UNIVERSITY OF EDUCATION, WINNEBA

EFFECTS OF MULTIPLE REPRESENTATIONS-BASED INSTRUCTION ON BASIC SCHOOL PUPILS' PERFORMANCE IN ADDITION OF MIXED FRACTIONS IN LA DADE-KOTOPON MUNICIPALITY

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MASTER OF PHILOSOPHY

2023

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**A thesis in the Department of Basic Education,
Faculty of Educational Studies, submitted to the School of
Graduate Studies in partial fulfillment
of the requirements for the award of the degree of
Master of Philosophy
(Basic Education)
in the University of Education, Winneba**

JUNE, 2023

DECLARATION

Student's Declaration

I, Philip Oduro Nkansah, declare that this thesis is my work and all secondary information used in the study has been duly acknowledged. No part of this thesis has therefore been presented in any form to any institution for the award of any other degree.

Signature: ....

Date: ....

Supervisors' Declaration

I declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines on supervision of thesis as laid down by the School of Graduate Studies, University of Education, Winneba.

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Signature: ……………………………………….…

Date: ……………………………………………..…

DEDICATION

To my family Lydia Asamoah Bawuah, Daniel Osei Bawauah, the staff of Airport Police JHS and Oforikrom D/A Basic School, Divine House of Liberty Chapel.

ACKNOWLEDGEMENTS

Wisdom, power, strength, and everything that I needed most to complete this thesis writing was given to me by the Holy Trinity (God the Father, God the Son, and God the Holy Spirit). Therefore, my profound gratitude is to the Trinity.

I am most grateful to my parents (Lydia Asamoah Bawuah and Daniel Asamoah Bawuah) and siblings for their prayers and financial support.

I am grateful to my supervisors Prof. Micheal J. Nabie and Prof. Clement Ali for their immense support, guidance, assistance, and invaluable suggestions.

I thank the head teachers and the staff of Airport Police JHS “1” and “2” for permitting me to carry out the research in their school and cooperating with me by allowing me to use their lessons to carry out my research.

I also express my heartfelt gratitude to the staff of Oforikrom D/A Basic School especially the head teacher and the SISO of Aduasa “A” (Mr. Agyekum Micheal) for your prayers and support.

I am grateful to the head pastor of Divine House of Liberty Chapel and Salvation Purity Ministry and the members for their prayers.

I am forever grateful to Miss Ruth Osei and Miss Kandra Frimpong Gyamfi for their prayers, support, and motivation.

Finally, to the research participants of this study, I am most grateful for your participation and for providing this work with the information that it needed to produce this report.

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GLOSSARY

CCP:	Common Core Program
GES:	Ghana Education Service
MoE:	Ministry of Education
MRBI:	Multiple Representations-Based Instructions
MRTMT:	Multiple Representations Translations Model Theory
NaCCA:	National Council for Curriculum and Assessment
NCTM:	National Council of Teachers of Mathematics
SBC:	Standard-Based Curriculum
SBC:	Standard-Based Program
SPSS:	Statistical Package for Social Sciences

ABSTRACT

The study examines the effects of multiple representation-based instructions on basic school pupils' performance in addition of mixed fractions in La Dade-Kotopon municipality. A non-equivalent control group quasi-experimental design was employed. One hundred and forty-seven pupils from two schools in the Airport-Rangoon circuit in La Dade-Kotopon municipality were used for the study (Airport Police JHS "1" and "2"). The control group consists of 74 respondents and the experimental group consists of 73 respondents. The seventy-three students in the experimental group were taught addition of mixed fractions using multiple representations-based instructions while the seventy-four learners in the control group were taught the same topic using conventional instructions. Three research questions and two null hypotheses guided the study. A pre-test was administered to the learners in the control and experimental groups. Afterwards both the experimental and control groups took a post-test. Data were analysed using frequencies, percentages, mean, standard deviation, and, paired sample t-test at a five percent significant level. It was found in the study that those who were taught with multiple representations-based instructions performed better than those who were taught addition of mixed fractions conventionally. It further revealed that there was a statistically significant difference in the performance of the use of multiple representations instructions and translations among them than conventional instructions. The study recommended that mathematics teaching should be done using multiple representations-based instruction in our basic schools to aid understanding.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter talks about the background to the study, the statement of the research problem, the purpose and objectives of the research, the significance of the study, the research questions, the research hypothesis, delimitation, and the definition of terms and organization of the study.

1.1 Background to the Study

Mathematics calculation process requires a clear and solid conceptual understanding. Mathematics studies is very important if there will be development in any country's science, technology, and economy. Mathematics remains one of crucial subject not only for obtaining an academic degree at school or college but also for preparing students for the future, regardless of the line of work they decide to pursue. This signifies that mathematics is applied to every aspect of the universe, from the tiniest particles to the greatest. There is the application of Mathematics in our daily lives and as well as in education because of the importance of the subject.

The Government of Ghana is dedicated to guaranteeing the provision of high-quality mathematics education due to the significance of the study of mathematics (Agyei & Voogt, 2011). Numerous initiatives have been made to raise arithmetic proficiency in classrooms. The Ghanaian government has introduced a number of initiatives in cooperation with various education sector partners to support good mathematics teaching or instructions and learning and to make the subject interesting (Ampadu, 2012). Mathematics studies have been made a core subject from the Basic Schools to the Senior High Schools in Ghana because of its importance in a learner's life. It is also a requirement one has to pass before entering into any tertiary to further his or her studies. The Ministry of Education (MoE) in Ghana and the government of Ghana are doing all that they could to make mathematics study an important and easy one for pupils. The government introduced a new mathematics curriculum in 2020 to reinforce the importance that the country attaches to mathematics education. Ghana does celebrate a day in February or March every year as a mathematics day to educate pupils and the populace on the need for mathematics education. Also, the Ministry of Education in Ghana seeks to tackle major issues within the STEM Education sector with a concentration on equipping Ghanaian Mathematics teachers with advanced skills and programs (MoE, 2021). There is an introduction of Professional Learning Community (PLC) in the Ghana curriculum for mathematic teachers to equip and provide math teachers with innovative teaching strategies and subject-specific information themselves with new methods of teaching and knowledge in handling the subject. All of the ministry's actions are intended to help students' understanding of and performance in the field of mathematics.

The Ministry of Education (MoE) has introduced a new curriculum that is interested in the modern way of teaching and learning mathematics and which seeks and fosters facilitators to use multiple representations-based instruction. In the new Standard Base Curriculum (SBC) (2020) and the Common Core Program (CCP) (2019), there is a shift from the old lecture and drill method of teaching to the use of multiple representations-based instruction for teaching and learning mathematics topics. The NaCCA SBC and CCP stress different instructional strategies that facilitators have to use for pupils to understand what is taught. The new curriculum acknowledges the different learning styles (tactile pupils, auditory pupils, kinesthetic and visual pupils) since the mode of assessment has changed from assessing pupils' performance only through a written examination. Therefore, there has been a need to represent lessons in multiple ways. The NaCCA SBC (2019) and CCP (2020) have adopted the teaching of mathematics using multiple representations of mathematical topics. This is seen through the rationale of the curriculum. The new curriculum promotes the use of multiple representations-based instruction by

1. Enabling pupils to work together to represent real-life mathematics situations in multiple ways (eg. oral, text, pictures, diagrams, equations, etc.).
2. Guiding and facilitating learning by generating discourse among pupils and challenging them to accept and share responsibility for their learning, based on their unique individual differences.
3. Select mathematics content, adapt and plan lessons to meet the interests, knowledge, understanding, abilities, and experiences of pupils
4. Supporting pupils to use appropriate different technologies to solve problems embedded in their culture and the larger society.

The various types of instructional representation are tools that help students comprehend basic mathematical concepts and relationships, enable them to communicate their understanding of mathematics to others, help students make connections between different mathematical ideas, and aid in the application of mathematics to real-world problems (NTCM, 2000). Representations can be interpreted as illustrations, virtual manipulatives, tangible hands-on manipulatives, and didactics.

The multiple representations-based instruction should be the basis for teachers of mathematics to adopt in the teaching of pupils to increase their academic performance (NTCM, 2000). In the context of teaching and learning mathematics, multiple representations-based instruction is when various representations are used for teaching a concept or solving a problem instead of only one mathematical representation (Ainsworth, 1999). According to Goldin and Shteingold (2001), it is frequently defined as offering the same information in multiple forms of external representation. Additionally, different instructional strategies and techniques are used when teaching students through numerous representations so that they can better understand what is being taught, modify their attitudes and behaviors, and improve their academic achievement

There are numerous benefits pupils get when they experience concepts in a variety of representations. Some researchers agree with the fact that multiple representations support abstraction and make abstract situation comes real to be solved. According to Tripathi (2008), the use of multiple representations when teaching mathematics is a powerful tool that makes it easier for students to understand mathematical subject matter. Multiple representations-based instruction make the pupils have real experience of the topic and therefore ease difficulties. Multiple representations-based instruction provides the means for pupils to construct and build their understanding of classroom instruction and this is the best means of teaching and learning (Goldin, 1990; Slavin, 2000; Nabie, 2009). The multiple representations-based instruction method make pupils build their understanding which helps them to be able to apply it to life situations.

However, despite the obvious advantages of employing different representations, detractors of the practice claim that doing so hinders students' comprehension of the material being taught. The student is not given the ability to independently reason through challenges.

Nabeel (2009) opined that excessive or poorly designed representations can impede learners understanding of the lesson taught. Too many poorly designed representations can lead to cognitive overload, confusion and decreased understanding. In addition, if facilitators do not carefully sequence and select representations it causes distraction to learners understanding.

Given the numerous benefits of multiple representations, fractions cannot be taught for proper understanding without the use of multiple representations. Because the multiple representations of lessons make pupils motivated to learn mathematical lessons such as fractions. Fractional knowledge is important in mathematics. The concept of fractions in mathematics is always considered difficult by pupils as they assume that the numerator and denominator are the whole numbers that need to be divided with each other (Alghazo & Alghazo, 2017). Fractional knowledge has been perceived as difficult among school children because most pupils find it difficult to understand the concept of fractions. According to Anamuah-Mensah and Mereku (2016), Ghanaian pupils performed poorly in the area of fractions in formal examinations, this has required other researchers to focus their attention on cultural effects on the conception of fractions. Şiap and Duru (2004) in their research found that pupils memorize formulae and algorithms instead of understanding the concept of fractions and their operation on the fraction is a contributing factor to why pupils perform poorly in mathematics. Fractions, which are seen as difficult for pupils and some teachers to teach are encountered in most topics at the Junior High level. The concept of fractions has a relationship with other mathematics topics such as rational numbers, ratio and proportion, decimals, probability, percentages, rates, integers, algebra, time, shapes, collecting and collecting, and handling data. According to Pearn and Stephens (2015), many researchers argue that a deep understanding of fractional knowledge is very important for the transition into algebra. Due to its relation with other topics, the acquisition of fractional knowledge makes pupils develop a greater love for the study of mathematics. Therefore, teachers must be careful to teach the fraction concept systematically by teaching all the modes of representing fraction to make pupils value the need of learning fraction since fraction is part of our daily lives.

There are two ways of classifying fractions. They are proper fractions and improper fractions. A proper fraction is the type of fraction with a denominator greater or bigger than its numerator. Pupils understand proper fractions with ease because they know it is a fraction that has its denominator greater than its numerator. In other words, they understand a fraction is considered "proper" if its numerator is smaller than its denominator and they understand the conceptual meaning. Example of the proper fractions is one fifth, one-half, three sevenths, etc. A fraction that has a larger numerator than denominator is said to be an improper fraction. Improper fractions include eight sevenths ($\frac{8}{7}$), five-thirds ($\frac{5}{3}$), ten-tenths ($\frac{10}{10}$), etc. There are forms of fractions. These are the Vulgar fraction, common or simple fraction, mixed fraction, complex fraction, and compound fraction (Adzifome, 2019). A vulgar fraction is a fraction whose numerator and denominator are natural numbers but the denominator is not a power of 10. The vulgar fraction is also known as the common fraction.

Adzifome (2019) defined a mixed fraction as the sum of an integer (except zero) and a proper fraction. A mixed fraction is an improper fraction that is expressed in the form of a whole number and a proper fraction. The whole number should not be zero. Most teachers and pupils find it difficult to understand that a mixed fraction is an improper fraction that has been expressed in the form of a counting number and a proper fraction. A mixed fraction is practically used when sometimes we share items and during measurements. In sharing, we do say "I was given two and a half of bread or cake". The two of the cake is the whole number or wholesome part and the half (1/2) is the proper fractional part. Because of pupils' understanding of mixed fractions, it's always problematic for pupils and they mostly make mistakes when they have to add mixed fractions. In taking measurements, for example, tailors or fashion designers, carpenters, etc. do measure the lengths of people, wood, distance, etc. When we measure two cups of rice and later add half to it to cook, the idea of mixing has been used.

In the teaching and learning of fractions, it becomes difficult for pupils to express the addition of mixed fractions or numbers in different modes of representing fractions such as verbal or oral representation, written symbols, pictures or diagrams, real-life situations, and manipulatives or use of the model. It is important in the study of fractions and operations with fractions that pupils can make strong connections among the modes of representation. The study of fractions and operations with fractions should be able to be represented to pupils in these modes of representations such as verbal, numerical, manipulative, real-life, and visual. The ability of learners to translate from one mode of representation to another depends on their level of understanding. İpek, Işık, and Albayrak 2005 in their research stated that there are serious problems in the transition between visual expression and other ways of expression. If pupils fail to get the right meaning of a fractional concept taught, its' application to problems and life situations becomes difficult. If the fractional concept is understood well through multiple means of representation-based instructions, it motivates the pupils' interest in learning mathematics and further continue to learn advanced mathematics at the Senior High level and beyond. If pupils are not performing well in mathematics as a result of a lack of conceptual and representational knowledge of fractions, it makes the parent of such pupils and stakeholders worry about their performance.

A possible cause of pupils' low performance in fractions is how lessons are presented to them. It appears that learners are not introduced to the appropriate forms of representations of fractional concepts. Learners are unable to solve addition of fraction and mixed fractions as a results of the use of traditional methods in the teaching and learning of fractions. Teachers tend to use lecture method because they want to complete the curriculum on time. They resort to teaching formulae and algorithm of fraction (the symbolic form of representations) to learners without considering other forms of instructions. Besides the teachers desire their learners to pass their exams and examiners also give low attention to other forms of representation. Therefore, the teachers stick to the use of symbolic form of representation. This method of instruction made most learners familiarize themselves with the formulae and algorithm of fraction without understanding the concept of mixed fractions. Diagrammatic form, word form and real life representation of mixed fractions are most difficult form of representation to learner because of the use of traditional instructions used in teaching of fractions to learners. This has made the learners performance in the BECE to drop down and most of them do not show much interest in learning mathematics. They consider mathematics study as one of their most difficult subject.

It is upon this problem that the researcher explored the effects of multiple representation-based instructions on basic seven pupils' performance in addition of mixed fractions in the La Dade- Kotopon District.

1.2 Statement of the Problem

Numbers, place value system, whole number operations, fractions and decimals, and problem-solving are the five fundamental building blocks of junior high school mathematics instruction (Wilson, 2009). This signifies the need for an understanding of the concept of fractions since it is applicable in other mathematical topics such as algebra, ratio and proportion, indices, rational numbers, etc. According to Anamuah-Mensah and Mereku, (2005); Davis, Bishop, and TiongSeah (as cited in Amuah, Davis, and Fletcher (2019) Ghanaian pupils in the Junior High level do perform least in the area of fractions in formal Examinations hence, the reason other researchers have focused their attention on cultural effects on the conception of fractions. The performance of pupils in mathematics has been a great concern to all stakeholders in education because most consider mathematics difficult to teach and learn. For this reason, it has made all stakeholders in mathematics education attach great importance to the study of mathematics since it is used in our everyday activities and also to better their performance in examinations.

The ability to work with fractions is a prerequisite for learning more complex mathematical concepts, but many students find it difficult to do so, especially those who struggle with math and who frequently lack the fundamental knowledge of whole numbers (Namkung & Fuchs, 2019). It is noticed that some pupils confuse themselves with addition of fractions and whole numbers. They do add fractions just as they add whole numbers and integers. For example, when they are to add one-fifth and two-sixth, some of the pupils are seen adding the numerators separately and denominators separately as they do when they are adding whole numbers ($\frac{1}{5} + \frac{2}{6} = \frac{3}{11}$) (Xu et al.,2021). It was found that most also don't know the difference between adding a fraction with a common denominator or the same denominator and fractions with different denominators. For example, given three sevenths and one-seventh for leaners to add, they add as $\frac{4}{7}$ as shown symbolically as ($\frac{3}{7} + \frac{1}{7} = \frac{4}{7}$). Consequently, when they are given $\frac{1}{3}$ + $\frac{1}{7}$ to solve most add just like they are adding fractions with a common denominator and the result they get is $\frac{2}{10}$ instead of it being $\frac{1}{3} + \frac{1}{7} = \frac{10}{21}$ of which they have to find the LCD first and then divide each of the denominators by the common LCD then later they multiply each denominator by their respective numerators and finally, they add the numerators and divide by the LCD (Xu et al., 2021 cited in Jarrah, Wardat, Gningue 2022). Pupils fail to understand and forget that when the denominators are different, they have to find the least common denominator (LCD) or least common multiple (LCM) and then multiply the number of times the denominator divides the common denominator (LCD) by the numerator. Afterward, they add the numerators and divide by the common denominator.

Learners have generally struggled to comprehend mixed numbers and fractions, both in terms of the concept itself and how to use it in actions like addition (Windria et al., 2020). It has been noticed that some pupils find it difficult to add mixed fractions and the study of addition of mixed fractions (Prahmana, 2019). For example, when pupils are given three whole and three-fourths to be added to six whole and one-third, they add the three and six whole together and for the fractional parts three fourths and one-third, they add the numerators together and the denominators together too. As shown $6\frac{1}{3} + 3\frac{3}{4}$ = 6 + 3 = 9 then they add the numerators 1 + 3 = 4 and the denominator 3 + 4 = 7. So, the result becomes $9\frac{4}{7}$. Instead of adding the three and six wholes together and then adding the fractional part three fourth and one-third together by finding the

LCD of the two fractions and then multiplying to the numerator. Then they add the numerator and denominator together and divide by the least common denominator. As shown symbolically as $6\frac{1}{3} + 3\frac{3}{4} = 6 + 3 = 9$ then $\frac{1}{3} + \frac{3}{4} = \frac{4 x 1 + 3 x 3}{12} = \frac{13}{12}$. Since the answer is an improper fraction, we convert it to a mixed fraction as $(1\frac{1}{12})$ and add to the wholes. This gives us the final result as $9 + 1\frac{1}{12} = 10\frac{1}{12}$. Some pupils do convert both mixed fractions into improper fractions but still add them as fractions with common denominators. As shown $\frac{19}{3} + \frac{15}{4} = \frac{34}{7}$. In addition, most pupils prefer to change from mixed fractions to improper fractions before they solve. But they do find it to simply add by finding a common denominator and also after they have arrived at the answer, they do find it difficult to convert from improper fraction to mixed fraction.

In addition, pupils find it uneasy when they are to add one whole and two-fifth of a cake to two whole and three-fifths of another cake, lest they find it difficult and burdensome to translate from the word form to the symbol form. This demoralizes them from being encouraged to the learning of mixed-fractions as a sub-topic to fractions in mathematics. Bayazit (2011) research showed that most participants or pupils depend on the symbols representation of conjugation; and other representations such as real-life or word form, manipulative forms, etc. become difficult for pupils to understand. Furthermore, they find it difficult to manipulate objects such as cakes, oranges, apples, etc to tell the answer of the addition of one whole and two-fifth of a cake/orange/apple to two whole and two-thirds of a cake/oranges/apples. Pupils do find it difficult to diagrammatize addition of one whole and two-fifths of a cake/orange/apple to two whole and two-thirds of a cake/oranges/apples.

Moreover, Anthony and Walshaw (2009) while they reviewed many studies concerning representations and transitions among them concluded that representation links between different various mathematical ideas and concepts, and it encourages pupils to understand the various connections among the idea and concepts as a result of discovering how to transition from one representation to another. According to Hwang, et al. (2007), developing students' abilities to use a variety of mathematical representations is essential for their success in overcoming problems with mathematics. Consistent with this, Mereku (2001) said the average Ghanaian pupils are performing low in mathematics due to the low or little attention given to other forms of representations at the basic level of education. This tells us that for effective and appropriate classroom teaching and learning of the addition of mixed fractions, pupils should be taught with multiple representations-based instruction and also to easily switch between modes of representations with ease. This has necessitated the researcher to investigate the effects of multiple representations-based instruction on pupils' performance in addition of mixed fractions in the La Dade-Kotopon Municipality in the Greater Accra region of Ghana.

1.3 Purpose of the Study

The purpose of the study was to investigate effect of multiple representations-based instruction on basic seven pupils' performance in addition of mixed fractions in the La Dade-Kotopon Municipality of Ghana.

1.4 Objectives of the Study

The specific objectives of this study are:

1. To examine effect of using multiple representation-based instructions in the teaching and learning of the addition of mixed fractions on pupils' academic performance in the La Dade-Kotopon Municipality of Ghana.
2. To evaluate how pupils' ability to translate from one mode of representation to another improves their academic performance in addition of mixed fractions.
3. To find pupils' perception of the effectiveness of multiple representations-based instruction in teaching and learning addition of mixed fractions.

1.5 Research Questions

The following research questions were formulated to guide the study.

1. What is the effect of multiple representations-based instruction on pupils' academic performance in addition of mixed fractions in the La Dade-Kotopon Municipality in the Greater Accra region of Ghana?
2. To what extent does pupils' ability to translate from one mode of representation to another improve their academic performance in addition of mixed fractions?
3. What are pupils' perception of the effectiveness of multiple representations-based instruction in teaching and learning addition of mixed fractions?

1.6 Hypotheses

The researcher wants to ascertain whether the use of multiple representation-based instructions and translation among representations improves pupils' academic performance more than traditional/conventional instructions among the control and the experimental groups. This necessitated the formulation of the hypotheses.

a. Null hypothesis 1, (H_{01}): There is no statistically significant difference between the performance of pupils taught with multiple representations-based instruction and pupils taught with traditional instructions in addition of mixed fractions among the experimental group.

b. Null hypothesis 2, (H_{02}): There is no statistically significant difference in the performance of pupils who can translate from one mode of representation to another among the experimental groups.

1.7 Significance of the Study

The significance of the study cannot be underestimated by stakeholders in education such as the Ministry of Education, Ghana Education Service, Teachers, pupils, and other researchers. The relevance of this study to teachers cannot be over-emphasised. The results from the study will reveal the appropriate representations teachers can use in the classroom to communicate and represent the addition of mixed fractions to pupils for better understanding. This will add to teachers' knowledge in teaching the addition of mixed fractions.

Also, the study will help boost pupils' confidence and interest in the study of fractions as a whole especially, the addition of mixed fractions which will consequently influence their attitude positively towards the study of mathematics and ground them as well in addition of mixed fractions. The study will help pupils to realise and appreciate the fact that they do use and apply mixed fractions daily in their activities when sharing items, and measurements.

It will be of great importance too to policymakers in the sequential study and good representation of mixed fraction knowledge in the mathematics curriculum for various grades. The study will provide empirical evidence and a database (resource material) for stakeholders and future researchers who intend to research further into this area of study.

The findings from the study will go a long way to influence school administrators positively to appreciate the essence of encouraging and motivating teachers to utilize more representations in developing concepts in mathematics, especially in the teaching and learning of fractions.

1.8 Delimitation of the Study

The study had nationwide interest but was conducted in the La-Dade Kotopon Municipality in Accra of Ghana in the Airport-Rangoon circuit and the pupils of Airport Police Junior High School "1" and "2" were used for the study because of the resources available to the researcher, proximity and the time factors. The researcher used the basic seven pupils for the study though he could have used any other class since addition of mixed fractions is taught from basic four to basic nine and beyond. Fractions cover a wide area of study such as addition, subtraction, multiplication, and division of common fractions, equivalent fractions, converting mixed fractions to improper fractions and vice versa, converting unlike fractions into a set of like fractions, comparison of fractions etc. For the sake of this research, the study was restricted to mixed fractions and the addition of mixed fractions. The study employed the use of four modes of representation. The use of manipulatives was not used for the study but was used in teaching as a mode of representation to the pupils because of financial cost, assessments and representation of results will be difficult.

1.9 Organisation of the Study

The study is organised into five chapters. Chapter one includes the background to the study, statement of the problem, objectives of the study, research questions and hypothesis, significance of the study, delimitations, organisation of the study, and definition of terms. Chapter Two discusses the conceptual framework and the review of related literature. Chapter Three deals with the research methodology, which includes the research design, population, sample and sampling technique, instrumentation, the procedure for collection, and analysis of data. Chapter Four presents the results and discussion. Chapter Five covers the summary of results, discussions, conclusions, recommendations, and suggestions for further study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

The chapter reviews the literature adjudged to be relevant to the study. Arshed and Danson (2015) state that literature review involves understanding the current state of a subject area, relating it to what has already been studied and identifying the gaps in this knowledge, establishing an overview of what has already been studied in the field or area under the intention of the investigation. This chapter of the study devotes itself to presenting the existing theories and works of literature in the arena of the effects of multiple representations based-instruction on basic seven pupils' performance in addition to mixed fractions in the La Dade-Kotopon District in the Greater Accra region of Ghana.

It discusses the meaning of representations in mathematics, the categories of representations, the relationship between representations, the role of representations, translation among representations, The constructivist view of representations, the meaning of multiple representations and representations-based instructions, The theoretical framework which highlights the study of Lesh, Post, Berh's (1987) Multiple Representations Translations Model Theory (MRTMT), meaning of fractions and mixed fraction or numbers, the addition of like & unlike denominators of mixed fractions, and meaning of academic performance. Pupil's academic performance and the conceptual framework and the role of multiple representations-based instructions in Ghanaian mathematics classroom in addition of mixed fractions.

2.1 Meaning of Representation in Mathematics

Representation has been significant element in mathematics instructions since it tends to make pupils to develop an ill attitude or a welcoming attitude to the study of mathematics (Mainali, 2021). How a mathematical lesson is represented to the pupils make them develop an ill attitude or a welcoming attitude towards it. Representation, to the individual it can stand for words such as depict, encode, label, symbolize, show, denote, etc. In the teaching and learning of mathematics, representation refers to a sign or combination of signs, characters, diagrams, objects, drawings, or graphs (Mainali, 2021). According to Hwang et al. (2007), the process of modelling concrete items in the real world into an abstract notion or symbol falls under the broad definition of representation in the field of psychology. Therefore, representation is viewed in mathematical psychology as a learner describing or connecting the relationship between things, reality, and symbols.

2.2 Categories of Representation

There are two distinctive categories of representations. External and internal representations are the two categories of representations.

2.2.1 Internal representations

According to Goldin and Janvier (1998), internal representations are defined as "individual cognitive configurations inferred from human behaviour describing some aspects of the process of mathematical thinking and problem-solving". According to Cobb, Yackel, and Wood (1992), internal representations exist in students' minds. The ideas, images, and thoughts in the pupils' minds that represent mathematical concepts, ideas, and objects are internal representations. According to Sokolowski (2018), internal representations can simply be described as how a learner understands a concept inside his or her mind. Internal representations are mental images that correspond to internal interpretations of what people perceive via their senses; as a result, they are hidden from view from the outer world. The data that students retain in their long-term memory are called internal representations. It is, in other words, a representation of mathematical ideas that exists only in the learner's mind.

