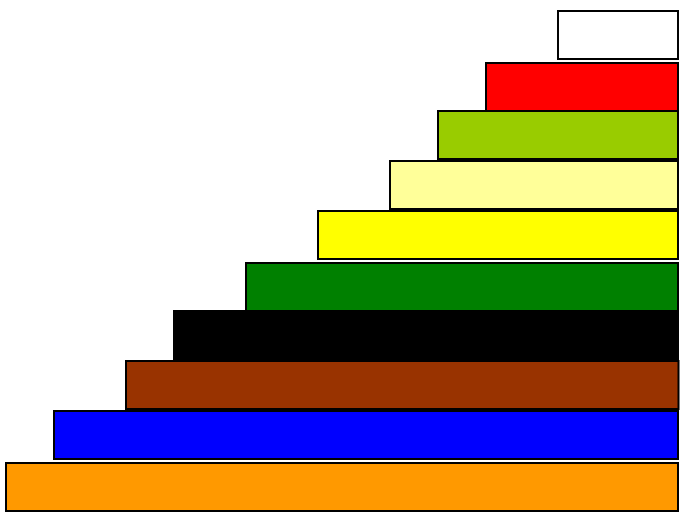


The researcher asked pupils to proceed similarity for each colour rod and determine its numerical value when white rod is the unit. When red is two units what is purple? for other colours as the unit



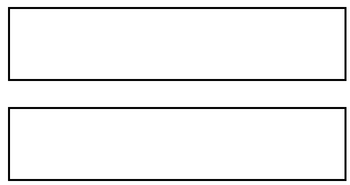
Step 3

Pupils were asked to build a staircase with the rods on their table. Noticing the relationships between the various colours and length with the shortest rod first to the longest rod, as shown below as shown below:



From the activities pupils identified that each rod in one white or one unit can be a number of times in the rods below (shortest to longest). Two white rods is equivalent to one red rod. Ten white rods is equivalent to one orange rod and so on. Pupils were asked to use the white rod as one unit, red rod as two units and so on to assign values to the rods.

Pupils answered few questions to test their understanding. For example “ how many red rods are equal in length to one rod of orange ?” pupils answered, “ five of red rods make equal length of one orange rod,” as shown below:



LESSON 1.

ADDITION OF WHOLE NUMBERS (TOTAL 10)

The objectives were to help pupils do simple addition by putting two or more addends together to get the sum and can also reverse the order of the pairs of numbers and add them. Though addition operation on whole numbers was not new to the pupils but from the uncontrolled analysis the researcher realized the need to start from the lower level to benefit everybody in the class.

ACTIVITY 1.

Pupils in groups of five members were asked to select any two rods, join the rods, end – to – end and find a single rod that would be equal in length to the joined rods together. Pupils discussed their findings with the researcher. For example, a group joined a light green rod and a black rod to have it equal in length to an orange rod (3 + 7 = 10),as shown below;

Pupils were given the opportunity to repeat the activity with different pairs of rods and record the results accordingly. For example, a brown rod and a red rod give an orange rod (8 + 2 = 10) as shown below

ACTIVITY 2: Reversibility of addition.

In this activity pupils were asked to repeat activity one of lesson one by reversing the order of the pairs of the rods as used in activity one and compare the results. For instance, a light green rod and black rod joined to have an orange rod and its reverse. Pupils, identified from the activities that there were two arrangements for every combination in solving addition, as shown in the diagrams below:

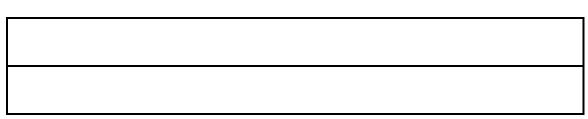
(i)  3 + 7 = 10

 7 + 3 = 10

Pupils repeated activities with other rods.

ACTIVITY 3

Pupils were asked to combine three rods or more and find a single rod that could be equivalent to the combination. For instance, make a train of one white rod. One purple and one yellow rod to have an orange rod.



Pupils repeated this activity with different rods to have a single rod. As a way of evaluation pupils were given homework.

LESSON 2

NUMBER PATTERN

The objective was to assist pupils to use Cuisenaire rods to form number patterns and extend the reversibility to learn other difficult combinations such as 2 + 8, 3 + 7, 4 + 6.

