THE USE OF DRAWINGS TO INCREASE PUPILS' PERFORMANCE IN MATHEMATICS

BY

EVELYN LOVELANCE ARHIN

B.A (HONS) Integrated Rural Art and Industry

KNUST

A Thesis submitted to the School of Graduate Studies,
Kwame Nkrumah University of Science and Technology, Kumasi,
in partial fulfillment of the requirements for the Degree of

Master of Philosophy in Art Education

Faculty of Art

College of Art and Social Sciences

July, 2012

© 2012, Department of General Art Studies

LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TECHNOLOGY
KUMASI

DECLARATION

I hereby declare that this submission is my own work towards the Master of Philosophy in Art Education and that to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

Evelyn Lovelance Arhin (PG4422910) 04/07/2012

(Student's Name and ID No.) Signature Date

Certified by:

Dr. (Mrs) Mavis Osei

(Supervisor) 04/07/2012

Signature Date

Certified by:

Nana Afia Opoku-Asare (Mrs)

(Head of Department) 05/07/2012

Signature Date

KNUST

ABSTRACT

There have been series of concerns raised on the general performance of pupils in mathematics in Ghana. Attainment in mathematics is generally low and this is evident in what pertains at the Ayigya M/A Primary School A, where performance of pupils in mathematics was observed to be low in relation to one other school. This study describes an interventional program for improving pupil performance in mathematics through the use of drawings. The study employed the Quasi-experimental and Action research methods with interviews, observation, achievement test and Likert scale assessment to examine how teaching and learning of mathematics is done in this school. It was also used to find out how drawing interventions can improve mathematical performance of pupils and to compare the performance of pupils in mathematics before and after the intervention. Using the purposive and convenience sampling of the non-probability sampling technique, a sample of 69 respondents comprising 62 pupils and seven teachers of Ayigya M/A Primary School A were selected for the in-depth study. Pupil performance was obtained by analysing the continuous assessment cards from the previous year. Pre- and post-test assessments were administered to measure improvement in pupil performance. Data collected was analyzed using SPSS statistical analysis software and Microsoft Office Excel to generate tables and charts. The study found that the teachers only use the standard textbook when teaching without considering the individual abilities of the pupils. The teachers also seldom integrate practical activities to explain mathematical concepts. Class participation was also found to be very low. With regards to the interventions, the study revealed that drawing exercises significantly improved pupil performance in mathematics over the study period. The interventions employed also heightened pupils' interest in the learning of mathematics. Their

KNUST

confidence and self-esteem also greatly improved and their problem solving skills were enhanced. The intervention activities also afforded the pupils a broader range of learning styles. It is recommended that to better integrate drawings into mathematics teaching and learning, mathematics teachers should acquaint themselves with the adapted model of Thomas & Switzer (2001) and implement it in their mathematics teaching. This model involves the introduction of mathematics concepts; presentation of scenario to initiate drawing activities; manipulation of drawing tools and materials; ensuring that the pupils draw; understanding of mathematics concept and improvement in mathematics performance.

KNUST

DEDICATION

With much gratitude to the almighty God, Jehovah, I dedicate this thesis to my husband, Dr. Obed Kojo Otoo; my daughter, Danielle Otoo; my parents, Charles and Agnes Arhin, my family and friends.

KNUST

ACKNOWLEDGEMENTS

This research work has been made possible through the contributions of many people and I express my sincere thanks to them all.

I convey my deepest gratitude to my supervisor, Dr. (Mrs) Mavis Osei for her invaluable supervision and constructive comments throughout the study and also to Dr. Osei-Poku for his encouraging comments.

I also express special thanks to the Head of Department, Nana Afia Opoku-Asare (Mrs) and the lecturers of the Department of General Art Studies of Kwame Nkrumah University of Science and Technology for the knowledge and experiences that they have imparted to me.

To my husband, Dr. Obed Kojo Otoo; my parents, Charles and Agnes Arhin and my brother, Benjamin Arhin, I say thank you for the support and the sharing of ideas.

I also convey my gratitude to the Head teacher and teachers of Ayigya M/A Primary School A for allowing me to carry out the research in the school and also for the information and assistance given to me for this research work.

KNUST

TABLE OF CONTENTS

KNUST

CHAPTER TWO - REVIEW OF RELATED LITERATURE

KNUST

LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TECHNOLOGY
KUMASI

KNUST

KNUST

KNUST

LIST OF PLATES (PHOTOGRAPHS)

KNUST

LIST OF FIGURES (ILLUSTRATIONS, GRAPHS, CHARTS, MAPS)

KNUST

LIST OF TABLES

KNUST

ABBREVIATIONS

COO	Creating Original Opera
CRDD	Curriculum Research and Development Division
EMIS	Education Management Information System
GNA	Ghana News Agency
IEA	International Association for the Evaluation of Educational Achievement
JHS	Junior High School
KNUST	Kwame Nkrumah University of Science and Technology
M/A	Metropolitan Assembly
MOE	Ministry of Education
NGO	Non-Governmental Organization
SAT	Scholastic Aptitude Test
SHS	Senior High School
SPSS	Statistical Package for Social Sciences
TIMMS	Trends in International Mathematics and Science Study
UNESCO	United Nations Educational Scientific and Cultural Organization
USA	United States of America

KNUST

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter considers the background to the study, statement of the problem, objectives, research questions, delimitation, limitations, definitions of terms, importance of the study, and organization of the rest of the text.

KNUST

1.2 Background to the Study

> Current educational experiences highlighting the importance of arts education have been advocated around the world. Programs' focusing on creativity-building education has attracted a great deal of attention. The movement encouraging arts activities within schools has attempted not only to promote the implementation of arts education in formal and non-formal settings, but also to improve the quality of education, appreciating the role of arts and creativity in school environment as a tool for promoting ethical values. As part of this movement, in November 1999, the Director-General of UNESCO launched an International Appeal for the Promotion of Arts Education and Creativity at School on the occasion of the 30th session of the General Conference of UNESCO (Iwai, 2003).

In view of these, Creative art was introduced into the Ghanaian basic school's curriculum in September, 2007. In spite of reforms in education, courses in our schools are taught separately and independently and thus lack integration although integration was part of the Ghanaian system of indigenous education. Edusei (1991), as cited in Ross (2004) affirms that "... indigenous education in Ghana developed as a holistic approach aimed at preparing learners for membership in society in ways that integrated rather than separated skills emphasizing relationships and interdependence of individuals to the whole" (p.118). This holistic approach to education is what is lacking in the present

LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TECHNOLOGY
KUMASI

Ghanaian educational system although research shows that integrated curriculum can enhance students' performance.

1.3 Statement of the Problem

Pupil attainment in mathematics in Ghana is generally low (Mereku, 2003). Many stake- holders in education have expressed concern about this. Mrs Elizabeth Amoah-Tetteh, former Deputy Minister of Education expressed concern about the falling standards in mathematics in Ghanaian schools. She pledged Government's support for efforts to assist pupils to learn and appreciate mathematics (GNA, 2009). In spite of government efforts, however, mathematics has not undergone much change in terms of how it is presented. This reflects consistently in low achievement levels in mathematics among students at the SHS and JHS (Agyei, 2010).

Results from the Trends in International Mathematics and Science Study (***TIMSS***), conducted by the International Association for the Evaluation of Educational Achievement (IEA) of the USA in 2003 and 2007 indicate that grade 8 children show poor mathematics achievement in Ghana. In the international study, Ghana's eighth graders were ranked 43rd among 44 and 46th among 47 countries that participated in the study in the respective years (Agyei, 2010). The situation is similar to what goes on at primary schools as well as the senior high schools. It is especially serious at the senior high schools in that passing mathematics is a requirement for gaining admission into tertiary institution. Failure to pass mathematics has resulted in many senior high school graduates being unable to continue at the tertiary level.

In Ghana, the general guidelines on the delivery of the curriculum in the math syllabus and teachers' handbooks advocates the use of investigational or activity methods by the teachers to encourage discovery learning. These are directed towards learning tasks which encourage inquiry, creativity, manipulative and manual skills. Mereku (2003) reports that only few learning/teaching activities that could encourage the use of discovery methods were included in the syllabus (Mereku, 2003). There are fewer drawing activities which limit the potential of learning through the visual arts.

KNUST

The teachers of mathematics adopt the expository method of teaching that induces rote learning ("chew and pour"), where students do not necessarily grasp the concepts of mathematics to help them in their everyday lives but learn to pass their exams and forget what they have learned soon afterwards (Agyei, 2010). This is confirmed by Mereku (2003) who investigated methods of teaching in Ghanaian primary mathematics textbooks and teachers' classroom practice. The study found out that in his sample, 68.2% of teachers never engaged pupils in practical and game activities in lessons, 31.8% occasionally did and none of them made this a regular part of their lessons. It was also noted that 18.2% of teachers never used approaches that bring conceptual understanding, 63.6% occasionally did and 18.2% regularly did that. With respect to encouraging pupils to use their own methods in solving problems, 95.5% of the teachers never did, 4.5% occasionally did so and none of them made that a regular part of their lessons. Unfortunately, there are also many students who are unable to learn by rote and who thus fail their exams.

This nationwide problem is no different from what pertains at the Ayigya M/A Primary School, located at Ayigya, a suburb in the Kumasi Metropolis. The general

performance of the pupils is low in the area of mathematics and teachers often use expository method of teaching instead of the advocated discovery method. The Class Two pupils in particular need to improve their performance in mathematics; the concerns of the staff are how to improve student performance in this area. Report Card assessments from the Class One teachers (as shown in Figure 1) showed that there is the need to bring in an intervention to help improve the performance in mathematics among the pupils.

KNUST

Table 1.1: Mathematics Report Card Grades From Class One

PERCENTAGE SCORES	NUMBER OF PUPILS ATTAINING	PERCENTAGES OF PUPILS
0 - 29	8	12.3
30 - 49	17	26.2
50 - 69	30	46.2
70 - 89	10	15.3
90 - 100	0	0
Total	65	100

Source: Fieldwork, 2012

Table 1.1 shows that none of the pupils scored between 90%-100%, 30 or 46.2% represent those who scored between 50%-69%, while eight or 12.3% scored between 0% -29%. These percentages reveal that something needs to be done urgently to help the pupils. Based on the foregoing, this research was designed to find out how drawing

activities can be used to improve the mathematical abilities of primary school children at the Ayigya M /A Primary School.

1.4 Objectives

1. To examine how teaching and learning of mathematics is done at Ayigya M/A Primary School.
2. To design drawing interventions to teach mathematics at Ayigya M/A Primary School.
3. To compare the performance of pupils before and after the intervention in order to measure improvement.

1.5 Research Questions

- What teaching and learning methods are used at the primary school?
- How can drawings improve the mathematical abilities of primary school children?
- How effective is the drawing intervention in improving pupil performance in mathematics?

1.6 Delimitation

The drawings are limited to simple drawings done by primary school pupils. The study is limited to pupils and teachers of Ayigya M/A Basic School.

KNUST
LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TECHNOLOGY
KUMASI

1.7 Limitation

The main limitation of the study is time constraint. Due to this limitation, the study was not replicated by the teacher which initially was the aim in order to validate the findings. Therefore this affects the generalizability of the study.

1.8 Definition of Terms

- **Drawing Intervention in Mathematics:** A programme designed to increase pupils' performance in mathematics and make mathematics teaching and learning enjoyable.

1.9 Importance of the Study

This study will help students see the relationship among the various subjects and help them retain some basic concepts in the various subject areas.

It will also serve as a reference material for other professionals in the field of art education. The study will again show whether it is possible to incorporate arts education with well-designed programme plans into our school curricula in order to achieve the possibilities that art education promises.

1.10 Organization of the rest of text

Chapter Two entails the review of literature relevant to the topic. Chapter Three deals with the strategies adopted in data collection, research design, the sample and sampling technique, administration of research instruments and data analysis plan. Chapter Four covers the discussion and analysis of the main findings whiles Chapter Five

presents the summary, conclusions drawn from the study and recommendations for improving the study of mathematics in the primary schools.

KNUST

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Overview

The review of related literature seeks to examine scholastic works done in the field of integrated curricula, integrated math art curricula, multiple intelligence as well as teaching and learning. It will capture the definitions of terms and concepts, and specifically examine the reasons for the lack of integration of visual art into mathematics curriculum, how the arts have improved the mathematical performance of primary school children and some methods of teaching and learning at the primary school level.

2.2 Integrated Curricula

The term "integration" comes from the Latin word *integrare,* which means to make something whole, a root also used, for example, in the word integer, meaning "whole number" (Grumet, 2004 as cited in Burnaford, Brown, Doherty, & Mclaughlin, 2007) . The term art integration has also evolved over the years. Terms such as arts-infused curriculum (Debra & Riedel, 2003 ; Mello, 2004), learning in and through the arts (Bamford, 2006; Bloomfield & Childs, 2000, cited in Burnaford, Brown, Doherty, & Mclaughlin, 2007), learning with the arts (Goldberg, 2006 cited in Burnaford, Brown, Doherty, & Mclaughlin, 2007), and arts as a vehicle for learning have all been used but are all slightly different in meaning. In spite of the current interest in arts integration, there is no agreement on the theory or practice or definition of the term (Parsons, 2004 as cited in Burnaford, Brown, Doherty, & Mclaughlin, 2007). Educationalists use the terms interdisciplinary curriculum, multidisciplinary curriculum and integrated curriculum

interchangeably. However, many experts in the field of arts integration have defined arts integration based on these three categories.

- Arts integration as learning through and with the arts.

Arts integration as learning through and with the arts refers to the potential for the transfer of learning between the arts and other subjects.

- Arts integration as a curricula connection process.

Arts integration in this way emphasize the need for genuine authenticity in identifying a common concept or unifying idea and guarding against false or superficial integration claims that are not consistent with the disciplines involved.

- Arts integration as a collaborative engagement.

Arts integration is often defined as a process of collaboration. Just who is involved in the collaboration differs according to the program or research project.

These sources of definitions for art integrated curricula are very relevant to my study in that it helped me in determining the type of integration and intervention that will appropriate for my study. Arts integration, for the purpose of this study, has been defined as a curricula connection process.

2.3 Theoretical Frameworks for Arts Integration

Gardner's (1983, 1993 & 1999) multiple intelligences theory has provided teachers and teaching artists with a framework for integrating the arts in the regular education classroom. Gardner's original list of intelligences, including logical-mathematical, linguistic, musical, spatial, bodily-kinesthetic, interpersonal, and intrapersonal, provide teachers with a straightforward planning tool for the purposes of arts integration. The

multiple intelligences approach has been extended well beyond the arts and has been the impetus for designing whole schools around approaches that address students' capacities.

Bresler (1995) describes four arts integration styles namely subservient, co-equal, affective integration, and social integration. The "subservient" style has been the target of often intense criticism from arts communities and there is evidence that such practices exist (Mishook & Kornhaber, 2006). Bresler describes this model as one in which the arts serve the basic academic curriculum in terms of content, pedagogy, and structures. The "co-equal" style addresses the content, goals, skills, and structure of the arts and non-arts disciplines equally. The "affective integration" style, according to Bresler, emphasizes the potential of the arts to evoke feelings, and gives students an opportunity to express themselves and be creative across disciplines. The "social integration" style suggests a more political goal for principals, who employ arts integration as a way to connect with communities through partnerships and projects.

Drawing on the works of Bresler and Gardner, Wiggins (2001) focuses on three key areas of integrated instruction as theoretical, curricular, and instructional. Wiggins finds Bresler's(1995) notion of "subservient" integration to be very common in schools. Wiggins cautions arts specialists to be aware and knowledgeable of the types of integration and their outcomes and to be strong educators in their own field.

Bamberger (2000) outlines a research procedure for investigating common learning processes in projects that "juxtapose activities that embody underlying conceptual structures and problem-solving strategies" (p.32). For instance, Bamberger describes music, mathematics, and sciences as disciplines that share structures and strategies.