2.2.2 External representations

According to Goldin and Janvier (1998), external representations are "structured physical situations that can be seen as embodying mathematical ideas" Any configurations that are physically embodied and discernible, such as pictures, concrete objects, tables, equations, schematics, drawings of one-, two-, or three-dimensional figures, or various types of schemata, are considered external representations by Sokolowi (2018). Cobb, Yackel, and Wood (1992) stated that external representations are situated in the students' environments. External representation is the physical symbols, objects, external rules, constraints, or relations that help the learner acquire knowledge and understand mathematical concepts. Number lines, diagrams, algebraic equations, and other forms of external representation are used to illustrate and convey mathematical relationships graphically (Goldin & Shteingold 2001).

2.3 Relationship between External Representation and Internal Representation

Goldin (1998) highlighted the close relationship between external and internal representations.

Signifier (External Representations)

↕

Signified (Internal Representations)

The outline clearly shows that there is a close relationship that can be found between internal representations and external representations in terms of semiotic views. In order to understand mathematics, he suggests using the external representational system (Goldin, 1998). They are universal, allow for visualization, and are simple to use. He described the internal representational system as yet another construct derived from mathematical behaviours (Goldin, 1998). With their assistance, it is possible to comprehend how every student learns and conceptualizes instructions or ideas. The relationship between the two systems, he continued, is not only crucial, but also the whole point. The environment of the learner should be planned to allow for the acquisition of various types of representations, from spoken language to mathematical symbols, in order to trace this interaction (Goldin, 1990). Because an individual learner's internal view or construct is embodied in their outward representation, internal and exterior representations are entwined with one another (Lesh, Post, & Behr, 1987).

Zhang (1997) opined that external representation can be internalized into internal representation by memorization, and internalized representation can be externalized into external representation. External representations, however, are not always the same as what occurs in a person's head (Haciomeroglu, Aspinwall, & Presmeg), as cited in Mainali (2021). Pupils when taught externally using manipulative or opaque teaching and learning materials help the learner to understand concepts on their own and build their internal structures and also to relate them to similar problems in life.

2.4 The Role of Representation

Goldin and Kaput (1996) in their article "a joint perspective on the idea of representation in learning and doing in mathematics" described some roles of representation as;

1. Representation as a means of instruction and communication. Representations have two functions as a means of communication: they aid in the exchange of ideas as well as interpersonal communication. However, a representation is nothing more than a collection of symbols. Instead, when students associate the symbols with mathematical ideas, representation comes to life. This mapping is a two-way channel since it helps learners communicate concepts more effectively and recognizes and interprets the concepts being conveyed by the symbols.
2. Representation is a thinking tool and gaining insights: representations are frequently thought of as a way to develop conceptual knowledge. Understanding of a topic is said to be demonstrated by the ease with which one may switch between different representations of the same concept
3. Representations supports students' mental constructions. Representations are also referred to as tools for generalization and abstraction since the right representation may be used to express generality. Furthermore, according to Kaput (1991), having an abstract mathematical idea "is better regarded as a notationally rich web of representations and applications". The use of an item, a statement of words, or a model to represent an action or a condition of affairs is known as representation. Clear thought, concept, and idea expression can be aided by representation.

2.5 Translation among Representations in Mathematics Education

According to Duval 2006, the development of only one mode of representation in teaching and learning mathematics is not enough to solve mathematical problems and to build pupils' conceptual understanding of mathematics. Pupils have to develop different representation skills and they should be able to successfully translate from one mode of representation to another. The truth is that representation is undoubtedly essential for understanding mathematics, and its translation into other languages is just as fundamental for both teaching and learning mathematics. Using representations and translation between and among representations edify pupils to solve complex mathematical ideas or concepts. Conceptual understanding is achieved when pupils can fluently translate between and within representations. Translation between representations is the fundamental skill to develop a concept, understanding and to promote students' thought of mathematics study (Helingo, Amin & Masriyah, 2019).

Lesh, Post, and Berh (1987) indicated that "translation requires establishing a relationship (or mapping) from one representational system to another. It should preserve the structural characteristics and meaning as in translating from one written language or representation to another. Translation ability or disabilities are significant factors influencing both mathematical learning and problem-solving performance, and strengthening or remediating these abilities facilitate the acquisition and use of elementary mathematical ideas".

Lesh asserts that a translation between representational systems can occasionally take the form of a plural translation. This means that a student may start by translating one representational system to another and then may map from this representational system to another system, combining multiple representational systems in the problem-solving process (Lesh, et al., 1987).

2.6 Strategies for Translating between Multiple Representations in Mathematics

Duval (2006) recommended the following strategies to translate from one mode of representation to another in Mathematics.

1. Conversion: Directly translating one representation into another. Example translating from word to symbols
2. Connections: Establishing relationships between representations. Example linking pictorial representation of fractions to real-life situations.
3. Reorganisation: Rearranging or reformatting information within a representation. Example rewriting a word problem concerning addition of mixed fractions.
4. Reflection: One considers the same information or concept from different perspective or representations.
5. Transformation: This means the learners ability to change or convert the nature of the information or representations. Example learners' ability to change from diagrammatic representation to real-life situation.

2.7 Constructivists Perspectives on Representation in Mathematics Education

According to the constructivist theory, people develop their understanding and knowledge of the world by putting their ideas, techniques and methods they have already learned and experienced to test (Kouicem, & Nachoua 2022). Therefore, rather than just imparting knowledge from instructor to a leaner, a constructivist approach to learning sees mathematics learning as the development of ideas, processes, and understanding in an environment of interaction (Mcleod 2023). This suggests that math teachers must present their lessons in a way that aids the learner in developing internal mental models that will aid students in connecting math to the real world and provide them with suitable hands-on activities that will de-emphasize memorization of facts, theorems, formulas, and algorithms (Leonard & Tracy as cited in Mainali, 2021). Constructivists contend that learning is more effective when a learner actively participates in the process rather than merely striving to absorb information. Children learn best when given the freedom to develop their own perspective based on actual experience and reflection.

According to Bruner (1966), intellectual development should be the primary objective of education rather than rote memorisation of facts and concepts without understanding. He was concerned with the acquisition and use of knowledge. He believes that there should be autonomy in pupils learning. In addition, Brunner believes that representation in the classroom is important means by which the learner shows what has been experienced and how the learner organizes for future use what has been experienced. He was interested in the ways that knowledge is organized and expressed using various modes of thought. A learner should be encouraged to create visual representations, such as a drawing of a shape or a diagram, after having the chance to manipulate the things directly.

Three categories or levels of cognitive representation were distinguished by Jerome Bruner: enactive, iconic, and symbolic. Bruner declared that students need three levels of engagement to build a complete understanding of a mathematics concept.

Enactive (first stage) is the display of knowledge by means of actions. Martin and Schwartz (2005) believes with respect to manipulatives, enactive representation forms have been found to increase student memory and support learners mathematical understanding. Enactive category involves the use of manipulatives and other hands-on objects (e.g., technological tools) to represent the mathematics concept. Bruner believed that the more forms of concrete representations the students are engaged with, the greater the opportunity for the learner to diminish their fixation on the physical object itself and instead focus on the mathematics forms it represents. Enactive representation forms are the most accessible and rudimentary representation form. For manipulatives to be effectively used, learners have to be taught the dos and don’ts and the appropriate behavior in handling the materials for the desired activities to avoid misuse and become familiar with the proper way of using the materials. Facilitators also have to guide the learner to be creative in applying or solving similar problems using manipulatives. For facilitators to be sure learners improve academically in mathematics study, they must have an authentic assessment to assess learners academic progress.

Iconic (second stage) is the visual analysis of pictures or images. This is also called visual presentations. Visual representation aids in reflection and communicating mathematics idea (Elia 2006). Pictures, images, graphs, diagrams, and tables are examples of the iconic representations. Images, pictures, and diagrams are very useful to mediate or to serve as connection between the concrete materials and the abstract representations of topics being represented by these representations. Visual representations can be used in teaching most of the topics in mathematics (Stylianou & Silver 2004).

Symbolic representation, (third stage) is when language and other symbols are used to describe experiences. symbolic representation is the use of the algebraic rules specifying a function.

2.8 Traditional or Conventional method of Teaching Fractions

Conventional education, also referred to as "traditional methods of instruction," is a popular approach in education. It has been an educational tool for ages. The deductive approach to teaching, which places the teacher at the centre of the classroom, is the foundation of traditional teaching approaches. The only information source is the teacher in the traditional instruction. As a recipient of knowledge, the student engages with and receives ideas and information from the teacher (Perse, 2017). The instructor is the one who guides the class, provides explanations, writes the material on the board, and gives assignments for learners to do. Students are expected to learn the material or textbook by heart and recite it, as well as to consider the teacher's decisions. Mehta (2019) claims that the conventional teaching approach lacks the ability to make decisions and solve problems. Students only study for final examinations or quizzes.

Traditional teaching methods relied on memorization and repetition of material, which prevented students from honing their critical thinking, problem-solving, and decision-making abilities. Conversional methods lack essential elements in teaching and learning such as effective questioning and explanations, activity-based learning, and student demonstration. These create anxiety and disengagement into the learner.

According to Schoenfield (1992), in traditional fractions instruction, the teacher provides examples of addition of fractions, and learners are expected to imitate the teacher's examples, procedure and activities the teacher used to add fractions. This implies that students absorb knowledge from the facilitator and are required to analyse and interpret it in light of the teacher's examples. Learners are given minimal tasks to complete since the teacher sets the rules for adding fractions, provides examples, and then explains the rules using the examples. Therefore, the learners follow the example given and also add just like they were taught without the learners comprehending what they did. Assessment focus on recall and procedural fluency.

2.9 Theoretical Framework

2.9.1 Lesh, Post, and Behr (1987) Multiple Representations Transition Model as a Guide to the Study

A lot of researchers have researched the appropriate ways through which mathematics should be taught so that it will bring total meaningful understanding to students. There are similarities in the idea that mathematics should be represented externally to the learner to help the learner to build his or her internal representation. But for the learner to build his or her internal representations or understanding, she or he has to be taught externally for understanding. That will help the learner to build his or her internal conceptual understanding.

The study's theoretical framework was based on the Multiple Representations Translations Model Theory (MRTMT) developed by Lesh, Post, and Berh in 1987. The theory uses translations between several representational modes and a representational model. Plans for the study's lessons were created using this paradigm. Lesh, Post, and Behr (1987) assert that representations are essential for comprehending mathematical ideas. "External (and thus observable) embodiments of students' internal conceptualizations" is how they defined representation. According to this approach, a pupil should be able to translate between and within modes of representation if they comprehend a mathematical concept. In order for students to build meaningful mathematical concepts and problem-solving skills, they move inside and between five different types of mathematical representation (Lesh & Doerr, 2003). Real-life situations or realistic representations, symbolic representations, word representations, diagrammatic representations, and manipulative representations are the modes of representations they propounded.

1. **Real-world situations or Realistic representation:**

Lesh and Doerr (2003) refer to events happening in the real world or life which pupils make mathematical connections with and construct meaningful mathematical concepts from it. This is explained as knowledge is organized around "real world" events. Park (2013) views realistic representations are real-life narratives, circumstances, or lived contexts that are connected to mathematical ideas or issues. He continued by noting that in order to explain or understand mathematical concepts or mathematical issues, teachers and students draw on their real-world knowledge and experiences. An example of realistic representation is when Asantewaa measures two and a half cups of rice to cook and later, she adds one and one-third cups of rice to it. It is represented symbolically as $2\frac{1}{2} + 1\frac{1}{3}$. Also, when Ama a restaurant operator buys six and two-fifths bottles of cooking oil and she realizes that it wouldn't be able to serve her customers. She then adds to it two and one-third bottles of oil.

2. **Manipulatives:**

Van de Walle, et al. (2013) defined the term "manipulative" to describe tangible objects, either created explicitly for mathematics (such as connecting cubes) or for other uses (such as buttons), that students and teachers can use to illustrate and explore mathematical principles. Hurst and Linsell (2020) described manipulative as tangible, actual items or materials that can be handled. Mathematics manipulative exist in a variety of sizes and shapes, such as worksheets, counting blocks, number charts, abacuses, sticks, stones, and bottle tops that students can hold in order to practice and achieve proficiency with new information. The ultimate goal of using manipulative in mathematics teaching is to help children handle abstract concepts and symbols that are used to represent these concepts. Lesh (1979) proposed that manipulatives could serve as an invaluable link between the physical and mathematical worlds. He argued that by giving kids a way to simulate real-world scenarios, such use would tend to encourage the ability to solve problems. The research done by Stein and Bovalino (2001), manipulatives can be valuable tools for teaching children to think and reason in deeper ways. They contend that manipulatives like pattern blocks, tiles, and cubes can help kids develop solid, integrated understandings of mathematical concepts by giving them concrete opportunities to compare and manipulate. Another research done by Ruzic and O'Connell (2001) found that by enabling students to utilize actual items to observe, mimic, and internalize abstract concepts, long-term use of manipulative has a favorable impact on their achievement. For example, one whole and three quarters added to two whole and three quarters can be taught using an orange/cake/pizza as a manipulative as shown.

Fig 2.1: One whole and three quarters added to two whole and three quarters can be taught using a pizza

3. **Pictures or diagrams or graphical representation (static figural models).**

   Sousa as cited in Putri (2015) defined pictorial or graphical representation as the skill of creating, reading, and interpreting graphs or pictures. The visual aid for visualizing mathematical operations for solving problems is a pictorial representation of the manipulation of concrete. It is crucial that the instructor explains how the example image connects to actual objects. The use of formal working with symbols is then employed to demonstrate how symbols offer a more concise and effective way to represent numerical operations. The capacity to convert mathematical issues into images or graphics is known as graphic or image representation competence (Hwang et al., 2007). Example, adding one and one quarter to two and three quarters becomes four and is represented pictorially or graphically as in the figure below.

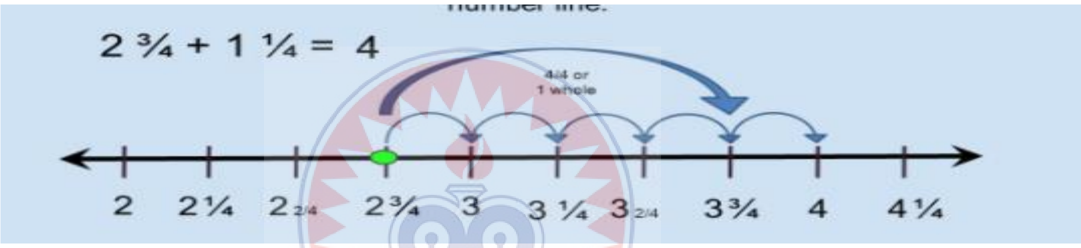


Fig 2.2 Adding one and one quarter to two and three quarters

4. **Spoken symbols or Language representation or Verbal representation**

According to Huinker as cited in Mainali (2021), language or verbal representations are the use of words and phrases to interpret, discuss, define, or describe mathematical ideas, informal and formal mathematical language. Language representations are written or spoken language to explain or describe mathematical concepts, mathematical thoughts, or ways of solving problems without the use of context (Park, 2013). In these representations, students and teachers can talk and write about mathematics using language that describes the concept. For example, six and two-fifths of oranges are added to five and one-third of oranges. The spoken or verbal statement can be written symbolically as

$$5\frac{1}{3} + 6\frac{2}{5}$$

5. **Written symbols or symbolic representation**

Symbolic representation of arithmetic ability is the ability to translate mathematical problems into arithmetic formulas (Hwang, et al, 2007). The digits, letters, and/or symbols used to represent numbers, formulas, or any other numerical, algebraic, fractional, or geometric concepts. Examples of symbolic representations include $\frac{10}{100}$, $4\frac{1}{10} + 8\frac{10}{10}$

Learners ability to solve and translate from one mode of representation to the other improves their academic performance.

2.9.2 Key steps Used in Multiple Representations Instructions

Lesh, Post and Berh (1987) suggested 8 key steps teachers can help pupils to develop deeper understanding of mathematical concepts and the ability to flexibly move between Multiple representation. These steps are as follows

1. Introduction: Introduce the concept or problem using a single representation (example symbolic representation or word)
2. Translation: Ask pupils to translate the concept or problem into other representations (example visual or diagrammatic form)
3. Connections: The teacher helps the pupils to connect the different representations to each other and to the problem.
4. Switching between representations: The learners should be encouraged to flexibly switch from one mode of representation to another to deepen understanding.

5. Reflection: The teacher asks pupils to reflect on the strength and limitations of each representations
6. Application: The teacher helps the students to apply their understanding by using multiple representations to solve problems or complete task.
7. Assessment: The teacher assesses pupils understanding by evaluating their ability to translate, connect, and switch between representations.
8. Feedback: Provide feedback that guides pupils in refining their understanding and representation skills.

2.10 Meaning of Fraction

In our daily lives fractions are commonly used. A half and a quarter are simple fractions that are used in daily life. The practice of utilizing fractions can be related to a measurement result, such as half a kilogram of flour or 1.5 meters of fabric, as well as a part of an object, such as half of the oranges or three-quarters of the cake. This shows fractions are used everywhere in our daily lives. Fractions have many interpretations. Fractions can be defined in five subconstruct.

2.11 Subconstruct Definitions of Fraction

1. Fraction as a part-whole

Örmeci (2012) said the most used definition of a fraction is part of a whole. Mathcentre, (2009) also explained fractions as a way of writing part of whole numbers. In the definition, the denominator is the same number of pieces that make up the entire unit or thing. The numerator is the number of those equal parts that are of interest or are taken out. When a cake is divided into eight equal parts and four parts are taken from the cake, the four parts taken are of interest and it is considered the numerator. The total parts of which the cake was divided is the denominator and it is considered as a whole. In addition, Lamon (1999) defined the part-whole as the situation in which a continuous quantity or a set of discrete objects are equally divided. The fraction is a comparison between the number of parts that make up the partitioned unit and the total number of parts that make up the partition. When a fraction is interpreted as a part-whole, it means that a whole has been divided into three equal parts, and only two of those parts are being taken into consideration (Wu, 2022). Part-whole describes the relation of a part of a quantity to its total amount. It should be noted that to define a fraction as part-whole, the portioning of the objects should be equal and a number of it has been taken off.

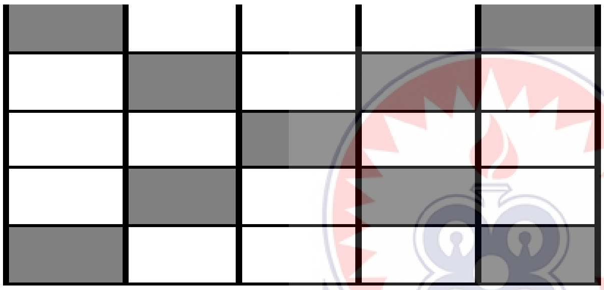


Fig. 2.3: The diagram shows twenty-five boxes of which nine boxes are shaded

The diagram shows twenty-five boxes of which nine boxes are shaded. This gives a fraction nine twenty-fifths ($\frac{9}{25}$).

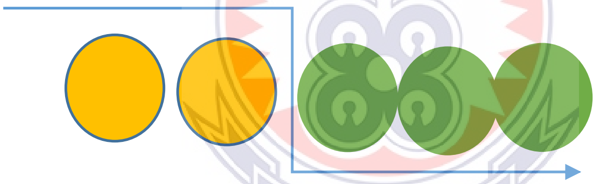
$$\frac{9\ \textit{is the numerator}\ \text{it is the number of parts present}}{25\ \textit{is the denominator}\text{it is the number of parts in}\ \textit{the whole}}$$

The vinculum is a bar that connects the numerator to the denominator. The operational sign division may be represented by the vinculum. Division by 0 is illogical and impossible (it means dividing objects among 0 individuals or people). A fraction with a denominator of 0 is similarly undefinable. Similarly, a fraction that has a denominator of 0 is also undefined.

2.11.1 Fraction as Ratio

Ledwith (2019) opined that a fraction is a comparison between two quantities. The definition is important to bring an understanding as equivalence. The ratio is written as a: b and interpreted as "for every **a** there is **b**" or "for every **b** there is **a**" (Lee, 2011). Instead of being a number by itself, the concept of ratio refers to a comparison or relationship between two quantities in a specific order. As ratio conveys the notion of relative magnitude, it is considered a comparative index rather than a number. (Behr et al., as cited in Getenet & Callingham, 2017). The number of boys in a class to the number of girls represents a ratio. The ratio of the total number of two ripped oranges to a total of three can be written as 2: 3 and the fraction as 2/3. For example, comparison Pictorially or diagrammatically as shown in Fig. 2.4.

Fig. 2.4: Ratio of two ripped oranges to three unripe oranges



Representing 2:3

2.11.2 Fraction as measure

According to Getenet and Callingham (2017), the ordering of numbers on a number line can be thought of as the measuring concept for fractions. In contrast to part-whole interpretations, this concept emphasizes how much (numerator) rather than how many pieces (denominator) (Van de Walle et al., 2013).

Two fractions, for instance, can only be added or subtracted as measures if they have the same units if their denominators are understood as measures (i.e., as distances from zero on the same scale). (Siemon et al., 2015; Charalambous & Pitta-Pantazi, 2006) Measure meaning represents measurement quantities such as length, area, and volume that could not be defined by integers. The measurement sub construct is the basis of iterating fractional parts. That is, two-fifths is constructed by iterating two one-fifths.

2.11.3 Fraction as Quotient

Martinez and Blanco (2021) definition of the quotient meaning of a fraction in situations of distribution implies that it is used when a whole or magnitude is dispersed evenly or divided into numerous portions of the same or various magnitudes. The quotient concept is fractions should be considered as division (Park, Güçler, & McCrory, 2013). How many liters of oil does each of the five people receive if they are to share eighteen liters of oil? This is written symbolically as 18/5 or 18 ÷ 5. This meaning of the concept of fraction is neglected in schools (Park, et al., 2013). Kilpatrick, et al. (2001) argued that "in some ways, (equal) sharing can play the role for rational numbers that counting does for whole numbers". Though mostly fraction is forgotten as division.

2.11.4 Fraction as Operator

According to Martinez and Blanco (2021), the fraction acts over a quantity through operations of division and multiplication, to transform this quantity into a new one. This meaning is associated with part-set one since the operation is always performed in a set. The Operator meaning of fractions is regarded as shrinker or stretcher; duplicator or partitioning quantities (Alacaci, 2010; Charalambous & Pitta-Pantazi, 2007). For instance, the question "after shrinking a number by, which fraction should be multiplied by the new number to obtain the original number?" is related to operator meaning. Charalambous and Pitta-Pantazi (2007) emphasized the conceptual connection between multiplying fractions and understanding what a fraction operator means. Students can therefore learn about fraction multiplication as it relates to operator meaning. Getenet and Callingham (2017), cited in Charalambous and Pitta-Pantazi (2006), claim that pupils can be motivated in a variety of ways by multiplying or dividing fractions. (e.g., 3/4 should be interpreted either as 3 × [1/4 of a unit] or 1/4 × [3 units])

2.12 Types of Fractions

Proper (also known as common) and improper (sometimes known as top-heavy) fractions are the two categories into which fractions exist.

2.12.1 Proper Fraction

A proper fraction has a numerator that is less than its denominator. A fraction must have a denominator that is greater than its numerator in order for it to be considered a proper fraction. A fraction which is less than one whole constitutes a proper fraction. They are both common fractions: 1/2 and 3/8.

2.12.2 Improper fraction

A fraction that its numerator is greater than its denominator is said to be an improper fraction. Improper fractions include eight sevenths $(\frac{8}{7})$, five-third $(\frac{5}{3})$, ten-tenth $(\frac{10}{10})$, etc. Improper fractions can also be written in a mixed fraction form to have a whole and a proper fraction.

2.13 Meaning of Mixed Fractions or Mixed Numbers

According to Adzifome (2019), mixed fractions are fractions with the summation of an integer (except zero) and a proper fraction. An improper fraction expressed as a whole number and a proper fraction is called a mixed fraction. For example, $6\frac{1}{7} = 6 + \frac{1}{7}$. A mixed fraction is having a whole number and a proper fraction added to it. A mixed fraction is mostly used when sharing items or measurements. In sharing we use "I was given two and a half of a bread or cake". The two full cake is the whole number or wholesome part and the half is the proper fractional part. Simply, mixed fractions can be said that add a proper fraction to a whole number that is not zero.

However, the form of mixed numbers could be confusing for students when they think the integer part (wholesome) of the mixed numbers is also fractions (Dasar as cited in Windria et al., 2020). Mixed numbers are improper fraction that has been expressed in the form of a whole number and a proper fraction. Mixed numbers are another form of improper fractions in the sense that they can be represented in a form of a whole number and a proper fraction. Because of their understanding of mixed fractions, it's always problematic for students and they mostly make mistakes when they have to add mixed fractions.

2.14 Pupils' Academic Performance

Hijazi and Naqvi (2006) opined academic performance is a multidimensional construct made up of a learner's abilities, attitudes, and actions that support academic success in the classroom. According to Ampofo and Osei-Owusu (2015), a student's academic achievement is determined by how much of the assigned coursework they are able to complete in a classroom environment. This indicates that while completing a course is the completion of the short- or medium-term goal of education, academic performance is judged by what is gained at the end of a course.

A lot of factors come to play to improve pupils' academic performance. (Ampofo, & Osei-Owusu, 2015) identified some of the factors that promote academic performance; parents' academic level, pupils' ambition in life, efforts of the learner, and the kind of environment the learner finds themselves in.

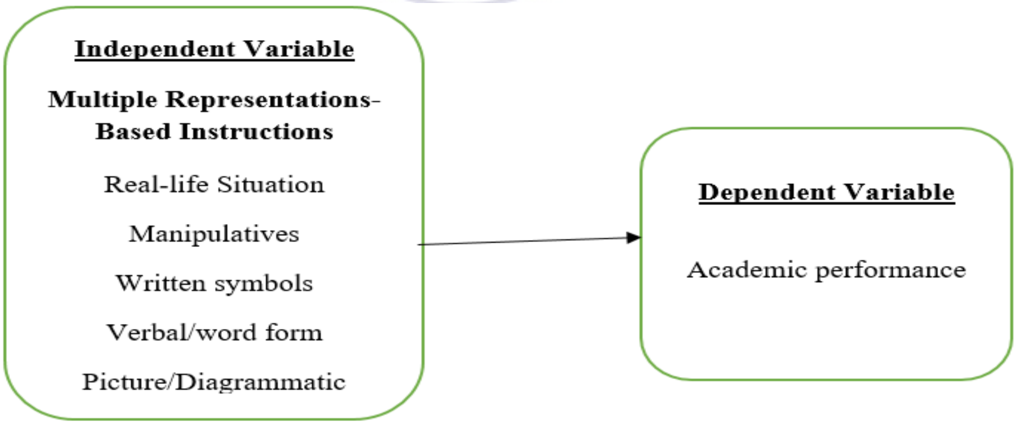
2.15 Perception of Pupils on the use of Multiple Representations-Based Instruction

Perception is the process by which we collect and analyse data from the environment. It would be correct to state that perception is a process rather than an action because we are continuously taking in and processing information from our surroundings (Perreault & McCarthy 2005). The idea of perception serves as an internal representation of external information. Perception is a highly intricate cognitive process that produces an individual's view of the world, which could differ significantly from reality. Perception is highly individualistic. Every learner has the way they perceive the importance of the use of multiple representations-based instructions. An individual's perception is shaped by the information they choose to take in, how they interpret it, and how long they choose to hold onto it. These decisions are based on their past experiences and prior exposure to similar information. Individual can have a good or positive perception or contrary a bad or negative perception. Another way to think about perception is as a process that involves a variety of highly relevant senses or prior experiences that try to give an organised image and also have relevance in specific contexts. Learners perception of multiple representations-based instructions in Mathematics is the distinct interpretation of how effective it improves learner's academic performance as a result of how it helped them to understand the concept taught.