ACTIVITY 1

With the knowledge or ideas pupils had acquired in lesson one pupils were demanded to choose a number from 1 to 10 and Cuisenaire rods to find all the possible combinations of numbers which would make up the chosen number. As shown in the diagrams below:

0 + 8 = 8
1 + 7 = 8
2 + 6 = 8
3 + 5 = 8
4 + 4 = 8
5 + 3 = 8
6 + 2 = 8
7 + 1 = 8

During this lesson a lot of ideas were discovered which include addition of equal numbers, for example 4 + 4 = 8, 5 + 5 = 10 idea of reversibility. (1 + 7 = 8 = 7 + 1, 3 + 5 = 8 = 5 + 3 …..,) and idea of addition of 1 (1 + 7, 1 + 9)

ACTIVITY 2

Pupils were asked to write pairs of whole numbers from 1 to 10 where their sum would be equivalent to the sum of the given pairs. For example, 1 + 8 = 3 + 6 = 4 + 5 = 2 + 7. Pupils were given class exercises to do individually. Work was marked and recorded in pupils exercise books.

LESSON 3

Extension of Addition of Whole Numbers (to 9+9).

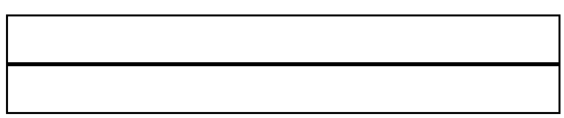
Objectives

To assist pupils use Cuisenaire rods to do addition of pairs numbers whose sums are greater than ten.

To discover additional facts for easy memorization.

ACTIVITY 1

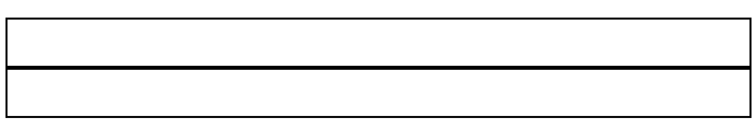
Pupils were asked to solve “5 + 6” using Cuisenaire rods. Some of the groups struggled with whilst others did it with less difficulty. Pupils were advised to make a train with the specific rods and compare with a ten – unit rod and any other suitable rod that would make up the length as shown below.



5 + 6 = 10 + 1 =11

Pupils were asked to solve specific problems, for example 7 + 7, 8 + 6, 9 + 8, 5 + 9, 9 + 9 to solve using the activity as in diagram below.

7 + 7 = 10 + 4 = 14



The activity was repeated with different pairs of numbers whose sums are beyond ten.

ACTIVITY 2

Number pattern followed the same strategy as in activity one. At this stage, the use of Cuisenaire rods was limited to sum 18.

For instance.

18 = 0 + 8	18 = 7 + 11
18 = 1 + 17	18 = 8 + 10
18 = 2 + 16	18 = 9 + 9
18 = 3 + 15	18 = 10 + 8
18 = 4 + 14	18 = 11 + 7
18 = 5 + 13	18 = 12 + 6
18 = 6 + 12	18 = 13 + 5

Finally, pupils solved the following addition problems as assignment.

1. $9 + \boxed{} = 18$
2. $10 + \boxed{} = 15$
3. $12 + 8 = \boxed{}$
4. $11 + 8 = \boxed{}$
5. $\boxed{} + 13 = 18$

6) $\begin{array}{r} 1\quad 3 \\ +\quad\ \ 7 \\ \hline \\ \hline \end{array}$

Week Two

Week two as devoted to the study of subtraction of whole numbers less or equal to ten.

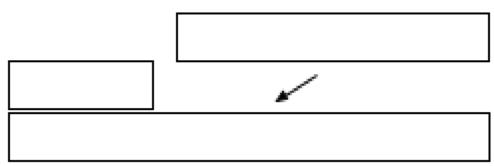
LESSON 1

Subtraction of whole Numbers less or Equal to Ten.

In this lesson relationship between addition and subtraction was emphasized. The objective of the lesson was to help pupils to use Cuisenaire rods to find missing addends in a given sentence. Then also to subtract a number from another which is less or equal to ten.