Shared structures include hierarchies, periodicity, units, ratio-proportion, symmetry, pattern, and constants-variables. These subject areas also share strategies such as counting and measuring, parts or wholes, similar or different, parsing or chunking, classifying, and naming. According to Bamberger (2000), common structures and strategies can become the organizing principles for planning and implementing integration.

In establishing an argument for substantive arts integration, Marshall (2006) drew on the cognitive theory to discuss state standards, especially in California, reminding the reader that art education principles represented in standards and frameworks necessitate lessons that go deep, that is mining the concepts behind images, ideas and processes—and broad, in the sense of making a web of connections between art content, art making and other domain and ideas. According to Marshall, art should not be isolated as a hermetic field but rather, an integrated arts education that connects to all areas of inquiry.

Cornett (2003) offers a comprehensive guide for teachers who want to integrate the arts (drama, visual art, dance, and music) and their literacy curriculum by describing the process as teaching with, about, in, and through the arts and offering detailed lesson plans and principles to guide them. While reading and writing guidelines are central to this approach, Cornett is also careful to incorporate the requisite fine arts standards in her text. Kelner & Flynn (2006) also propose the development of reading comprehension through drama, and suggest this merging of purposes because the two fields have some "natural links" (p.2). There exists some research to support or endorse the use of drama in teaching of reading (Podlozny, 2000; Wagner, 1998, 2002).

Aprill (2001) does not agree with the treatment of discipline specific arts instruction and arts-integrated teaching as dichotomous practices with different sets of rules rather than being a continuum in which varied but connected practices inform and light up each other. Scripp & Subotnik (2003) advocate a framework for innovation "based on comprehensive, interdisciplinary programs that are intended to benefit all children in public schools" (p.8). The approach suggested by Scripp and Subotnik does not exclude arts-specific teaching and learning and is in fact dependent upon it as part of a continuum of arts learning. They further suggest a framework as a path of innovation "from performance based, non-compulsory curricula for the benefit of the talented few toward comprehensive, interdisciplinary programs designed for the benefit of every child in the school community" (p. 9).

Snyder (2001) describes the processes of connection, correlation, and integration as current trends in education but cautions against connection as the most popular, most used, and least meaningful way of linking disciplines. From Snyder's view point, connection is when one discipline is used in the service of another. Snyder notes that connections, for example, seldom develop musical concepts and skills but they are the most popular approach to helping students realize relationships between prior knowledge and newer experiences. Correlation in Snyder's conceptual framework occurs when two disciplines share common materials or activities. With correlation no plan is made to develop important ideas across disciplines to form generalizations. When correlation becomes consistent in a school, Snyder comments that many schools begin to seek funding for professional development, teaching artists, and arts materials. According to Snyder, with the current climate of testing accountability, correlation curriculum often

stops as teachers and students prepare for standardized high stakes tests, usually in mathematics and reading.

Rosenbloom (2004) has proposed three philosophies of interdisciplinary curriculum as arguments for and against the practice in schools, particularly in the field of music: The purist philosophy represents the view that music study should never be diluted or devalued by attempting to integrate it with other subjects (Freyberger, 1995; Gee, 2003). There are those in the arts community who feel strongly that integration is unacceptable under any circumstances. According to Reimer (1997) and Rosenbloom (2004), since music is not taught as a way to teach other subjects, in the same manner other subjects are not taught as ways to teach music, and while music can enhance a variety of other values, musical values are what music educators should principally serve.

Literature on the theoretical frameworks of art integrated curricula helps in realizing the various criticisms that have been raised in the field as a means to avoid making certain fundamental mistakes in the study. One other thing that was noteworthy is the fact that even when subjects are integrated throughout lessons, it tends to stop when teachers are preparing students for standardized tests. With this in mind, teacher respondents in the study were made to realize that integration is also useful when preparing student for test and can even be used when conducting a test.

2.4 Importance of the Arts in Education

Several scholars have identified several strong points for art education and the need for art integration. Goldberg (1997) has identified seven reasons for promoting art education. These are:

1. The arts expand expressive outlets and provide a range of learning styles available to children.
2. The arts enable freedom of expression for second language learners.
3. The arts provide a stage for building self-esteem.
4. The arts encourage collaboration and intergroup harmony.
5. The arts empower students and teachers.
6. The arts deepen teachers' awareness of children's abilities and provide alternative methods of assessment.
7. The arts provide authentic cultural voices and complexity to teaching and learning.

Eisner (2004), in writing on the merits of art education, brought out six lessons that education can learn from the arts about the practice of education. The lessons, according to Eisner, are as follows:

1. The arts teach education the ability to compose qualitative relationships that satisfy some purpose.
2. The arts teach education how to formulate aims.
3. The arts teach education that form and content is most often inextricable.
4. The arts teach education that not everything knowable can be articulated in propositional form.
5. The arts teach education the relationship between thinking and the material with which teachers and their students work.
6. The arts teach education motives for engagement.

Eisner (2004) also described the importance of the arts to students. According to Eisner, the arts teach students to act and to judge in the absence of rule, to rely on feel, to pay attention to nuance, to act and appraise the consequences of one's choices and to revise and then to make other choices. Furthermore arts integration supports the development of students' motivations, interests, and pre-service relationships (Mello, 2004).

The arts also contribute to education in at least five key areas. These areas include aesthetic development, socio-emotional development, socio-cultural development, cognitive development and academic achievement (Iwai, 2003). Understanding the importance of the arts and their impacts on the mind and spirit of every child is crucial since they serve as vehicles for development learning for children of all ages and abilities as well as offering essential opportunities for creative expression, problem solving and social development (Potter, 2007 as cited in Adu-Agyem, Enti & Peligah, 2009) Visual art is a link to other subjects as well as a part of everyday life. In art the concept of line, shape, balance, size relationships, measuring, estimation and organization of design are taught. These concepts are directly related to math objectives (Hanson, 2002). According to Hanson, the use of art elements and principles to visually explain an abstract mathematical concept and allowing the student to create a design, gives the student a greater chance of understanding. Art can entice students to read and help access their knowledge of what they read as well as help them remember information.

In determining the importance of arts in education, Wolf (1999) has generated qualitative data from observations, interviews, student ethnographies, and collections of student works in four classrooms, and then asked the teachers to identify evidence of

student learning that was directly related to their students' participation in Creating Original Opera. The Creating Original Opera (COO) project involves the integration of reading, writing, music, and acting. The objective was to find moments of shared problem-solving during the opera work and compare their characteristics with what took place during non-opera classroom interactions (e.g., during a math lesson). From a process of data analysis conducted with the teachers, Wolf (1999) was able to determine that there was more sustained and rational collaboration over time when students were engaged in creating the opera than when working in other aspects of the curriculum. Wolf used analytical tables and verbatim transcripts of classroom dialogue and interview responses to show the specific features of collaborative interactions.

KNUST

2.5 Downsides of Integrated Curriculum

Critics claim there is little evidence that an integrated curriculum is any more effective than a well-prepared traditional curriculum. George (1996) claims that an integrated curriculum does the following :

1. Addresses the real life concerns of students any more than a good traditional curriculum.
2. Presents more opportunities for problem solving.
3. Promotes independent learning by students.
4. Provides more effective involvement with the environment.
5. Provides more opportunities for student involvement in planning the curriculum.
6. Allows teachers more opportunities to be facilitators.
7. Permits learning in greater depths.

8. Permits students to capitalize on prior learning more effectively.
9. Allows for more application of curriculum outcomes.
10. Permits more concrete experiences for slower learners or more enrichment opportunities for able students.
11. Encourages more transfer or retention of learned information.
12. More effectively renews and invigorates career teachers with new experiences.
13. More effectively promotes achievements, personal development or harmonious group citizenship.

KNUST

These following points about interdisciplinary curriculum however make the above points debatable. In defining interdisciplinary approach, Haynes (2002) describes as "inquiries which critically draw upon two or more disciplines and which lead to an integration of disciplinary insights" (p.7). The interdisciplinary approach is also another method of teaching and learning at the primary school. According to Haynes, interdisciplinary approach has become an important and challenging technique in the modern curriculum and because the approach synthesizes more than one discipline and creates teams of teachers and students that enrich the overall educational experience.

Many researchers find many strong points, as well as downsides, of interdisciplinary studies. For example, Boyer and Bishop (2004) conducted a study that highlighted the advantages of the interdisciplinary approach titled "Young Adolescent Voices" in which 77 students from three middle schools were asked what they thought about their interdisciplinary team program. Boyer and Bishop found that interdisciplinary teaming not only had a positive effect on students learning but also inhibited personal growth while students learned tolerance for their peers as well as leadership and

LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TECHNOLOGY
KUMASI

collaboration skills. The study found that the majority of students found the experience beneficial and that the students spoke of long-term relationships and of a democratic learning environment that honored their voices and empowered them as learners.

Often the definition of interdisciplinary approach integrates team-teaching as a technique in which teachers from multiple disciplines work with each other to design a curriculum, instruct the class, and grade teams of students for time periods that can possibly extend to more than one year. Though it seems like a great idea, having more than one instructor can create problems in the sharing of responsibilities. For example team-taught courses that lay a claim to interdisciplinary often fail to achieve their objectives precisely because the individual members of the instructional team themselves never really begin to understand their common concerns in a fashion that may properly be called interdisciplinary (Haynes, 2002). Other downsides of team teaching can be associated with problems such as lack of sufficient time for collaboration work, lack of training in group dynamics, overlapping roles, territorial and status conflicts, and inadequate funding (Haynes, 2002). Although having disadvantages, interdisciplinary team teaching remains a popular approach with many benefits.

Empirical evidence on the benefits of interdisciplinary team teaching includes Podlozny's (2000) research on the effects of drama instruction on students in the United States, the United Kingdom, and Holland. The researcher consulted academic databases and journals from 1965 through 2000 and found about 200 experimental studies, most of which considered the relationship between drama instruction and verbal achievement. Podlozny also conducted seven meta-analyses on 80 of the 200 experimental studies of which 38 were published. She looked at the impact of drama instruction on the following

KNUST
LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TECHNOLOGY
KUMASI

outcomes: oral measures of story understanding, written measures of story understanding, reading achievement, reading readiness, oral language development and improvement, vocabulary development, and writing skills. With the exception of vocabulary development, all the other measures showed, at a minimum, a moderate positive relationship between drama instruction and the desired output. Podlozny theorized that since students are asked to process text more actively in their drama settings, they develop the skills identified above in a more rigorous and active manner. She showed that even on the vocabulary measure, there was some indication that drama instruction had a positive impact. This evidence of the importance of art in education provided support this current study.

2.6 How Arts Can Improve Students Mathematics Performance

Hallman & Price (1998) investigated the effect of background music on behaviour and mathematics achievement of children with emotional and behavioral difficulties. All of the children in the study were between nine and ten years old and attended a school for children with emotional and behavioural difficulties. Hallman and Price found that background music of a "calming nature" significantly improved math performance and significantly decreased rule breaking behaviour of children with emotional and behavioural difficulties. Additionally, the researchers found that the "calming music" had the greatest effect on children who had hyperactive behaviors.

Vaughn (2002) and Catterall, Chapleau, Iwanaga & James (2002) confirmed the findings of Hallman and Price (1998) in multiple studies that found that students who take music classes in high school are more likely to score higher on standardized

mathematics tests such as the SAT. According to Vaughn, musical training in rhythm emphasizes proportion, patterns and ratios that are expressed as mathematical relations. Similarly, Catterall et al (2002) found that students who are consistently involved in orchestra or band during their middle and high school years performed better in math at grade 12. According to Catterall et al the results were even more pronounced with students from low-income families. They authors saw that those who were involved in orchestra or band were more than twice as likely to perform at the highest levels in math as their peers who were not involved in music.

Similarly, Andrea, Nancy & Welch (1995) found that 920 elementary school students in 52 classrooms in Boston, Cambridge and Los Angeles who were given visual and performing arts lessons for three years outscored non-program students, earning significantly higher report card grades in the core subject areas of language arts, math, reading and social studies. However, findings by Fioranelli (2001) and Attwell (1988) do not agree with those of Hallman & Price (1998), Vaughn (2002), Catterall et al (2002) and Andrea et al (1995). Fioranelli's study examined the effect of background classical music on mathematics problem solving skills of third grade students in a computer lab setting. Classical music was played in the background during the treatment group's computer lab sessions, while no music was played during the control group's sessions. Fioranelli (2001) found no significant differences between the mathematics problem solving skills of third grade students who had listened to classical music and those who did not. Attwell (1988) on the other hand, examined the effects of background music with subliminal auditory stimulation on math achievement and attitude of eighth-grade students. In this study a taped subliminal auditory message "Math can be fun and easy"

was embedded in a music ask at 10 decibel below the music level and repeated every ten seconds. Results from the math diagnostic test and attitude scale however, revealed no significant effects of background music on math achievement or attitude of these eighth-grade students.

Ingram & Riedel (2003) also investigated the mathematical performance of kindergarten students after the integration of arts into mathematics teaching. In the research the students engaged in a literature-based, integrated mathematics-arts activity where they explored and discussed lines, rectangles, and squares and then created a piece of abstract artwork in the spirit of Piet Mondrian. Multiple regression analysis indicated a statistically significant relationship between the extent of integration and student gain scores in mathematics for students in grades three, four, and five. In a model that includes other student characteristics that influence learning, for every increase of one level in the extent of integration, the gain score for third grade students increased by 1.15 scale score points. For a teacher that integrates the arts a lot, arts integration was related to a 3.45 scale score point increase on the math test. The district considered scale scores of 10.0-15.0 to be in the one-year gain range for third grade mathematics.

In fourth and fifth grade, every unit increase in teachers' use of arts integration increased students' gain score by 0.52 and 0.71 scale score points, respectively. The district's one-year gain range for the fourth grade was 7.8-11.8, and for fifth grade,it was 6.3- 9.5. Ingram and Riedel (2003) said that by engaging in this literature-based integrated activity, students came to recognize the connections between mathematics and the visual arts, with one student describing that "shapes are in math and art" and another

stating, "Patterns and lines are in both." Further, students experienced how mathematics, and in particular shapes, are everywhere in the world around them.

This is empirical evidence of how the arts had helped in improving students' performance in mathematics served as a basis for this study which uses drawing as a means to find out whether it can improve the mathematical abilities of pupils or not.

2.7 Reasons for the Non-Integration of Visual Arts into Mathematics Curriculum

KNUST

There are several reasons for the non-integration of the visual arts into mathematics curriculum. Hanson (2002) identified at least three primary reasons for this: the lack of academic value placed on visual art instruction; pressure to achieve and maintain higher standardized test scores in core curriculum areas; and the lack of identification and use of multiple talents and skills are the primary reasons for the non-integration of visual arts into mathematics curriculum. This information has direct relevance to this study which sought to use drawing as a tool to mediate the teaching and learning of mathematics in primary school.

2.8 Methods of Mathematics Teaching and Learning in Ghana

Mereku' (2003) study which investigated the congruence between the official teaching methods presented in the Ghanaian primary mathematics curriculum, the use and teachers' classroom practice with regards to mathematics teaching brought to light the fact that only few activities that encourage the use of discovery methods of teaching and learning are included in the syllabus. The inclusion of few drawing activities limits the potential of learning through the visual arts. As a consequence of infrequent use of teaching/learning materials and practical activities in mathematics teaching, the pupils

have little chance of asking questions during lessons. Mereku's study revealed that just about 17% of the 35 teachers sampled provided meaningful answers to pupils' questions mainly because the majority of the teachers hardly engaged their pupils in activities that urged them to ask questions. Though about 70% of the 35 teachers were found to be teaching challenging mathematics topics, as many as 98% of the number relied solely on the examples and exercises recorded in the official textbooks. Mereku also found that the majority of the mathematics teachers studied made their pupils to use only the standard textbook examples irrespective of their abilities.

KNUST

According to Mereku, mathematics lessons in most classrooms visited followed a similar pattern. There was little difference in the sequence of presentation, form of classroom organization and classroom discourse patterns. The sequence of presentation generally followed the pattern that can be described as 'teacher-led' class discussion that used familiar situations and examples, followed by pupils' examples and exercises. The failure of the teachers to use structured teaching materials, practical and game activities while relying solely on textbook routine tasks indicate that the few teachers who attempted to teach for conceptual understanding and application also relied mainly on exposition and did not teach for comprehension or promote discovery learning.