2.16 Conceptual Framework

2.16.1 The relationship between Lesh, Post, and Berh (1987) Multiple representations Transition model and academic performance

Lesh, et al. (1987) identified five distinct modes of representations that occur in mathematics learning and problem-solving; which are real-world situations, manipulatives, pictures or diagrams, spoken symbols, and written symbols. The model is not hierarchical for that matter, any mode that can make the learner understand the concept taught should be used in teaching the learner to aid his or her academic performance. Some pupils can easily understand abstract illustrations, some need to be taught with manipulatives, and others too have to have a picture of the concept taught before they can understand concepts and improve their academic performance. The model seeks that the facilitator knows his or her pupils and helps them perform academically by varying how they represent the mathematical topic of addition of mixed fractions. Fig 2. 5 shows the relationship between Lesh et al. (1987) model of representation and how it relates to an improvement in pupils' academic performance.



Source: Authors Construct

Fig. 2.5: MRBI and Academic Performance

The model given in Figure 2.5 above, shows the link between how MRBI can improve pupils' academic performance. Translation among and within the five distinct modes of representation is important in aiding student academic performance. The translations among and within representations help pupils to develop the meaning of concepts and also preserve structural understanding. Lesh (1979) and Lesh and Kelly (1997) noted that in order to translate between representational modes, a learner must first conceptualize the mathematical idea within the given representational system. As a learner's concept of a given idea develops, the related underlying translation networks become more complex. Learners' academic performance is based on the ability to easily translate from one mode of representation to another. When a learner is to mention how many bottles of oils, she/he will have when given one and three quarters of oil to add to two and a half bottles. A good problem solver should be able to flexibly translate from real-life to either symbolic form and then solve to tell the number of bottles he/she will have. The learner should be presented with all modes of representations for him or her to decide which of them he or she can use to find solutions to problems.

According to Lesh, for students to understand and improve on a mathematical concept like "$1\frac{1}{3}$", they should be able to:

1. recognize "$1\frac{1}{3}$" embedded in a variety of different representational systems,
2. flexibly manipulate "$1\frac{1}{3}$" within the given representational system,
3. accurately translate the idea from one representational system to another (Lesh, et al. 1987)

For the facilitator to contribute to improving the academic performance of the learner, he or she simplifies, concretizes, particularizes, illustrates, and paraphrases ideas or concepts in the learner's environment. He or she breaks down the topic into teachable form that the learner will understand what he or she means. The then concretizes what is broken down using manipulatives or pictures or diagrams. In terms or real-life situation, the facilitator can paraphrase the idea and illustrate the concept using charts or diagrams. The multiple means in which the facilitator will use to build the learners understanding of addition of fractions will help improve the learner's performance since the learner does not need to memorise facts or concepts in adding fractions. The learner can use any mode of representation which he or she sees appropriate or understands it well to solve addition of mixed fractions.

2.16.2 The Role of Multiple Representations-based Instructions in Ghanaian Mathematics Classrooms in Addition to mixed fractions

A lot of researchers have defined multiple representations in many ways. Multiple representations, according to Janvier (1987), are a combination of something that is recorded on paper, something that exists in the form of actual objects, and something that is deliberately put together as an arrangement of thoughts in one'. According to Ainsworth (2014), when students use different mathematical abilities or information by switching between and choosing the best representation for the task at hand, multiple representations play a complimentary function. When the learner's comprehension of a second representation is supported by comparing it to a familiar representation, several benefits can be obtained. When students combine several representations to gain comprehension of the nature of the representations and the domain, they can get a better understanding. Ainsworth (1999) believes multiple representations in learning has motivational benefit and helps pupils to deeply understand concepts.

The Ghanaian classroom consists of pupils with different learning styles. This is a result of the Ghanaian classroom being an inclusive classroom. Ghana's inclusive education policy (2015) explains Inclusive Education as regardless of a child's physical, intellectual, social, emotional, linguistic, or other limitations, schools ought to and provide for all students. The Ghanaian mathematics classroom constitutes pupils with different learning styles. Some of the pupils in the class are auditory pupils (pupils that learn by hearing or listening to what they are taught), visual pupils (pupils who learn by seeing what they are taught such as charts, pictures, videos, tables, etc), kinesthetic pupils (learner prefer to have real-life experience on what is taught), Read and writing pupils (pupils that learn by reading the written word) logical or creative pupils (pupils use logical reasoning and analytic skills to solve problems, find patterns, etc) critical thinkers and problem solvers, etc.

This shows that it behoves on mathematics facilitators to help every learner in the class to understand mathematical concepts of addition of mixed fractions by representing them in diverse ways. Ainsworth, Bibby, and Wood (2002) believe that multiple representations and converting/translating between and within these representations are important, to help students understand mathematics ideas. Multiple representations-based instructions for the teaching of the addition of mixed fractional lessons will help sustain the interest of all pupils.

Mahama and Kyeremeh (2022) in their research found that multiple representations-based instructions improve pupils' fractional knowledge and positively impact pupils' performance in solving problems on common fractions and they, therefore, concluded that MRBI is an effective approach, that mathematics teachers need to incorporate in their teaching of fractions. Therefore, they recommended that facilitators should employ the MRBI approach for basic school mathematics to enhance pupils' understanding of mathematics concepts, especially at mathematics education's foundation (basic level).

According to Adu-Gyamfi (2003), he conducted a study on External Multiple Representations in Mathematics Teaching. The review's objective was to examine and gather data from existing studies on multiple representations in order to determine whether or not the evidence backed up or contradicted the claim that using multiple representations in mathematics instruction helped students gain a deeper understanding of mathematical relationships and problem-solving proficiency. He came to the conclusion that students who were taught using numerous representations-based instruction had a more comprehensive understanding of mathematical relationships and performed better when given problem-solving activities.

Ofosu, Owusu-Darko and Abubakar (2020) effect of multiple representation-based instructions (MRBI) on SHS students' ability to solve problems on linear functions and their applications concluded that the use of multiple representations-based instruction had positive impact on the experimental group. The statistics on the experimental group performance after the administration of the intervention showed that, the experimental group performance on the post-test was better than the control group. From the various studies, it is shown that, the used of multiple representations-based instructions improve learners' academic performance in the Ghanaian classroom. The gap the study also seek to address is whether translating among various modes of representations can help learners to be able to solve addition of mixed fractions effectively to improve their academic performance. The study agrees that mixed fractions cannot be taught properly for understanding if it is taught using conventional means of instructions. The facilitator has to employ other modes of representation for learners to understand what is taught. Ghanaian mathematics facilitators or educators have to employ different representational instructions that will make the study of mathematics and of course the study of the addition of mixed fractions interesting.

CHAPTER THREE

METHODOLOGY

3.0 Overview

In this chapter, the methods used in the study were explained. These encompass the research paradigm, research approach, research design, study population, sampling frame and technique, data collection instrument, piloting of the research instrument, research procedure, validity and reliability, and data analysis procedure.

3.1 Research Paradigm

According to Creswell (2014) research paradigm is the framework that guides research. The positivist paradigm asserts that real events can be observed empirically and explained with logical analysis (Kaboub, 2008). Positivist paradigm is a research approach in social sciences that emphasizes the use of scientific methods to study social phenomena. It's based on the idea that social reality can be objectively measured and quantified, just like in natural sciences. Positivism depends on quantifiable observations that lead to statistical analysis (Dudovskiy, 2022).

3.1.1 Key features of Positivist paradigm

1. Objectivity: research aims to be neutral and unbiased.
2. Empiricism: Data is collected through observation and experience
3. Quantification: Data is analysed using statistical methods
4. Causality: Researchers look for cause-and-effect relationship
5. Generalization: Findings are intended to be applicable to broader populations

3.2 Research Approach

The approach for the study was quantitative. By collecting precise, constant numerical data and analysing it using mathematical techniques, such as statistics that ask who, what, when, where, how much, how many, and how, quantitative research explains phenomena. It requires information, analysis, and the ability to think objectively. When participants offer quantifiable data that is subsequently mathematically assessed and the study is conducted in an impartial, objective manner, these characteristics of unique research are present (Creswell, 2014). According to Apuke (2017), a quantitative research approach focuses on quantifying and evaluating variables to get results. In order to answer questions like who, how much, what, where, when, how many, and how, it involves using numerical data and statistical methods to investigate that data. It also describes how to obtain facts in numerical form to explain a problem or phenomena. Quantitative research is the process of collecting and interpreting numerical data. It can be used to uncover patterns and averages, establish theories, investigate causes, and extrapolate results to bigger groups (Bhandari, 2020).

3.3 Research Design

The design for the study was non-equivalent group design of the quasi-experiment. The blueprint for the gathering, measurement, and analysis of data is called the research design, which encompasses all strategies used to choose how to combine the many study components coherently and logically (De Vaus, 2001). A research design concentrates on the end result and every step used to get there. In this respect, a research design is seen as a practical plan that links together specific research techniques and procedures to gather a valid and reliable body of data for empirically grounded analyses, conclusions, and theory formation (Vosloo, 2020). According to

Trochim (2006), the objectives of the study influence the research design that has to be used. For the objectives of the study to be achieved, the researcher used a pre-test post-test non-equivalent group quasi-experimental design.

Quasi-experimental is experimental research in which the research subjects are not likely to be assigned randomly. By definition, a quasi-experimental design lacks random assignment; however, participants are assigned to conditions (treatment versus no treatment or comparison) through self-selection, administrator selection (e.g., by officials, teachers, policymakers, etc.), or both of these methods (White & Sabarwal as cited in Creswell (2014)). In quasi-experiments, the researcher uses intact groups that are accessible to him or her as control and experimental groups rather of randomly assigning individuals to them. In many natural contexts when the researcher exercises restricted control over the timing of the experimental stimuli, making a genuine experimental design not feasible, quasi-experimental designs are advised (Campbell & Stanley, 1966).

A non-equivalent group design is a type of quasi-experiment used for evaluating the relative impact of various treatments given to participant groups in an unrandomized manner. Because the participants have been assigned to treatments nonrandomly, differences in the composition of the treatment groups can bias the estimates of the treatment effects (Reichardt, 2005). It is a between-subjects design in which participants have not been randomly assigned to conditions

Pre-test post-test non-equivalent group design is a design in which one or more experimental groups are exposed to a treatment or intervention and then compared to one or more control groups who did not receive the treatment (Dimitrov, & Rumrill 2003). The study employed a pre-test post-test non-equivalent control group to investigate the effects of multiple representation-based instructions on basic seven pupils' academic performance in addition of mixed fractions in the La Dade-Kotopon municipality.

The pre-test post-test non-equivalent control group design was appropriate for this study because it demanded pupils' academic performance before and after an intervention was given (involved human behaviour) and did not permit complete randomisation of the subjects and control variables. The design for the study is as represented below:

E= O_1 X1 O_2

C= O_3 X2 O_4

Where O_1, and O_3 are the pre-test in the two groups while O_2 and O_4 represent the post-test in the two groups, and X1 and X2 represent the treatment group and the control group respectively. Four pre-existing classes were used for the study (Airport Police JHS 1A, 1B, 1C, and 1D) and were compared. Four classes were taught using the traditional method which is the symbolic method representation and whole class discussion. Airport Police JHS 1B and 1C were used as the experimental group. Therefore, JHS 1B and 1C results were put together as the experimental group likewise JHS 1A and 1D results were also put together as the control group. The classification was done through balloting by the class teachers. Both the experimental and control groups were given a pre-test question to answer. After that, the researcher taught pupils from the experimental group using the intervention (multiple representations-based instructions). Thus, the experimental group, they were taught how to add mixed fractions using multiple representations-based instructions (four modes of representation and also how to transition from one mode to the other). They were given a post-test to determine their performance. The post-test consisted of four modes of representation. In the control group, they were given the pre-test without any intervention, and later they were given the post-test to find their performance level.

3.4 Population

According to Shukla (2020), population consists of all the units to which the findings of the research can be applied. In other words, the population is a set of all the units which possess variable characteristics under study and for which findings of the research can be generalised. The population, therefore, is the broader or the universal group (people/items/objects) on which the researcher generalises. The population for the study consisted of all Basic Seven pupils in the Airport-Rangoon circuit in the La Dade-Kotopon municipality in the Greater Accra of Ghana. The circuit had nine public basic schools.

The target population was Airport Police JHS "1" and "2" pupils. The total population of pupils was 163. The pupils have been taught fractions in the second term and the topic of mixed fractions wasn't new to the pupils. Their scores were analysed to establish whether a significant difference exists between the control group and the experimental group or not and also to investigate pupils' perception of the effectiveness of multiple representation-based instructions in the addition of mixed fractions and whether there exists a significant difference in the use of multiple representations-based instructions and traditional instructions or not.

3.5 Sample and Sampling Technique

A sample is a part of the population that represents it completely. It means, the units, selected from the population as a sample, must represent all kinds of characteristics of different types of units of the population (Shukla, 2020).

A method used to select a sample is called the sampling method. A Survey sampling technique was used for the study. It employed both probability sampling and non-probability sampling technique. It involved convenient sampling of the schools since the two schools were the nearest schools to the researcher. Purposive sampling was used to select the classes. Purposive because pupils learn of mixed fractions and operations with mixed fractions in the basic seven. The four classes (A, B, C, and D) were intact groups so the researcher used the participants for the study since they already existed in the two schools. Random sampling was used to select the control class and the experimental class. The class prefects were made to select among the two classes in each school which class becomes the control class and the experimental class by balloting. This was taken care by the various mathematics teachers in the school. Through the ballot by the prefect under the supervision of the various mathematics teachers in Airport Police JHS “1” and “2”, the B classroom and the C classrooms were selected as the treatment or experimental group and A and D classes became the control group for the studies.

The two schools used for the study had a different number of pupils on a roll and each basic seven classroom consisted of two classrooms. The first school Airport Police JHS “1” had two classes named A and B and each class had 40 and 39 pupils respectively. The second school Airport Police JHS “2” had two basic seven classrooms named C and D. Each of the classrooms consisted of 43 and 41 pupils respectively. Therefore, in all the classrooms, there were 163 pupils in the basic seven in the two schools. The researcher used the two classes of Airport Police “1” and Airport Police “2” JHS. The number of males and females in class A was 13 and 25 which represent 34.2 and 65.8 percent respectively. 16 and 21 males and females respectively were in Class B which in terms of percentage were 43.2 and 56.8. The number of males and females in class C was 14 (38.9 %) and 22 (61.1 %) respectively. The number of males and females in class D was 17 (47. 2%) and 19 (52.8 %) respectively.

Some pupils were truant so the researcher could not include them in the studies. Some also answered the pre-test questions but were absent on the day of the post-test. The researcher couldn’t use them for the study. There were 147 pupils left for the studies and the researcher used the pupils as a sample size for the study. The sample consisted of 60 (41 %) males and 87 (59 %) females. The number of pupils used in Airport Police “1” JHS was 75 which consisted of 38 and 37 pupils respectively for classes A and B. The number of pupils used in Airport Police “2” JHS was 72 which consisted of 36 and 36 pupils respectively for classes C and D. Classes A and D were used as the control group for the study and it consisted of 74 pupils while the class of B and C were used as the experimental class and they were 73 in number.

3.6 Data Collection Instruments

Teacher-made achievement tests and structured questionnaires were used as the main instrument for the data collection. Teacher-made achievement tests are those that are constructed by the teacher to assess the learning progress of the students and also to identify if there is any learning difficulty with that particular content or concept (Ignou 2017). The items on the teacher-made achievement test were constructed based on the lesson taught and the learning objectives in the Basic School Curriculum. This instrument aimed to provide a measurement of the performance of pupils in both pre-test and post-test. The teacher-made achievement test was preferred in this study to other types of tests due to the following reasons: it reflects instruction and curriculum; it is sensitive to student's abilities and needs; it provides immediate feedback about pupils' progress; and finally, it can be made to reflect small changes in knowledge (O'Malley, 2010).

The teacher-made achievement test for the study was a multiple-choice questionnaire for respondents to answer. Linn and Miller (2005) stated that "multiple choice items can effectively measure many of the simple learning outcomes measured by short answer item, true-false item, and matching type item. In addition, it can measure a variety of complex outcomes in the knowledge, understanding, and application areas". The teacher made test for the pre-test consisted of three sections based on the research questions formulated as shown in Appendix A. The first section "A" was the demographic data about the respondents which contain the name of the respondents, number, gender, age, name of school, and group. It was used based on the research hypothesis. The second section "B" was made up of four research questions of which each question consisted of four test items and each question consisted of four alternatives based on the four modes of representations for the study. The second section "B", was to find out how respondents can solve the addition of mixed fractions based on the four modes of representations as stated in research objective one. The third section "C" consisted of six research questions of which each research question consisted of four questions and four alternatives. It was demanded of respondents to be able to translate from one mode of representation to another based on research objective two. With parts B and C, respondents were to select only the best answer among the four alternatives to help determine their academic performance.

The teacher made test for the post-test consisted of four sections based on the research questions formulated. It is shown in Appendix B. The first section "A" was the demographic data about the respondents which contain the name of the respondents, number, gender, age, name of school, and group. It was used based on research hypothesis one. The second section "B" was made up of four research questions of which each question consisted of four test items and each question consisted of four alternatives based on the four modes of representations for the study. The second section "B" was to find out how respondents can solve the addition of mixed fractions based on the four modes of representations as stated in research objective one. The third section "C" consisted of six research questions of which each research question consisted of four questions and four alternatives. It was demanded of respondents to be able to translate from one mode of representation to another based on research objective two. With parts B and C, respondents were to select only the best answer among the alternatives.

The fourth section "D" was a Likert scale questionnaire that consisted of seven questions that demanded that those in the experimental group respond to five-point rating scale questionnaires based on their perception of the effectiveness of the use of the intervention on their academic performance as shown in Appendix C.

3.7 Piloting the Research Instrument

The research instrument was pretested before the actual data collection. A pilot test of the instrument for the study was conducted in the Queen of Peace Roman Catholic Basic "A" school in the La-Nkwantanang (Madina) Municipality in the Greater Accra region of Ghana in September 2022. It was conducted in the form one class during school hours. The mathematics periods and other periods were used for the piloting. Thirty pupils were used for the pilot studies. Ten males and twenty females. Fifteen were used as the treatment group and another fifteen as a control group. The school had similar characteristics to the two schools used for the study.

The pilot test gave a foreknowledge of the duration to be used by respondents for each section in responding to the research questions. It helped in rephrasing and restructuring some of the research questions. It also helped in correcting some of the alternatives in the multiple-choice questions. In addition, it helped in redesigning some of the diagrams used for the studies both the pre-test and post-test questionnaires. The pilot study also helped to plan for the fieldwork to make it less stressful and for the objectives of the study to be attained. The pre-test consisted of 10 multiple-choice tests. The first four research questions were based on the objective of one of the research questions and the other six were based on the objective of the studies. Another instrument used was a structured questionnaire. This consisted of 12 Likert-scale questions which it was administered to only the pupils in the experimental group.

3.8 Validity of Instrument

Heale and Twycross (2015) defined validity as the extent to which a concept is accurately measured in a quantitative study. In other words, the extent to which the scores from a measure represent the variables they have to measure.

Validity of the test instrument was ensured through content means. After the instruments were designed, copies were given to the researcher's two supervisors at the University of Education, Winneba, and one mathematics teacher at Queen of

Peace R/C School at Madina to check for the corrections, appropriateness of language, clarity of constructions, representativeness, and completeness of test items. They helped the researcher to edit and correct the mechanical, diagrammatic, and grammatical errors in the instruments. After their comments and constructive criticisms, some refinements were made where necessary. This was done to improve the content validity of the instruments (teacher-made achievement test and the questionnaire).

3.9 Reliability of the Instruments

Heale and Twycross (2015) opined that reliability of instrument is the consistency of the instrument in producing the same or similar results given the same condition on different occasions. It is the degree of a study instrument such as a questionnaire, or an interview guide to measure a subject or a variable at different occasions and on all occasions consistently given the same or similar results. Reliability was established by using a pilot test, and collecting data from thirty (30) subjects who were not part of the study but had similar characteristics of those who were chosen for the main study. There were 15 participants each in both the experimental and the control groups. The instrument's reliability estimate was established through the Cronbach Alpha reliability method. The pre-test and post-test for the teacher-made test were computed for reliability and the Cronbach alpha coefficient was 0.77 for the pre-test and 0.81 for the post-test of the teacher-made tests and 0.74 for the questionnaire which indicates a good and acceptable degree of internal consistency for the teacher-made test and questionnaire.

3.10 Data Collection Procedure

The researcher sent an introductory letter from the Basic Education department at the University of Education, Winneba to the Municipal Education Office of the La Dade-Kotopon. A letter was given to the researcher for approval and also the office issued a letter to the researcher to be taken to the two schools and also to the School Improvement Support Officer (SISO) for the schools to assist the researcher in his research. The researcher sent the letter to the headmaster and the headmistress of the two schools for them to grant him permission and the necessary support. The head teachers introduced the researcher to the mathematics teachers for assistance. There were four teachers of mathematics in the school and each school had two mathematics teachers. Each head in collaboration with the teachers of the two classes scheduled the time for meeting and holding the lesson for both the control group and the experimental group. The duration for each lesson was one hour and each lesson commenced at 2:00 pm and ended at 3:00 pm.

The researcher prepared the marking scheme for the teacher-made tests (both the pre-test and post-test). Each question carried a mark and there were forty questions. The scheme was made for easy scoring of the test items.

In the first week, the teachers used four days to teach fractions but much attention was tailored towards the addition of fractions and mixed fractions from the 10^{th} - the 13^{th} of October 2022. They taught it using the traditional method or conventional method of teaching fractions. The traditional method of instructions seeks to use the symbolic form of representation in lesson delivery. The symbolic form of representation is the only means through which fraction was taught to learners. On the fifth day, Friday, 7^{th} October, the pre-test was administered by the researcher with the support of the mathematics teachers of the two schools. Respondents were given two hours to finish answering the questions. They were to circle or underline the right alternative among all the four multiple choice items. After the test, the questions were collected from the learners and was marked by the researcher and the mathematics teachers. The researcher sought for other colleagues help to go through the marked script to avoid errors of marking.

During the following week, from 17^{th} – 20^{th} October 2022, the researcher trained a mathematics teacher in the two schools on how to use multiple representations-based instruction in adding mixed fractions. The two teachers trained in each school taught the treatment group using the intervention. The facilitators were trained during their free periods in the morning and also sometimes during break time. On the first day, they were trained on the meaning of fractions and representing mixed fractions using diagrams, manipulatives, real-life, word form and symbolic form. On the second day, the researcher trained the facilitators on word form of representation and how to translate from the word form of representation of addition of mixed fractions to the symbolic form of representation.

The facilitators were also trained on how to represent addition of mixed fractions diagrammatically and also to translate from diagrammatic representation to symbolic representation. The third day, the researcher trained the facilitators on translating from word form of representation to real-life situations. They were trained on how to change a statement form of representation to real-life representation of addition of mixed fractions. On the fourth day, the facilitators were trained on representing diagrammatic representations in the real-life situation. They were trained to also add mixed fractions by changing from diagrammatic form of representation to word form of representation. The treatment group of Airport Police JHS "1" and Airport Police two were taught during the hours of 1:00-2:00 pm right after their second break by the two trained teachers. The control groups were revising the addition of fractions and mixed fractions during the time the treatment groups were also having their lessons. But the teachers for Airport Police "1" taught the pupils in Airport Police "2" while the mathematics teacher in Airport Police "2" also taught the pupils in Airport Police "1" JHS with the same traditional method of teaching likewise the experimental groups were taught with the intervention. On Friday 21st October 2022, both the control group and the treatment groups were given a post-test to write under the supervision of the researcher and the mathematics teachers. Respondents were given two hours to finish the questions, but the respondents in the treatment group were given extra 30 minutes to answer the research questions on the structured questionnaire to solicit their perception of the effectiveness of the intervention based on Ainstworth, (2018), views on the importance of multiple representations to the learner. The tests were organised at their big halls for general assembly and worship. Appendices E and F show the introductory letter and lesson plan for the study.

3.11 Data Analysis

The research questions, hypothesis of the study as well as scales of measurement influenced how the data has to be analysed. The international Business Machine Software Package for the Service Solution (IBM SPSS 20) was used in the analysis of the results. All variables were keyed into the IBM SPSS. The frequency distribution of each of the variables in the data files was processed. The outputs were carefully reviewed for missing data and unusual or unexpected entries.

Descriptive statistics of frequency counts and percentages were employed for all the demographic variables, and while the Mean and Standard Deviations was used to answer the research question one and two while frequency and percentages was used for research question three and the paired samples t-test was used to test the null hypotheses.

Research question one which examines effect of multiple representations-based instructions on pupils' academic performance in addition of mixed fractions was analysed using descriptive statistics. The research question two "to what extent does pupils' ability to translate from one mode of representation to another improve their academic performance in addition of mixed fractions?" was analysed using descriptive statistics.

Research question three which was a Likert scale questionnaire which demanded the perception pupils on the effectiveness of the use of multiple representations-based instruction in the addition of mixed fractions was analysed using frequency and percentages. The research hypothesis one which is "there is no statistically significant difference between the performance of pupils taught with multiple representations-based instruction and pupils taught with traditional instructions in addition of mixed fractions among the experimental groups and the research hypothesis two which is "there is no statistically significant difference in the performance of pupils who can translate from one mode of representation to another among the experimental groups" were analysed using the Paired Sampled t-Test.

3.12 Ethical Considerations

The researcher executed the ethical procedures practiced by researchers in conducting research including the following:

The researcher sought a letter of introduction from the Department of Basic Education and sent it to La-Dade Kotopon Educational Office. The letter from the Educational Office was sent to the school authorities to seek permission before the administration of questionnaires and test items. In these letters, the purpose of the study was clearly stated to both the respondents and the authorities. The consent of the participants was also sought for the study and also were informed of their rights to redraw at any time from the study. The confidentiality and anonymity of participants were respected in the study by the researcher. Participants were given the assurance that their identities would be concealed. Though the participants were made to write their names on the scripts but it was secretly kept from the third party getting access to it.

The names were sought so that the researcher can easily identify participants who took part in the pre-test and the post-test. Though numbers could have been used for the sake of anonymity but it was found from the pilot study that some participants forgot their numbers and therefore they wrote any number they could remember. The final report did not have the name of the participants but was represented with numbers by the researcher. The participants were assured that the data will be used for the stated purpose of the research. To avoid plagiarism, the works of people used for the study were duly cited in the literature review, acknowledge in the text, and listed in the reference section.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

The study seeks to investigate the effects of multiple representations-based instructions on pupils' performance in addition of mixed fractions in the La Dade-Kotopon Municipality in the Greater Accra region of Ghana. Results are presented and analysed in two sections namely Section A and Section B. Section A deals with the demographic data while Section B concerns the main data. The demographic data consisted of the name of the participant, age, gender, and class. Section B which was the main data was guided by the following objectives

1. To examine effect of using multiple representation-based instructions in the teaching and learning of the addition of mixed fractions on pupils' academic performance in the La Dade-Kotopon Municipality of Ghana.
2. To evaluate how pupils' ability to translate from one mode of representation to another improves their academic performance in addition of mixed fractions.
3. To find pupils' perception of the effectiveness of multiple representations-based instruction in teaching and learning addition of mixed fractions.

It was also guided by three research questions and two hypotheses. The research questions and hypotheses were;

a. What is the impact of multiple representations-based instructions on pupils' academic performance in addition of mixed fractions in the La Dade-Kotopon Municipality in the Greater Accra region of Ghana?

b. To what extent does pupils' ability to translate from one mode of representation to another improve their academic performance in addition of mixed fractions?

c. What are pupils' perceptions of the effectiveness of multiple representations-based instructions in addition of mixed fractions?

Research hypotheses

i. Null hypothesis 1, (H_{01}): There is no statistically significant difference between multiple representation-based instructions and traditional instructions in addition of mixed fractions among the experimental groups

ii. Null hypothesis 2, (H_{02}): There is no statistically significant difference in the performance of pupils who can translate from one mode of representation to another among the experimental groups.