ACTIVITY 1

The researcher started this activity by asking pupils in groups to put for example a rod of 6 units and a rod of 2 units side by side on their tables. The researcher then asked the pupils to find a rod which could be put end – to – end with the 2 unit rod, so that the two together would be of the same length as the 6 unit rod. Pupils discovered that they needed a 4 – unit rod, this was recorded as 2 + 4 = 6, shown below.



Pupils using different combination of numbers repeated this activity.

ACTIVITY 2

Upon activity 1, the researcher asked pupils which rod was not there initially. Pupils responded as 4 unit rod (purple). Where was it? Pupils answered that it was missing. The researcher then suggested that a "box" ($\boxed{}$) should be used in place of the missing number in the addition fact. This was recovered on the chalkboard as $2 + \boxed{} = 6$. The researcher said that by counting on, this can be represented as $2 + \boxed{4} = 6$ and by counting back, this can be represented as 6 – 2 = 4. The researcher then discussed with pupils other relationships that could be written using 2, 4 and 6 as follows.

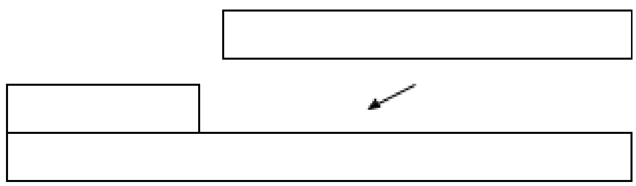
2 + 4 = 6

6 – 2 = 4

6 – 4 = 2

ACTIVITY 3

Pupils were asked to compare two unequal rods, find the missing rod that will be joined to the shorter to be equal in length to the longer rod and record this as a subtraction fact.



10 + 4 = 6

This activity was repeated for many other examples.

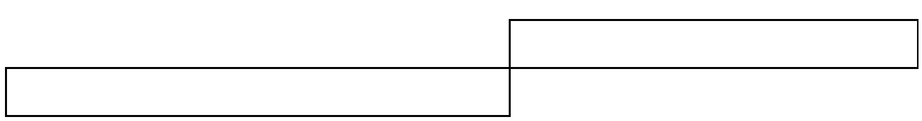
LESSON 2

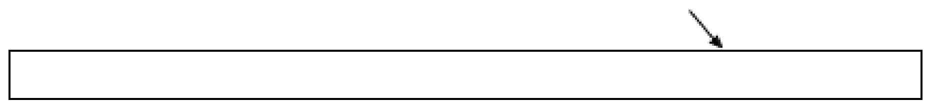
Extension of Subtraction.

As pupils understand subtraction with smaller numbers, the activities described earlier were extended to cover larger numbers. The aim of the lesson was to assist pupils learn subtraction facts.

ACTIVITY 1

Pupils were asked to join two rods end - to – end, compare it with a brown rod (8 – unit rod) and record the result they had.





18 + 8 = 10

Pupils were asked to repeat this activity with other rods.

ACTVITY 2

Number patterns were studied in their activity to help pupils learn about subtraction facts, as follows:

9 – 1 = 8	10 – 1 = 9	18 – 1 = 17
9 – 2 = 7	10 – 2 = 8	18 – 2 = 16
9 – 3 = 6	10 – 3 = 7	18 – 3 = 15
9 – 4 = 5	10 – 4 = 6	18 – 4 = 14
9 – 5 = 4	10 – 5 = 5	18 – 5 = 13
9 – 6 = 3	10 – 6 = 4	18 – 6 = 12
9 – 7 = 2	10 – 7 = 3	18 – 7 = 11

As evaluation, the lesson was concluded with exercise on the chalkboard for pupils to write within ten minutes.

1. 10 – 2 = $\square$
2. 19 – 10 = $\square$
3. 11 – 6 = $\square$
4. 15 – 5 = $\square$
5. 18 – 8 = $\square$
6. 17 – 2 = $\square$

7. $18 - 5 = \boxed{}$

8. $12 - 4 = \boxed{}$

9. $16 - 3 = \boxed{}$

10. $19 - 4 = \boxed{}$

Controlled

There was an administration of controlled in the following week. Its objective was to find out if the interventions had the desired effect on pupils? Understanding of basic operations on whole numbers. Ten test items similar to the uncontrolled items were constructed.