In this study of examining how teaching and learning of mathematics is done in primary schools, Mereku's (2003) provided a model that guided the researcher to isolate the factors relevant and the findings that indicate teacher use of arts integration to promote discovery learning as the primary math syllabus specifies.

2.9 Early Childhood Visual Arts Theory

The overriding paradigm for visual arts education in the early childhood education sector has been one of developmental appropriateness, with an emphasis on process, child self-direction, and the passive role of the teacher (Visser, 2005). This child-centered art theory approach favored giving children unbridled freedom to express their ideas, in a climate where creativity and experimentation are emphasized. Teachers adopt non-intervention roles as facilitators, providing a stimulating environment with adequate and varied art materials, and offering praise for the children's efforts. There is no direction or influence on the children's creative processes (Bamford, 2006; Boughton, 1999). In contrast, children are seen as confident decision makers who use visual arts as a medium for demonstrating their knowledge and expressing their ideas (Eisner & Ecker, 1970; Gunn, 1998).

The writings of John Dewey influenced the practice of visual arts being taught as part of an integrated curriculum rather than a separate discipline in the early childhood field, and this practice continues today. Dewey's belief was that children should be treated as active learners whose creative energies centre on themselves and their world (Chapman, 1978; Gunn 2000). Ballengee-Morris & Stuhr (2001) also believed that visual arts should be taught contextually and not as an isolated subject, in order to provide a more informed understanding of the concerns and issues that are relevant in children's lives. After researching and reviewing various models of visual arts education, such as child-centered art teaching, creative self-expressive art and cognitive art education, Ballengee-Morris & Stuhr (2001) decided that a social reconstructionist multicultural approach with an integrated curriculum was an appropriate teaching and learning strategy

for arts and visual culture education. Education in visual culture involves an awareness of the cultural experiences of the child, as children create art to express things about themselves, their social context, the things that impact upon them and their surroundings (Freedman, 2003). This approach has now overtaken cognitive arts as the dominant prescriptive theory (Bracey, 2003).

2.10 Relationship between Theory and Visual Arts Practice in Early Childhood

Pearson (2001) states that a single theory that will encompass all teaching methodologies in visual arts is unlikely to be offered, and is not needed. Chalmers (2001) declares that, "art education can never be based on only one theory of art" (p. 86). However, Pearson (2001) also argues that teachers need a better understanding of the theoretical tools they use to be able to use them more skillfully. According to Bracey (2003), if teachers are unclear about the theory that illuminates their practice, they can have little hope of understanding how they might change their practice for the better. More importantly, if they have no grasp of what counts as an epistemology of art, there can be no certainty that what they offer young people is, indeed, knowledge to do with art.

Early childhood education cannot be avoided when developing curriculum for children in this case primary school children. These sources proved useful in that it informed me as to the kind of drawing activities to use when developing the art interventions.

2.11 Multiple Intelligences

Howard Gardner represents those theorists who have dismissed the idea of one type of intelligence as typically measured by today's psychometric instruments. He posits that there are seven (later eight) types of intelligences (Gardner, 1993):

1. Linguistic intelligence
2. Logical-mathematical intelligence
3. Spatial intelligence or the ability to form a mental model of the spatial world and to maneuver within it using this model.
4. Musical intelligence.
5. Bodily-kinesthetic intelligence or the ability to solve problems using one's body as performed by athletes, dancers and other crafts people.
6. Interpersonal intelligence or the ability to understand other people.
7. Intrapersonal intelligence or the ability to understand one's self.

Gardner (1993) maintains that the first two are the types of intelligence commonly measured by IQ tests, and which are commonly accepted as "intelligence." Gardner later added an eighth intelligence to his taxonomy, Naturalist Intelligence, which he defined as "expertise in the recognition and classification of the numerous species - the flora and fauna - of his or her environment" and also a ninth intelligence which he called existentialist intelligence (Gardner, 1999, p. 48). Sternberg's Triarchic Theory (Li 1996) can be viewed as an interpretation of intelligence as information processing provides us with a useful summary of Sternberg's theory. He tells us that: "In Sternberg's general theory, there are three sub theories: the componential sub theory, the experiential sub theory and the contextual sub theory, each divided into sub domains of concern. The

contextual sub theory deals with the context of intelligence. Intelligence in the real world requires adaptation, selection, and/or shaping the environment. Measurement of contextual intelligence would relate to the issue of social perception, culture fairness, and cultural relativeness. The experiential sub theory deals with the issue of novelty and automatizing of processing. It is related to the notion of learning and the dynamic interplay between controlled and automated processing in the competition for cognitive resources. Finally, there is the componential sub theory, which is subdivided into (a) meta components, (b) performance components, and (c) knowledge acquisition components, which are directly related to learning" (p. 38)

Since 1983, when Howard Gardner published *Frames of Mind,* multiple intelligences theory has been embraced by educators as a tool for understanding and effectively meeting the learning needs of their students (Armstrong, 1993 & 1994). Gardner's MI Theory has also been applied to foreign language teaching and learning by many scholars including Berman (1998) and Tanner (2001).

2.12 Using Multiple Intelligences in the Classroom

Accepting Gardner's (1999) Theory of Multiple Intelligences has several implications for teachers in terms of classroom instruction. The theory states that all seven intelligences are needed to productively function in society. Educators, therefore, should think of all intelligences as equally important. This is in great contrast to traditional education systems, which typically place a greater emphasis on the development and use of verbal and mathematical intelligences. Thus, the Theory of Multiple Intelligences implies that educators should recognize and teach to a broader range of talents and skills.

A second implication is that teachers should structure the presentation of material in a style that engages most or all of the intelligences. For example, when teaching about the revolutionary war, a teacher can show students battle maps, play revolutionary war songs, organize a role play of the signing of the Declaration of Independence, and have the students read a novel about life during that period. This kind of presentation not only excites students about learning, but it also allows a teacher to reinforce the same material in a variety of ways. By activating a wide assortment of intelligences, teaching in this manner can facilitate a deeper understanding of the subject material.

Everyone is born possessing the seven intelligences. Nevertheless, all students will come into the classroom with different sets of developed intelligences. This means that each child will have his own unique set of intellectual strengths and weaknesses. These sets determine how easy or difficult it is for a student to learn information when it is presented in a particular manner. This is commonly referred to as a learning style. Many learning styles can be found within one classroom. Therefore, it is impossible, as well as impractical, for a teacher to accommodate every lesson to all of the learning styles found within the classroom. Nevertheless the teacher can show students how to use their more developed intelligences to assist in the understanding of a subject which normally employs their weaker intelligences (Lazear, 1992). For example, the teacher can suggest that an especially musically intelligent child learn about the revolutionary war by making up a song about what happened.

According to Lazear (1992) since all children do not learn in the same way, they cannot be assessed in the same way. Therefore, it is important that an educator create an "intelligence profiles" for each student. Knowing how each student learns will allow the

teacher to properly assess the child's progress. This individualized evaluation practice will allow a teacher to make more informed decisions on what to teach and how to present information.

Traditional tests (such as multiple choice, short answer and essay) require students to demonstrate their knowledge in a predetermined manner. Supporters of Gardner's theory claim that a better approach to assessment is to allow students to explain the material in their own ways using the different intelligences. Preferred assessment methods include student portfolios, independent projects, student journals, and assigning creative tasks (Lazear, 1992).

Reviewing studies on multiple intelligences made me realized that when various intelligences are considered when planning lessons and test, the student who might be considered daft can perform better. This knowledge proved very helpful when preparing the post test for the experimental group.

2.13 Learning

According to Farrant (1996) learning is the process by which we acquire and retain attitudes, knowledge, understanding, skills and capabilities that cannot be attributed to inherited behaviour patterns or physical growth. To Farrant, capacity for learning is innate and is based on psychological factors whiles rate of learning is based on both inherited and environmental factors. In contrasts to this assertion, Skinner (as cited in Farrant, 1996) opines that learning is seen as a series of experiences, each of which influences behaviour. Learning results should therefore be considered in terms of understanding the core processes within the content standards.

2.14 Learning Theories

Learning theories address key questions, for example, how does learning happen? How does motivation occur? What influences students' development? According to Wiki books (2006) there are at least four theories about learning. These include Behavioralist, Constructivist, Post-modern and Experiential Learning Theories.

2.14.1 Behaviorism

KNUST

Behaviorism comprises several individual theories that have a common theme functioning within them. This common theme is found in the ways which the theorists define what learning is, and how it is accomplished. The common assumptions of these theorists are threefold (Merriam & Caffarella, 1999). The first emphasizes that observable behaviour rather than internal thought processes create learning. Second says it is the environment that creates learning and determines what is learned, not the individual learner. The third says learning is the ability to understand the overall process, and the ability to repeat or reinforce that process (Merriam & Caffarella, 1999). This theory is most commonly seen in adult learning when organizations take repeatable training steps and systematize them into manageable tasks.

The hypothesis behind behaviouralist learning theory is that all learning occurs when behaviour is influenced and changed by external factors (Merriam & Caffarella, 1999). Behaviouralism disregards any notion that there may be an internal component to man's learning. Grippin and Peters (1984) emphasize that "*contiguity*...and *reinforcement* are central to explaining the learning process" (Merriam & Caffarella, 1999, p. 251) in regard to an individual's subjugation to external stimulus as a

determinant of response (i.e., behavior). Contiguity is understood as the timing of events that is necessary to bring about behavioral change, while reinforcement refers to the probability that repeated positive or negative events will produce an anticipated change in behavior (Merriam & Caffarella, 1999).

However, the theory has been criticized as being overly simplistic. Behaviorist theory presents learning in short manageable blocks that build on previously learned behaviors. Kearsley (1994) identified three fundamental principles common in behaviorist learning:

KNUST

1. Positive reinforcement of the desired behavior will most likely prompt the same behavior.
2. Learning should be presented in small manageable blocks.
3. Stimulus generalization of learning can produce secondary conditioning.

While it is true that behaviorist theories can be simplistic in their concept, their application to the human has allowed for much to be discovered about learning, memory and even neuroscience. Since the late 1800's, psychologists using behavioral principles have established hundreds of tests to identify both how learning and memory occur in varying complexities of brain structures. Across many species, for example, it has been shown that when the reinforcing agent is "painless" then learning occurs in the cerebellum. However if there is an emotional connection (particularly negative such as fear) to the reinforcer then learning and memory occur in the amygdale (Kolb & Whishaw, 2005)

2.14.2 Constructivism

Constructivism is a synthesis of multiple theories diffused into one form. It is the assimilation of both behaviorialist and cognitive ideals. The "constructivist stance maintains that learning is a process of constructing meaning; it is how people make sense of their experience" (Merriam & Caffarella, 1999, p. 260). This is a combination effect of using a person's cognitive abilities and insight to understand their environment. This coincides especially well with current adult learning theory. This concept is easily translated into a self-directed learning style, where the individual has the ability to take in all the information and the environment of a problem and learn.

Although varying constructivist theories exist, there is agreement between the theories "that learning is a process of constructing meaning; it is how people make sense of their experience" (Merriam & Caffaerall, 1999, p. 261). Two viewpoints of constructivist theories exist. They include the individual constructivist view and the social constructivist view. The individualist constructivist view understands learning to be an intrinsically personal process whereby "meaning is made by the individual and is dependent upon the individual's previous and current knowledge structure" (p. 261) and as a result can be considered an "internal cognitive activity" (p. 262). The social constructivist view, however, premises that learning is constructed through social interaction and discourse and is considered, according to Drivers (1994), to be a process in which meaning is made dialogically (Merriam & Caffaerall, 1999).

Reviewing constructivist learning theory is very helpful in that the study seek to design mathematics teaching model that will lead to discovery learning which is based on the constructivist point of view.

2.14.3 Post-modernism

Post-modernism differs from most approaches to learning in two fundamental ways. The first is that rationality and logic are not important to attaining knowledge. The second is that knowledge can be contradictory. Because of the contextual nature of knowledge, individuals can hold two completely incongruent views of one subject at the same time (Kilgore, 2001).

KNUST

Post-modernism relates to post-industrialism. The industrial era came about as a result of Newtonian thinking – an era wherein thought and processes were considered in mechanistic terms of efficiency and effectiveness and understood scientifically through the processes of reductionism (the simplification of the complex into understandable and at times overly simplistic terms). The learning gleaned from the industrial (modern) era laid a foundation for the world to add new knowledge through a new era - what is now termed as the "post-modern" era. Presently, several post-modern theories exist, but at the core of each of these theories is the basic concept that what was once only understood within the context of reductionism is now beginning to be understood within the context of interrelatedness - an understanding that "things are much more diverse, fluid, illusionary, and contested, including the reality of the world itself" (Merriam & Caffarella, 1999, p. 356) than originally thought.

Though truth is central to postmodern thinking, it is not the search for truth that is valued. In contrast, the postmodern mind challenges what is accepted truth. According to Astley (1985) and Gergen (1992), as cited in Dierkes et. al. (2003), postmodernists challenge "the conventional wisdom, routines, static meanings, and axioms of 'normal'

science, thereby exposing knowledge to non-dogmatic forms of thought" (p. 44). One can see how this philosophy has become embraced in academia and one could argue that it is the primary modus operandi in many institutions of higher learning, especially in philosophy and the humanities.

The postmodern approach to learning is founded upon the assert that there is not one kind of learner, not one particular goal for learning, not one way in which learning takes place, nor one particular environment where learning occurs (Kilgore, 2001). Kilgore makes several assertions about the postmodern view of knowledge:

1. Knowledge is tentative, fragmented, multifaceted and not necessarily rational.
2. Knowledge is socially constructed and takes form in the eyes of the knower.
3. Knowledge is contextual rather than "out there" waiting to be discovered.

Hence, knowledge can shift as quickly as the context shifts, the perspective of the knower shifts, or as events overtake us.

Deconstruction is a powerful postmodern tool for questioning prevailing representations of learners and learning. According to Kilgore (2001), the purpose of deconstruction is to identify and discredit the false binaries that structure a communication or "discourse"; that is, to challenge the assertions of what is to be included or excluded as normal, right, or good. In postmodernism there are no universal norms or "truth" on which to judge the validity of any message of knowledge; rather the postmodernist works toward a continuous construction of truth as multiple alternatives are included in the body of known information.

LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TECHNOLOGY
KUMASI

The postmodernism approach to learning is relevant to this study because it allows for varied learning styles, and also takes into consideration the varying learning abilities of a learner.

2.14.4 Experiential Learning Theory

Experiential Learning Theory emphasizes the role that true experiences play in the learning process. It is this emphasis that distinguishes itself from other learning theories. Cognitive learning theories emphasize cognition over affect and behavioral learning theories deny any role for subjective experience in the learning process.

KNUST

Scholars in the field of education have two contrasting views when it comes to the concept of experiential learning. The first view defines experiential learning as a sort of learning which enables students to apply newly acquired knowledge in a relevant setting. The relevant setting can be a sponsored institution of learning with trainers, instructors, teachers, or professors to guide the lesson. The other school of thought defines experiential learning as "education that occurs as a direct participation in the events of life" (Houle, 1980, p. 221). Thus, learning is not achieved in a formal setting, but in the practice of reflection of daily experiences. Kolb furthers the second definition of experiential learning by developing a model which details learning process through experiences. Kolb & Fry's (1975) experiential learning model is a continuous spiral process which consists of four basic elements:

1. Concrete experience
2. Observation and reflection
3. Forming abstract concepts

4. Testing in new situations

Immediate or concrete experiences are the basis for observation and reflections. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn (Kolb & Fry, 1975).