4.1 Socio-Demographic Data of Participants

Table 4.1 shows the distribution of participants in the experimental and control groups with respect to gender.

Table 4.1: Gender Distribution of Participants

	Control Group		Experimental Group		Groups combined	
Sex	**Frequency**	**Percentage (%)**	**Frequency**	**Percentage (%)**	**Total**	**Percentage (%)**
Male	30	40	30	41	60	41
Female	44	60	43	59	87	59
Total	**74**	**100**	**73**	**100**	**147**	**100**

Source: Field Data, 2022

Table 4.1 shows 147 pupils were used for the study. There were 74 (50.4%) were used as the control group (participants taught with traditional/conventional instructions). 30 (40%) of the participants were males and 44 (60%) were females in the control group. The females were more than the number of males by 14 participants in the control group. There were 73 (49.6%) participants were used as the experimental group (participants taught with multiple representations-based instruction). 30 (41%) of the participants were males and 43 (59%) were females in the experimental group. The number of female participants in the experimental group outnumbered the males by 13 participants.

4.2 Research Question One: What is effect of multiple representations-based instruction on pupils' academic performance in addition of mixed fractions in the La Dade-Kotopon Municipality in the Greater Accra region of Ghana?

Research question one sought to find effect of multiple representations-based instruction on pupils' academic performance in addition of mixed fractions. Test items were constructed on the four modes of representation for real-life representations, symbolic representations, diagrammatic representations, and word/statement forms of representation. The test items were constructed in a way that the learner should have mastery on each form of representations and can correctly answer questions on each mode of multiple representation.

The real-life representation of addition of mixed fractions was concerned with real-life stories or situations, or experienced contexts that are related to mathematical concepts or problems solving in addition of mixed fractions. Realistic representation sought to find how pupils can add mixed fractions in their daily lives and also to find from pupils how they can apply the addition of mixed fractions to solve life problems in their life activities. The test items were constructed to suit daily life activities. The symbolic representations of addition of mixed fractions were concerned with how pupils can add mixed fractions in their symbol form or arithmetic formulas. Test items were in symbolic form for pupils to answer. The diagrammatic form or pictorial representation sought to find out how pupils can make a mental picture or show a visual representation of the manipulation of concrete materials to help visualize mathematical operations in problem-solving. The test items were constructed in the form of diagrams for pupils to add using diagrams. The word or statement form of representation sought to find how language or verbal representations are used to interpret, discuss, define, or describe mathematical ideas, informal and formal mathematical language in addition of mixed fractions. Test items were constructed in word/statement form.

Each mode of representation had four multiple-choice test items for respondents to answer. Each test item had four alternatives ranging from A-D. One of the options/alternatives contained the correct answer and pupils score a mark of 1 for selecting the correct response. Each of the test items was marked out of four. Each participant's performance on the pre-test and post-test test were keyed into the IBM SPSS 20.0. The frequency distribution of each of the variables in the data files was processed. The outputs were carefully reviewed for missing data and unusual or unexpected entries keyed in SPSS version 20 for analysis.

The performance of the pupils on the achievement post-test score was compared to the performance on the pre-test. The pre-test was administered to both the experimental and control groups. Before administering the pre-test, both groups were taught using conventional instructions. Afterward, the experimental group was taught with the intervention while the control group was taught using the traditional method of teaching. This was done to find out whether the use of multiple representations-based instructions improved the performance of the pupils more than conventional instructions. A post-test was administered to the control group and the experimental groups to test for the effectiveness of the use of the intervention. Descriptive statistics such as frequencies, percentages, mean, and standard deviation were used for the analysis.

Table 4.2: Descriptive statistics of pupils' performance in addition of mixed fractions of the control and experimental groups in the pre-test

Multiple representations (forms of MRBI)	Score from 0-4	Control group		Experimental Group	
		No. of correct/incorrect responds	Percentage (%) of correct/incorrect responds	No. of correct/incorrect responds	Percentage (%) of correct/incorrect responds
Real-life representation of addition of mixed fractions	0	11	14.9	13	17.8
	1	30	40.5	29	39.7
	2	23	31.1	13	17.8
	3	8	10.8	15	20.5
	4	2	2.7	3	4.1
Total		**74**	**100**	**73**	**100**
Diagrammatic representation of addition of mixed fractions	0	14	18.9	10	13.7
	1	17	23.0	19	26.0
	2	23	31.1	18	24. 7
	3	17	23.0	17	23.3
	4	3	4.1	9	12.3
Total		**74**	**100**	**73**	**100**
Symbolic representation of addition of mixed fractions	0	18	24.3	14	19.2
	1	32	43.2	31	42.5
	2	16	21.6	18	24.7
	3	6	8.1	4	5.5
	4	2	2.7	6	8.2
Total		**74**	**100**	**73**	**100**
Word/statement form of addition of mixed fractions	0	17	23.0	6	8.2
	1	26	35.1	25	34.2
	2	16	21.6	23	31.5
	3	10	13.5	14	19.2
	4	5	6.8	5	6.8
Total		**74**	**100**	**73**	**100**

Source: Field data, 2022

Table 4.3: Mean and Standard Deviation for the Experimental and Control Groups

Multiple representations (forms of MRBI)	Control group		Experimental group	
	Mean	Standard Deviation (*SD*)	Mean	Standard Deviation (*SD*)
Real-life representation of addition of mixed fractions	1.46	0.968	1.53	1.131
Diagrammatic representation of addition of mixed fractions	1.70	1.144	1.95	1.246
Symbolic representation of addition of mixed fractions	1.22	0.997	1.41	1.116
Word/statement form of addition of mixed fractions	1.46	1.184	1.82	1.059

Source: Field Data 2022

From Table 4.3 above, the majority of the pupils in both groups performed below the average score of 2 marks in the pre-test. The number of pupils in the control class that scored above the average mark in real-life addition of mixed fractions was only 10/74 representing 13.5% while pupils in the experimental group that scored above the average mark were 18/73 representing 24.6%. The number of pupils in the control class that scored above the average mark in the diagrammatic representation of addition of mixed fractions was only 20/74 representing 27.1% while pupils in the experimental group that scored above the average mark were 30/73 representing 41.1%. The number of pupils in the control class that were able to score above the average mark in symbol representation of addition of mixed fractions was only 8/74 representing 10.8% while pupils in the experimental group that scored above the average marks were 10/73 representing 13.7%. The number of pupils in the control class that scored above the average mark in the word/statement form of addition of mixed fractions was only 15/74 representing 20.3% while pupils in the experimental group that scored above the average mark were 19/73 representing 26.0%.

Table 4.3 shows the mean score and the standard deviation for the control group (*M*=1.46, with *SD*=0.968) and the experimental group (*M*=1.53, with *SD*=1.131) for the pre-test showed that the pupils had similar characteristics and there is no significant difference in pupils' performance in real-life representation of addition of mixed fractions. The mean score and the standard deviation for the control group (*M*=1.70, with *SD*=1.144) and the experimental group (*M*=1.95, with *SD*=1.246) for the pre-test showed that the pupils had similar characteristics and there is no significant difference in pupils' performance in the diagrammatic representation of the addition of mixed fractions. The mean score and the standard deviation for the control group (*M*=1.22, with *SD*=0.997) and the experimental group (*M*=1.41, with *SD*=1.116) for the pre-test showed that the pupils had similar characteristics and there is no significant difference in pupils' performance in symbolic representation of the addition of mixed fractions. The mean score and the standard deviation for the control group (*M*=1.46, with *SD*=1.184) and the experimental group (*M*=1.82, with *SD*=1.059) for the pre-test showed that the pupils had similar characteristics and there is no significant difference in pupils' performance in word/statement form of representation of addition of mixed fractions.

It is seen that the pupils' possessed similar academic performance on the pre-test for all four modes of representation. An intervention of the use of multiple representations-based instruction was given to the experimental group while the control group was taught with the conventional instructions. This was done to find out whether the use of the intervention (multiple representations-based instructions) improved pupils' academic performance more than traditional/conventional instructions. The results after the treatment are shown in Table 4.4

Table 4.4: Descriptive statistics of pupils' performance in addition of mixed fractions of the control and experimental groups in the post-test

Multiple representations (forms of MRBI)	Score from 0-4	Control group: No. of correct/incorrect responds	Control group: Percentage (%) of correct/incorrect responds	Experimental Group: No. of correct/incorrect responds	Experimental Group: Percentage (%) of correct/incorrect responds
Real-life representation of addition of mixed fractions	0	8	10.8	3	4.1
	1	40	54.1	9	12.3
	2	24	32.4	20	27.4
	3	1	1.4	31	42.5
	4	1	1.4	10	13.7
Total		**74**	**100**	**73**	**100**
Diagrammatic representation of addition of mixed fractions	0	11	14.9	1	1.4
	1	23	31.1	1	1.4
	2	22	29.7	8	11.0
	3	9	12.2	14	19.2
	4	9	12.2	49	67.1
Total		**74**	**100**	**73**	**100**
Symbolic representation of addition of mixed fractions	0	10	13.5	2	2.7
	1	27	36.5	6	8.2
	2	27	36.5	27	37.0
	3	6	8.1	12	16.4
	4	4	5.4	26	35.6
Total		**74**	**100**	**73**	**100**
Word/statement form of addition of mixed fractions	0	17	23.0	0	0
	1	29	39.2	7	9.6
	2	24	32.4	17	23.3
	3	3	4.1	29	39.7
	4	1	1.4	20	27.4
Total		**74**	**100**	**73**	**100**

Source: Field Data, 2022

Table 4.5: Mean and standard deviation for the experimental and control groups

Multiple representations (forms of MRBI)	Control group: Mean (*M*)	Control group: Standard Deviation (*SD*)	Experimental group: Mean (*M*)	Experimental group: Standard Deviation (*SD*)
Real-life representation of addition of mixed fractions	1.28	0.731	2.49	1.015
Diagrammatic representation of addition of mixed fractions	1.76	1.214	3.49	0.852
Symbolic representation of addition of mixed fractions	1.55	1.009	2.73	1.109
Word/statement form of addition of mixed fractions	1.22	0.896	2.85	0.938

Source: Field Data, 2022

From Table 4.4 above, it's seen that pupils in the experimental class performed higher and better scores than the control group in all four modes of representation. The mean for the study for each mode of representation is 2. The number of pupils in the control class that were able to score above the average mark in real-life addition of mixed fractions was 2/74 representing 2.8% while pupils in the experimental group that scored above the average mark were 41/73 representing 52.6%. The number of pupils in the control class that were able to score above the average mark in diagrammatic representation of addition of mixed fractions was 18/74 representing 24.4% while pupils in the experimental group that scored above the average marks were 63/73 representing 86.3%. The number of pupils in the control class that were able to score above the average mark in symbolic representation of addition of mixed fractions was 10/74 representing 13.5% while pupils in the experimental group that scored above the average mark were 38/73 representing 52.0%. The number of pupils in the control class that scored above the average mark in the word/statement form of addition of mixed fractions was 4/74 representing 5.5% while pupils in the experimental group that scored above the average mark were 49/73 representing 67.1%.

Table 4.5 above shows the mean score and the standard deviation for the control group (*M*=1.28, with *SD*=0.731) and the experimental group (*M*=2.49, with *SD*=1.015) for the post-test in the real-life representation of addition of mixed fractions. This showed that the pupils in the experimental group performed better than the pupils in the control group. There was a significant difference in pupils' performance in the realistic representation of addition of mixed fractions on the post-test because the use of multiple representations-based representations (MRBI) improved the experimental group performance. The mean score and the standard deviation for the control group (*M*=1.76, with *SD*=1.214) and the experimental group (*M*=3.49, with *SD*=0.852) for the post-test in the diagrammatic representation of addition of mixed fractions. This showed that the pupils in the experimental group performed better than the pupils in the control group. There was a significant difference in pupils' performance in the diagrammatic representation of addition of mixed fractions on the post-test because the use of MRBI improved the experimental group performance. The mean score and the standard deviation for the control group (*M*=1.55, with *SD*=1.009) and the experimental group (*M*=2.73, with *SD*=1.109) for the post-test in symbolic representation of addition of mixed fractions. This showed that the pupils in the experimental group performed better than the pupils in the control group. There was a significant difference in pupils' performance in the symbolic representation of addition of mixed fractions on the post-test because the use of MRBI improved the experimental group's performance in addition of mixed fractions. The mean score and the standard deviation for the control group (*M*=1.22, with *SD*=0.896) and the experimental group (*M*=2.85, with *SD*=0.938) for the post-test in Word/statement form of addition of mixed fractions. This showed that the pupils in the experimental group performed better than the pupils in the control group. There was a significant difference in pupils' performance in word/statement form of representation of addition of mixed fractions on the post-test because MRBI improved the experimental group performance in addition of mixed fractions.

4.3 Hypothesis One: There is no statistically significant difference between the performance of pupils taught with multiple representations-based instruction and pupils taught with traditional instructions in addition of mixed fractions among the experimental group.

The research hypothesis was to ascertain whether there is a statistically significant difference between the performance of pupils in the experimental group taught with conventional/traditional instructions compared to those in the experimental group who were taught with multiple representation-based instructions. The score of the experimental group on each of the modes of representation on the post-test was compared to the score of the same group on the test item on the pre-test. Before administering the pre-test to those in the experimental group, the pupils were taught with traditional/conventional instructions first. Afterward, the same experimental group was taught with MRBI, and the post-test was given to them to answer. The post-test score of the experimental group (pupils taught with MRBI) was compared to their pre-test score (pupils taught with traditional/conventional instructions). Their scores were compared using a paired sample t-test. The paired sampled t-test was used to test the hypothesis at a significance level of 0.05. Table 4.6 shows the result of a paired-sampled t-test conducted to compare the pre-test and post-test scores of the experimental class on the effectiveness of the use of the intervention.

Table 4.6: A paired sampled t-test statistic comparing the results of the pre-test and post-test scores among the experimental group

Multiple representations (forms of MRBI)	Instructions	*N*	*M*	*SD*	T	df	*p*
Real-life representation of addition of mixed fractions	Exp. 1	73	1.53	1.131	-6.788	72	0.000
	Exp. 2	73	2.49	1.015			
Diagrammatic representation of addition of mixed fractions	Exp. 1	73	1.95	1.246	-9.100	72	0.000
	Exp. 2	73	3.49	0.852			
Symbolic representation of addition of mixed fractions	Exp. 1	73	1.41	1.116	-7.111	72	0.000
	Exp. 2	73	2.73	1.109			
Word/Statement form of representation of addition of mixed fractions	Exp. 1	73	1.82	1.059	-6.208	72	0.000
	Exp. 2	73	2.85	0.938			

Source: Fieldwork, 2022 *Significance. $p < 0.05$

Key: *N= Number*, *M= Mean*, *SD= Standard deviation*, *T= statistics* *df*= Degree of freedom *p= Probability*, Exp. 1 = *Experimental grouped taught with traditional instructions (pre-test score)*, Exp. 2 = *Experimental group taught with multiple representation-based instructions (post-test score)*

The result in Table 4.6 above shows that there was a statistically significant difference between pupils' pre-test (M = 1.53, *SD*= 1.131) and post-test scores (M = 2.49, *SD* = 1.015); t(72)= -6.788, p = 0.000) performance for real-life representation of addition of mixed fractions. There was a statistically significant difference between pupils' pre-test (M = 1.95, *SD*= 1.246) and post-test scores (M = 3.49, *SD* = 0.852); t(72)= -9.100, p = 0.000) performance for the diagrammatic representation of addition of mixed fractions. There was a statistically significant difference between pupils' pre-test (M = 1.41, *SD*= 1.116) and post-test scores (M = 2.73, *SD* = 1.109); t(72)= -7.111, p = 0.000) for symbolic representation of addition of mixed fractions. There was a statistically significant difference between pupils' pre-test (M = 1.82, *SD*= 1.059) and post-test scores (M = 2.85, *SD* = 0.938); t(72)= -6.208, p = 0.000) statement/word form of representation of addition of mixed fractions.

4.4 Research question two: To what extent does pupils' ability to translate from one mode of representation to another improve their academic performance in addition of mixed fractions?

The research question sought to find how pupils' ability to translate from one mode of representation to another improved their academic performance in addition of mixed fractions.

Section C of the research instrument contained six test items that required pupils to effectively identify a match between translation from one mode of representation to another. The form of translation was as follows

- Translating from real-life representations to symbolic representations and vice versa; the items were constructed in real-life situations and pupils were to identify a match between translation from real-life to symbolic form or the item was constructed in a symbol form and the pupils were to identify a match between translation from symbolic form to real-life situations.
- Translating from symbolic representations to word forms of representations and vice versa; the items were constructed in symbols form of representation and pupils to identify a match between translation from symbolic representation to word/statement form or the item was constructed in a word/statement form and the pupil to identify a match between translation from word form to symbolic form.
- Translation from real-life representations to diagrammatic representations and vice versa; the items were constructed in real-life situations and pupils to identify a match between translation from real-life situation to a diagrammatic form and vice versa.
- Translating from symbolic representations to diagrammatic representations and vice versa; the items were constructed in a symbolic form of representation and

pupils to identify a match between translation from symbolic representation to a diagrammatic form or the item was constructed in a diagrammatic form and the pupil to translate from picture/diagram form to symbolic form.

- Translating from diagrammatic representations to word and vice versa; the items were constructed in diagrammatic form of representation and pupils to identify a match between translation from diagrammatic representation to word/statement form and vice versa.
- Translating from real-life representations to word/statement form of representations and vice versa; the items were constructed in real-life situations and pupils to identify a match between translation from real-life representations to a word/statement form or the item was constructed in a word/statement form and the pupil change it to real-life situations

Four test items were constructed under each form of translation. A multiple-choice test item was constructed for the pupils to select the best option that represents translation from one mode of representation to another. Each test item had four alternatives ranging from A-D. The responses from each pupil were marked out of four. Afterward, each pupil's performance was computerized in SPSS 20.

The performance of the pupils on the achievement post-test score was compared to the performance on the pre-test. This was done to find out whether translation from one mode of representation to another improved the performance of the pupils. Descriptive statistics such as frequencies, percentages, mean, and standard deviation were used for the analysis.

Table 4.7: Descriptive statistics of pupils' performance on translation from one mode of representation to another in addition of mixed fractions of the control and experimental groups in the pre-test

Mode of translations	Score	Control group No. of pupils	Control group Percentage (%)	Experimental Group No. of pupils	Experimental Group Percentage (%)
Translating from real-life representations to symbolic representations and vice versa	0	8	10.8	9	12.3
	1	31	41.9	20	27.4
	2	30	40.5	36	49.3
	3	5	6.8	6	8.2
	4	0	0.0	2	2.7
Total		**74**	**100**	**73**	**100**
Translating from symbolic representations to word forms of representations and vice versa	0	12	16.2	6	8.2
	1	23	31.1	16	21.9
	2	27	36.5	39	52.4
	3	12	16.2	12	16.4
	4	0	0.0	0	0.0
Total		**74**	**100**	**73**	**100**
Translating from real-life representations to diagrammatic representations and vice versa	0	8	10.8	11	15.1
	1	24	32.4	14	19.2
	2	29	39.2	21	28.1
	3	7	9.5	22	30.1
	4	6	8.1	5	6.8
Total		**74**	**100**	**73**	**100**
Translating from symbolic representations to diagrammatic representations and vice versa	0	16	21.6	5	6.8
	1	20	27.0	19	26.0
	2	14	18.9	22	30.1
	3	12	16.2	19	26.0
	4	12	16.2	8	11.0
Total		**74**	**100**	**73**	**100**
Translating from diagrammatic representations to word and vice versa	0	32	43.2	29	39.7
	1	25	33.8	31	42.5
	2	13	17.6	7	9.6
	3	4	5.4	4	5.5
	4	0	0.0	2	2.7
Total		**74**	**100**	**73**	**100**
Translating from real-life representations to word/statement form of representations and vice versa	0	26	35.1	23	31.5
	1	29	39.2	32	43.8
	2	12	16.2	8	11.0
	3	1	1.4	5	6.8
	4	6	8.1	5	6.8
Total		**74**	**100**	**73**	**100**

Source: Field Data, 2022

Table 4.8: Mean and standard deviation of pupils' performance on translation from one mode of representation to another in addition of mixed fractions of the control and experimental groups in the pre-test

Mode of translations	Control group Mean	Control group Standard Deviation (*SD*)	Experimental group Mean	Experimental group Standard Deviation (*SD*)
Translating from real-life representations to symbolic representations and vice versa	1.43	0.778	1.62	0.907
Translating from symbolic representations to word forms of representations and vice versa	1.53	0.954	0.821	0.821
Translating from real-life representations to diagrammatic representations and vice versa	1.72	1.054	1.95	1.177
Translating from symbolic representations to diagrammatic representations and vice versa	1.78	1.388	2.08	1.115
Translating from diagrammatic representations to words and vice versa	0.85	0.902	0.89	0.980
Translating from real-life representations to word/statement form of representations and vice versa	1.08	1.144	1.14	1.146

Source: Field Data, 2022

In Table 4.8 shows the mean score and the standard deviation for the control group (*M*=1.43, with *SD*=0.778) and the experimental group (*M*=1.62, with *SD*=0.907) for the pre-test showed that the pupils had similar characteristics and there is no significant difference in pupils' performance in translating from real-life representations to symbolic representations and vice versa. The mean score and the standard deviation for the control group (*M*=1.53, with *SD*=0.954) and the experimental group (*M*=1.78, with *SD*=0.821) for the pre-test showed that the pupils had similar characteristics and there is no significant difference in pupils' performance in translating from symbolic representations to word forms of representations and vice versa.

The mean score and the standard deviation for the control group (*M*=1.72, with *SD*=1.054) and the experimental group (*M*=1.95, with *SD*=1.177) for the pre-test showed that the pupils had similar characteristics and there is no significant difference in pupils' performance in translating from real-life representations to diagrammatic representations and vice versa. The mean score and the standard deviation for the control group (*M*=1.78, with *SD*=1.388) and the experimental group (*M*=2.08, with *SD*=1.115) for the pre-test showed that the pupils had similar characteristics and there is no significant difference in pupils' performance in translating from symbolic representations to diagrammatic representations and vice versa. The mean score and the standard deviation for the control group (*M*=0.85, with *SD*=0.902) and the experimental group (*M*=0.89, with *SD*=0.980) for the pre-test showed that the pupils had similar characteristics and there is no significant difference in pupils' performance in translating from diagrammatic representations to word and vice versa. The mean score and the standard deviation for the control group (*M*=1.08, with *SD*=1.144) and the experimental group (*M*=1.814, with *SD*=1.146) for the pre-test showed that the pupils had similar characteristics and there is no significant difference in pupils' performance in translating from real-life representations to word/statement form of representations and vice versa.

Table 4.9: Descriptive statistics of pupils' performance on translation from one mode of representation to another in addition of mixed fractions of the control and experimental groups in the post-test

Mode of translation	Score	Control group No. of pupils	Control group Percentage (%)	Experimental Group No. of pupils	Experimental Group Percentage (%)
Translating from real-life representations to symbolic representations and vice versa	0	11	14.9	1	1.4
	1	12	16.2	3	4.1
	2	22	29.7	6	8.2
	3	15	20.3	7	9.6
	4	14	18.9	56	76.7
Total		**74**	**100**	**73**	**100**
Translating from symbolic representations to word forms of representations and vice versa	0	12	16.2	2	2.7
	1	12	16.2	2	2.7
	2	28	37.8	7	9.6
	3	15	20.3	25	34.2
	4	7	9.5	37	50.7
Total		**74**	**100**	**73**	**100**
Translating from real-life representations to diagrammatic representations and vice versa	0	11	14.9	3	4.1
	1	24	32.4	8	11.0
	2	26	35.1	16	21.9
	3	9	12.2	19	26.0
	4	4	5.4	27	37.0
Total		**74**	**100**	**73**	**100**
Translating from symbolic representations to diagrammatic representations and vice versa	0	10	13.5	3	4.1
	1	19	25.7	5	6.8
	2	15	20.3	8	11.0
	3	18	24.3	17	23.3
	4	12	16.2	40	54.8
Total		**74**	**100**	**73**	**100**
Translating from diagrammatic representations to word and vice versa	0	21	28.4	4	5.5
	1	33	44.6	17	23.3
	2	16	21.6	28	38.4
	3	3	4.1	20	27.4
	4	1	1.4	4	5.5
Total		**74**	**100**	**73**	**100**
Translating from real-life representations to word/statement form of representations and vice versa	0	22	29.7	5	6.8
	1	34	45.9	12	16.4
	2	12	16.2	20	27.4
	3	6	8.1	23	31.5
	4	0	0.0	13	17.8
Total		**74**	**100**	**73**	**100**

Source: Field data 2022

Table 4.10: Mean and standard deviation of pupils' performance on translation from one mode of representation to another in addition of mixed fractions of the control and experimental groups in the post-test

Translations	Control group		Experimental group	
	Mean	Standard Deviation (*SD)*	Mean	Standard Deviation (*SD)*
Translating from real-life representations to symbolic representations and vice versa	2.12	1.313	3.56	0.913
Translating from symbolic representations to word forms of representations and vice versa	1.91	1.184	3.27	0.947
Translating from real-life representations to diagrammatic representations and vice versa	1.61	1.057	2.81	1.174
Translating from symbolic representations to diagrammatic representations and vice versa	2.04	1.308	3.18	1.135
Translating from diagrammatic representations to word and vice versa	1.05	0.890	2.04	0.978
Translating from real-life representations to word/statement form of representations and vice versa	1.03	0.891	2.37	1.161

Source: Field Data, 2022

In Table 4.10 shows the mean score and the standard deviation for the control group (*M*=2.12, with *SD*=1.313) and the experimental group (*M*=3.56, with *SD*=0.913) for the post-test showed that there is a significant difference in pupils' performance in translating from real-life representations to symbolic representations and vice versa. The mean score and the standard deviation for the control group (*M*=1.91, with *SD*=1.184) and the experimental group (*M*=3.27, with *SD*=0.947) for the post-test showed that there is a significant difference in pupils' performance in translating from symbolic representations to word forms of representations and vice versa. The mean score and the standard deviation for the control group (*M*=1.61, with *SD*=1.057) and the experimental group (*M*=2.81, with *SD*=1.174) for the post-test showed that there is a significant difference in pupils' performance in translating from real-life representations to diagrammatic representations and vice versa. The mean score and the standard deviation for the control group (*M*=2.04, with *SD*=1.308) and the experimental group (*M*=3.18, with *SD*=1.135) for the post-test showed that there is a significant difference in pupils' performance in translating from symbolic representations to diagrammatic representations and vice versa. The mean score and the standard deviation for the control group (*M*=1.05, with *SD*=0.890) and the experimental group (*M*=2.04, with *SD*=0.978) for the post-test showed that there is a significant difference in pupils' performance in translating from diagrammatic representations to word and vice versa. The mean score and the standard deviation for the control group (*M*=1.03, with *SD*=0.891) and the experimental group (*M*=2.371, with *SD*=1.161) for the post-test showed that there is a significant difference in pupils' performance in translating from real-life representations to word/statement form of representations and vice versa.

4.5 Research Hypothesis 2: There is no statistically significant difference in the performance of pupils' who can translate from one mode of representation to another.

The research hypothesis sought to determine if there is a statistically significant difference between pupils who can successfully translate from one mode of representation to another and those who cannot translate from one mode to another because they were taught using traditional instructions instead of multiple representations-based instruction. The score of the experimental group on each of the forms of translation on the pre-test was compared to their score on the test item on the post-test. Before administering the pre-test, the pupils were taught with traditional/conventional instructions. Afterward, the same experimental group was taught with multiple representations-based instruction (MRBI) and translation among them. They were given a post-test afterward to answer. The post-test score of the experimental group (pupils taught with MRBI and translation among them) was compared to their pre-test score (pupils taught with traditional/conventional instructions).