Ten pupils took part in the test. Pupils were provided with plain sheets as answer sheet. Pupils were allowed 30 minutes. Questions were printed and given to pupils. Both classteacher and the researcher supervised the activity. The answered sheet was collected from the pupils at the end of the test and was marked and the scores were recorded for analysis.

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CHAPTER FOUR

Results and Findings

This chapter is devoted to the analysis of the interview, the controlled and uncontrolled. Problems encountered during the administration of controlled and uncontrolled and interventions.

Analysis of Interview Result

As a way of finding out how conversant the teacher of the selected class was with the use of Cuisenaire rods in teaching the basic operation (addition and subtraction) involving whole numbers, the researcher interviewed the classteacher. The researcher asked nine questions which the classteacher responded to. The detailed analysis is shown below. The letters “Q” and “R” denotes questions and responses respectively as shown below.

Q1: Are you a trained teacher?

R: Yes.

Q2: how many years have you been teaching as a trained teacher?

R: fifteen years.

Q3: How many years have you taught in the upper primary class five?

R: four years.

Q 4: How have you found the performances of your pupils in the basic operations involving whole numbers?

R: Pupils find it difficult performing the basic operation of subtraction.

Q5: Do you use any teaching and learning materials in teaching basic operations involving whole numbers? If yes, which are regular ones? If no why.

R: Yes, bundles of sticks, abacus and bottle tops.

Q6: Have you ever used Cuisenaire rods to teach basic operations? If yes, how do you normally do it? If no, why?

R: No because I am not conversant with the use of Cuisenaire rods.

Q7: Were you taught how to use Cuisenaire rods when you were in Training college?

R: Yes, but it was taught theoretically not practically.

Q8: Do you need any assistance in the use of Cuisenaire rods in teaching basic operation (addition and subtraction involving whole numbers).

R: Yes.

Q9: Do you think pupil's understanding of basic operations on whole numbers has any positive effect on pupils learning mathematics? How?

R: Yes, because learning mathematics depends on the effective use of the basic operations. Thus it will help pupils to understand other concepts.

Discussion of Interview Result.

From the interview, it is well known that the classtecher is trained and has taught for fifteen (15) years which he had gained some amount of experience in the profession but had taught in the upper primary class five for four years which also indicated that he had acquired little experience in the primary five class.

He said pupils find it difficult performing the basic operations of subtraction. The classteacher said the only teaching and learning materials he has being using involving basic operations is bundles of sticks, abacus and bottle tops. This is because he is not conversant with the use of Cuisenaire rods since he was taught practically in the Training College.

The class teacher said that learning mathematics depends on the effective use of the basic operations. This helps other pupils to understand other concepts. This identifies that the classteacher was aware of the sensitivity of the basic operations.

Problems from the Uncontrolled Administration.

The researcher encountered few problems during the administration of the questions, which include:

1. A number of pupils could not write their names on the answer sheet given to them.
2. A number of pupils could not write legibly.
3. Few pupils did not have writing materials like pencil and pen.
4. Pupils rushed to submit their work while they had not completed the exercise.
5. Some pupils could not solve any of the problems.

Intervention

Having finished marking and analyzing the results, the researcher revisited the class with interventions. He had ten lessons with the pupils on the basic operations (addition and subtraction) on whole numbers more than or equal to 18. He used well – prepared lesson notes as guided for effective and sequential presentation. Having used two weeks for the intervention only. The researcher had three contact days with 60 minutes duration each for a lesson. In the first and the second week, he had two contact days with 60 minutes time duration each. A number of topics were treated during the intervention era.

The researcher adopted activity–oriented approach. The pupils performed the activity in groups of five members each. Pupils were evaluated at each stage of instruction. Exercised were conducted and marked in the classroom. He used the pupils performance to evaluate the objects for the lessons. Additional work from textbook were given to pupils as homework for consolidation of work

Controlled Problems Encountered

During the controlled period, there was not much problem encountered, things were successful but pupils did not come early for the commencement of the test. The day considered with one for sport so pupils felt reluctant to come for the test.

The classteacher has to go round calling pupils for the test.