2.15 Approaches to Learning and Studying

Biggs (1987) has categorized different approaches to learning. Biggs' research views learning as having five levels, three of which indicate a surface approach to learning:

- An increase in knowledge
- Memorizing
- The acquisition of procedures

and two which indicate a deep approach to learning:

- The abstraction of meaning
- Understanding reality

Students who adopt a deep approach to learning are interested in learning for its own sake, they want to understand ideas for themselves and learn by *transforming*. They tend to:

- Relate ideas to previous knowledge and experience
- Look for patterns and underlying principles
- Be actively involved and interested in course content
- Adopt an evidence based approach
- Critically examine arguments

KNUST
LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TECHNOLOGY
KUMASI

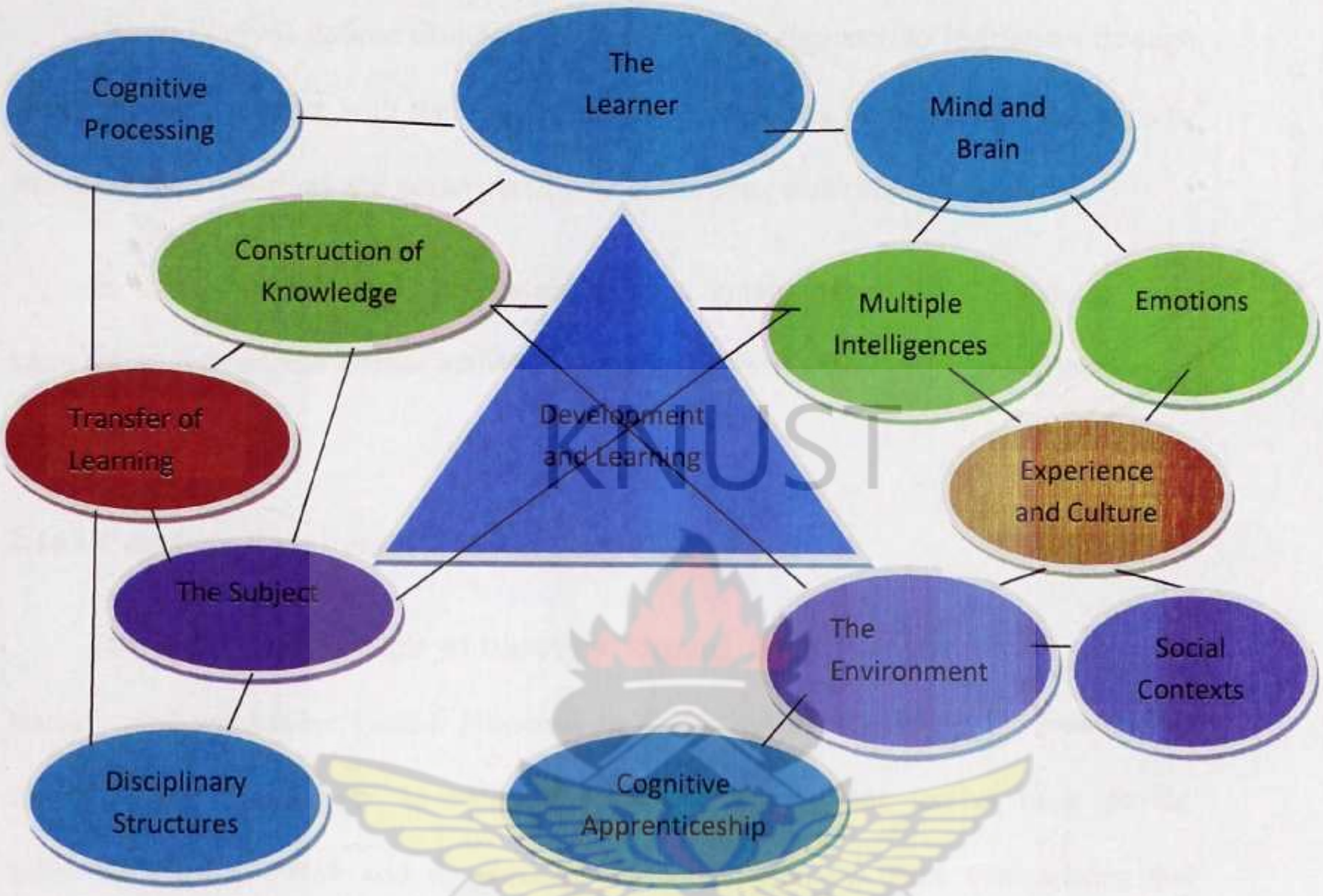
Students who adopt a surface approach to learning often want merely to get through a course and learn by reproducing. They tend to:

- Study without reflecting on purpose or strategy
- Memorize facts and procedures by rote
- Treat the course as unrelated sets of knowledge
- Have difficulty in making sense of new ideas and concepts
- Feel pressured about the amount of work involved

KNUST

Theories are interconnected. Various theories describe different, interrelated parts of a more comprehensive learning process. Figure 2.1 is a visual that illustrates some of the ways in which learning theories are related.

Figure 2.1: Interconnectedness of Learning Theories



Source: Austin, Hammond, Orcutt & Rosso, 2001

Learning theories cannot be overlooked in education. The various sources reviewed made me aware of external factors that can affect learning. This drew my attention on how the drawing activities helped the respondents in the study who were likely affected by external factors.

2.16 Discovery Learning

Ormrod (1995) defines discovery learning as, "an approach to instruction through which students interact with their environment by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments".

In discovery learning, the learner not an empty vessel into which to pour knowledge. Instead, the learner actively explores problems, discovering the principles or concepts to be learned.

KNUST

2.16.1 Cognitive Requirements of Discovery Learning

The underlying principle of discovery learning is that learning occurs when the learner must use his/her mental processes to figure out or "discover" the meaning of something for him/herself. In order to achieve discovery, the learner must do the following (Hood, 1996): add up observations and inferences, make comparisons and interpret data.

Through these cognitive actions, the learner creates a new insight he/she did not have before (Hood, 1996). Defined in this way, we can easily classify discovery learning as a constructivist approach.

2.16.2 Types of Discovery Learning

Hood (1996) presents the following three types of discovery learning:

- Free: The learner is the source of the question or problem as well as the source of the solution.

LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TECHNOLOGY
KUMASI

- Modified: The teacher is the source of the questionor problem, but the student is the source of the solution.
- Guided: The teacher is the source of the questionor problem as well as the source of the solution (e.g., provides a path to follow).

2.16.3 Strengths and Weaknesses of Discovery Learning

Discovery learning offers the following key strengths:

- Engages and motivates the learner.
- Makes the learner an active participant in the learning process.
- Promotes life-long learning.
- Builds on existing knowledge base.

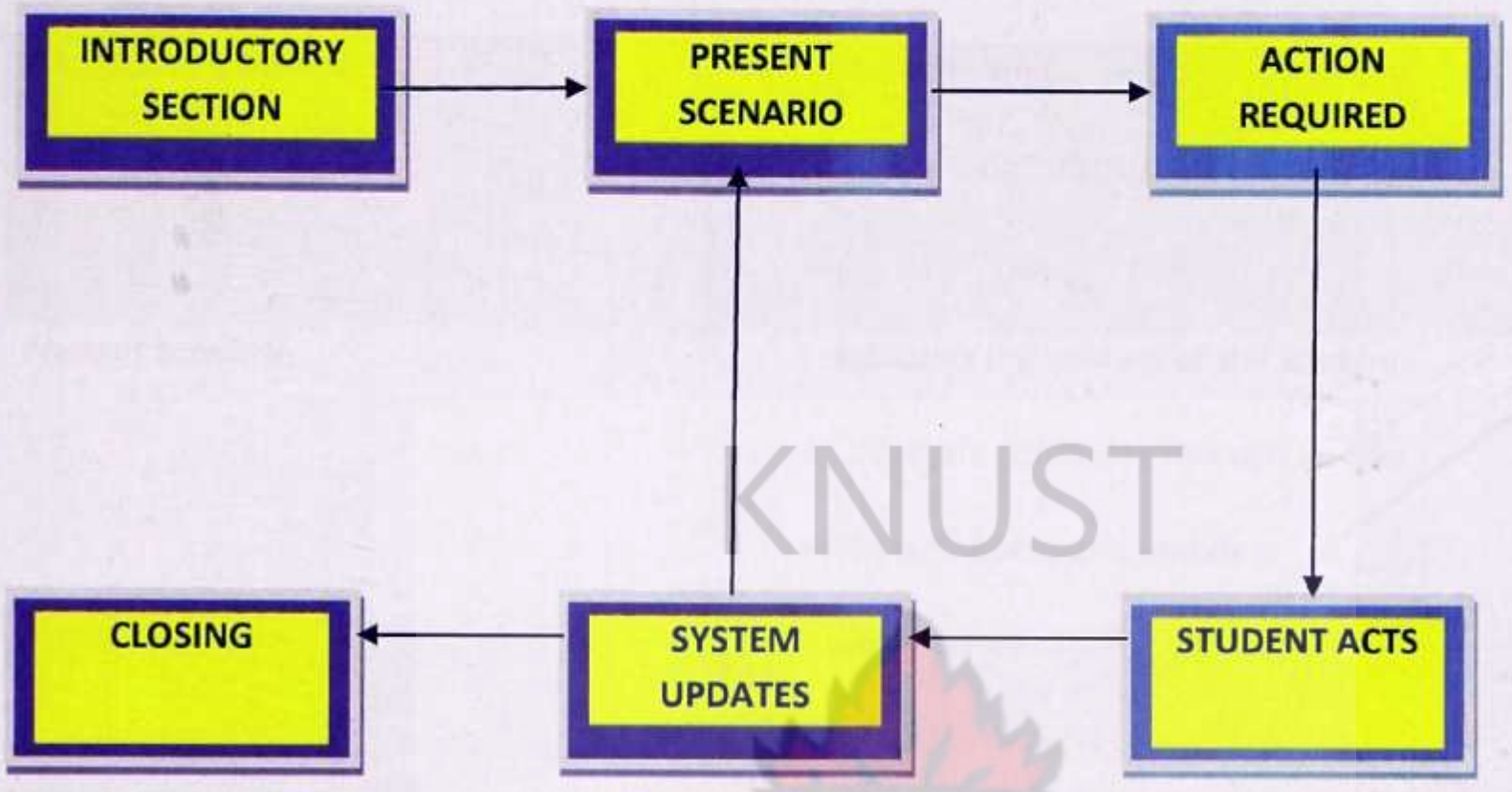
The following weaknesses should be considered when using discovery learning:

- May confuse the learner if no initial framework or guidance is available
- Is not best approach for some situations (e.g., high-risk tasks in a non-simulation environment) - In such cases, expository and/or modelling with guided practice approaches would be more appropriate.

KNUST

2.16.4 A Model of Discovery Learning

Figure 2.2: Model of Discovery Learning



Source: Thomas & Switzer, 2001

KNUST

Table 2.1: Explanation of Discovery Learning Model

ELEMENT	DESCRIPTION
Introductory Section	Introduces the simulation by providing objectives, directions/instructions, and Scenario opening.
Present Scenario	Establishes the context of the scenario. As the cycle continues through learner Actions, the scenario updates.
Action Required	Based on the scenario, the learner is required to make a choice, react to an event, manipulate an object, or seek more Information.
Student Acts	The learner performs the required action.
System Updates	After completing an action, the learner typically receives some level of feedback. The system update typically has an effect On the scenario.
Closing	Provides a summary and typically an opportunity to try the simulation again. If used as an assessment, a summative feedback message is typically provided here.

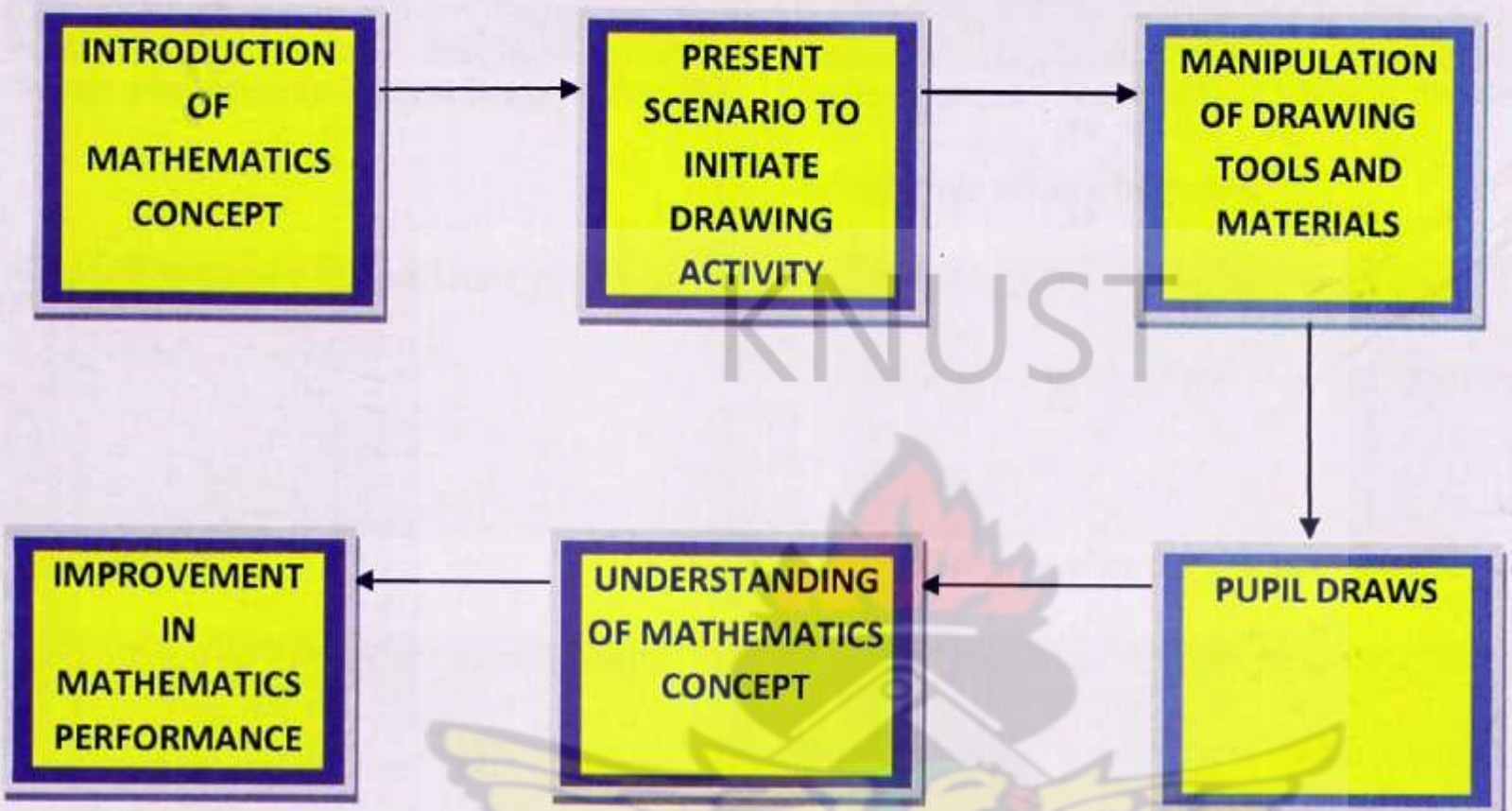
Source: (Thomas & Switzer, 2001)

KNUST
LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TECHNOLOGY
KUMASI

2.16.5 Adapted Model For Mathematics Teaching and Learning

The model in figure 2.2 was adopted and modified as is seen in figure 2.3 for the study.

Figure 2.3: Model for Mathematics Teaching and Learning



Source: Adapted from (Thomas & Switzer, 2001)

KNUST

Table 2.2 Explanation of Adapted Model for Mathematics Teaching and Learning

ELEMENT	DESCRIPTION
Introduction of Mathematics Concept	Teacher Introduces the mathematics concept to be taught.
Present Scenario to Initiate Drawing Activity	Teacher poses a scenario that initiates thinking or cognitive actions by pupils.
Manipulation of Drawing Tools and Materials	Pupils make their own choice of tools and materials to be used for the drawing. Example is choice of color.
Pupil Draws	The pupil draws what the teacher instructs.
Understanding of Mathematics Concept	The pupil drawing what the teacher instructed leads to the understanding of mathematics concept by pupil.
Improvement in Mathematics Performance	The pupil mathematics performance improves as a result of engaging in the discovery learning process.