Their scores were compared using a paired sample t-test. A paired sampled t-test was used to test the hypothesis at a significance level of 0.05. The paired sample t-test was used to find whether there is a significant difference in the use of MRBI and traditional instructions from their post-test translation performance and pre-test. Table 4.11 shows the test score of the experimental class translation performance.

Table 4.11: A paired sampled t-test statistic for comparing pre-test score and post-test score for experimental group in translation from one mode of representation to another

Translation	Instructions	*N*	*M*	*SD*	T	Df	p
Translating from real-life representations to symbolic representations and vice versa	Exp. 1	73	1.62	0.907	-15.407	72	0.000
	Exp. 2	73	3.56	0.913			
Translating from symbolic representations to word forms of representations and vice versa	Exp. 1	73	0.82	0.821	-11.523	72	0.000
	Exp. 2	73	3.27	0.947			
Translating from real-life representations to diagrammatic representations and vice versa	Exp. 1	73	1.95	1.177	-4.999	72	0.000
	Exp. 2	73	2.81	1.174			
Translating from symbolic representations to diagrammatic representations and vice versa	Exp. 1	73	2.08	1.115	-6.160	72	0.000
	Exp. 2	73	3.18	1.135			
Translating from diagrammatic representations to word and vice versa	Exp. 1	73	0.89	0.980	-6.826	72	0.000
	Exp. 2	73	2.04	0.978			
Translating from real-life representations to word/statement form of representations and vice versa	Exp. 1	73	1.14	1.146	-7.321	72	0.000
	Exp. 2	73	2.37	1.161			

Source: Fieldwork, 2022 *Significance. $P < 0.05$

Key: *N= Number, M= Mean, SD= Standard deviation, T= statistics df=* Degree of freedom *p= Probability*, Exp. 1 = *Experimental grouped taught with traditional instructions (pre-test score)*, Exp. 2 = *Experimental group taught with multiple representation-based instructions (post-test score)*

The result in Table 4.11 shows that there was a statistically significant difference between pupils' pre-test score (M = 1.62, *SD*= 0.907) and post-test scores (M = 3.56, *SD* = 0.913); t(72)= -15.407, p = 0.000) for translating from real-life representations to symbolic representations and vice versa. There was a statistically significant difference between pupils' pre-test score (M = 0.82, *SD*= 0.821) and post-test scores (M = 3.27, *SD* = 0.947); t(72)= -11.523, p = 0.000) for translating from symbolic representations to word forms of representations and vice versa. There was a statistically significant difference between pupils' pre-test score (M = 1.95, *SD*= 1.177) and post-test scores (M = 2.81, *SD* = 1.174); t(72)= -4.999, p = 0.000) for translating from real-life representations to diagrammatic representations and vice versa. There was a statistically significant difference between pupils' pre-test (M = 2.08, *SD*= 1.115) and post-test scores (M = 3.18, *SD* = 1.135); t(72)= -6.160, p = 0.000) for translating from symbolic representations to diagrammatic representations and vice versa. There was a statistically significant difference between pupils' pre-test (M = 0.89, *SD*= 0.980) and post-test scores (M = 2.04, *SD* = 0.978); t(72)= -6.826, p = 0.000) for translating from diagrammatic representations to word and vice versa. There was a statistically significant difference between pupils' pre-test (M = 1.14, *SD*= 1.146) and post-test scores (M = 2.37, *SD* = 1.161); t(72)= -7.321, p = 0.000) for translating from real-life representations to word/statement form of representations and vice versa.

4.6 Research Question 3: What are pupils' perceptions of the effectiveness of multiple representations-based instructions in addition of mixed fractions?

The research question sought to find out the perception of the experimental class towards the effectiveness of multiple representation-based instructions in addition of mixed fractions.

A research questionnaire was used to collect data from the respondents on the effectiveness of the use of multiple representations-based instructions. The questionnaire was administered to only the experimental group to find from them their thought about the use of multiple representations-based instructions in teaching mathematics. The experimental group was used because they had experienced the two methods of instructions (MRBI and conventional instructions). The questionnaires were on a five-point Likert-type scale: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. The questionnaires were developed according to Wayan *et al*, 2021 and Ainsworth, (2021), Tripathi, (2008) and (Goldin, 1990, Slavin, 2000, Nabie, 2009) suggestions on the importance of the use of multiple representations-based instructions. The ratings were as follows.

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

The items for the questionnaires used for collecting data from the respondents for the study were;

1 The use of multiple representation based-instructions helps pupils to understand complex mathematics topics such as addition of mixed fractions easily than traditional instructions

2 The use of multiple representation based-instructions makes abstract concepts of addition of mixed fractions real and easy to solve than traditional instructions.

3 The use of multiple representation based-instructions helps create pupils' readiness, a serene and friendly classroom for pupils to learn addition of mixed fractions through traditional instructions.

4 The use of multiple representations and translation among them sustain the interest of pupils in learning addition of mixed fractions as compared to traditional instructions

5 The use of multiple representation based-instructions helps to cater for the learning challenges of pupils in the addition of mixed fractions as a topic than traditional instructions.

6 The use of multiple representations necessitates an easy understanding of the concept of addition of mixed fractions than traditional instructions.

7 The researcher recommends the use of multiple representations in the teaching of mathematics. Do you agree with the researcher?

Descriptive statistics were used to organised the responses to the questionnaire data into frequency counts and converted them into percentages The results of the analysis are presented in Table 4.12 below.

Table 4.12: Distribution of percentage frequency of pupils' perception of the effectiveness of multiple representations-based instructions in addition of mixed fractions

S/N	Statement	% Frequency of Responses			
		Agree	Neutral	Disagree	Total
1	The use of multiple representation based-instructions helps pupils to understand complex mathematics topics such as mixed fractions more easily than traditional instructions	57 (78.1%)	6 (8.2 %)	10(13.7%)	73(100%)
2	The use of multiple representation based-instructions makes abstract concepts of addition of mixed fractions become real and easy to solve than traditional instructions.	63(86.3%)	8(11.0%)	2(2.7%)	73(100%)
3	The use of multiple representation based-instructions help create pupils' readiness for, serene and friendly classroom for pupils to learn addition of mixed fractions than traditional instructions.	58(79.4%)	5(6.8)	10(13.7%)	73(100%)
4	The use of multiple representations and translation among them sustain the interest of pupils in learning addition of mixed fractions as compared to traditional instructions	63(86.3%)	4(5.5)	6(8.2%)	73(100%)
5	The use of multiple representation based-instructions helps to cater for the learning challenges of pupils in the addition of mixed fractions as a topic than traditional instructions.	60(82.2%)	8(11.0%)	5(6.8)	73(100%)
6	The use of multiple representations necessitates an easy understanding of the concept of addition of mixed fractions than traditional ins	59(80.8%)	7(9.6%)	7(9.6%)	73(100%)
7	The researcher recommends the use of multiple representations in the teaching of mathematics. Do you agree with the researcher?	69(94.5%)	4(5.5)	0(0.0%)	73(100%)

Source: Field Data, 2022

The median for the data was 4. 57 pupils representing 78.1% of the respondent in the experimental group agreed that the use of multiple representation based-instructions helps pupils to understand complex mathematics topics such as mixed fractions more easily than traditional instructions. 6 pupils representing 8.2% were neutral about the statement while 10 pupils representing 13.7% disagreed to the statement.

63 pupils representing 86.3% of the respondent agreed that the use of multiple representations-based instructions make abstract concepts of addition of mixed fractions become real and easy to solve than traditional instructions. 8 pupils representing 11.0% were neutral about the statement and 2 pupils representing 2.7% of respondents disagreed with the statement. 58 pupils representing 79.4% of the respondent agreed that the use of multiple representation based-instructions help create pupils' readiness, a serene and friendly classroom for pupils to learn addition of mixed fractions than traditional instructions. 5 pupils representing 6.8% were neutral about the statement and 10 pupils representing 13.7% of respondents disagreed with the statement.

63 pupils representing 86.3% of the respondent agreed that the use of multiple representations and translation among them sustain the interest of pupils in learning addition of mixed fractions as compared to traditional instructions. 4 pupils representing 5.5% were neutral about the statement and 6 pupils representing 8.2% respondents disagreed to the statement. 60 pupils representing 82.2% of the respondent agreed that the use of multiple representations and translation help to cater for the learning challenges of pupils in the addition of mixed fractions as a topic than traditional instructions. 8 pupils representing 11.0% were neutral about the statement and 5 pupils representing 6.8% of respondents disagreed with the statement. 59 pupils representing 80.8% of the respondent agreed that the use of multiple representations-based instructions necessitates an easy understanding of the concept of addition of mixed fractions than traditional instructions. 7 pupils representing 9.6% were neutral

about the statement and 7 pupils representing 6.8% of respondents disagreed with the statement. 69 pupils representing 94.5% of the respondent agreed that multiple representations-based instructions should be used in teaching addition of mixed fractions than traditional instructions. 4 pupils representing 5.5% were neutral about the statement.

4.7 Discussions of Research Questions and Hypotheses

4.7.1 Discussion of results from research question one

Table 4.13: Summary of the pre-test and post-test results of the mean and standard deviations results of the control and experimental group performance

	Control group				Experimental group			
	Pre test		Post test		Pre test		Post test	
Mode of representations	Mean (M)	Standard Deviation (SD)	Mean (M)	Standard Deviation (SD)	Mean (M)	Standard Deviation (SD)	Mean (M)	Standard Deviation (SD)
Real-life representation	1.46	0.97	1.28	0.73	1.53	1.13	2.49	1.02
Diagrammatic representation	1.70	1.14	1.76	1.21	1.95	1.25	3.49	0.85
Symbolic representation	1.22	0.99	1.55	1.01	1.41	1.12	2.73	1.11
Word/statement form	1.46	1.18	1.22	0.90	1.82	1.10	2.85	0.94
Mean of Mean	1.46		1.45		1.68		2.89	

From Table 4.13 the mean of mean for the control group on the pre-test was 1.46 and the mean of mean for the experimental group on the pre-test was 1.68. This show that, the performance of the learners on the pre-test was similar. After administering the intervention, the post-test result show that the mean of mean for the control group was 1.45 while the mean of mean for the experimental group was 2.89. It is clearly seen that, there have been differences in the performance of the experimental and the control group. The experimental group performance after receiving the intervention of the use of multiple representations-based instruction had improvement in their performance more than the control group. The study confirms the research done by Adu-Gyamfi (2003) and Mahama and Kyeremeh (200) who says that the use of MRBI improves learners' academic performance.

4.7.2 Discussion of results from research hypothesis one

Table 4.14: Paired sampled t-test statistics for comparing pre-test and post-test scores among the Experimental group.

Mode of representation	Group	N	M	SD	T	df	p
Real-life representation of addition of mixed fractions	Exp. 1	73	1.53	1.13	-6.788	72	0.000
	Exp. 2	73	2.49	1.02			
Diagrammatic representation of addition of mixed fractions	Exp. 1	73	1.95	1.24	-9.100	72	0.000
	Exp. 2	73	3.49	0.85			
Symbolic representation of addition of mixed fractions	Exp. 1	73	1.41	1.12	-7.111	72	0.000
	Exp. 2	73	2.73	1.11			
Word/Statement form of representation of addition of mixed fractions	Exp. 1	73	1.82	1.06	-6.208	72	0.000
	Exp. 2	73	2.85	0.94			

Source: Fieldwork, 2022 **Significance. $p < 0.05$*

From the Table 4.14 above, shows the mean differences between the experimental group performance on both the pre-test and post-test. Pupils' performance on the post-test for all four modes of representation shows that the intervention of the use of multiple representations-based instruction had a more positive effect on pupils' performance than the traditional/conventional instructions. The intervention improved pupils' academic performance in addition of mixed numbers. The post-test score of the pupils in the experimental group revealed that the intervention (multiple representations-based instruction) improved pupils' academic performance more significantly than traditional instructions. Therefore, the null hypothesis was rejected. The study affirms the study of NCTM (2000) that there is statistically significant difference between multiple representations-based instruction and traditional instruction and therefore the use of MRBI should be the basis of instructions for Mathematics facilitators in the classroom.

4.7.3 Discussion of research question two

Table 4.15: Summary of the pre-test and post-test results of the mean and standard deviations results of the control and experimental group performance

Mode of translations	Control group Pre test Mean	Control group Pre test Standard Deviation (SD)	Control group Post test Mean	Control group Post test Standard Deviation (SD)	Experimental group Pre test Mean	Experimental group Pre test Standard Deviation (SD)	Experimental group Post test Mean	Experimental group Post test Standard Deviation (SD)
Translating from real-life representations to symbolic representations and vice versa	1.43	0.778	2.12	1.313	1.62	0.907	3.56	0.913
Translating from symbolic representations to word forms of representations and vice versa	1.53	0.954	1.91	1.184	0.821	0.821	3.27	0.947
Translating from real-life representations to diagrammatic representations and vice versa	1.72	1.054	1.61	1.057	1.95	1.177	2.81	1.174
Translating from symbolic representations to diagrammatic representations and vice versa	1.78	1.388	2.04	1.308	2.08	1.115	3.18	1.135
Translating from diagrammatic representations to words and vice versa	0.85	0.902	1.05	0.890	0.89	0.980	2.04	0.978
Translating from real-life representations to word/statement form of representations and vice versa	1.08	1.144	1.03	0.891	1.14	1.146	2.37	1.161
Mean of mean	**1.40**		**1.62**		**1.41**		**2.87**	

From Table 4.15 shows the mean of mean for the control group in translating from one mode of representation to another was 1.40 and the experimental group was 1.41 for the pre-test. This show that, the performance of the learners on the pre-test was similar. After the administration After administering the intervention, the post-test result show that the mean of mean for the control group was 1.62 while the mean of mean for the experimental group was 2.87. This signify that, there have been difference in the performance among the control and the experimental group. The experimental group have improvement in their performance in translating from one mode of representation to another after they were taught with the use of MRBI. Though there was a bit of improvement in their performance of the control group on the post-test but it was insignificant. Duval (2006) believes that learners ability to translate from one mode of representation to another improve their academic performance has also been affirmed with this study. The experimental class performance on the post-test on each mode of representations improved more than their performance on the pre-test.

4.7.4 Discussion of the results of hypothesis two

Table 4.16: Paired sampled t-test statistics for comparing pre-test and post-test scores among the Experimental group.

Translation	Group	N	M	SD	T	Df	p
Translating from real-life representations to symbolic representations and vice versa	Exp. 1 Exp. 2	73 73	1.62 3.56	0.907 0.91	-15.407	72	0.000
Translating from symbolic representations to word forms of representations and vice versa	Exp. 1 Exp. 2	73 73	0.82 3.27	0.82 0.95	-11.523	72	0.000
Translating from real-life representations to diagrammatic representations and vice versa	Exp. 1 Exp. 2	73 73	1.95 2.81	1.18 1.17	-4.999	72	0.000
Translating from symbolic representations to diagrammatic representations and vice versa	Exp. 1 Exp. 2	73 73	2.08 3.18	1.12 1.14	-6.160	72	0.000
Translating from diagrammatic representations to word and vice versa	Exp. 1 Exp. 2	73 73	0.89 2.04	0.98 0.98	-6.826	72	0.000
Translating from real-life representations to word/statement form of representations and vice versa	Exp. 1 Exp. 2	73 73	1.14 2.37	1.15 1.16	-7.321	72	0.000

The data showed in Table 4.16 that, the experimental group performance on the post-test score was better than their pre-test score. The pupils' after receiving the intervention performed well on the post-test for translation among the four modes of representation than their pre-test performance when they were taught with conventional instructions. In conclusion learners' ability to translate from one mode of representation to another influence their academic performance. Therefore, the null hypothesis was rejected since multiple representations-based instructions and translation among them improve learners' academic performance. The study affirms the research of Duval (2006) and Helingo, Amin and Masriyah (2019) learners' ability to translate as a result of been taught with various form of representation improves their academic performance.

4.7.5 Discussion on research question three

Table 4.17: Distribution of percentage frequency of pupils' perception of the effectiveness of multiple representations-based instructions in addition of mixed fractions

S/N	Statement	% Frequency of Responses			
		Agree	Neutral	Disagree	Total
1	The use of multiple representation based-instructions helps pupils to understand complex mathematics topics such as mixed fractions more easily than traditional instructions	57 (78.1%)	6 (8.2 %)	10 (13.7%)	73 (100%)
2	The use of multiple representation based-instructions makes abstract concepts of addition of mixed fractions become real and easy to solve than traditional instructions.	63 (86.3%)	8 (11.0%)	2 (2.7%)	73 (100%)
3	The use of multiple representation based-instructions help create pupils' readiness for, serene and friendly classroom for pupils to learn addition of mixed fractions than traditional instructions.	58 (79.4%)	5 (6.8%)	10 (13.7%)	73 (100%)
4	The use of multiple representations and translation among them sustain the interest of pupils in learning addition of mixed fractions as compared to traditional instructions.	63 (86.3%)	4 (5.5%)	6 (8.2%)	73 (100%)
5	The use of multiple representation based-instructions helps to cater for the learning challenges of pupils in the addition of mixed fractions as a topic than traditional instructions.	60 (82.2%)	8 (11.0%)	5 (6.8%)	73 (100%)
6	The use of multiple representations necessitates an easy understanding of the concept of addition of mixed fractions than traditional instruction.	59 (80.8%)	7 (9.6%)	7 (9.6%)	73 (100%)
7	The researcher recommends the use of multiple representations in the teaching of mathematics. Do you agree with the researcher?	69 (94.5%)	4 (5.5%)	0 (0.0%)	73 (100%)

In Table 4.17, the experimental group after receiving the intervention (MRBI), the learners supported the idea that MRBI should be used as the basis of instruction in the classroom. The experimental class supported the idea that the use of multiple representation-based instruction should be the basis for teaching by all mathematics teachers. This shows that multiple representations-based instruction should be encouraged to be used in the Ghanaian mathematics classrooms since it improves pupils' academic performance. NCTM (2000) believes that the use of MRBI should be used as a means of instruction in the mathematic classroom of which the study confirms it too.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.0 Introduction

This chapter provides a summary of the study. Based on the summary and the key findings of the study, conclusions were drawn. The chapter also provides recommendations and suggestions for further study.

5.1 Summary of the Study

The objective of this study was to investigate the effects of multiple representation-based instructions on basic seven pupils' performance in addition of mixed fractions in La Dade-Kotopon municipality in the Greater Accra region of Ghana. The study employed the non-equivalent pre-test-post-test control group Quasi-Experimental research design. The sample for the study was 147 pupils from four basic seven classes in two different schools. The sample consisted of 60 males and 87 females. The number of pupils used in Airport Police "1" JHS was 75 which consisted of 38 and 37 pupils respectively for classes A and B. The number of pupils used in Airport Police "2" JHS was 72 which consisted of 36 and 36 pupils respectively for classes C and D. In each school, there were an experimental class and a control class. Class A of Airport Police JHS 1 was used as the control class while class B was used as an experimental class. Likewise, in Airport Police JHS 2, class C was used as the experimental class while class D was used as the control class.

The control and experimental groups were taught with the use of traditional instructions for four days a week. Every period in the week took an hour. Both groups were assessed after teaching. The assessment was used as the pre-test for the study. There was four days' treatment using multiple representations-based instructions of addition of mixed fractions for the experimental class while the control classes were also taught with the traditional method of instruction in addition of mixed fractions. There were four lessons in the week and both the control group and the experimental groups were given a post-test to write on the fifth day after the instructions. Afterward, the experimental groups were given a questionnaire to answer which demanded their perception of the use of the intervention.

The teacher-made tests and questionnaires were used for data collection. The data were processed using SPSS version 20 and analysed using descriptive (frequency, percentages, mean, and standard deviation). The teacher-made test was a multiple-choice test items and it administered to the control and the experimental group during the pre-test and post-test. An inferential statistic (dependent sample t-test or paired sampled t-test) was used to test for the hypotheses if there were statistically significance difference in the use of the intervention (multiple representation-based instructions) as compared to the conventional instructions. The pre-test and post-test score of the pupils in the experimental group was used to test for the hypotheses.

The study revealed that those who were taught using multiple representations-based instructions (experimental group) understood addition of mixed fractions and performed better than those who were taught with conventional instructions when the post-test was administered. The experimental classes were able to translate between the four modes of representations with ease and that also helped in improving their performance than the control classes. The study confirms the multiple representations-based instructions should be adopted as basis for teaching of pupils to increase their academic performance (NCTM, 2000).

In the testing of the hypotheses, it was revealed that the performance of the experimental group after they were taught with the use of multiple representations-based instructions and translation among the modes of representations on the post-test was better than their pre-test performance. This means there was a statistically significant difference between multiple representations-based instructions and conventional instructions. This shows that the use of multiple representations-based instructions improves pupils' performance in addition of mixed fractions than the traditional method of instruction.

The experimental classes had a positive perception of the use of multiple representations-based in teaching addition of mixed fractions and supported the idea that the use of multiple representation-based instructions should be the basis for teaching by all mathematics teachers through the questionnaires developed from Ainstworth, (2018), views on the importance of multiple representations to the learner.

5.2 Conclusion

The study investigated effects of multiple representations-based instruction on basic pupils' performance in addition of mixed fractions in La Dade-Kotopon municipality in the Greater Accra region of Ghana. It was found that the use of multiple representations-based instruction helped pupils to understand with ease addition of mixed fractions more than the use of conventional instructions. This is as a result, lessons are presented in such a way that it caters for the learning needs of all pupils whether the learner is kinaesthetic, auditory, visual, oral, etc. The concrete objects and picture used in teaching makes learning become real which helps the learner to understand abstract concepts. It also makes sure pupils can translate from one mode of representation to another thereby assisting pupils to overcome their fear for the study of mathematics. Lessons are presented to the learner in systematic form since it involves the facilitator using the appropriate method of which the learner can build his or her internal understanding and therefore transfer the idea to solve other abstract problems. There is a statistically significant difference between multiple representations-based instruction and conventional instructions. The conventional instructions mostly depend on rote memorization of facts without understanding concepts which the use of MRBI helps the learner to understand concepts both internally and externally. The pupils taught with MRBI recommended the use of MRBI as basis of instructions so had a good perception about the use of the intervention in teaching and learning.

5.3 Limitations of the Study

The study, like other research works, falls short of the ideal though its purpose was achieved. The study focused on addition of mixed fractions while there are other aspects of fractions to be studied and also other mathematic topics that could have been studied. The study was conducted in public basic schools therefore its findings can't be generalised to private schools and some other public basic schools in the municipality. Most of the references were from foreign countries.

5.4 Recommendations

Based on the main findings which were multiple representations-based instructions improved learners' academic performance in addition of mixed fractions. MRBI helps learners to easily translate from one representation to another in addition of mixed fractions, MRBI sustains pupils' interest, ease understanding, and makes the abstract study of addition of mixed fractions real and easy to be applied in the pupil's life, the researcher made the following recommendations

a. Mathematics teachers should vary their classroom teaching practices by employing the use of multiple representations-based instruction of lessons more than the use of traditional instruction. Teachers should not only present the symbolic mode of representation to pupils but should teach the other modes of representing addition of mixed fractions. They should guide pupils to also translate from one mode of representation to another to better their understanding.

b. The La-Dade Kotopon Municipal Education Directorate (LADMEO) should organize in-service training for mathematics teachers concerning the use of multiple representations-based instruction to enhance effective teaching of the addition of mixed fractions and fractions in general. Facilitators should be trained to guide learners to develop their translation skills. Learners should be at ease to translate from any form of representation to another with minimal or without difficulty. Mathematics teachers should be given in-service training concerning how to translate from one mode of representation to another to enhance effective teaching of addition of mixed fractions and fractions in general. During their Professional Learning Community (PLC) meetings, mathematics teachers should be taught the need for the use of multiple representations-based instruction and translation among them in teaching and learning of mathematics topics which includes addition of mixed fractions.

c. Learners should also be motivated learn mixed fractions and fractions in general. They should not perceive fraction as a topic which is brought from space. They must be motivated to develop greater love for mathematics through the use of multiple representations-based instructions.

5.5 Suggestion for Further Research

This study investigated the effects of multiple representation-based instructions on basic seven pupils' performance in addition of mixed fractions in La Dade-Kotopon municipality in the Greater Accra region of Ghana. Based on the information gathered from the study, it is suggested that further research on the effectiveness of multiple representations-based instructions for teaching subtraction, multiplication, and division of fractions, at different grade levels and a larger sample size should be carried out. Researchers can make further research on whether there is a significant difference between male and female pupils' performance with the use of multiple representations-based instruction. Researchers can make further investigations into the use of multiple representations-based instructions for other mathematics topics.

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APPENDICES

APPENDIX A

THE EFFECTS OF MULTIPLE REPRESENTATIONS-BASED INSTRUCTIONS ON BASIC SCHOOL PUPILS' PERFORMANCE IN ADDITION OF MIXED FRACTIONS IN LA DADE-KOTOPON MUNICIPALITY.

PRETEST QUESTIONNAIRES FILLED BY TREATMENT AND CONTROL GROUP LEARNERS

Dear learner, I am a final year Master of Philosophy (MPhil) student at the University of Education, Winneba (UEW), and researching the above-mentioned topic. This forms part of my studies towards the award of the degree of Master of Philosophy in Basic Education. This study will help me to know how valuable multiple representations-based instructions improve pupils' performance in addition of mixed fractions and how it sustains the interest of the learner in learning of fractions. The study will also help me to know how learners can translate from one form of representation to the other. I would therefore be very grateful if you could kindly complete the attached questionnaire. Your responses are strictly confidential and will be used only for this research. Your honest and objective answers to the following questions will be highly appreciable.

Please use either a pencil or pen to tick (V) only one response in each case for each statement on the research instruments.

Researcher: Philip Oduro Nkansah. (0248525442 / 0506575234)

SECTION A

DEMOGRAPHIC DATA

1. Name:……………………………………………………………………………..

   Number……………….…….

2. Gender: A. Male ( ) Female ( )

3. Age: a) 10 years and below ( ) b) 11-13 years ( ) c) 14- 16 years ( ) d) 17 and above

4. Name of school:…………………………………………………………………

5. Group……………………………………………………………………………

SECTION B

Research question 1

Real-life representation of addition of mixed fraction

Please read carefully and circle the correct answer to the alternative lettered A-D

1. Nana Yaa prepares her stew. She started to prepare her stew with one and a half cooking oil and later she added two and three quarters of cooking oil to it. How many bottles of cooking oil has she used?

   A. Two full and three-quarter bottles of cooking oil

   B. Three full and three-quarter bottles of cooking oil

   C. Four full and one quarter bottles of cooking oil

   D. Five full and one quarter bottles of cooking oil

2. Stella was given six and two seventh of cakes to celebrate her birthday. When Gloria adds five and one seventh of cakes to it, how many cakes does Stella have in all?

   A. Eleven full and one seventh cakes

   B. Twelve full and one seventh cakes

   C. Eleven full and three seventh cakes

   D. Eleven full and three seventh cakes

3. Owusu sliced four and five-eighths of his oranges. Oduro also sliced six and a half of his oranges. Owusu and Oduro added their oranges together. How many Sliced oranges do they have in all?

   A. Eleven whole and one-eight sliced oranges

   B. Eleven whole three-eight sliced oranges

   C. Twelve whole one-eight sliced oranges

   D. Twelve whole one and half oranges

4. How many straws does Kelvin have to build a pen when he cut ten and two-fifth straws and he added to it four and two-third straws?