Analysis of Uncontrolled and Controlled scores.

The uncontrolled and controlled scores were analysed in order to test the stated hypothesis of the researcher's work. Below are the tabulation of the scores, the analysis and the interpretation of scores (See appendix G).

Table 1:

The Uncontrolled and Controlled Scores Obtained by the Pupils

Pupils Serial No.	Uncontrolled Score (X)	Controlled
Scores (Y)		
1	2	7
2	3	8
3	5	7
4	4	8
5	3	6
6	2	8
7	2	9
8	3	10
9	6	10
10	9	10

Table 2:

Uncontrolled		Controlled	
Scores (x)	No. of Pupils/ Frequency Pupils Frequency	Scores (y)	No. of
0	2	0	0
1	1	1	0
2	1	2	0
3	1	3	0
4	1	4	0
5	2	5	0
6	0	6	1
7	1	7	2
8	1	8	2
9	0	9	2
10	0	10	3

The scores were recorded according to pupils serial numbers in the class. The scores of each pupil in the uncontrolled and the controlled are shown in table 1 in the columns marked ‘x’ and ‘y’ respectively. Table 1 indicates that ten (10) pupils for controlled and uncontrolled and ten (10) items were used, which were marked in the uncontrolled was zero (0) while the greatest mark scored was two (as shown in table 2). 5 pupils scored from two to five (5) which constitute 50%. Also three pupils constituted 20% scored above five (5). The most frequent scores were one and two (1 and 2).

In the controlled, the least score was 6 and the maximum was 10. Majority of the pupils scored from seven to ten which constituted 90%. This was an improvement over the uncontrolled and controlled which was 3.5 and 8.4 respectively. The mean difference was 4.9. The test statistics used to calculate the difference between the means was the t – test for non – independent groups. The computation of 't' was done using the statistical formula.

$$t\,c = \frac{\frac{d}{sd}}{\sqrt{N - 1}} \qquad \text{where}$$

N = numbers of pupils or sample size.

D = mean difference between uncontrolled and controlled scores.

SD = standard deviation of the difference, and

tc = computed – t.

$$d = \frac{\sum d}{N}$$

$$SD = \frac{\sqrt{\sum (d - d)^2}}{N}$$

Results interpretation

The researcher had computed – t as 8.17 (as shown in appendix F). The t – critical with a degree of freedom of 9 at 0.05 level of significance (5%) was 2.034. Since the calculated t at 5% level of significance was more than the t – critical. There was significant difference in the performance. Hence the null hypothesis must be rejected.

The improvement in the pupils' performance could be attributed to the effective use of Cuisenaire rods and the active involvement of the pupils in the intervention activities.

With the above interpretation, the researcher could deduce that if Cuisenaire rods are effectively used in the teaching and learning of basic operations on whole numbers, pupils understanding on the concept of numbers and operations could be improved.

CHAPTER FIVE

Summary, Conclusion and Recommendations

This chapter contains a summary of the project, where it was conducted, the sample, how the data was collected and analyzed. It ends up with conclusions and recommendations.

Summary

The research was conducted to introduce an effective way of using Cuisenaire rods in the teaching and learning of basic operations (addition and subtraction) involving whole numbers. The researcher used King's Presbyterian Primary five pupils at Jasikan for the study.

To compare pupils performance uncontrolled questions were designed for pupils to answer. A two weeks intervention was organized for pupils using Cuisenaire rods to solve basic operations (addition and subtraction) involving whole numbers. The researcher identified the following:

1. In the course of the intervention, pupils developed interest in the use of Cuisenaire rods to solve problems on the basic operations (addition and subtraction)
2. The classteacher did not use enough teaching and learning materials to teach the basic operations involving whole numbers.

3. The classteacher was not conversant with the use of Cuisenaire rods in teaching basic operations especially with subtraction aspects of whole numbers.
4. The post-test scores showed an improved performance of the pupils in the operations on whole numbers.

Conclusion

The researcher concludes from the study that if teachers use Cuisenaire rods effectively in teaching basic operations on whole numbers and other basic concepts in mathematics, pupil's interest in mathematics will aroused. Results obtained from the analysis of the uncontrolled and controlled showed that there was a significant difference in the pupils performance in the post-test.