Source: Adapted from Thomas & Switzer, 2001

KNUST
W J SANE NO BADWENMA

2.17 Summary and Conclusion

The reviewed literature revealed that the use of art, in this case drawings to teach mathematics has not been replicated in the local setting at Ayigya M/A Primary School. The study was conducted to fill this gap in knowledge.

Reviewing the methods of mathematics teaching in Ghana provided empirical evidence of what exist in Ghanaian clasroom with respect to mathematics teaching as compared to what the syllabus advocates. This knowledge informed the development of a model that will bridge the gap between what the syllabus advocates and what actually goes on in the classroom.

Literature reviewed in the field of integrated curricula provided a basis for this research in that, it highlighted the strong points and downsides in designing and implementing an integrated art curricula.

The various learning theories reviewed informed this study as to which theory will be applicable in designing a teaching model of mathematics that will take into consideration the multilple intelligences in the Ghanaian classroom as well as lead to discovery learning. Discovery learning is the main goal of the Ghanaian primary school mathematics syllabus.

In conclusion, literature cited attest to the fact that the arts are very useful to education by establishing a relationship between thinking and the material with which teachers and their students work. This knowledge can be capitalized by professionals in curriculum research and development.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter discusses the research method used in finding out whether the use of drawings can increase pupil learning in mathematics. It brings to light in details the research approach, research design, sampling and sampling technique, the primary and secondary data, data collection instruments, administration of instruments, data collection procedures and data analysis plan.

KNUST

3.2 Research Design

In research, studies are done using different paradigms. The main paradigms are quantitative and qualitative (Leedy & Ormrod, 2005). According to Given (2008) , qualitative methods are best for addressing many of the *why* questions that researchers have in mind when they develop their projects. Whereas quantitative approaches are appropriate for examining *who* has engaged in behaviour or *what* has happened and while experiments can test particular interventions, these techniques are not designed to explain why certain behaviours occur. Qualitative approaches are typically used to explore new phenomena and to capture individuals' thoughts, feelings, or interpretations of meaning and process. It is the search for qualities, the very characteristics of our experience in a particular study (Stokrocki,1997). Thus qualitative inquiry looks at the quality of a particular activity whereas quantitative inquiry looks at how often it occurs. The study

employed the Quasi-Experimental and Action Research methods under both quantitative and qualitative paradigms of research design.

3.3 Quasi-experimental

The Quasi-Experimental research is a combination of qualitative and quantitative methods of inquiry. The qualitative method provides a holistic description of the phenomena under study. The quantitative on the other hand quantifies data and converts it to numerical scores. It also allows for the generalization and answering of research questions (Fraenkel & Wallen, 2009). Stokrocki (1997) describes qualitative method of inquiry as a systematic process of describing, analyzing and interpreting insights discovered in everyday life.

Although both qualitative and quantitative methods of research begins with empirical observation of a phenomenon and its characteristics, the former focuses on directly observed comparison resulting in new insights and reclassifications whereas the latter focuses on strict numerical comparison and classification (Stokrocki,1997). This means that using mixed method of both qualitative and quantitative paradigms of research enriches the study with strengths from both sides. According Fraenkel & Wallen (2009), mixed method of qualitative and quantitative research methods helps with the clarification and explanation of relationships found to exist between variables. It also helps with the in-depth exploration of relationships between variables. It also helps to confirm or cross validate relationships between variables. In view of these benefits, Quasi-Experimental method of research was adopted for this study to help clarify and provide in-depth explanations of variations between variables of the experimental group

and the control group. It also provided a form of triangulation to verify variations that exist between the experimental group and the control group.

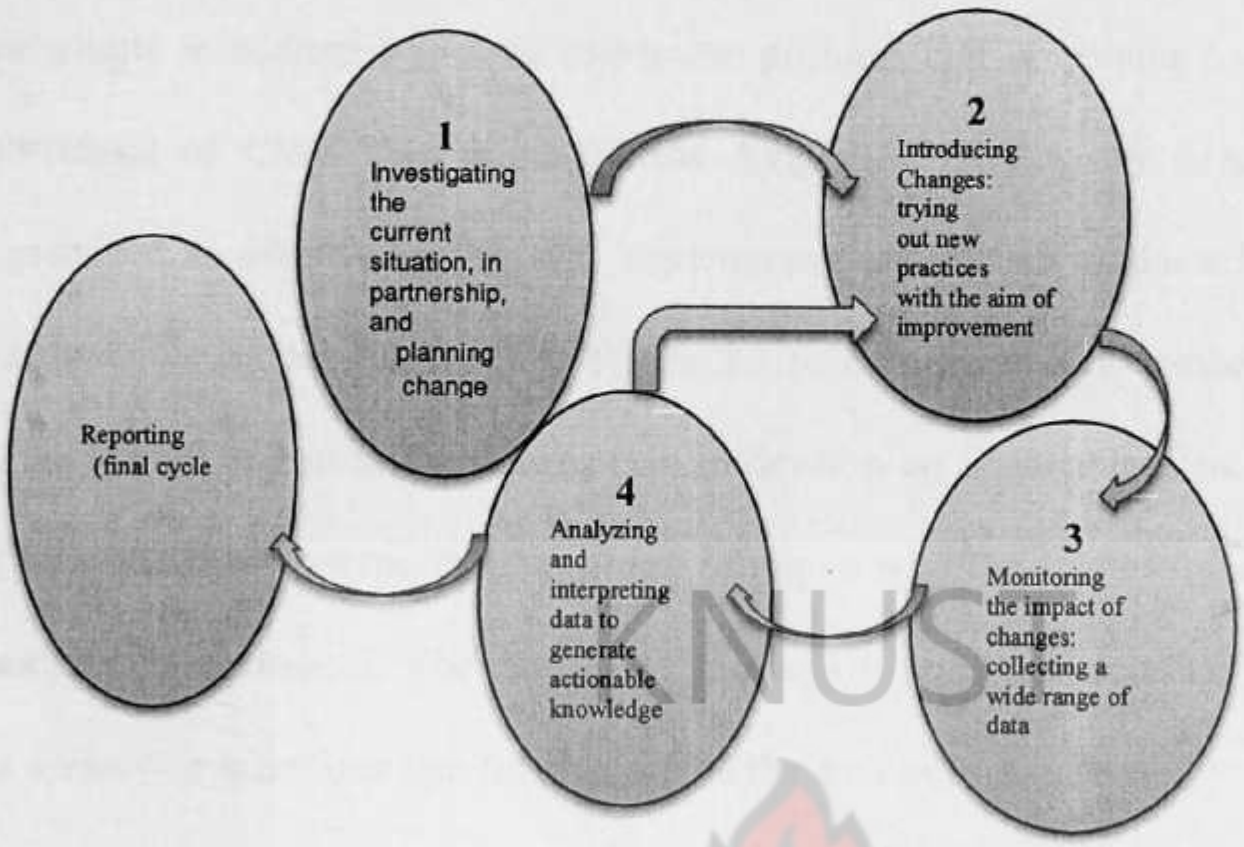
3.3.1 Action Research

Given (2008) describes "action research" as a flexible but unique research method suited to researching and supporting change. Fraenkel & Wallen (2009) explain that the aim of an "action research" is to solve some kind of day-to-day immediate problem or gather information in order to inform local practice and it is done by one or more individuals or groups. Fraenkel & Wallen (2009) however, caution 'such studies, taken individually, are seriously limited in *generalizability*', this can however, be done if such studies are replicated by others using samples of similar characteristics. In view of this caution, the study was conducted by the researcher with the aid of the class teacher of the experimental group for the first term. The teacher then replicated the study by using the mathematics teaching model proposed by the researcher to teach mathematics during the subsequent terms using the same sample.

Given (2008) provides a model for Action Research (Fig.3.1) which is described as a cycle.

KNUST

Figure 3.1: Model for Action Plan



Source: Given, 2008

Fraenkel & Wallen (2009), categorize action research into two main types, namely Practical Action Research and Participatory Action Research. The former is intended to address a specific problem within a classroom, school, or other "community." It can be done in a variety of settings, such as educational, social service, or business locations. Its focus is to improve practice in the short term by providing an action plan that, ideally, will be implemented and further evaluated as well as to inform larger issues. The latter, which is also known as collaborative research, resolves specific problems. It encourages consensual, democratic, and participatory strategies to encourage people to examine reflectively problems affecting them. Further, it encourages people to formulate accounts and explanations of their situation, and to develop plans that may resolve these problems'.

The practical Action Research method was adopted for this study since the researcher sought to address a specific classroom problem that is, helping to resolve the low performance of Class Two pupils of the Ayigya M /A Primary School A. The research provided an action plan that was implemented and further evaluated. The study employed the cycle model described in Figure 3.1 to investigate how mathematics was taught in the school and used the information to develop an actionable plan. The action plan was introduced to an experimental group of pupils with the aim of improving their performance in mathematics. The impact of the action plan was carefully monitored through a series of evaluations that formed part of the data collection strategy.

KNUST

3.4 Population for the Study

The target population for this research was the staff and pupils of the lower primary classes in KNUST Primary School and the Ayigya M/A Primary School. Upon knowing that the average pupil at the KNUST lower primary scored 73.7% in mathematics, the researcher realized that the impact of the study would not be fully appreciated; the focus then shifted to the staff and pupils of the Ayigya M/A Primary School.

Ayigya M/A Primary School has one set of buildings, it operates as two schools with A and B streams with separate staff and pupils. The target population for the study was assessed to be 1145 pupils (545 pupils for School A and 600 pupils for School B), 36 teachers (18 teachers for each school), and two head teachers (one for each school). This population was clearly unreachable considering the limited academic period allowed for the study and therefore required a sampling that could yield a sample to represent the whole population. Using School A, the accessible population became the pupils and

teachers of Ayigya M/A Primary School A with 545 pupils, 18 teachers and one head teacher.

3.5 Sampling

The population of a study can affect its generalizability. The more narrow the population, the more limited its generalizability even though it saves time, effort, and probably money. However, if the study can be replicated, then it can be generalized (Fraenkel & Wallen, 2009). In order to work within the time frame for the study, only the Classes 2A and 2B teachers, head teacher and pupils of Ayigya M /A Primary School A who attended school and participated in classwork during the period of the study constituted the resulting sample. This made the sample narrower, which might have affected the credibility of the generalizability of the study. However, this problem was eliminated when the class teacher replicated the study by using drawings to explain mathematics concept during class exercises.

3.6 Sampling Techniques

The researcher adopted the non-probability sampling technique of qualitative research approach in selecting the sample for the study. According to Given (2008), participants in this technique of sampling are selected because they meet pre-established criteria. The purposive and convenience sampling of non-probability sampling techniques were used in the selection process. The purposive sampling technique ensured that participants recruited comprised only Class 2 pupils of the selected school who needed to improve their performance in mathematics. The convenience sampling technique employed was based on the criterion that participants were accessible throughout the

period of study and thus could be easily recruited. The population of Ayigya M/A Primary School A as the sampled school offered readily accessible pupils in terms of its close proximity to KNUST, the research base, and the fact, that the performance of the pupils in mathematics was low enough to merit being used as the subjects of the study.

3.7 The Sample

The sample selected for in-depth study comprised the two Class Two (A and B) pupils and the teachers of the Ayigya M/A Primary School. The study participants consisted of 62 pupils and seven teachers. The control group had 28 pupils with a class teacher and the experimental group comprised 34 pupils with a different class teacher. The other five teachers were interviewed for in-depth information on the teaching and learning of mathematics in the school.

3.8 Primary and Secondary Data

Primary data was collected from field notes recorded through observation of how teaching and learning of mathematics was done in the sampled school. Secondary data was collected from records of the pupils' continuous assessment, school records, books and official documents.

3.9 Data Collection Instruments

Considering the research approach, the study employed the use of interviews, observation, achievement test, and attitude scale to obtain data for the study.

3.9.1 Interviews

In Action research, interviews tend to be less formal and often a bit more unstructured (Fraenkel & Wallen, 2009). In the light of this, the study adopted the informal type of interview to get a holistic view of how teaching and learning of mathematics was being done in the sampled school. It also offered the researcher an opportunity to get the views of teachers as well as pupils with regard to the drawing activities that were introduced as an intervention to help the pupils improve upon their performance. The unstructured form of interview made participants feel comfortable and free to express themselves. An interview guide was used (refer to Appendix E) to ensure that the right questions were asked of all the interviewees in the same order.

3.9.2 Observation

The researcher employed both the participant and the non-participant forms of observation. To gain insight into how teaching and learning of mathematics was being done at the school, the researcher took on the role of observer-as-participant under non-participant method of observation. That is, the researcher sat on the sidelines and made herself known to the class under observation but did not participate in the class activities (Fraenkel & Wallen, 2009). Six visits of 30 to 45 minutes per visit were made to the school for a period of two weeks.

In implementing the intervention, the overt role of participant observation was used. Here the pupils being studied were made aware of the researcher's presence in the school and her participation in the class activities (Fraenkel & Wallen, 2009). The researcher participated in the classroom activities by implementing the intervention with

the class teacher. This was done three times a week with each session lasting one and a-half to two hours in each case.

3.9.3 Achievement Test

Achievement test can be used as a means to measure an individual's knowledge in a given area or subject as well as learning or the effectiveness of instruction (Fraenkel & Wallen, 2009). Achievement test was used to measure the performance of the sampled pupils in mathematics before, during and after the intervention. The results from these tests were analyzed to measure the effectiveness of the interventional instruction administered to the pupils.

KNUST

3.9.4 Pictorial Likert Scale

Attitude is an important concept that is often used to understand and predict people's reaction to an object or change and how behaviour can be influenced (Page-Bucci, 2003). To understand the pupils' reaction or feelings toward the intervention, the Pictorial Likert scale (refer to Appendix D) was used by the researcher. The Pictorial Likert scale uses pictures in place of text in communicating levels of choice, with the most common set of pictures being the smiley face (Reynolds-keefer, Johnson, Dickenson, & Mcfadden, 2009).

3.10 Administration of Research Instruments/Tools

A preliminary study was conducted at the KNUST Primary school and the Ayigya M/A Primary before the actual research. Having sought permission from the heads of the two schools, interview schedules were prepared to find out the validity of the interview

guide to the study. On agreed dates, teachers of the lower primary classes in both schools were interviewed on the general performance of pupils in mathematics. An achievement test was also conducted in Class 2 of the B stream of the Ayigya M/A Primary School to check its appropriateness. The assessment record cards were also critically studied which enabled the researcher gain insight into the pupils' general performance in mathematics in KNUST Primary School which showed a high performance mark of 73.7 %, implying that pupils in this school were already doing well and would not reflect the impact of the study. The focus then shifted to Ayigya M/A Primary School where the pupils' average performance of mathematics was 50.5%.

KNUST

3.11 Ethical Consideration

As Given (2008) states, 'ethics in qualitative research which is currently often associated only with the relationship of researchers to those they study, is an integral aspect of all decision making in research, from problem formulation to presentation of results. The issue of ethics was carefully considered as much as possible so as not to infringe on the rights of participants in the study. This was done by according participants the needed respect throughout the study. In showing respect to participants, the researcher did not become judgmental or complacent.

To ensure that the ethical integrity of this study was not compromised, an introductory letter from the Head of the Department of General Art Studies, KNUST (refer to Appendix A) was given to the heads of the participating schools to introduce the researcher and also to request their assistance to help the researcher solicit the required data. The Head teachers communicated this information to the various classes and their

teachers. The intent of the study was made known to the participants in detail before commencement. This paved the way for the researcher to embark on the study in the school while acting as an assistant to the sampled class teachers. The teachers and pupils were by no means inconvenienced as they allowed the researcher to observe, interview, conduct a test as well as teach them during the intervention project. The researcher interacted freely with the staff during observation and interview in order to make it as natural as possible.

Data collected from the school records with regards to mathematics achievement were treated as confidential data and the participants were assured of anonymity with regards to the information given even though the thesis will eventually become a public reference material. The school was assured receipt of a copy of the final report on the study so as to work on areas where they were deficient.