   A. Fourteen three sixth straws

   B. Fourteen and a half straws

   C. Fifteen and a quatre straws

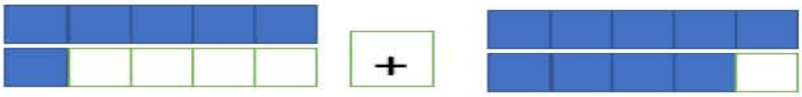
   D. Fifteen wholes and one fifteenth straws

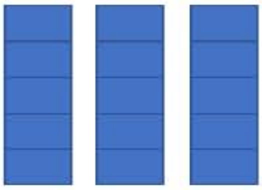
Research question 2

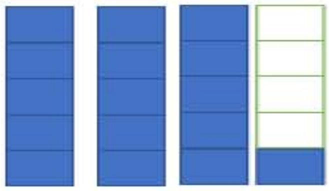
Diagrammatic Representation and manipulative representation

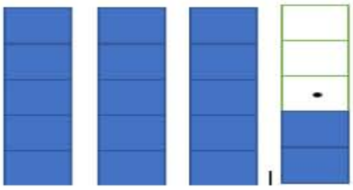
Please carefully study the diagram and add the fractional models. Circle the correct answer to the alternative lettered A-D.

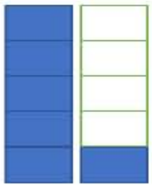
1. T

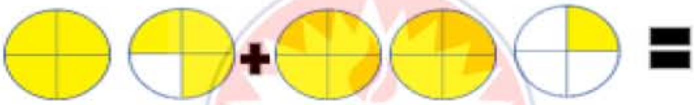


A. 

C. 

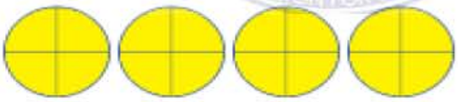
B. 

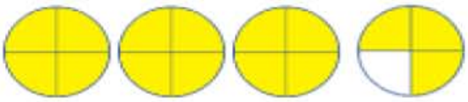
D. 

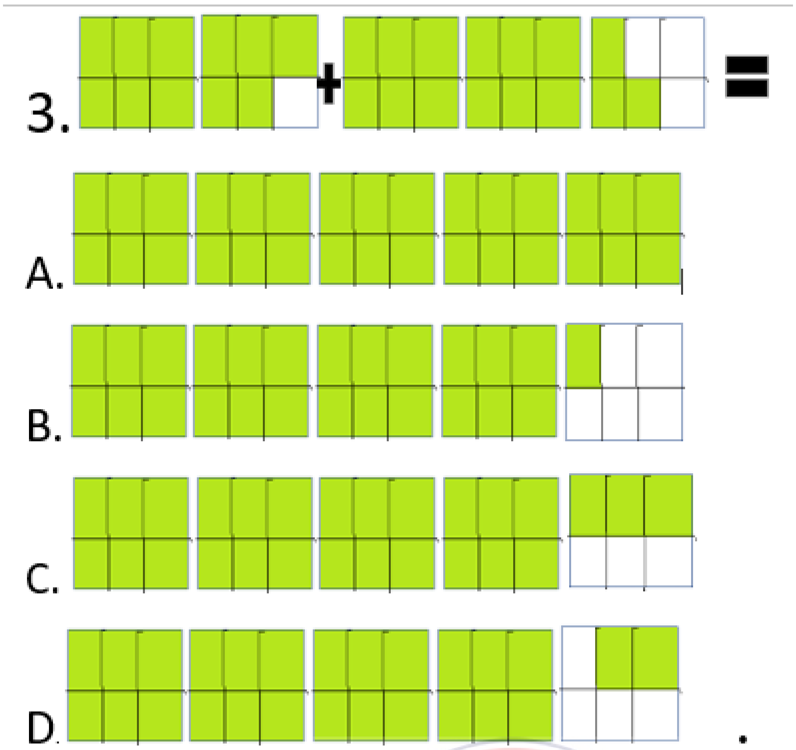
2. 

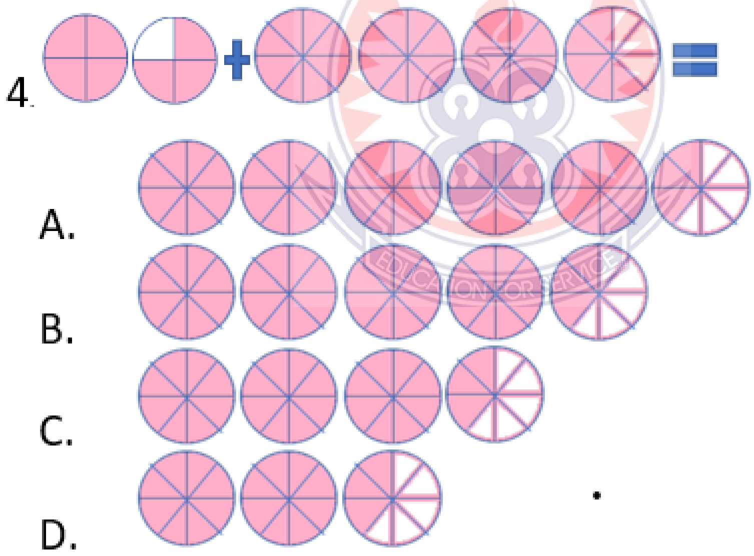
A. 

B. 

C. 

D. 





Research question 3

Symbolic representation

Please solve carefully and circle the correct answer to the alternative lettered A-D

1. simplify $\mathbf{4\frac{1}{2}} + \mathbf{2\frac{1}{2}}$

A. 6 B. **7** C. $8\frac{1}{2}$ C. $9\frac{1}{2}$

2. Solve $\mathbf{1\frac{5}{7} + 2\frac{3}{4}}$

   A. $\mathbf{4\frac{5}{56}}$ B. $\mathbf{4\frac{5}{28}}$ C. $\mathbf{4\frac{13}{28}}$ D. $\mathbf{3\frac{13}{28}}$

3. Evaluate $\mathbf{5\frac{1}{2} + 2\frac{3}{5}}$

   A. $\mathbf{5\frac{7}{12}}$ B. $\mathbf{7\frac{7}{10}}$ C. $\mathbf{6\frac{1}{5}}$ D. $12\frac{1}{2}$

4. Simplify $\mathbf{4\frac{2}{3} + 7\frac{8}{9}}$

   A. $\mathbf{12\frac{5}{9}}$ B. $12\frac{1}{6}$ C. $\mathbf{16\frac{1}{5}}$ D. $\mathbf{16\frac{1}{9}}$

Research question 4

Word/Statement form of representation

Please read carefully and circle the correct answer to the alternative lettered A-D

1. Adding four whole one-fifth to two whole three-fifths gives

   A. Six whole one-fifth C. four whole one-fifth

   B. six whole four-fifth D. four whole four-fifth

2. A whole and two-thirds are added to seven whole three seventh becomes

   A. seven whole three seventh C. nine whole two twenty-first

   B. nine whole two tenths D. nineteen whole two twenty-first

3. Which of the answer is correct when you add three whole four ninths to five whole six-sevenths?

   A. Nine whole nineteen sixty-thirds C. eleven whole nineteen sixty-thirds

B. Ten whole nineteen sixty-thirds D. fifteen whole nineteen sixty-thirds

4. What is the total of two whole four seventh and three whole three-seventh?

A. two whole four seventh C. six wholes

B. six whole four seventh D. seven wholes

Part C

Translation from one mode of representation to other

Research question 5

Translating from real-life representations to symbolic representations and vice versa

Please read carefully and circle the correct answer to the alternative lettered A-D

1. Two and a half cooking oil added to two and three-quarter cooking oil can be written symbolically as

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

2. $\mathbf{5\frac{1}{5}} + \mathbf{3\frac{2}{3}}$ can be written in real real-life situation by using oranges as

A. Five and four-fifth pieces of oranges are added to one and two third pieces of oranges

B. Three and two third pieces of oranges are added to five and five-fifth pieces of oranges

C. Three and two third pieces of oranges are added to five and one-fifth pieces of oranges

D. Three and two third pieces of oranges are added to six and five-fifth pieces of oranges

3. Four and five-eighths of cake are added to six half of cake is written symbolically as

A. $\mathbf{6\frac{1}{2} + 4\frac{5}{8}}$ B. $\mathbf{6\frac{1}{2} + 6\frac{5}{8}}$ C. $\mathbf{6\frac{1}{2} + 4\frac{8}{5}}$ D. $\mathbf{5\frac{1}{2} + 4\frac{5}{8}}$

4. Kwame added ten and two-fifth of strawberry juice in a tank to another tank of fourteen and two-thirds strawberry juice. This is written as

A. ***A.*** $\mathbf{10\frac{2}{3} + 14\frac{5}{2}}$ B. $\mathbf{13\frac{2}{3} + 10\frac{2}{5}}$ C. $\mathbf{14\frac{2}{3} + 10\frac{2}{5}}$

D. $\mathbf{16\frac{2}{3} + 10\frac{2}{5}}$

Research question 6

Translating from symbolic representations to word forms of representations and vice versa

Please read carefully and circle the correct answer to the alternative lettered A-D

1. $\mathbf{4\frac{1}{2} + 2\frac{5}{7}}$ is written in a statement form as
   A. Four and half is added to two and five sixth
   B. Four and half is added to two and five seventh
   C. Two and half is added to four and half
   D. Two and five seventh is added to four and half
2. Fourteen whole and three quatres is added to five whole and five sixth is written as

A. $\mathbf{4\frac{1}{2}} + \mathbf{2\frac{5}{7}}$ B. $\mathbf{14\frac{1}{3}} + \mathbf{5\frac{5}{7}}$ C. $\mathbf{5\frac{5}{6}} + \mathbf{14\frac{3}{4}}$ D. $\mathbf{14\frac{3}{4}} + \mathbf{5\frac{5}{7}}$

3. $\mathbf{11\frac{5}{7}} + \mathbf{12\frac{3}{8}}$ is written in statement as

   A. Twelve and three eight is added to ten and five seventh

   B. Twelve and three eight is added to eleven and five seventh

   C. Ten and five seventh adds to Twelve and three eight

   D. Twelve and three eight is added by seven five seventh

4. When seven and three-quarter is added to seventeen and five-seventh can be represented as

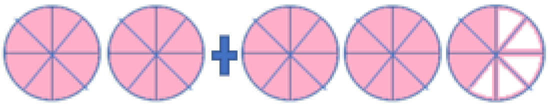
   A. $\mathbf{17\frac{5}{7}} + \mathbf{12\frac{3}{4}}$ B. $\mathbf{17\frac{5}{7}} + \mathbf{2\frac{3}{4}}$ C. $\mathbf{17\frac{5}{7}} + \mathbf{12\frac{3}{4}}$ D. $\mathbf{7\frac{5}{7}} + \mathbf{12\frac{3}{4}}$

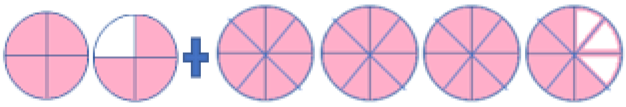
Research question 7

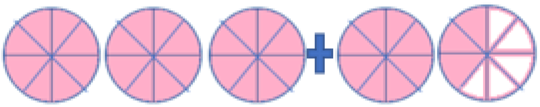
Translating from real-life representations to diagrammatic representations and vice versa

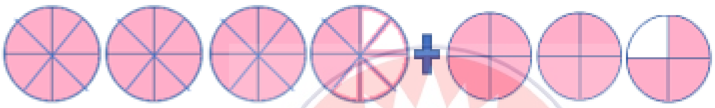
Please read carefully and circle the correct answer to the alternative lettered A-D

1. Stephen bought one and three quatre pizza and he received from a friend another three and five-eight pizza. He added all the cakes together. This can be showed in a diagram form as

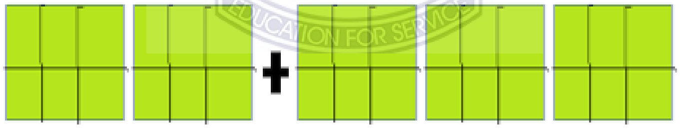
A. 

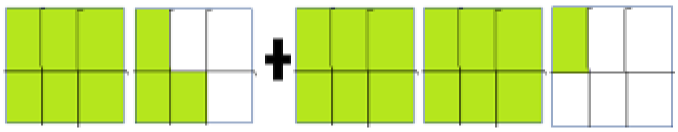
B. 

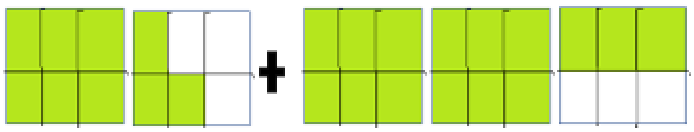
C. 

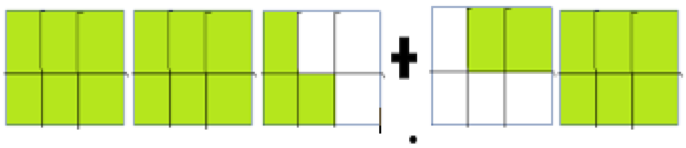
D. 

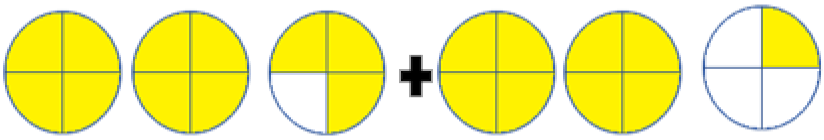
2. Kinsley adds one full box of erasers and two-sixth box of erasers to two boxes and three-sixth boxers of erasers. This can be represented diagrammatically as

A. 

B. 

C. 

D. 

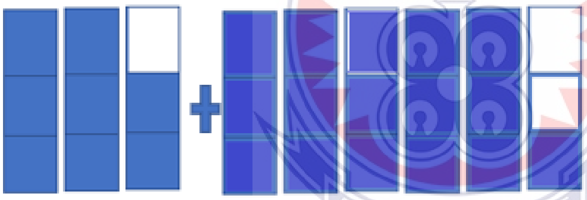
3.  . is the same as

A. Boatenmaa has three and three-quarter cakes. She adds another two and a quarter of cakes to it.

B. Boatenmaa has two and three-quarter cakes. She adds another two and a quarters of cakes to it.

C. Boatenmaa has two and three-quarter cakes. She adds another four and one-quarter of cakes to it.

D. Boatenmaa has two and three-quarter cakes. She adds another six and a quarter of cakes to it.

4. 

A. Linda was given five and one third plot of land from her father. She bought two and five seventh of another plot of land to what the father gave her.

B. Linda bought two and one-third plots of land and her father added five and two thirds to the one she bought.

C. Linda bought two and two-third plots of land and her father added five and one-thirds to the one she bought.

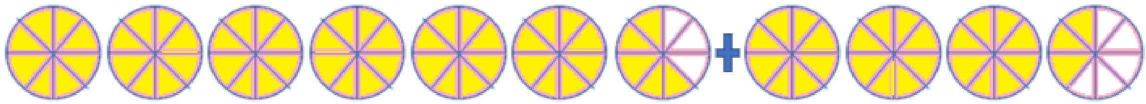
D. Linda bought two and one-quatre plots of land and her father added five and two thirds to the one she bought.

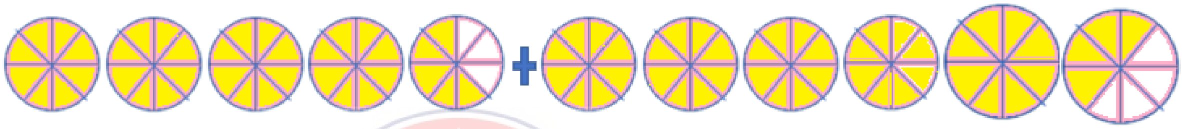
Research question 8

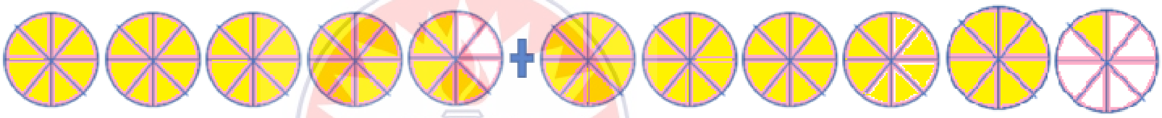
Translating from symbolic representations to diagrammatic representations and vice versa

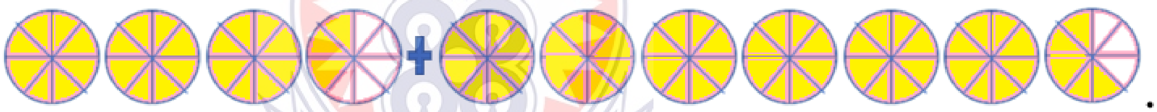
Please read carefully and circle the correct answer to the alternative lettered A-D

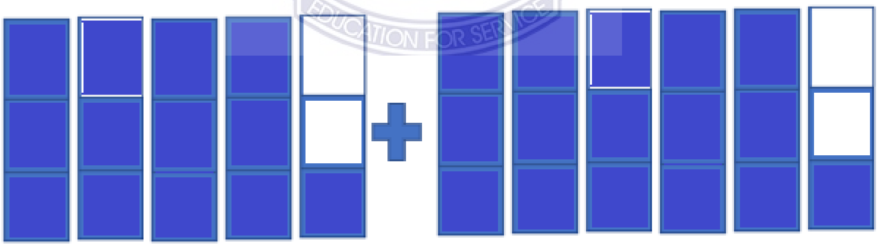
1. $6\frac{5}{8} + 3\frac{3}{8}$ can be represented diagrammatically as

A. 

B. 

C. 

D. 

2.  can be represented symbolically as

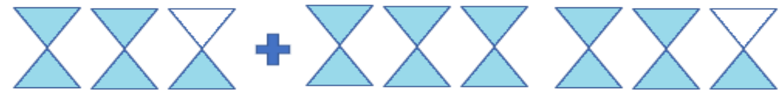
A. $4\frac{1}{3} + 5\frac{3}{8}$

B. $4\frac{2}{3} + 5\frac{1}{4}$

C. $4\frac{1}{3} + 5\frac{2}{3}$

D. $4\frac{2}{3} + 5\frac{1}{3}$

3. $2\frac{1}{2}$ + $5\frac{1}{2}$ can be represented diagrammatically as

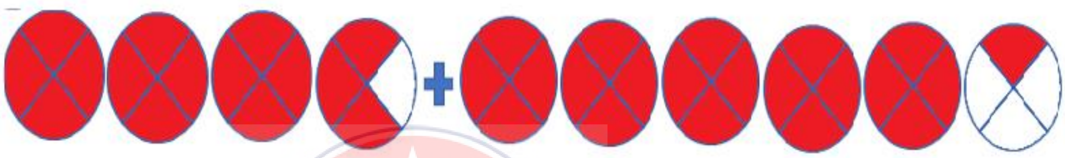
A. 

B. 

C. 

D.  .

4. The diagram below can be represented symbolically as



A. $3\frac{2}{4} + 5\frac{1}{4}$

B. $3\frac{2}{4} + 5\frac{1}{8}$

C. $3\frac{1}{4} + 5\frac{1}{4}$

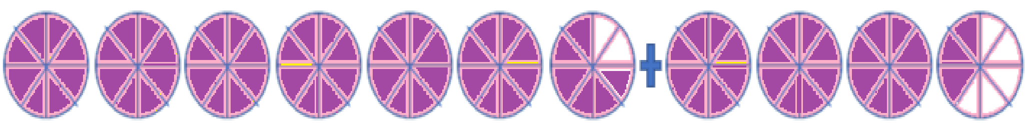
D. $3\frac{2}{8} + 5\frac{3}{4}$

Research question 9

Translating from diagrammatic representations to word and vice versa

Please read carefully and circle the correct answer to the alternative lettered A-D

1. Which of the diagram represented can be written in word as?



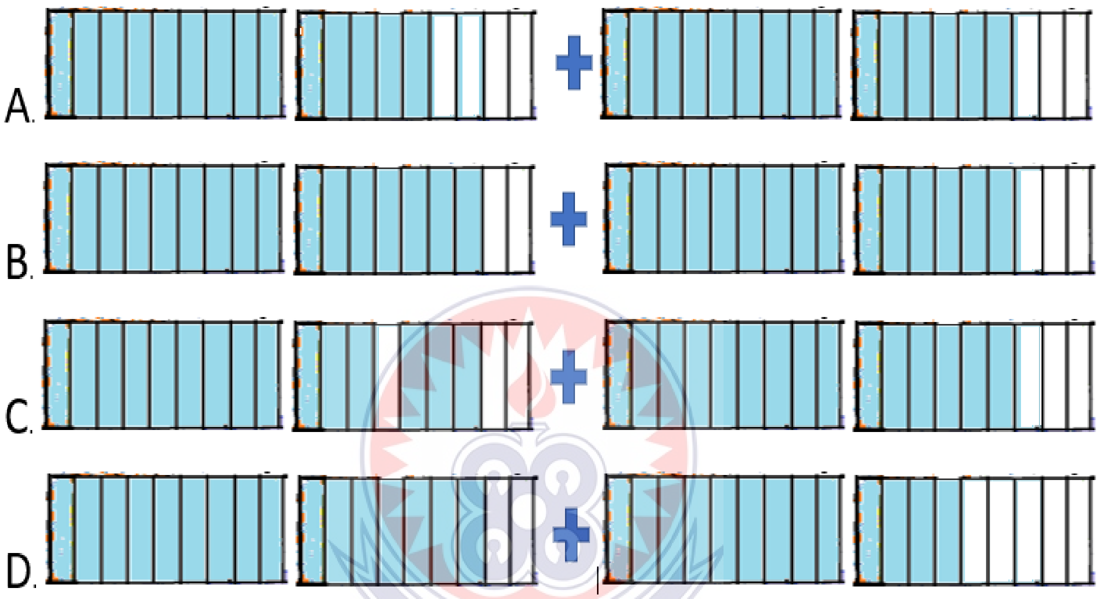
A. Six and six-eight pieces of water melon is added to four and another three-eight pieces of melon

B. Three and three-eight pieces of melon is added to six and two-eight pieces of another water melon

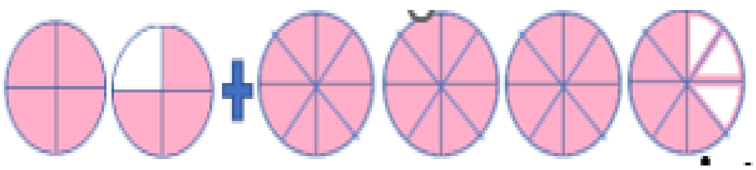
C. Six and six-eight pieces of water melon is added to another three and three-eight pieces of melon

D. Three and three-eight pieces of melon is added to six and six-eight pieces of another water melon

2. A whole six-nineth is added to a whole four-nineth



3. The diagram can be interpreted as



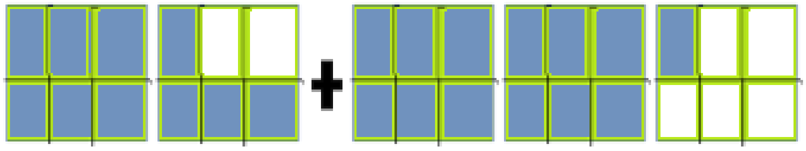
A. One whole a quarter is added to three whole five-eights

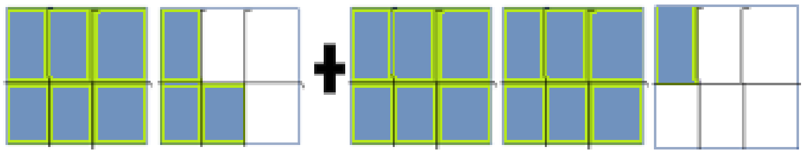
B. Three whole five eights are added to one whole three quarter

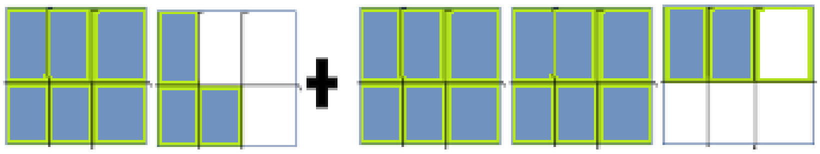
C. One whole three-quarter is added to three whole five-eights

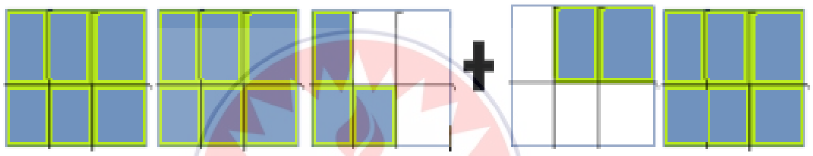
D. Three whole five eights are added to one whole three eighths

4. Two whole one-sixth is added to a whole and half can be represented diagrammatically as

A. 

B. 

C. 

D. 

Research question 10

Translating from real-life representations to word/statement form of representations and vice versa

Please read carefully and circle the correct answer to the alternative lettered A-D

1. Enam has three and half acres of land. she bought another four and three-seventh acres of land and added to the one she has. This can be written in another statement as

   A. Three and half added to four and three-seventh

   B. Four and three-seventh is added to three and half

   C. Three and three fifth added to four and three-seventh

   D. Four and three-seventh is added to three and fifth

2. Sampson received six and three-quarter pieces of cloth from Peniel and he added it to his seven and three-eight pieces of cloth to sew dresses for his customers. Which of the alternative has the same meaning as the statement above?
   A. Six and three-quarter is added to seven and three-eight
   B. Six and three-quarter is added to seventeen and three-eight
   C. Seven and three-eight is added to six and three-quarter
   D. Seventeen and three-eight is added to six and three-quarter
3. Korankye bought two and three-quarter packs of sugar from one shop and he adds six and two-thirds packs from another shop. This can also be written as
   A. Six and two thirds plus two and three-quarters
   B. Six and two thirds minus two and three-quarters
   C. Two and three-quarters is added to six and two seventh
   D. Two and three-quarters added six and two thirds
4. Mike walked Eleven and five-sixth kilometres to Accra sports stadium before he continued to walk four and two-nineth kilometres to the bus stop. His total journey can be represented as………………………… in word form.
   A. Eleven and five-sixth is added to four and two-nineth
   B. Four and two-nineth is added Eleven and five-sixth
   C. Eleven and five-sixth is added to fourteen and two-nineth
   D. Fourteen and two-nineth is added Eleven and five-sixth

APPENDIX B

THE EFFECTS OF MULTIPLE REPRESENTATIONS-BASED INSTRUCTIONS ON BASIC SCHOOL PUPILS' PERFORMANCE IN ADDITION OF MIXED FRACTIONS IN LA DADE-KOTOPON MUNICIPALITY

POST-TEST QUESTIONNAIRES FILLED BY TREATMENT AND CONTROL GROUP LEARNERS

Dear learner, I am a final year Master of Philosophy (MPhil) student at the University of Education, Winneba (UEW), and researching the above-mentioned topic. This forms part of my studies towards the award of the degree of Master of Philosophy in Basic Education. This study will help me to know how valuable multiple representations-based instructions improves pupils performance in addition of mixed fractions and how it sustains the interest of the learner in learning of fractions. The study will also help me to know how learners can translate from one form of representation to the other. I would therefore be very grateful if you could kindly complete the attached questionnaire. Your responses are strictly confidential and will be used only for this research. Your honest and objective answers to the following questions will be highly appreciable.

Please use either a pencil or pen to tick (V) only one response in each case for each statement on the research instruments.

Researcher: Philip Oduro Nkansah. (0248525442 / 0506575234)

SECTION A

DEMOGRAPHIC DATA

1. Name:……………………………………………………………………………….

   Number……………….…….

2. Gender: A. Male ( ) Female ( )

3. Age: a) 10 years and below ( ) b) 11-13 years ( ) c) 14- 16 years ( ) d) 17 and above

4. Name of school:…………………………………………………………………

5. Group………………………………………………………………………………

SECTION B

Please read carefully and do select one of the options among the alternatives that are correct for all the four modes of representations.