Recommendation and Suggestion

Teacher trainees in the Training College should be introduced to the preparation and the use of Cuisenaire rods as one of the teaching and learning materials in mathematics. A course in "Instructional material preparation and development" should be introduced in the first semester of the second year training programme. This should be assessed according as they go out for their out segment in order to become conversant with the use of Cuisenaire rods. Teaching at the Training Colleges should also be practical oriented and not solely theoretical.

Periodic-in-service education and training should be organized for teachers in the field to upgrade their knowledge and skills on the use of certain teaching and learning materials which the teachers are not conversant with.

Education service should establish resource centres in every circuit so that teachers can easily learn how to prepare and borrow the needed materials for effective teaching and learning of mathematics. Teachers should use various materials or models for teaching the same topic or concept and this would offer every pupil in the class the opportunity to grasp the concept. A mathematics specialist should be attached to each circuit to supervise the performance of teachers in mathematics teaching in the various schools. This would help identify the needy teachers as far as the teaching of the mathematics is concerned and the appropriate remedy should be provided immediately.

Textbook writers should ensure that their products communicate the methods they intend teachers to use in the delivery of the content they put in their materials. They should collaborate with educational technologists in designing packages of structured instructional materials needed for teaching the various mathematical principles and facts. The absence of materials, teachers would continue to resort to the expository methods with which they are familiar.

The researcher hopes that the few suggestions and recommendations will be given the necessary attention so that the teaching of basic operations (addition and subtraction) on whole numbers and mathematics as a whole will be improved.

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APPENDIX A

Uncontrolled Questions

SCHOOL: KING'S PRESBYTERIAN PRIMARY

NAME: ………………………………………..

CLASS: ………………………………………..

AGE: …………………………………………..

1. $17 + 7 = \boxed{}$
2. $\boxed{} = 18 + 8$
3. 16

   \- 10

4. 19

   +9

6. $15 - 2 = \boxed{}$
7. $12 - 4 = \boxed{}$
8. $20 - 5 = \boxed{}$
9. $18 + 3 = \boxed{}$
10. $15 - 1 = \boxed{}$

5. 17

- 11

Appendix B

Controlled Questions

SCHOOL: KING'S PRESBYTERIAN PRIMARY

NAME: …………………………………………..

AGE: …………………………………………

1. 9 + 9 = $\boxed{}$

2. 21 + $\boxed{}$ = 31

3. $\boxed{}$ = 18 - 7

6. 12

+ 3

7. 20 – 5 = $\boxed{}$

4. 10

 - 9

______

8. 18 + 9 = $\boxed{}$

9. $\boxed{}$ = 11 - 5

5. 8 + 4 = $\boxed{}$

10. 25 + $\boxed{}$ = 33

APPENDIX C

Uncontrolled Response

School: KING'S PRESBYTERIAN PRIMARY

NAME: …………………………………………

Class: Five

Age: Eleven

1. 17 + 7 = $\boxed{}$

6. 15 – 2 = $\boxed{15}$

7. 12 – 4 = $\boxed{10}$

2. = $\boxed{12}$ 18 + 8

8. 20 – 5 = $\boxed{15}$

3. 16

- 10

20

4. 19

+ 9

19

5. 17

- 11

9

9. 18 + 3 = $\boxed{20}$

10. 15 – 1 = $\boxed{14}$

Appendix D

Controlled Response

SCHOOL: KING'S PRESBYTERIAN PRIMARY

NAME: Obeng Olando

CLASS: Five

Age: Ten

1. 9 + 9 $\boxed{18}$

2. 21 + $\boxed{10}$ = 31

6. 12

+ 3

3. $\boxed{11}$ = 18 – 7

4. 10
 - 9
______

5. 8 + 4 = $\boxed{12}$

7. 20 – 5 = $\boxed{15}$

8. 18 + 9 = $\boxed{27}$

9. $\boxed{6}$ = 11 - 5

10. 25 + $\boxed{8}$ = 33

Appendix E

Interview Questions Guide

SCHOOL: KING'S PRESBYTERIAN PRIMARY

CLASS : ………………………………

AGE : ……………………………….