3.12 Data Analysis Plan

SPSS statistical analysis software as well as Microsoft Office Excel was used to arrive at a comparative analysis of the results from the achievement test. The SPSS was used to generate percentages from the results as well as find correlation between the variables studied to show the strength and weakness of the intervention. Microsoft Office Excel was then used to generate charts and tables representing these percentages. In using comparative analysis, field notes taken from the classroom observation of how teaching and learning were done were transcribed into reports and compared to details documented literature sourced. The results from the achievement test of both groups as well as their

general behaviour were also interpreted by making detailed comparison. Details of these are presented in Chapter 4.

KNUST

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF MAIN FINDINGS

4.1 Overview

This chapter describes the procedure adopted for analyzing data collected through interviews, observations, achievement test and attitude scale on how teaching and learning of mathematics is done at the Ayigya M/A Primary School and how a drawing intervention was implemented in the teaching and learning process. It also gives a detailed comparison of achievement test results for the experimental group and the control group studied.

4.2 Education in Ghana

Education in Ghana occurs at Basic, Secondary and Tertiary levels. There are 10,768 Junior High Schools, both private and public, and 704 Senior High Schools. Most Senior High Schools in Ghana are public (EMIS, 2010). Basic education begins with a two-year kindergarten education, followed by a six-year primary, and three year junior high school education. Junior High School terminates with the pupils writing the Basic Education Certificate Examination (BECE), which qualifies them continue their education in Senior High Schools. Gaining entry into tertiary institutions requires the completion of senior high education by writing and passing the West African Senior Secondary Education Certificate Examination (WASSCE) (CRDD, 2007). Where a school is located has a direct bearing on the performance of the students.

In Ghana there are rural and urban schools. Rural schools are characterized by poor infrastructure and facilities, low enrolment, less qualified teachers and fewer textbooks and other teaching and learning materials. Urban schools are however, over-staffed with qualified teachers, are over-enrolled, better funded and monitored, have better infrastructure and adequate resources to work with (Opoku-Asare, 2000). Apart from the rural- urban disparity, there is also the private and public disparity. According to Opoku-Asare, Ghanaian education is characterized by uniform adoption of textbooks (often inadequate for individual use) and mixed ability teaching. Private schools in Ghana have almost all the logistics necessary for effective teaching and learning except that some of them lack trained teachers; public schools on other hand lack some logistics that could ensure effective teaching and learning even though they have trained teachers. There is therefore better performance on the part of private schools than public schools.

The main focus of education in most Ghanaian schools seems to be making the students pass their external examinations in order to gain entry into higher institutions which affects how teaching and learning is done in the schools and how the students fare after graduating (Asihene, 2009).

4.3 Primary Education in Ghana

Primary school education follows pre-school and lasts for six academic years. Subjects are taught in accordance with a syllabus provided by the Ministry of Education. EMIS (2010) reports that Ghana has a total of 18,579 primary schools (13,835 public schools and 4,744 private schools). Enrolment in public primary schools was 3,099,234, while private primary schools had 710,024 pupils. Thus, the total enrolment in both the

public and private primary schools was 3,809,258 in 2010. Ashanti Region recorded the highest enrolment in primary schools (709,081) while the Upper West Region had the lowest enrolment of 135,476. The Kumasi district in Ashanti Region had 247 public and 429 private primary schools with an enrolment of 96,563 and 83,487 pupils respectively (EMIS, 2010).

4.4 Primary School Mathematics Syllabus

KNUST

The Ghana Primary School Mathematics Syllabus (CRDD, 2007) is made up of the rationale, general aims, scope of syllabus, organization of the syllabus and general objectives. It also includes time allocation, teaching the syllabus, years and units, and syllabus structure (CRDD, 2007). See appendix- for details of the syllabus.

4.4.1 Rationale of the Syllabus

The Ghana Primary School Mathematics curriculum stresses mathematical knowledge and skills that should help the young person to develop basic numeracy competence to be able to function effectively in society. In order for young people to enhance their chances in taking full advantage of the numerous opportunities in the fields of science, engineering, technology and in other areas in manufacturing, they should be able to acquire certain mathematical skills. Examples of such mathematical skills include the ability to use numbers competently, read and interpret numerical data, reason logically, solve problems involving calculations, and have mathematical reasoning. Other vital mathematical skills which young people need to acquire comprise effective communication with other people using accurate mathematical data and interpretations. It is the acquisition of these qualities and the important quality of functional mathematics

which modern life demands that mathematics education in Ghana aims to emphasize in the teaching and learning programs in the school system. The syllabus therefore puts a great deal of emphasis on the development and use of basic mathematical knowledge and skills (CRDD, 2007).

4.4.2 General Aims of the Syllabus

The mathematics syllabus is designed to help the pupil to:

KNUST

- Develop basic ideas of quantity and space.
- Use basic mathematics and necessary strategies for solving problems encountered in daily life by recognizing relationships between numbers.
- Reason logically by selecting and applying criteria for classification and generalization.
- Communicate effectively using mathematical terms and symbols.
- Use appropriate instruments for various systems of measurement.
- Carry out investigations using various mathematical ideas and operations.
- Develop the habits of diligence, perseverance, confidence and precision as a result of their mathematical training.

4.4.3 Scope of Syllabus

The major areas of content covered in all the primary grades are as follows

- **Numbers and Operations with numbers**

Numbers covers reading and writing numerals and the four operations on them- addition, subtraction, multiplication and division. The syllabus omits the use of sets to introduce

operations on numbers especially addition and subtraction. Because addition developed by using the union of sets consisting of like objects conflicts with the proper understanding of sets as collections of distinct objects (CRDD, 2007).

- **Shape and Space**

Shape and space covers the content that used to be called geometry. The syllabus deals with this topic by using models and real objects (CRDD, 2007).

KNUST

- **Measurement**

Measurement is intended to help pupils understand and use various units appropriately through practical activities (CRDD, 2007).

- **Collecting and Handling Data**

The syllabus introduces the collecting and handling of data in a manner that requires pupils to collect data from various sources and then learn to organize, represent and interpret the information gathered (CRDD, 2007).

- **Problem Solving**

Problem solving is not a topic by itself in the syllabus but nearly all topics include problem-solving activities. The syllabus requires that teachers and respective textbooks will include appropriate and realistic problems that will require mathematical reasoning rather than mere recall and use of standard algorithms. The development and use of estimation skills are emphasized both in numerical operations and measurement of capacity, mass, time, money, length, area and volume (CRDD, 2007).

- **Investigation with numbers**

Investigation with numbers leads to pupils to discover number patterns and relationships of and to use the four operations meaningfully (CRDD, 2007).

The Primary School Mathematics syllabus has been designed in such a way that the level of difficulty of the content will be within the knowledge and ability of the majority of the primary school pupils in the various classes. The introduction of a number of mathematical terms have been delayed or omitted completely from the syllabus. These terms include sets, right angle, commutative, associative and distributive properties, statistics, sequence, geometry, axes, probability and symmetry. This has been done to help pupils to avoid rote memorization and rather emphasize the proper development and use of mathematical concepts, skills and reasoning techniques in problem solving (CRDD, 2007).

The syllabus advises teachers to provide opportunities for pupils to work co-operatively in small groups to carry out activities and projects both during class time and out of class time when necessary.

4.4.4 Organization of the Syllabus

The syllabus is structured to cover the entire six years of primary education. Each year's work has been divided into units. The unit topics for each year have been arranged in the sequence in which teachers are expected to teach them. No attempt has been made to break each year's work into terms. This is desirable because it is quite difficult to predict, with any degree of certainty, the rate of progress of pupils during those early stages. Moreover, the syllabus discourages teachers from forcing the instructional pace

but rather advice teachers to ensure that pupils progressively acquire a good understanding and application of the material specified for each year's class work. The syllabus also encourages teachers not to gloss over any topic for lack of time because it is not desirable to create gaps in pupils' knowledge (CRDD, 2007).

1. General Objectives of the Syllabus

The pupil will:

KNUST

- Socialize.
- Adjust to and handle number words.
- Perform number operations.
- Make use of appropriate strategies of calculation.
- Recognize and use patterns, relationships and sequence and make generalizations.
- Recognize and use functions, formulate equations and inequalities.
- Identify the arbitrary/standard units of measure.
- Use the arbitrary/appropriate unit to estimate and measure various quantities.
- Collect, process and interpret data.

2. Time Allocation

At the Lower Primary Level Mathematics is allocated eight periods a week, each period consisting of 30 minutes. The eight periods should be divided into four double periods, each of one-hour duration for the week (CRDD, 2007).

4.4.7 Teaching of the Syllabus

The syllabus explains that a class may have some pupils of different physical problems and mental abilities. Some of the students may have high mental ability, while others may

be slow learners; some may be dyslexic and not be able to read well as others in the class. All these are special needs children who need special attention. Teachers should ensure that they give equal attention to all pupils in your class to provide each of them the opportunities for learning. Pupils with disabilities may have hidden talents that can only come to light if teachers provide them with the necessary encouragement and support in class (CRDD, 2007).

4.4.8 Years and Units

KNUST

The syllabus has been planned on the basis of years and units. Each year's work is covered in a number of units sequentially arranged and in a meaningful manner such that each unit's work will provide the necessary and enabling skills for the next unit (CRDD, 2007).

4.4.9 Structure of the Syllabus

The syllabus is structured in five columns (See Appendix G). These are: Units, Specific Objectives, Content, Teaching and Learning Activities and Evaluation (CRDD, 2007).

- **Units**

The units are the major topics to be studied for the year. Teachers are expected to follow the unit topics according to the linear order in which they have been presented. However, if teachers find at some point that teaching and learning in the class will be more effective if they branch to another unit before coming back to the unit in the sequence, they are encouraged to do so.

- **Specific Objectives**

The specific objectives begin with numbers such as 1.2.5 or 3.4.1. These numbers are referred to as "Syllabus Reference Numbers". The first digit in the syllabus reference number refers to the year/class, the second digit refers to the unit and the third refers to the rank of the objective. For instance the numbers 1.2.5 refers to Specific Objective 5 of Unit 2 of Primary 1. The strong points for using the syllabus reference number include the provision of an easy way of communication among teachers and educators. It further provides an easy way for selecting objectives for test construction.

- **Content**

The content presents a selected body of information that teachers need to use in teaching a particular unit. In some cases, the content presented is quite exhaustive and in other cases teachers can add some more information based upon their own training and on current knowledge and information.

- **Teaching/Learning Activities**

This requires that teachers help pupils to learn to compare, classify, analyze, look for patterns, spot relationships and come to their own conclusions. Teachers are to avoid rote learning and drill-oriented methods and rather emphasize participatory teaching and learning. Teachers are encouraged to re-order the suggested teaching/learning activities and also add to them where necessary in order to achieve optimum pupil learning. In order of pupils to acquire the capacity for analytical thinking and the capacity for applying their knowledge to problems and issues, teachers are encouraged to begin each lesson with a practical problem.

- **Evaluation**

This includes the suggestions and exercises for evaluating the lessons of each unit. Evaluation exercises can be in the form of oral questions, quizzes, class assignments, essays, project work and many more. Teachers are to ask questions and set tasks and assignments that will challenge pupils to apply their knowledge to issues and problems and that will engage them in developing solutions, and in developing observational and investigative skills.

KNUST

4.5 Characteristics of the study school

The Ayigya M/A Primary School is located at Ayigya Zongo in the Oforikrom sub-metropolitan area of Kumasi. It is in a lower class neighborhood where residents are predominantly Muslims. The school has four blocks: one is two storey, two are one storey and one uncompleted building. It has 10 classrooms and a large playing field for games which the community also uses for funerals, football matches and other social activities. The school consists of Kindergarten, Primary and Junior High School. The Kindergarten and the Primary school are run in streams and operate as Schools A and B, each with its own teacher. Pupils who graduate from the Primary section continue to the Junior High School. This study was limited to School A only.

4.5.1 Primary School A

School A has one head teacher who has 28 years' experience in the teaching profession and one deputy head who has 17 years' experience. It also has 16 trained full-time teachers, and two supporting staff. One of the teachers has a university degree, but the other teachers have the Ghana Teacher Certificate 'A' required to teach in Ghana's

basic schools. Of the 18 teachers, three are males and 15 are females. They are all Ghanaians and belong to different ethnic groups.

School A's enrollment is 545 with an average class size of 40 pupils. The pupils are mostly Muslims and live in the neighborhood and therefore walk to school. About 90% of the pupils are not proficient in English but are able to express themselves well in the Asante Twi language. The attendance rate is 90%, with a chronic truancy rate of 10%.

KNUST

4.6 Demography of Respondents

The study used the pupils of Class 2 in School A which is made up of two classes, named Class 2 A and class 2 B. The Class 2A served as the experimental group and the Class 2B as the control group. The experimental group consisted of 34 pupils made up of 16 girls and 18 boys with an average age of 9 years. The control group constituted 28 pupils made up of 15 girls and 13 boys with an average age of 8 years. The class teacher for Class 2A (experimental group) had 10 years of teaching experience and the teacher for Class 2B (control group) had six years' teaching experience.

The study found that 70% of the pupils in the two classes do not live with their biological parents; they are either living with relatives or guardians. It was realized that some of the pupils dropped out of school during the research period due to the fact that they are moved to different schools whereas others were sent to their home-towns when relatives they were staying with died or the elders of their families called for the pupils.

Table 4.1: Class Enrolment for Class 2A and 2B

CLASS	ENROLMENT		
	GIRLS %	BOYS %	TOTAL %
2A (Exp)	16 (51.6%)	18 (58.1%)	34 (54.8%)
2B (Control)	15 (48.4%)	13 (41.9%)	28 (45.2%)
TOTAL	31	31	62 (100%)

Source: Fieldwork, 2012

KNUST

4.7 Teaching and Learning of Mathematics at Study School

Finding out how teaching and learning of mathematics is done in the class sampled was based on the following indicators:

1. learning methods
2. frequency of practical activities
3. using of practical approaches that bring understanding
4. the degree of participation of pupils in lessons
5. the consideration of multiple intelligence when teaching

- **Learning Methods**

It was observed that mathematics lessons usually began with the teacher's presentation where the teacher explains the concept to be taught to the pupils and then writes examples from the textbook on the chalkboard. Lessons normally took 50 minutes. To establish whether the pupils understood the concept, questions are asked by the teacher. When questions are asked only between three and five pupils are able to answer them. This suggested that more than half of the pupils do not understand what is taught. It was

again observed that when pupils found it difficult to grasp a concept, the teacher explained it to them again using only textbook examples. This is in line with Mereku's (2003) finding that the majority of teachers make pupils to use only the standard textbook methods irrespective of their abilities. However, the syllabus gives teachers the freedom to use other relevant examples outside what is found in the textbooks. This is to enhance the understanding of pupils.

- **Frequency of Practical Activities**

KNUST

On the frequency of practical activities done during lessons, it was found that none of the teachers used any practical activities to explain the outlined concepts to their pupils as the syllabus requires them to do. The reason given for non-introduction of practical activities in teaching mathematics in Ayigya M/A Primary 2A was that the teachers are required to conduct a specified number of exercises during the term, failure of which results in serious sanctions from education officials. Therefore to meet the requirements and work within time, the teachers forgo practical activities and focus on the recommended class exercises. This observation is consistent with Mereku's (2003) finding that teachers frequently do not employ practical activities in their teaching.

- **Usage of Practical Demonstration in Teaching Mathematics**

In determining the usage level of practical approaches to increase understanding, it came out that the pupils are given exercises in their workbooks after every lesson, and to get them to answer correctly and avoid presenting wrong answers, the teachers write the correct answers on the chalkboard for the pupils to copy. Also, it was established that most of the pupils are not proficient in English; hence the teachers use Asante Twi to

sometimes teach the lessons. The failure of teachers to use structured teaching materials and practical game activities, and the sole reliance on the mathematics textbook routine tasks indicate that the few teachers who may attempt to teach for conceptual understanding and application of the concepts would rely mainly on exposition, and teach for reception and not discovery learning as Mereku, (2003) suggests.