Research question 1

Real life representation of addition of mixed fraction

Please read carefully and circle the correct answer to the alternative lettered A-D

1. Selina prepares her food for her family. She started to prepare her stew with two and three quarters of cooking oil and later she added two and one quarters cooking oil to it. How many bottles of cooking oil did she use?

   A. Two full and three quarters bottles of cooking oil

   B. Three full and three quarters bottles of cooking oil

   C. Four full and one quarters bottles of cooking oil

   D. Five bottles of cooking oil

2. Foster received five and two seventh of cakes by his friends. When Gifty his sister adds one and one seventh of cakes to it, how many cakes does foster has in all?

   A. Five and one seventh cakes

   B. Six and three seventh cakes

   C. Seven and three seventh cakes

   D. Eight and three seventh cakes

3. Blessing shaded four and five-eighth of A4 papers. Oscar also shaded three and a half of A4 papers. When Blessing and Oscar add their papers together, how many shaded A4 papers will they have in all?

   A. Seven and one-eight A4 papers

   B. Eight and one-eight A4 papers

   C. Nine and one-eight A4 papers

   D. Twelve A4 papers

4. How many Acres of land does Kingsley have if he purchased four and half acres and later, he paid for an additional five and a quarters acre?

   A. Nine and three quarters acre

   B. Ten and a quarters acre

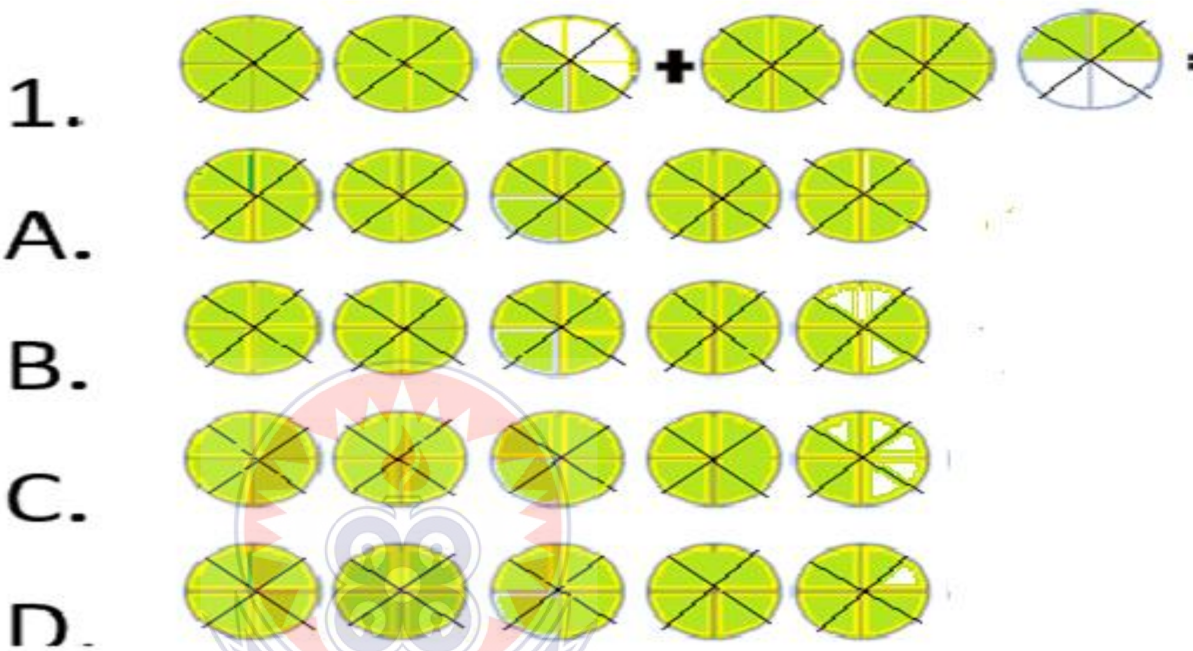
   C. Eleven and three quarters acres

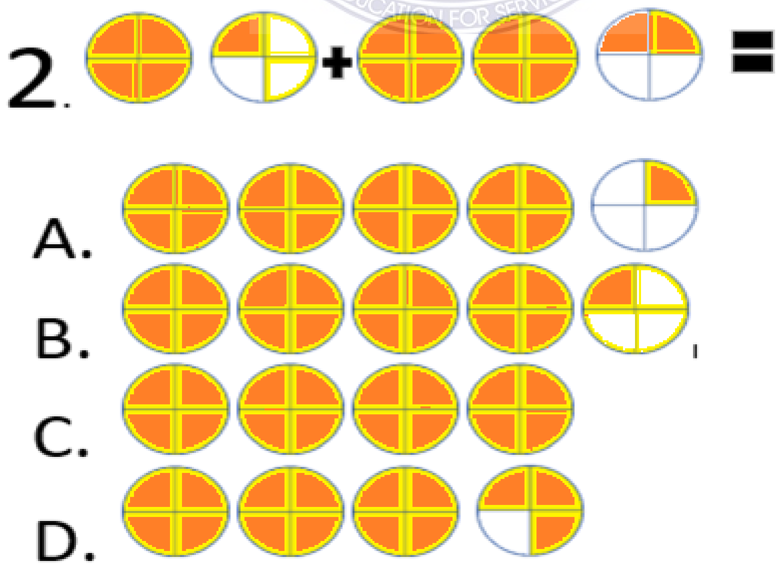
   D. Fifteen a quarters acre

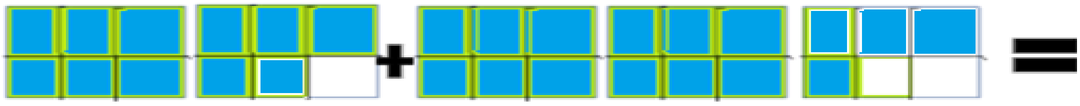
Research question 2

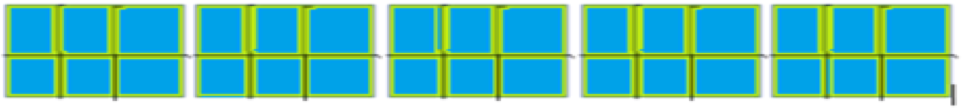
Diagrammatic Representation and manipulative representation

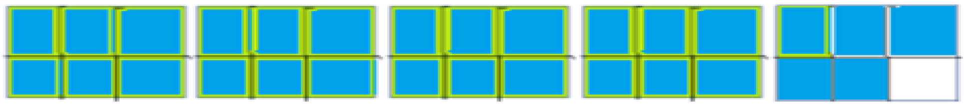
Please carefully study the diagram and add the fractional models. Circle the correct answer to the alternative lettered A-D.

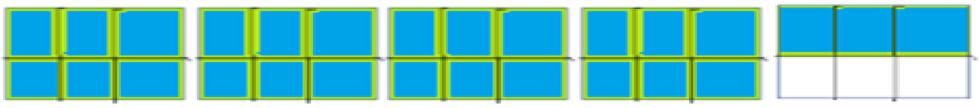


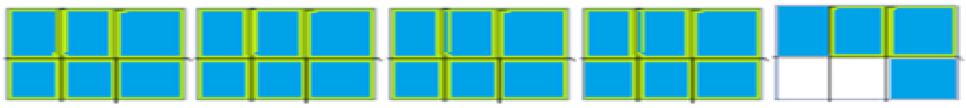


3. 

A. 

B. 

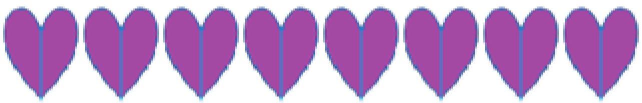
C. 

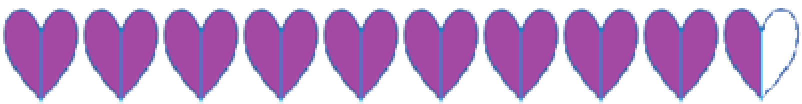
D. 

4. 

A. 

B. 

C. 

D. 

Research question 3

Symbolic representation

Please solve carefully and circle the correct answer to the alternative lettered A-D

5. simplify $\mathbf{8\frac{1}{2}} + \mathbf{5\frac{1}{2}}$

   B. $18\frac{1}{2}$ B. **14** C. $13\frac{1}{2}$ C. $9\frac{1}{2}$

6. Solve $\mathbf{5\frac{5}{7}} + \mathbf{4\frac{3}{4}}$

   A. $\mathbf{1\frac{5}{28}}$ B. $\mathbf{10\frac{13}{28}}$ C. $15\frac{13}{28}$ D. $\mathbf{28\frac{13}{28}}$

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

   A. $\mathbf{5\frac{14}{15}}$ B. $\mathbf{8\frac{14}{15}}$ C. $\mathbf{9\frac{14}{15}}$ D. $12\frac{3}{20}$

8. Simplify $4\frac{2}{13} + \mathbf{7\frac{7}{26}}$

   A. $\mathbf{12\frac{5}{36}}$ B. $11\frac{1}{6}$ C. $\mathbf{11\frac{5}{36}}$ D. $\mathbf{11\frac{11}{26}}$

Research question 4

Word/Statement form of representation

Please read carefully and circle the correct answer to the alternative lettered A-D

5. Adding four whole three-fifth to three whole three-seventh gives

   C. Seven whole one-thirty-fifth C. Eight whole one-thirty-fifth

   D. Seven whole four-fifth D. Eight whole four-fifth

6. Five and two-thirds are added to seven and three seventh becomes

   C. Twelve and eight-thirty fifth

   C. thirteen whole two twenty-first

   D. Thirteen whole two tenths

   D. thirteen and two-twenty second

7. Which of the answer is correct when two whole four ninths are added to five whole three-sevenths?

   C. Seven whole fifty-five sixty-third

   C. Eleven whole fifty-five sixty thirds

   D. Ten whole nineteen sixty-thirds

   D. Eight whole fifty-five sixty-third

8. What is the total of nine whole four eleventh and three whole three-eighth?

   A. Twelve whole sixty eighty-fifth

   C. Thirteen whole eight thirty-fifth

   B. sixteen whole four seventh

   D. Twelve whole sixty-five-eighty-eighth

|**SECTION C**

Translation from one mode of representation to other

Research question 5

Translating from real-life representations to symbolic representations and vice versa

Please read carefully and circle the correct answer to the alternative lettered A-D

5. six and a three-quarters bucket of water added to six and a quarters bucket of water can be written symbolically as

A. $6\frac{1}{4} + 6\frac{3}{4}$ B. $2\frac{1}{2} + 6\frac{3}{4}$ C. $6\frac{3}{4} + 2\frac{3}{6}$ D. $6\frac{3}{4} + 8\frac{1}{2}$

6. $7\frac{1}{5} + 2\frac{2}{3}$ can be written in real real-life situation by using oranges as

   A. Seven and five-fifth pieces of oranges are added to one and two third pieces of oranges

   B. Two and two third pieces of oranges are added to seven and one-fifth pieces of oranges

   C. Two and two third pieces of oranges are added to seventeen and one-fifth pieces of oranges

   D. Three and two third pieces of oranges are added to six and five-fifth pieces of oranges

7. Kingdom measured three and six-eleventh cups of flour to prepare cakes. He then added four and three-quarters cups to his first measurement. This is written symbolically as

   A. $3\frac{6}{11} + 4\frac{3}{4}$ B. $6\frac{1}{2} + 3\frac{6}{7}$ C. $3\frac{1}{2} + 4\frac{8}{5}$ D. $4\frac{1}{2} + 3\frac{5}{8}$

8. Joan put six and three-fifth cup of salt in another container which contained one and two-thirds cups of salt. This is written as

   A. $1\frac{2}{3} + 6\frac{1}{2}$ B. $1\frac{2}{3} + 6\frac{3}{5}$ C. $6\frac{2}{3} + 1\frac{2}{5}$ D. $10\frac{2}{3} + 5\frac{2}{5}$

Research question 6

Translating from symbolic representations to word forms of representations and vice versa

Please read carefully and circle the correct answer to the alternative lettered A-D

5. $5\frac{2}{5} + 3\frac{5}{7}$ is written in a statement form as

   A. Three and five seventh is added to five and three-fifth

   B. Three and five seventh is added to five and two-fifth

   C. Five and two fifth is added to three and five seventh

   D. six and five seventh is added to five and three-fifth

6. Nine and three quarters is added to fifteen and a quarter is written as

   B. $15\frac{1}{2} + 9\frac{5}{7}$ B. $15\frac{1}{4} + 9\frac{5}{7}$ C. $15\frac{1}{4} + 9\frac{3}{4}$ D. $9\frac{3}{4} + 5\frac{5}{7}$

7. $1\frac{6}{13} + 2\frac{3}{8}$ is written in statement as

   A. Two and eight-thirds added to one and three eight

   B. Two and three-eighth are added to a whole and six-thirteen parts

   C. five seventh adds to a whole and six-thirteen parts

   D. Two and three-eight is added by seven five seventh

8. When five and two fifth are added to seventeen and five-seventh can be represented as

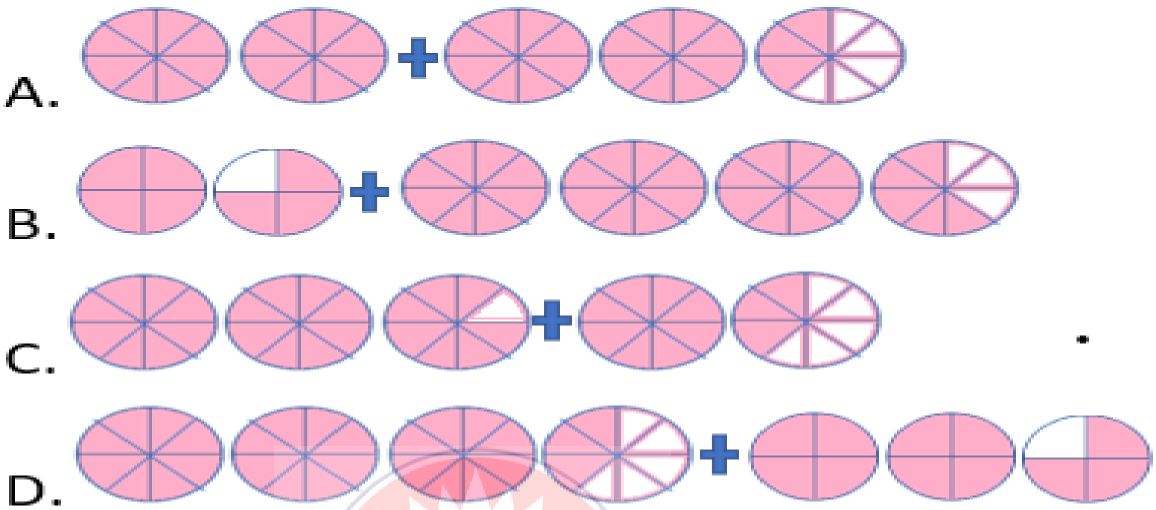
   B. $17\frac{5}{7} + 12\frac{3}{4}$ B. $17\frac{5}{4} + 5\frac{2}{5}$ C. $17\frac{5}{7} + 5\frac{2}{5}$ D. $7\frac{5}{7} + 17\frac{3}{4}$

Research question 7

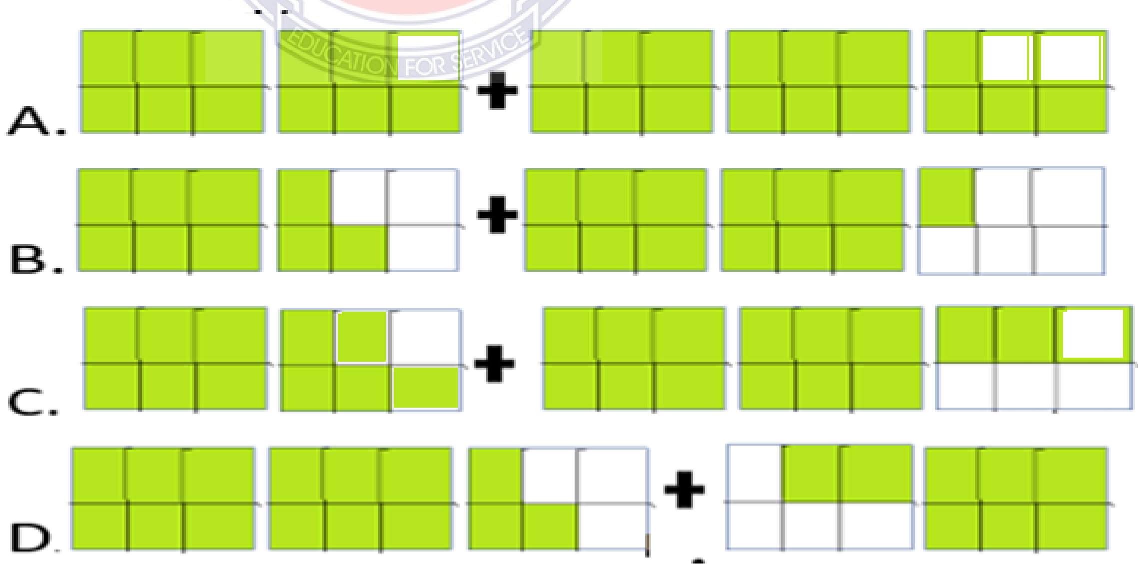
Translating from real-life representations to diagrammatic representations and vice versa

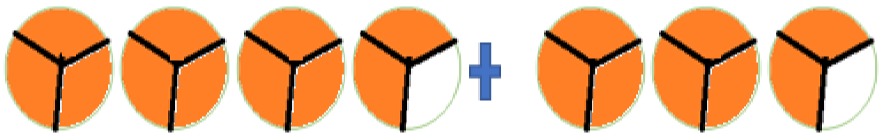
Please read carefully and circle the correct answer to the alternative lettered A-D

1. Philipa shared three and three eight pizza to her friends and the next day she shared another two and three-quarters to her friends. The addition of the pizza shared can be showed in a diagram form as



2. Kessben adds two and two sixth cubes of sugar in a pack to another one and five-sixth cubes of sugar. This can be represented diagrammatically as



3. 

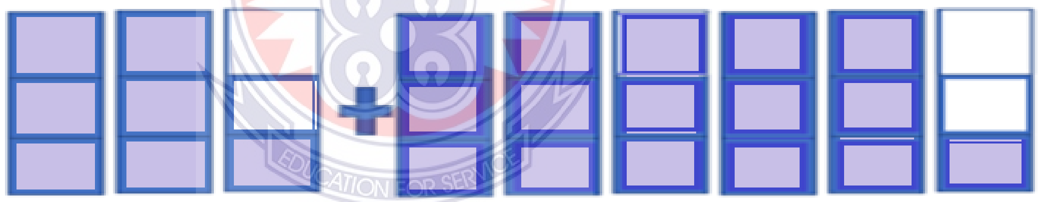
is the same as

A. Ruth has three and two-third cakes. She adds another two and two and two-thirds cakes to it.

B. Ruth has two and three quarterss cakes. She adds another two and one-third of cakes to it.

C. Ruth has two and three-thirds cakes. She adds another two and one-third of cakes to it.

D. Ruth has two and three quarterss cakes. She adds another six and one-quarters of cakes to it.

4. 

is written same as

A. Priscilla was given five and one third plot of land from her father. She bought two and five seventh of another plot of land to what the father gave her.

B. Priscilla bought two and one-third plots of land and her father added five and three-third to the one she bought.

C. Priscilla bought two and a third plots of land and her father added five and a third to the one she bought.

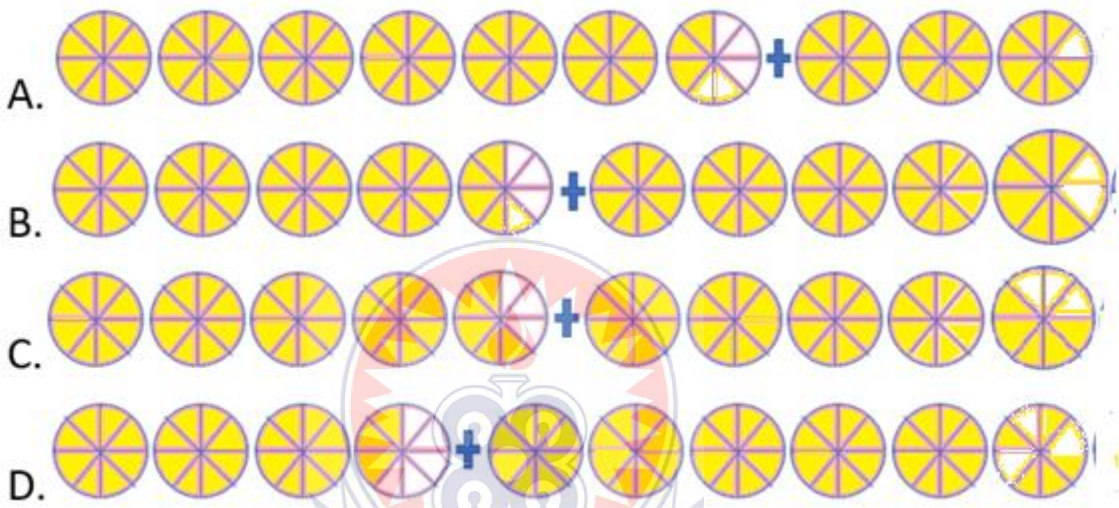
D. Priscilla bought two and one-quarters plots of land and her father added five and two thirds to the one she bought.

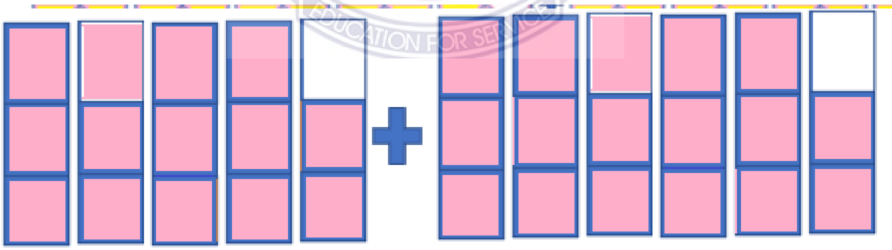
Research question 8

Translating from symbolic representations to diagrammatic representations and vice versa

Please read carefully and circle the correct answer to the alternative lettered A-D

2. $3\frac{3}{8} + 5\frac{5}{8}$ can be represented diagrammatically as



2.  can be represented symbolically as

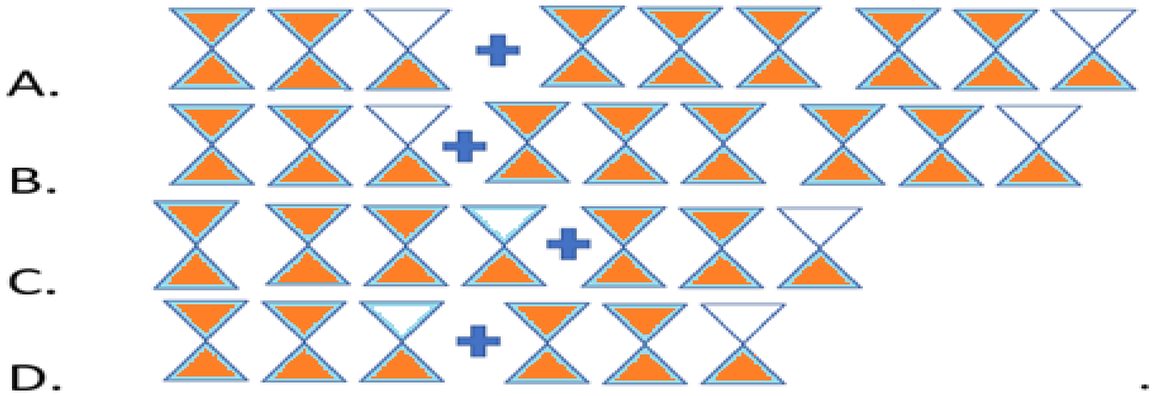
C. $4\frac{1}{3} + 5\frac{3}{8}$

D. $4\frac{2}{3} + 5\frac{1}{4}$

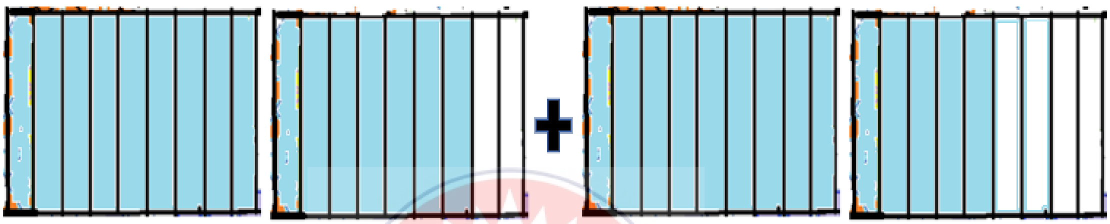
C. $4\frac{2}{3} + 5\frac{2}{3}$

D. $4\frac{2}{3} + 5\frac{1}{3}$

5. $3\frac{1}{2}$ + $2\frac{1}{2}$ can be represented diagrammatically as



6. The diagram below can be represented symbolically as



C. $1\frac{2}{9}$ + $5\frac{1}{4}$ C. $3\frac{1}{4}$ + $1\frac{5}{9}$

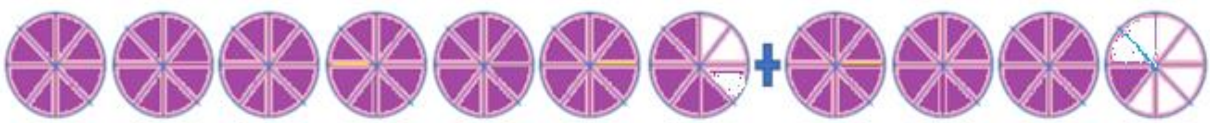
D. $1\frac{7}{9}$ + $1\frac{5}{9}$ D. $1\frac{5}{9}$ + $5\frac{3}{4}$

Research question 9

Translating from diagrammatic representations to word and vice versa

Please read carefully and circle the correct answer to the alternative lettered A-D

1. The diagram shown below can be written in statement as



A. Six and six-eight pieces of water melon is added to four and another three-eight pieces of melon

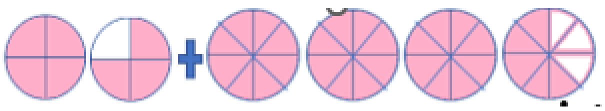
B. Three and three-eight pieces of melon is added to six and two-eight pieces of another water melon

C. Six and six-eight pieces of water melon is added to another three and three-eight pieces of melon

D. Three and one-eight pieces of melon is added to six and five-eight pieces of another water melon

2. A whole one-nineth is added to a whole six-nineth

3. The diagram can be interpreted as



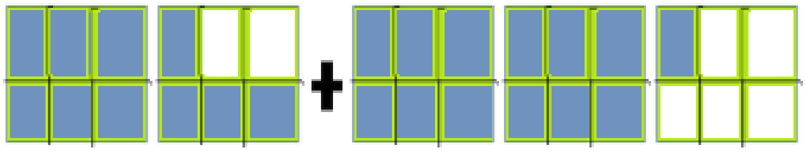
A. One whole and a quarter is added to three whole five-eights

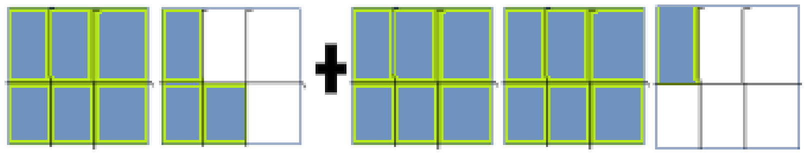
B. Three whole five eights are added to a whole three-quarters

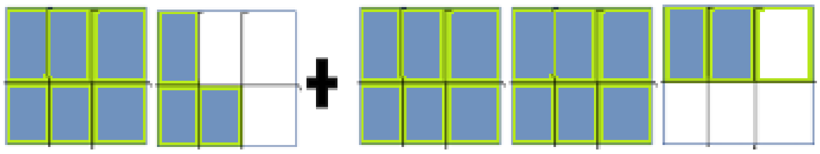
C. One whole three-quarters is added to three whole five-eights

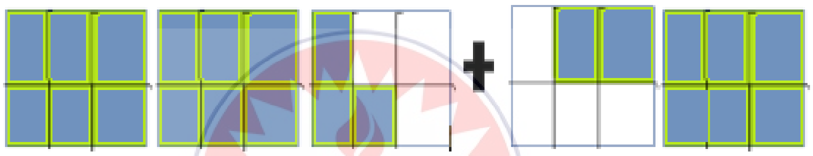
D. Three whole five eights are added to one whole three eighths

4. Two and a sixth is added to one and half can be represented diagrammatically as

A. 