1. Are you a trained teacher?

   ………………………………………………………………

2. How many years have you been teaching as a teacher?

   ………………………………………………………………..

3. How many years have you taught in the upper primary class five?

   ……………………………………………………………………

4. How have you found the performance of your pupils in the basic operation (addition and subtraction) involving whole numbers?

   ………………………………………………………………………

5. Do you use any teaching and learning materials in teaching of basic operations (addition and subtraction) involving whole numbers?

   ………………………………………………………………………………………

   ………………………………………………………………………………………

6. Have you ever used Cuisenaire rods to teach basic operation involving whole numbers? If yes, how do you normally do it? If no why?

   ………………………………………………………………………………………

   ………………………………………………………………………………………

7. Were you taught how to use Cuisenaire rods when you were in Training College?

   ………………………………………………………………………………………

8. Do you need my assistance on the use of Cuisenaire rods in teaching basic operations on whole numbers?

   …………………………………………………………………………………….

9. Do you think pupils understanding in basic operations on whole numbers have any positive effect on pupils learning mathematics? How?

   ………………………………………………………………………………………

   ………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

Appendix F

Response to Interview Questions Guide

SCHOOL KING'S PRESBYTERIAN PRIMARY

TEACHER'S NAME : Ohene Kingsley

CLASS : Five

AGE : Twenty – eight

1. Are you a trained teacher? …………Yes…………….

2. How many years have you been teaching as a trained teacher? …
   Fifteen years
3. How many years have you taught in the upper primary class five?
   ……………Four years…………………………
4. How have you found the performance of your pupils in the basic operation (addition and subtraction) involving whole numbers? …Pupils find it difficult performing the basic operations of subtraction
5. Do you use any teaching and learning materials in teaching of basic operation (addition and subtraction) involving whole numbers? …………Yes……………
   If yes, which are the regular ones? Yes, I use boundless of sticks, abacus and bottle tops. If no why? ……………………………………………………………
6. Have you ever used Cuisenaire rods to teach basic operation involving whole numbers?   If yes, how do you normally do it? If no, why? No, because I am not conversant with the use of Cuisenaire rods
7. Were you taught how to use the Cuisenaire rods when you were in Training College? Yes, but it was taught theoretically
8. Do you need any assistance on the use of Cuisenaire rods in teaching basic operations on whole numbers? Yes
9. Do you think pupils understanding in basic operations on whole numbers have any positive effect on pupils learning mathematics? If yes how?
   Yes, because, learning mathematics depends on the effective use of the basic operations. Thus it will help pupils to understand other concepts.

Appendix G

Calculation of the Means

Ps Serial No.	Uncontrolled (X)	Controlled (Y)	Diff. of (Y-X) =d	Diff. of Means (d-d)	(d – d) 2

1	2	7	5	0.1	0.01
2	3	8	5	0.1	0.01
3	5	7	2	-2.9	8.41
4	4	8	4	-0.9	0.81
5	3	6	3	-1.9	3.61
6	2	8	6	1.1	1.21
7	3	9	6	1.1	1.21
8	4	10	6	1.1	1.21
9	6	10	4	-0.9	0.81
10	9	10	1	-3.9	15.21

Uncontrolled test mean = $\frac{\sum (x)}{N} = \frac{35}{10}$

$= 3.5$

Controlled test mean $= \frac{\sum (y)}{N} = \frac{84}{10}$

$= 8.4$

Differences of mean = controlled test – uncontrolled test

$= 8.4 - 3.5 = 4.9$

$\therefore SD = \sqrt{\frac{\sum (d-d)^2}{N}}$

$= \sqrt{\frac{32.5}{10}}$

$= \sqrt{3.25} \quad = 1.8$

$$Tc = \frac{d}{\frac{sd}{\sqrt{N-1}}}$$

$$Tc = \frac{4.9}{\frac{1.8}{\sqrt{10-1}}} = \frac{\frac{4.9}{1.8} \times \frac{1}{9}}{\frac{\sqrt{9}}{1} \times \frac{1}{9}}$$

$$= \frac{4.9\sqrt{9}}{1.8}$$

$$= \frac{4.9\,(3)}{1.8}$$

$$= \frac{14.7}{1.8}$$

$$= 8.17$$