- **Participation of Pupils in the Teaching-Learning Process**

KNUST

The observation revealed virtually no participation of pupils in the lessons taught by the teachers. The pupils remained passive because it was realized that they hardly understood the mathematical concepts that were taught by their teachers. The lessons were theoretical with no practical activities that could get them involved to make them understand the lessons. This supports the submission made by Mereku, (2003) that infrequent use of teaching/learning materials and practical activities do not enhance the participation abilities of pupils in lessons.

- **Consideration of Multiple Intelligences in Teaching Mathematics**

Consideration of the theory of multiple intelligences is essential in teaching. One implication of multiple intelligences is that it allows teachers to structure the presentation of material in a style that engages most or all of the intelligences. This kind of presentation not only excites students about learning, but it also allows a teacher to reinforce the same material in a variety of ways. By activating a wide assortment of intelligences, teaching in this manner can facilitate a deeper understanding of the subject material (Gardner, 1993). On the issue of whether teachers consider the different learning abilities of pupils when teaching, it was observed that the teachers do not consider the

different learning abilities of the pupils when teaching because the same method of teaching was used for every pupil. This observation contrasts the submission made by Lazear (1992) that since all children do not learn in the same way, they cannot be assessed in the same way. Therefore, it is important that an educator creates an "intelligence profile" for each student. Knowing how each student learns will allow the teacher to properly assess the pupils' progress. This individualized evaluation practice will allow a teacher to make more informed decisions on what to teach and how to present information.

KNUST

4.8 Drawing Interventions Proposed by the Researcher

Based on what was observed in the classroom, the researcher developed a drawing intervention activity to help enhance the indicators identified for observing teaching and learning of mathematics, which include learning methods, frequency of practical activities, usage of practical demonstration in teaching mathematics, degree of pupils' participation in the teaching of mathematics, and consideration for pupils' learning styles deduced from the theory of multiple intelligences in teaching. Before the drawing intervention was developed, a preliminary study indicated that like all other schools in Ghana (Boafo-Agyemang, 2010; Ampeh, 2011), in Ayigya M/A Primary School A, creative art is taught by the class teachers. These teachers however, only present scenarios to pupils for them to draw from memory. In order to integrate creative art and mathematics, the researcher adopted imaginative drawing as part of the interventional instruction.

Table 4.2 describes the action plan for the intervention. It details the weekly activities done by researcher as well as the materials used and the time spent in implementing the art based activities. The interventions were based on the Thomas & Switzer (2001) model as defined in Figure 2.3.

Table 4.2: Description of Drawing Interventions

WEEK	INTERVENTION	PUPIL ACTIVITIES	RESEARCHER/CLASS TEACHER ACTIVITIES	MATERIALS	DURATION
Week One	Pre-test to assess mathematics performance	Class two pupils took pre-test	Researcher conducted and marked pre-test	Math concepts pre-test	Lasted 20 minutes
Week Two	Used drawing activities to explain the concept of subtraction and division	Pupil drew from memory to show understanding of concept	Class teacher introduced concept. Researcher posed story questions to initiate drawing.	A4 plain drawing paper, lead pencils, non-toxic coloured crayons and pencils	Lasted 60 minutes
Week Three	Used drawing activities to explain fractions of half	Pupil drew from memory objects and their halves	Class teacher presented concept. Researcher demonstrated	A4 plain drawing paper, lead pencils, non-toxic coloured crayons and pencils	Lasted 90 minutes
Week Four	Used drawing activities to explain fourths and quarters	Pupil drew from memory objects and their quarters	Class teacher explained concept. Researcher monitored pupils in coming out with quarters from their objects	A4 plain drawing paper, lead pencils, non-toxic coloured crayons and pencils	Lasted 90 minutes
Week Five	Drawing activities to explain clock times	Pupil designed their own clocks	Class teacher introduced the topic. Researcher assisted pupils	A4 plain drawing paper, lead pencils, non-toxic coloured crayons and	Lasted 120 minutes

KNUST

				pencils, scissors	
WEEK	INTERVENTION	PUPIL ACTIVITIES	RESEARCHER/CLASS TEACHER ACTIVITIES	MATERIAL	DURATION
Week Six	Drawing activities to explain time difference	Drawing competition between two parties to show time difference	Class teacher and researcher supervised competition	Chalk board and chalk	Lasted 90 minutes
Week Seven	Drawing activities to help pupils identify various Ghanaian currency notes and coins	Pupils drew and coloured the various notes and coins	Class teacher and researcher assisted pupils	A4 plain drawing paper, lead pencils, non-toxic coloured crayons and pencils, scissors	Lasted 90 minutes
Week Eight	Drawing activities to help pupils identify various Ghanaian currency notes and coins	Pupils drew and cut objects and used it in buying and selling activities	Class teacher and researcher assisted and supervised	A4 plain drawing paper, lead pencils, non-toxic coloured crayons and pencils, scissors	Lasted 120 minutes
Week Nine	None	Pupils took a posttest	Researcher conducted and marked posttest	Math concept posttest	Lasted 45 minutes

Source: Fieldwork, 2012

4.8.1 Description of the Interventions

The main objective of the study was to increase pupil performance in mathematics through drawing activities. Various drawing activities were used alongside with various teaching methods. These methods included discussing the use of problem questions, manipulation of tools and materials for art, and identifying drawing relationships between mathematics and art. The pupils drew images and coloured them on the drawing sheets. They were very enthusiastic about the whole project.

The researcher began by consulting the class teachers to get an idea about the general performance of the two classes and to find out the mathematics concepts to be taught for the term. These concepts were in the Class 2 mathematics text books. The researcher organized and supplied the materials needed for the intervention lessons. The teachers were contacted and informed of the intervention and when it would commence. The teachers were encouraged to participate in the entire process. Nine weeks were used for the class 2A intervention activities. Furthermore, activities from weeks two to eight, and the Pictorial Likert scale activity in week nine were done for the experimental group only. Both the control group and experimental group learned the same mathematical concepts.

Week One: Pre-test (See Appendix B) was taken by both the experimental and control groups to get an idea of any prior knowledge of maths, how much they understood the concepts and their performance based on the standard test from Oforikrom sub-metro. The pre-test lasted 20 minutes for each of the group. The number of pupils who wrote the test was 28 pupils for the experimental group and 25 pupils of the control group. The test was marked and recorded by researcher.

Week Two: During this week, the concept that was taught was division. The pupils were given the materials to be used for the activities: drawing sheets, pencils, and non-toxic crayons. The teacher introduced the concept and questions were posed to initiate the drawing. In illustrating 30÷2, the pupils were asked to draw themselves and a best friend (See Plate 4.1). They were then asked to draw 30 fruits of their choice and share them equally with their friends (See Plate 4.2). After the drawings, the pupils were asked to count the number of fruits each person had. During the three days of teaching this

concept, pupil attendance was 29 for the first day, 26 for the second day and 26 for the third day. The second and third days were rainy days and according to the teacher, she was surprised by the attendance because when it rains, attendance usually drops to an average of 15 pupils. The reason for the high turn up is likely to have been the pupils show of enthusiasm with the intervention activity. The teacher also commented that she had realized that the pupils understood the concept at the end of the week. Plates 4.1 and 4.2 show the drawing activity done for 30÷2.

KNUST

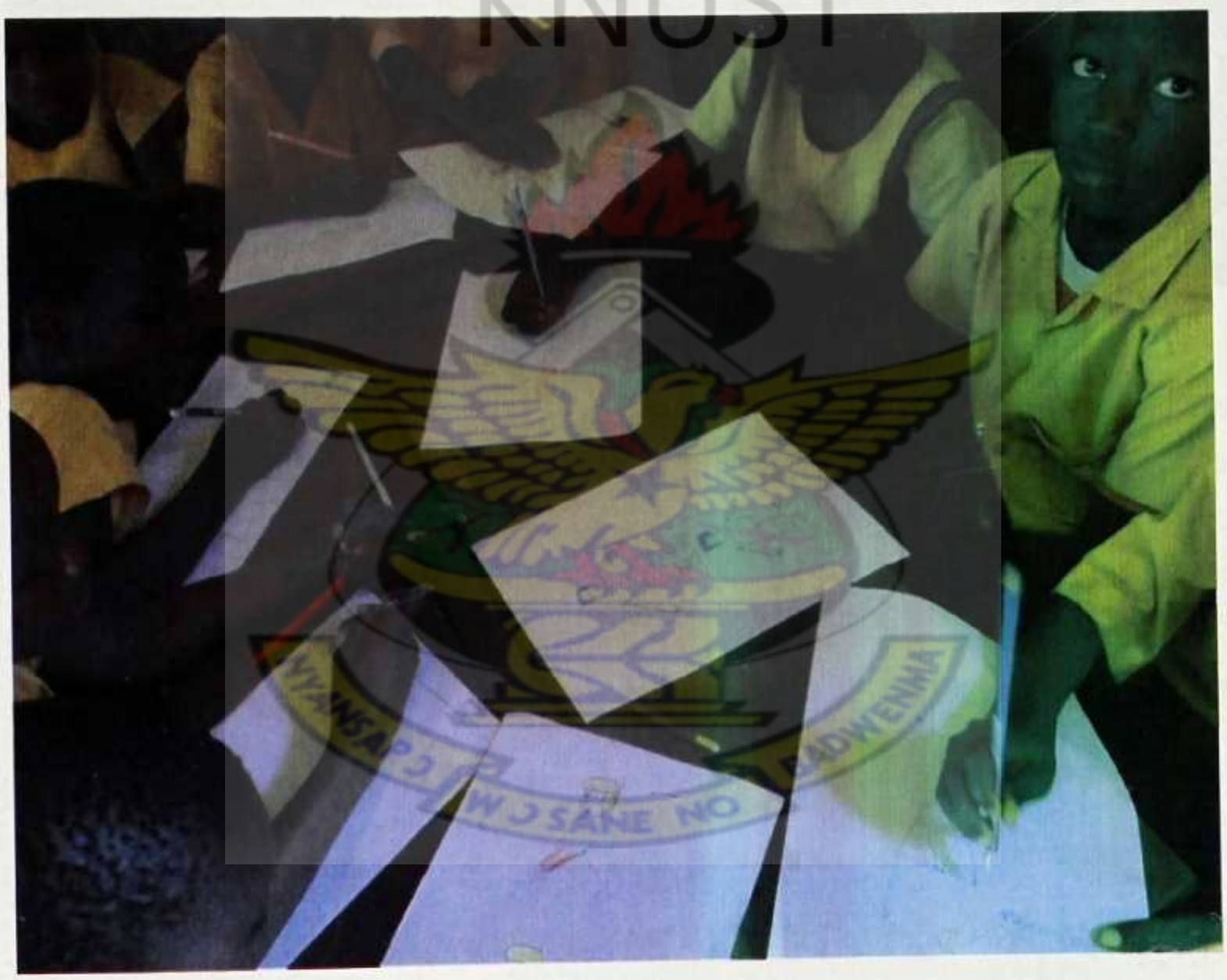


Plate 4.1: Pupils drawing themselves and their friends

Source: Fieldwork, 2012

LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TE
KUMASI


KNUST

Plate 4.2: Pupils drawing fruits to share among their friends

Source: Fieldwork, 2012

Weeks Three and Four: The concepts of fractions with halves and quarters were taught during weeks three and four. The class teacher presented the concepts and thereafter the pupils were told to get their drawing materials ready. The pupils were asked to identify geometric shapes from their environment and draw them, and to also to draw different geometric shapes from a particular geometric shape. For example, the pupils were able to identify rectangle and after dividing it, they came out with triangle (Refer to Plate 4.3). Additionally, the pupils were asked to draw any object of their choice, and then divide it into two equal halves and draw the half part. For quarters, each pupil drew a circle and divided it into four equal parts to show the fourths and quarters (refer to Plate 4.4). They were also asked to draw quarters of other objects. Attendance for the six days

was 28, 33, 25, 29, 30, and 33 for these lessons. The second and sixth days recorded the highest attendance (33) because some truant pupils heard about the activities and came to school. At the end of the third and fourth weeks, the teacher indicated that the very shy ones were participating in class activities and the below average pupils have improved in their class exercise performance. Plates 4.3 and 4.4 show drawing activities involving geometric shapes.

Plate 4.3: Pupils drawing rectangles and dividing them into two halves to get triangles

Source: Fieldwork, 2012


KNUST

Plate 4.4: Pupils drawing circles and dividing them into four equal parts to show quarters

Source: Fieldwork, 2012

Weeks Five and Six: The concept of time was discussed in weeks five and six. The pupils were given their drawing materials and the class teacher presented the topic for the day. The researcher then asked the pupils to draw a clock of their choice and indicate the times (see plate 4.5). Moreover, to show time differences, drawing competition was organized in the class. Two pupils were called to the board to draw one sibling (see plate 4.6). The start time of this activity was recorded, and both pupils started at the same time. The pupils were then allowed enough time to complete the drawing. Each completion time was then recorded. In order to show the time difference spent by the two pupils, each completion time was then subtracted from the start time to know the length of time each pupil used. The time used by the first pupil was then subtracted from the time used by the second pupil to show the time difference between the two pupils.

The whole class participated in this and they were excited to the extent that they did not want the class to end. The attendance for the six days was 31, 33, 28, 30, 28, and 33.

Plate 4.5: Pupils drawing clocks of their choice and indicating the times

Source: Fieldwork, 2012

Plate 4.6: Pupils drawing siblings on the board

Source: Fieldwork, 2012

Weeks Seven and Eight: These weeks dealt with the concepts of money, buying and selling. The class teacher introduced the concepts, and the pupils were given their drawing materials. The pupils were then asked to draw the various notes and coins of the Ghana cedi. This activity was supervised by the class teacher and the researcher. During the eighth week, buying and selling activities were organized in the class. The pupils were asked to draw and cut an object they wished to sell (refer to plate 4.7) and they were also to come out with their own prices. Group shops were organized and pupils from different groups bought items from different shops (refer to plate 4.8). The class teacher and the researcher assisted to help the pupils grasp the concepts of giving change for money paid. If a change for a transaction became difficult for a group, the whole class is asked to come out with the correct change. Class participation was 100%, and that promoted the pupils' interaction and socializing. At the end of the eighth week, the teacher said that the activities were so exciting and that she hoped to continue with them.

The attendance for the six days was 30, 33, 32, 32, 30, and 32.

LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TE
KUMASI

Plate 4.7: Pupils drawing and cutting objects they wish to sell

Source: Fieldwork, 2012

Plate 4.8: Pupils selling their objects in group shops

Source: Fieldwork, 2012

Week Nine: A post-test (see Appendix C) was organized for the experimental group (see plate 4.10) and the control group (see plate 4.9). The experimental group was given extra sheets to demonstrate their answers through drawings whereas the control group answered the questions the usual non-activity way as the teachers did with them. The experimental group's post-test lasted an hour and that of the control group lasted for 30 minutes. A Likert scale of two smiley faces: a happy face and a sad face were used to find out how the experimental group felt about the intervention. All the pupils chose a happy face, and that showed a high level of excitement with the activities. The pupils asked whether the activities would be repeated during the following term.

KNUST

Plate 4.9: Post-test for the Control Group

Source: Fieldwork, 2012


KNUST

Plate 4.10: Post-test for the Experimental Group

Source: Fieldwork, 2012

The intervention activities support the idea that when drawings are integrated into mathematics teaching and learning, pupils' interest in mathematics becomes greater (Ingram & Riedel, 2003; Andrea, Nancy & Welch, 1995). Moreover, the outcome of the drawing intervention activities confirms Goldberg's (1997) conclusion that the arts provide a stage for building self-esteem, encourage collaboration and intergroup harmony, expand expressive outlets, and provide a range of learning styles available to children. Also, the intervention results support the claim that arts integration supports the development of students' motivations and interests (Melo, 2004; Eisner, 2004). Additionally, the submission by Potter (2007) and Adu-Agyem, Enti & Peligah (2009) that the arts offer essential opportunities for creative expression, problem solving and social development are confirmed by the intervention activities.

4.9 Achievement test results for the Control Group and the Experimental Group

The detailed comparisons of the achievement test results (pre-test and post-test) for the control group and experimental group are presented in this section.