B. 

C. 

D. 

Research question 10

Translating from real-life representations to word/statement form of representations and vice versa

Please read carefully and circle the correct answer to the alternative lettered A-D

1. Otoo weeded six and three-quarter acres of land on Monday. He weeded another four and three-eighth acres of land the following day. If the acres of the land he weeded in the two days are put together, what statement represents this?
    A. Six acres added to four and three-eight
    B. Six and three-quarters added to three and four-quarters
    C. Four and three-eighth added to six and three-quarter
    D. six and three-quarter added four and nine-sixteenth

2. Peter printed nine and five-sixth rims of papers in the morning. He printed an additional rim of six and seven-twelve rim in the afternoon. If the number of rims of papers printed are put together, this can be represented in other words as,

   A. Nine and five-sixth is added to six and seven-twelve

   B. Six and seven-twelve is added to nine and five-sixth

   C. Nine and five-sixth taken from six and seven-twelve

   D. Nine and five-sixth is added four-five

3. Adesi walked one and three-quarter miles from school and continued his journey to the church walking a distance of one and a half mile. This can also be written as

   A. One and three-quarterss plus two and three-quarterss

   B. Two and half added to one and three-quarterss

   C. Two and three-quarterss is added to six and two seventh

   D. One and half added to one and three-quarterss

4. Four and two-nineth is added six and five-sixth can be represented in real life as

   A. Moses run his first race of eleven and five-sixth kilometres and continued his second race of six and two-nineth

   B. Moses run his first race of eight and five-sixth kilometres and continued his second race of four and two-nineth

   C. Moses run his first race of two and five-sixth kilometres and continued his second race of four and two-nineth

   D. Moses run his first race of six and five-sixth kilometres and continued his second race of four and two-nineth

APPENDIX C

Research questionnaire filled by only the experimental group after the administration of the intervention

SECTION D

Please read carefully and tick (V) the appropriate response to the items that best reflect the extent to which you agree or disagree with the following statements.1-Strongly disagree, 2-Disagree, 3=Neutral 4-Agree, 5-strongly agree. Please do tick only one option on a statement in the box. It requires your perception on the effectiveness of the use of multiple representations-based instructions in teaching addition of mixed fractions.

	Strongly disagree	disagree	neutral	agree	Strongly agree
1. The use of multiple representations based-instructions helps learners to understand complex mathematics topics such as mixed fractions easily than traditional instructions					
2. The use of multiple representations based-instructions make abstract concepts of addition of mixed fractions become real and easy to solve than traditional instructions.					
3. The use of multiple representations based-instructions help create learners' readiness, serene and friendly classroom for learners to learn addition of mixed fractions than traditional instructions.					
4. The use of multiple representations-based instructions sustain the interest of learners in learning addition of mixed fractions as compared to traditional instructions					
5. The use of multiple representation based-instructions help to cater for learning challenges of learners in the addition of mixed fractions as a topic than traditional instructions.					

6. The use of multiple representations necessitates easy understanding of the concept of addition of mixed fractions than traditional instructions					
7. The researcher recommends the use of multiple representations in teaching of mathematics. Do you agree with the researcher?					

APPENDIX D

UNIVERSITY OF EDUCATION, WINNEBA
FACULTY OF EDUCATIONAL STUDIES
DEPARTMENT OF BASIC EDUCATION
P. O. Box 25, Winneba, Ghana
beducation@uew.edu.gh
+233 (050) 9212015

Date: February 8, 2022

The District Director
La Dade-Kotopong District Education Directorate
Accra, - GAR

Dear Sir/Madam,

LETTER OF INTRODUCTION

We forward to you, a letter from Mr. Philip Oduro Nkansah, a second year M.Phil student of the Department of Basic Education, University of Education, Winneba, with registration number 200012901.

Mr. Philip Oduro Nkansah is to carry out a research on the Topic "***The Effects of Using Multiple Representation- Based Instructions on Basic Seven Students' Performance in Addition of Mixed Fractions in the La Dade-Kotopong District.***

We would be grateful if permission is granted him to carry out this study in the District.

Thank you.

Yours faithfully,

DEPT. OF BASIC EDUCATION
UNIVERSITY OF EDUCATION
WINNEBA, GHANA

....
MR. NIXON SABA ADZIFOME
(Ag. Head of Department)

www.uew.edu.gh

APPENDIX E

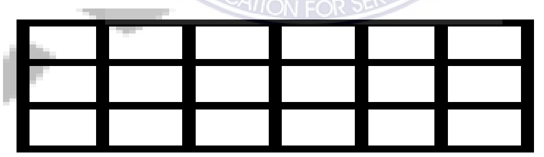
LESSON PLAN FOR CONTROL GROUP AND EXPERIMENTAL GROUPS BEFORE THE PRE-TEST WAS ADMINISTERED

1st Day: Monday Date: 10/10/2022 Period: 5 Time: 2:00 pm-3.00pm Class: B.S 7	Subject: Mathematics Strand: Number Sub-Strand: Fractions, Decimals and Percentages School: Airport Police JHS Class Size: 40

Content Standard: B7.1.3.1 Simplify, compare and order a mixture of positive fractions (i.e., common, percent and decimal) by changing all to equivalent (i) fractions (ii) decimals, or (iii) percentages	Indicator: B7.1.3.1.1 Determine and recall the percentages and decimals of given benchmark fractions (i.e., tenths, fifths, fourths, thirds and halves) and use these to compare quantities.	Lesson: 1 0f 4

Performance Indicator By the end of the lesson, the learner will be able to 1. Explain the meaning of fractions 2. Shade a given fraction 3. Mention the types of common fractions	Core competencies/values Problem Solving Skills; Critical Thinking; Justification of Ideas; Collaborative Learning; Personal Development and Leadership Attention to Precision

Key Words: Fractions, Tenth, Hundredth, Mixed fractions, Improper fractions, Proper

fractions, quarter, Half, Numerator, denominator		
Phase/Duration	Learners Activities (Intro, Main & Evaluation)	Resources (LTRs)
Phase 1 Duration 10 mins	Learners bisect oranges to half, quarters	• Graph Board/book • York series mathematics textbook • Teachers resource pack • Learners resource pack • A4 papers • Oranges • Cuisenaire rod • Aki-Ola Mathematics
Phase 2 Duration 45 mins	Activity 1 The facilitator as a guide assists learners in small group to interpret the meaning of fraction Activity 2 The facilitator as a guide assists learners in small group to shade and illustrate fractions. Eg. $\frac{5}{6}$  Activity 3 Mention at least three types of common fractions Assessment	

	Classwork: Learners' shade benchmark fractions.	
Phase 3 5 mins	Teacher summarizes the lesson after quizzing the learners on what they studied for the day.	Reflection

2nd Day: Tuesday Date: 11/10/2022 Period: 5 Time: 2:00 pm-3.00pm Class: B.S 7	Subject: Mathematics Strand: Number Sub-Strand: Fractions, Decimals and Percentages School: Airport Police JHS Class Size: 40

Content Standard: B7.1.3.1 Simplify, compare and order a mixture of positive fractions (i.e., common, percent and decimal) by changing all to equivalent (i) fractions (ii) decimals, or (iii) percentages	Indicator: B7.1.3.1.1 Determine and recall the percentages and decimals of given benchmark fractions (i.e., tenths, fifths, fourths, thirds and halves) and use these to compare quantities.	Lesson: 2 of 4

Performance Indicator By the end of the lesson, the learner will be able to 1. Write down some examples of equivalent	Core competencies/values Problem Solving Skills; Critical Thinking; Justification of Ideas;

fractions 2. Express some fractions in its simplest form 3. Compare some benchmark fractions		Collaborative Learning; Personal Development and Leadership Attention to Precision
Key Words: Equivalent fractions, Tenth, Hundredth, Mixed fractions, Improper fractions, Proper fractions, quarter, Half, Numerator, denominator, Benchmark fractions		
Phase/Duration	Learners Activities (Intro, Main & Evaluation)	Resources (LTRs)
Phase 1 Duration 10 mins	Learner's fold A4 papers	• Graph Board/book • York series mathematics textbook • Teachers resource pack • Learners resource pack • A4 papers • Oranges • Cuisenaire rod • Aki-Ola Mathematics
Phase 2 Duration 45 mins	Activity 1 The facilitator as a guide assists learners in small group to explain the meaning of equivalent fractions and give some examples. E.g., $\frac{1}{3} = \frac{3}{18} = \frac{10}{30}$ Activity 2 The facilitator as a guide assists learners in small group to convert some fractions into it simplest form. E.g., $\frac{15}{18} = \frac{5}{6}$ Activity 3 The facilitator as a guide assists learners in small	

	group to Compare some given fractions using <, > or = E.g., $\frac{5}{6} > \frac{1}{2}$ Assessment Classwork: Facilitator assess the learners	
Phase 3 5 mins	Facilitator summarizes the lesson after the learners do exercise on what they studied for the day.	Reflection

4th Day: Monday Date: 13/10/2022 Period: 5 Time: 2:00 pm-3.00pm Class: B.S 7 Class Size:	Subject: Mathematics Strand: Number Sub-Strand: Fractions, Decimals and Percentages School: Airport Police JHS

Content Standard: B7.1.3.1 Simplify, compare and order a mixture of positive fractions (i.e., common, percent and decimal) by changing all to	Indicator: B7.1.3.1.2 Compare and order fractions (i.e. common, percent and decimal fractions up to thousandths) limit to the benchmark fractions. B7.1.3.2.1 Explain the process of addition and	Lesson: 4 of 4

equivalent (i) fractions (ii) decimals, or (iii) percentages	subtraction of two or three unlike and mixed fractions	

Performance Indicator	Core competencies/values
By the end of the lesson, the learner will be able to 1. Order fractions in ascending or descending form 2. Convert improper fractions to mixed fraction and vice versa 3. Add some common fractions with common denominator	Problem Solving Skills; Critical Thinking; Justification of Ideas; Collaborative Learning; Personal Development and Leadership Attention to Precision

Key Words: Equivalent fractions, Tenth, Hundredth, Mixed fractions, Improper fractions, Proper fractions, quarter, Half, Numerator, denominator, Benchmark fractions

Phase/Duration	Learners Activities (Intro, Main & Evaluation)	Resources (LTRs)
Phase 1 Duration 10 mins	Learner's model with A4 papers addition of fractions.	• Graph Board/book • York series mathematics textbook • Teachers resource pack • Learners resource pack • A4 papers
Phase 2 Duration 45 mins	Activity 1 The facilitator as a guide assists learners in small group to order in ascending or descending form of the following fractions. $\frac{7}{3}, \frac{3}{8}, \frac{10}{30}$	

	Activity 2 The facilitator as a guide assists learners in small group to convert some improper fractions to mixed fraction and vice versa E.g.,$3\frac{5}{8} = \frac{29}{8}$ Activity 3 The facilitator as a guide assists learners in small group to add some common fractions with common denominator E.g., $\frac{5}{6} + \frac{1}{6} = \frac{6}{6} = 1$ Assessment Classwork: Facilitator assess the learners	• Oranges • Cuisenaire rod • Aki-Ola Mathematics
Phase 3 5 mins	Facilitator summarizes the lesson after the learners do exercise on what they studied for the day.	Reflection

4th Day: Thursday Date: 11/10/2022 Period: 5 Time: 2:00 pm-3.00pm Class: B.S 7 Class Size:	Subject: Mathematics Strand: Number Sub-Strand: Fractions, Decimals and Percentages School: Airport Police JHS

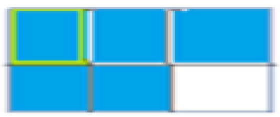
<table>
<tr><td colspan="2">Content Standard:
B7.1.3.2 Demonstrate an understanding of the process of addition and/or subtraction of fractions and apply this in solving problems</td><td colspan="2">Indicator:
B7.1.3.2.1 Explain the process of addition of two or three unlike and mixed fractions</td><td>Lesson: 6</td></tr>
<tr><td colspan="3">Performance Indicator
By the end of the lesson, the learner will be able to
1. Order fractions in ascending or descending form
2. Convert improper fractions to mixed fraction and vice versa
3. Add some common fractions</td><td colspan="2">Core competencies/values
Problem Solving Skills; Critical Thinking; Justification of Ideas; Collaborative Learning; Personal Development and Leadership Attention to Precision</td></tr>
<tr><td colspan="5">Key Words: Equivalent fractions, Tenth, Hundredth, Mixed fractions, Improper fractions, Proper fractions, quarter, Half, Numerator, denominator, Benchmark fractions</td></tr>
<tr><td>Phase/Duration</td><td colspan="3">Learners Activities (Intro, Main & Evaluation)</td><td>Resources (LTRs)</td></tr>
<tr><td>Phase 1
Duration
10 mins</td><td colspan="3">Learner's model with A4 papers addition of fractions.</td><td>• Graph Board/book
• York series mathematics textbook</td></tr>
</table>

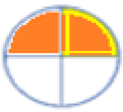
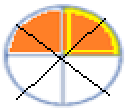
Phase 2 Duration 45 mins	Activity 1 The facilitator as a guide assists learners in small group to add fractions with different denominators. E.g., $\frac{2}{3}+\frac{3}{8}=1\frac{1}{24}$ Activity 2 The facilitator as a guide assists learners in small group to add mixed fractions. E.g., $4\frac{2}{3}+2\frac{3}{8}=7\frac{1}{24}$ Activity 2 The facilitator as a guide assists learners in small group to solve word problem for addition of mixed fractions.E.g.,$3\frac{5}{8}=\frac{29}{8}$ Activity 3 The facilitator as a guide assists learners in small group to add some common fractions E.g., $\frac{5}{6}+\frac{1}{12}=\frac{11}{12}$ Assessment Classwork: Facilitator assess the learners	• Teachers resource pack • Learners resource pack • A4 papers • Oranges • Cuisenaire rod • Aki-Ola Mathematics
Phase 3 5 mins	Facilitator summarizes the lesson after the learners do exercise on what they studied for the day.	Reflection

Appendix F

LESSON PLAN FOR EXPERIMENTAL GROUP BEFORE THE POST-TEST WAS ADMINISTERED

<table>
<tr><td colspan="2">1st Day: Monday
Date: 17/10/2022
Period: 5
Time: 2:00 pm-3.00pm
Class: B.S 7</td><td colspan="3">Subject: Mathematics
Strand: Number
Sub-Strand: Fractions, Decimals and Percentages
School: Airport Police JHS
Class Size:</td></tr>
<tr><td colspan="2">Content Standard:
7.1.3.1 Simplify, compare and order a mixture of positive fractions (i.e. common, percent and decimal) by changing all to equivalent (i) fractions (ii) decimals, or (iii) percentages</td><td colspan="2">Indicator:
B7.1.3.1.1 Determine and recall the percentages and decimals of given benchmark fractions (i.e. tenths, fifths, fourths, thirds and halves) and use these to compare quantities.</td><td>Lesson: 1 of 4</td></tr>
<tr><td colspan="3">Performance Indicator
By the end of the lesson, the learner will be able to
1. Explain the meaning of fraction
2. Illustration of fractions using diagrams
3. Illustrate some equivalent fractions
4. Mention some types of common fractions</td><td colspan="2">Core competencies/values
Problem Solving Skills; Critical Thinking; Justification of Ideas; Collaborative Learning; Personal Development and Leadership Attention to Precision</td></tr>
</table>

Key Words: Equivalent fractions, Tenth, Hundredth, Mixed fractions, Improper fractions, Proper fractions, quarter, Half, Numerator, denominator, Benchmark fractions		
Phase/Duration	Learners Activities (Intro, Main & Evaluation)	Resources (LTRs)
Phase 1 Duration 10 mins	Learner's model with A4 papers addition of fractions.	• Graph Board/book • York series mathematics textbook • Teachers resource pack • Learners resource pack • A4 papers • Oranges • Cuisenaire rod • Aki-Ola Mathematics
Phase 2 Duration 45 mins	Activity 1 The facilitator as a guide assists learners in small group to explain the meaning of fractions. Eg. Part of a whole, a measure, ratio, division, sharing Activity 2 The facilitator as a guide assists learners in small group to illustrate some fractions diagrammatically and graphically. E.g., $\frac{5}{6}$ =  Activity 3 The facilitator as a guide assists learners in small group to write and model equivalence of some	

	fractions. E.g., $\frac{5}{8} = \frac{10}{16}$,  =  Activity 4 The facilitator as a guide assists learners in small group to mention some types of common fractions Assessment Classwork: Facilitator assess the learners	
Phase 3 5 mins	Facilitator summarizes the lesson after the learners do exercise on what they studied for the day.	Reflection

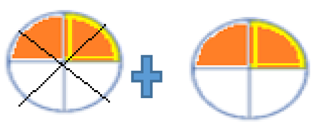
2nd Day: Tuesday Date: 18/10/2022 Period: 5 Time: 2:00 pm-3.00pm Class: B.S 7 Class Size:	Subject: Mathematics Strand: Number Sub-Strand: Fractions, Decimals and Percentages School: Airport Police JHS

Content Standard:	Indicator:	Lesson: 2
B7.1.3.2 Demonstrate an understanding of the process of addition and/or subtraction of fractions and apply this in solving problems	B7.1.3.2.1 Explain the process of addition of two or three unlike and mixed fractions	of four

Performance Indicator	Core competencies/values
By the end of the lesson, the learner will be able to 1. Write word form and symbolic form of addition of fractions 2. Add fractions by changing from word representation to symbolic form and vice versa. 3. Add fractions in diagrammatic form to symbolic form	Problem Solving Skills; Critical Thinking; Justification of Ideas; Collaborative Learning; Personal Development and Leadership Attention to Precision

Key Words: Equivalent fractions, Tenth, Hundredth, Mixed fractions, Improper fractions, Proper fractions, quarter, Half, Numerator, denominator, Benchmark fractions

Phase/Duration	Learners Activities (Intro, Main & Evaluation)	Resources (LTRs)
Phase 1 Duration 10 mins	Learner's fold A4 papers	• Graph Board/book • York series mathematics textbook • Teachers resource pack
Phase 2 Duration 45 mins	Activity 1 The facilitator as a guide assists learners in small group to write wo form and symbolic form of	

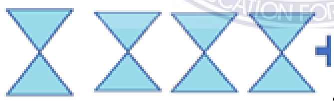
	addition of fractions E.g., $3\frac{1}{3} + \frac{3}{4}$= three-quarters is added to three whole one-third, $12 + \frac{3}{18}$ = three-eighteenth is added to twelve, Activity 2 The facilitator as a guide assists learners in small group to add fractions by changing from word representation to symbolic form and back to word as the solution. E.g., One whole one-quarters is added to three whole five-eights. $3\frac{5}{8} + 1\frac{1}{4} = 4\frac{7}{8}$. Thus, Four whole seven-eighth Activity 3 The facilitator as a guide assists learners in small group to write diagrammatic form and symbolic form of addition of fractions. E.g.,  $= \frac{4}{8} + \frac{2}{4}$ Assessment Classwork: Facilitator assess the learners	• Learners resource pack • A4 papers • Oranges • Cuisenaire rod • Aki-Ola Mathematics

Phase 3 5 mins	Facilitator summarizes the lesson after the learners do exercise on what they studied for the day.	Reflection

3rd Day: Tuesday Date: 19/10/2022 Period: 5 Time: 2:00 pm-3.00pm Class: B.S 7 Class Size:	Subject: Mathematics Strand: Number Sub-Strand: Fractions, Decimals and Percentages School: Airport Police JHS

Content Standard: B7.1.3.2 Demonstrate an understanding of the process of addition of fractions and apply this in solving problems	Indicator: B7.1.3.2.1 Explain the process of addition of two or three unlike and mixed fractions	Lesson: 3 of 4

Performance Indicator By the end of the lesson, the learner will be able to 1. Add fractions by changing from diagrammatic representation to symbolic form. 2. Write word form to real life representation form of fractions 3. Add mixed fractions by changing from word form to real life representation form	Core competencies/values Problem Solving Skills; Critical Thinking; Justification of Ideas; Collaborative Learning; Personal Development and Leadership Attention to Precision

Key Words: Equivalent fractions, Tenth, Hundredth, Mixed fractions, Improper fractions, Proper fractions, quarter, Half, Numerator, denominator, Benchmark fractions		
Phase/Duration	Learners Activities (Intro, Main & Evaluation)	Resources (LTRs)
Phase 1 Duration 10 mins	Learner's fold A4 papers	• Graph Board/book • York series mathematics textbook • Teachers resource pack • Learners resource pack • A4 papers • Oranges • Cuisenaire rod • Aki-Ola Mathematics
Phase 2 Duration 45 mins	Activity 1 The facilitator as a guide assists learners in small group to add fractions by changing from diagrammatic representation to symbolic form and back to diagrammatic form as the solution. E.g.,   . Thus, $2\frac{1}{2} + 1\frac{1}{2} = 4$ Activity 2 The facilitator as a guide assists learners in small group to write from word form to real life representation form of addition of fractions. E.g., half is added to four and three-seventh is written in real life as Sam bought four and three-seventh	

	acres of land and he bought half an acre to the first one. Activity 3 The facilitator as a guide assists learners in small group to add fractions in real life representation to word form of representation and vice versa. Assessment Classwork: Facilitator assess the learners	
Phase 3 5 mins	Facilitator summarizes the lesson after the learners do exercise on what they studied for the day.	Reflection

3rd Day: Tuesday Date: 19/10/2022 Period: 5 Time: 2:00 pm-3.00pm Class: B.S 7 Class Size:	Subject: Mathematics Strand: Number Sub-Strand: Fractions, Decimals and Percentages School: Airport Police JHS

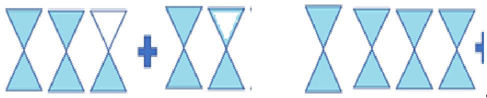
Content Standard: B7.1.3.2 Demonstrate an understanding of	Indicator: B7.1.3.2.1 Explain the process of	Lesson: 3 of 4

the process of addition of fractions and apply this in solving problems	addition of two or three unlike and mixed fractions	

Performance Indicator	Core competencies/values
By the end of the lesson, the learner will be able to 4. Add fractions by changing from diagrammatic representation to symbolic form. 5. Write word form to real life representation form of fractions 6. Add mixed fractions by changing from word form to real life representation form	Problem Solving Skills; Critical Thinking; Justification of Ideas; Collaborative Learning; Personal Development and Leadership Attention to Precision

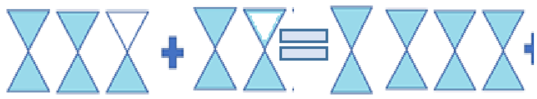
Key Words: Equivalent fractions, Tenth, Hundredth, Mixed fractions, Improper fractions, Proper fractions, quarter, Half, Numerator, denominator, Benchmark fractions

Phase/Duration	Learners Activities (Intro, Main & Evaluation)	Resources (LTRs)
Phase 1 Duration 10 mins	Learner's fold A4 papers	• Graph Board/book • York series mathematics textbook • Teachers resource pack • Learners resource pack
Phase 2 Duration 45 mins	Activity 1 The facilitator as a guide assists learners in small group to add fractions by changing from diagrammatic representation to symbolic form and back to diagrammatic form as the solution. E.g.,	

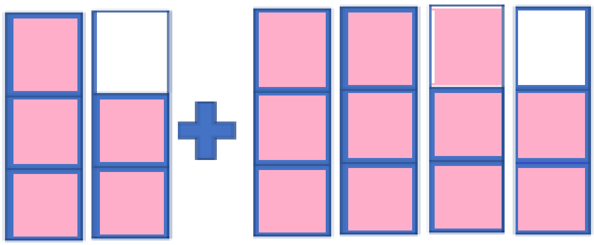
	. Thus, $2\frac{1}{2} + 1\frac{1}{2} = 4$ Activity 2 The facilitator as a guide assists learners in small group to write from word form to real life representation form of addition of fractions. E.g., half is added to four and three-seventh is written in real life as Sam bought four and three-seventh acres of land and he bought half an acre to the first one. Activity 3 The facilitator as a guide assists learners in small group to add fractions in real life representation to word form of representation and vice versa. Assessment Classwork: Facilitator assess the learners	• A4 papers • Oranges • Cuisenaire rod • Aki-Ola Mathematics

Phase 3 5 mins	Facilitator summarizes the lesson after the learners do exercise on what they studied for the day.	Reflection

4th Day: Tuesday Date: 20/10/2022 Period: 5 Time: 2:00 pm-3.00pm Class: B.S 7	Subject: Mathematics Strand: Number Sub-Strand: Fractions, Decimals and Percentages School: Airport Police JHS Class Size: 40		
Content Standard: B7.1.3.2 Demonstrate an understanding of the process of addition of fractions and apply this in solving problems	Indicator: B7.1.3.2.1 Explain the process of addition of two or three unlike and mixed fractions		Lesson: 4 of 4
Performance Indicator By the end of the lesson, the learner will be able to 1. Add mixed fractions by changing from diagrammatic representation to real life representation form. 2. Write word form to diagrammatic representation form of fractions 3. Add mixed fractions by changing from	Core competencies/values Problem Solving Skills; Critical Thinking; Justification of Ideas; Collaborative Learning; Personal Development and Leadership Attention to Precision		

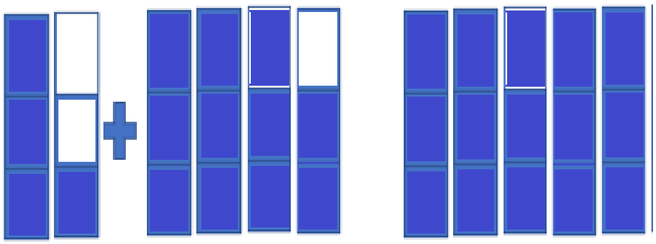
	diagrammatic form to word form representation form	
Key Words: Equivalent fractions, Tenth, Hundredth, Mixed fractions, Improper fractions, Proper fractions, quarter, Half, Numerator, denominator, Benchmark fractions, real life representation, word representation, diagrammatic representation		
Phase/Duration	Learners Activities (Intro, Main & Evaluation)	Resources (LTRs)
Phase 1 Duration 10 mins	Learner's fold A4 papers	• Graph Board/book • York series mathematics textbook • Teachers resource pack • Learners resource pack • A4 papers • Oranges • Cuisenaire rod • Aki-Ola Mathematics
Phase 2 Duration 45 mins	Activity 1 The facilitator as a guide assists learners in small group to add mixed fractions by changing from diagrammatic representation to real life form and back to diagrammatic form as the solution. E.g., Opoku bought two and half acres of land and he bought one and half acres to the first one. His total plot of land becomes four acres.  Activity 2 The facilitator as a guide assists learners in small	

group to represent word form to diagrammatic representation of fractions. E.g., Three and two-third is added to one and two-third.



Activity 3

The facilitator as a guide assists learners in small group to write from word form to diagrammatic representation form of addition of fractions. E.g., three two-thirds are added to one and one and one-third is represented diagrammatically as



Assessment

Classwork: Facilitator assess the learners

Phase 3 5 mins	Facilitator summarizes the lesson after the learners do exercise on what they studied for the day.	Reflection