4.9.1 Pre-test of Control Group and Experimental Group

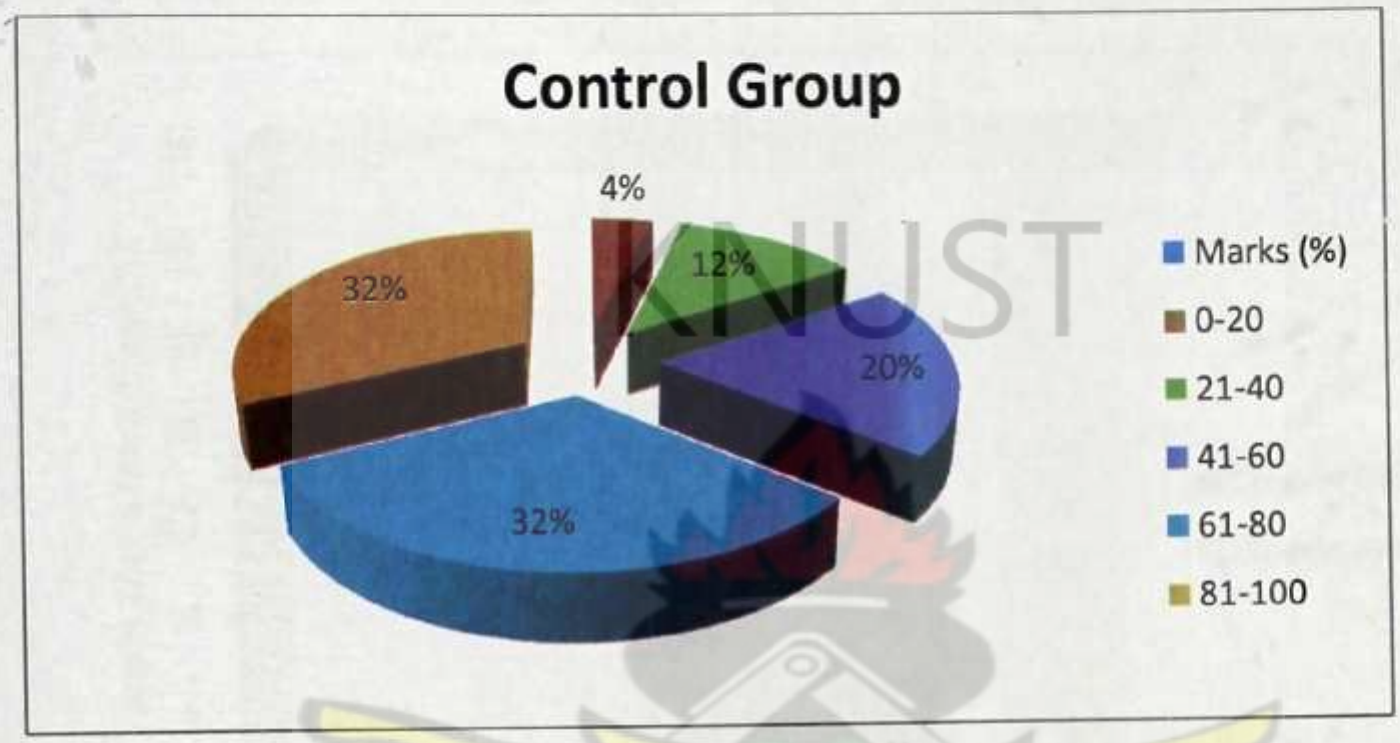


Figure 4.1: Pre-test results for Control Group

Source: Fieldwork, 2012

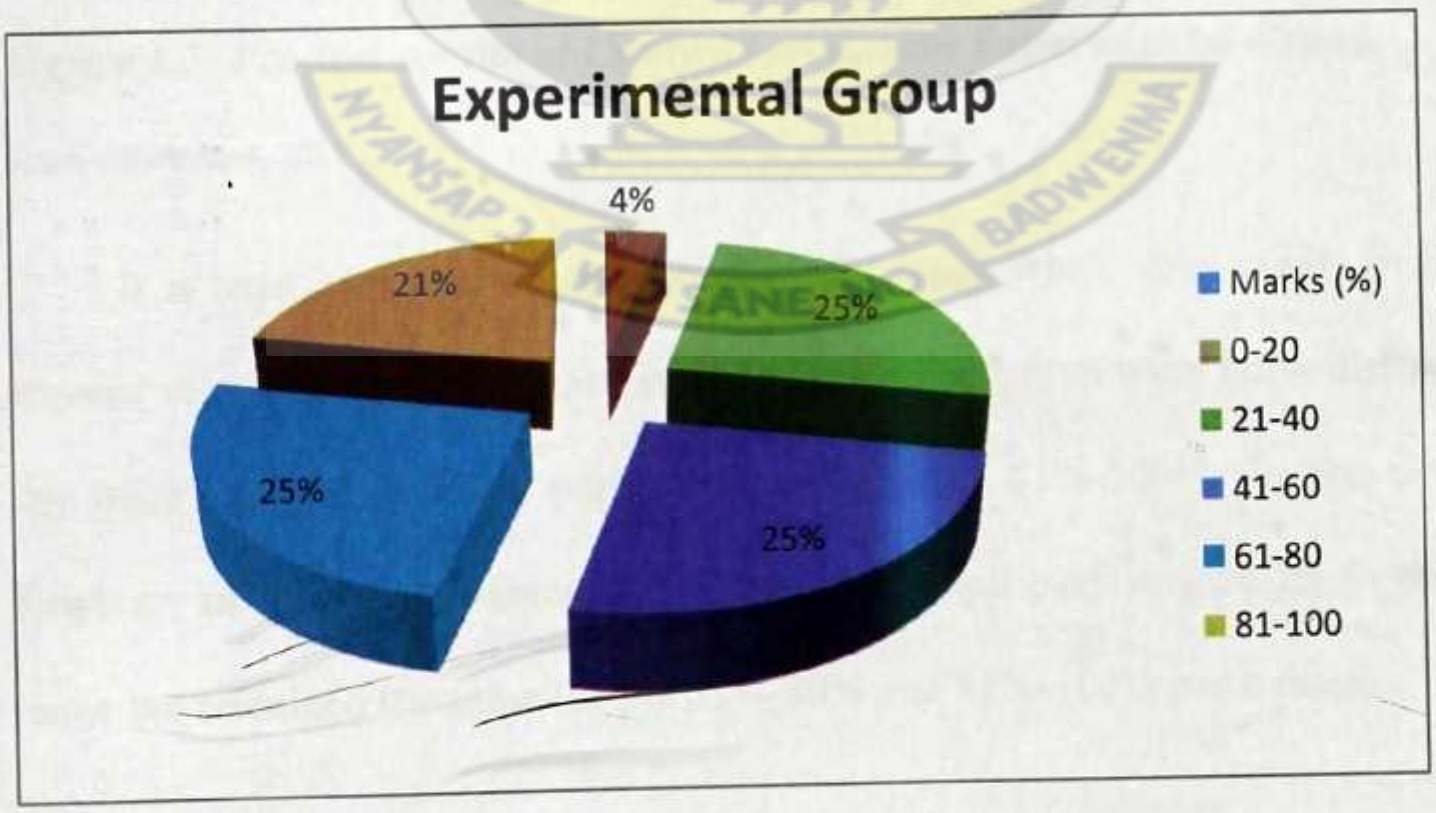


Figure 4.2: Pre-test results for Experimental Group

Source: Fieldwork, 2012

Figure 4.1 and Figure 4.2 show the results of the pre-test conducted for the control and experimental groups respectively in mathematics before the introduction of the drawing intervention to the experimental group.

4.9.2 Comparison of Pre-test between Control Group and Experimental Group

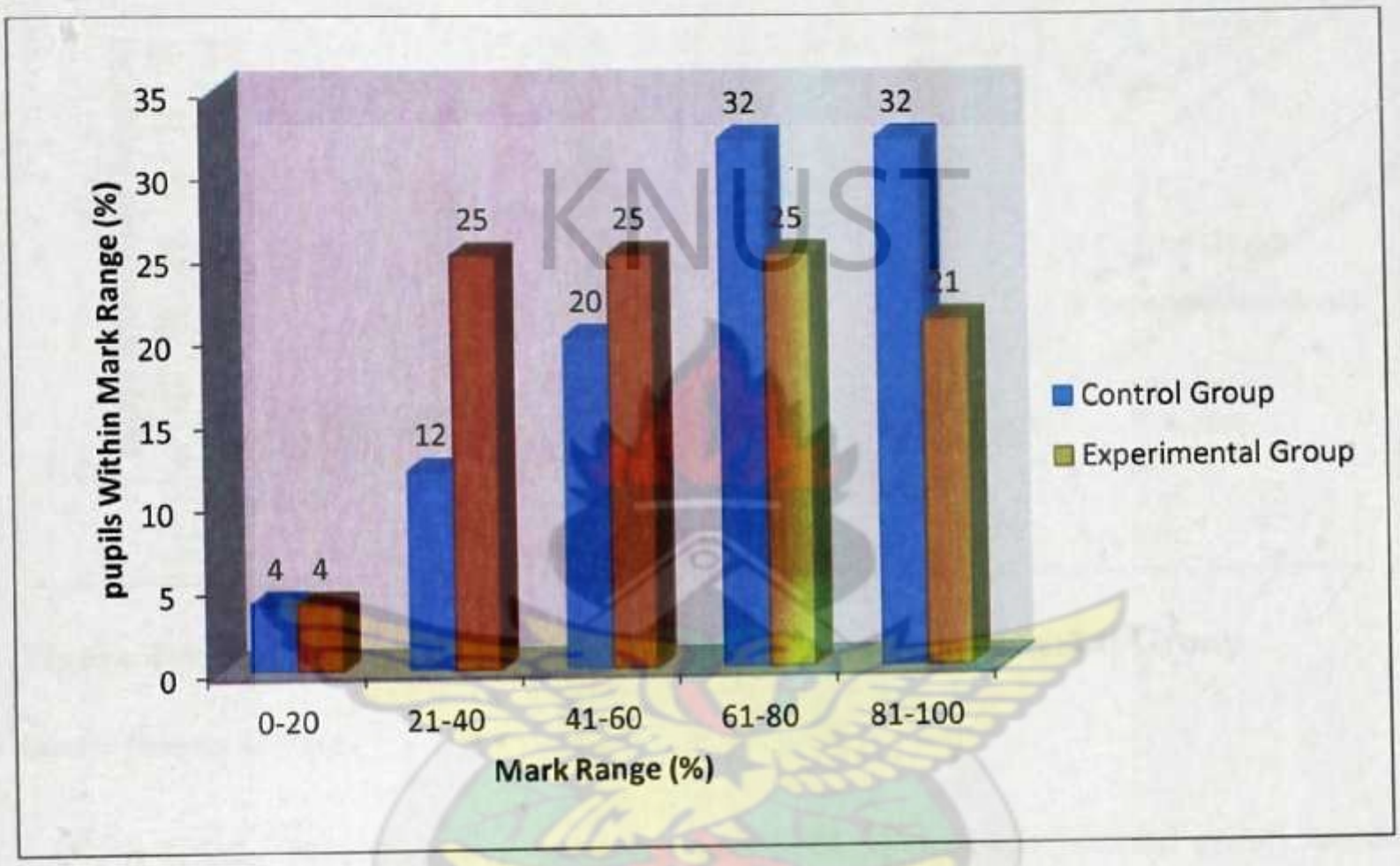


Figure 4.3: Pre-test results of Control Group and Experimental Group

Source: Fieldwork, 2012

It is seen here that except for 0%-20% range where four pupils in both groups showed same performance, those in the experimental group were fairly distributed across the mark range but fewer pupils scored between 81%-100%. In the control group however, there was an exponential increase in pupil performance up to the 61%-80% range but remained the same for the 61%-80% and 81%-100% mark ranges.

4.9.3 Comparison of Post-test between Control Group and Experimental Group

The comparison between the post-test results of both the control and experimental groups is presented in Figure 4.4. During the post-test, no drawing intervention was introduced for the control group but for the experimental group there was a drawing intervention.

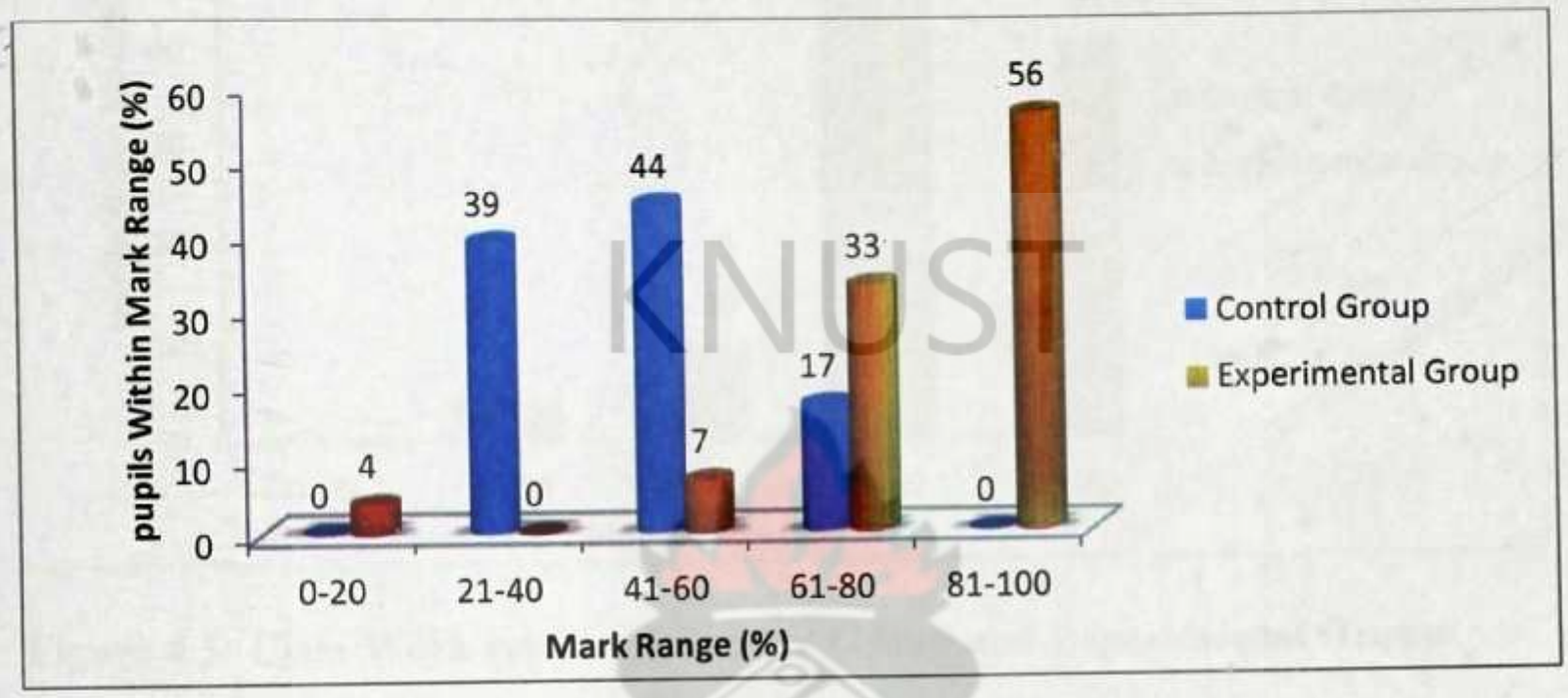


Figure 4.4: Post-test results of Control Group and Experimental Group

Source: Fieldwork, 2012

It is seen here that more than one half 56% of the experimental group scored 81-100% as against 33% the control group. The significance of this result is that the drawing intervention actually improved the mathematics performance of the experimental group over the performance of the control group which had no drawing intervention during the post-test. This confirms Ingram & Riedel's (2003) conclusion that pupils'3 mathematical performance improves after the integration of arts into mathematics teaching.

4.9.4 Comparison of Class Work between Control Group and Experimental Group

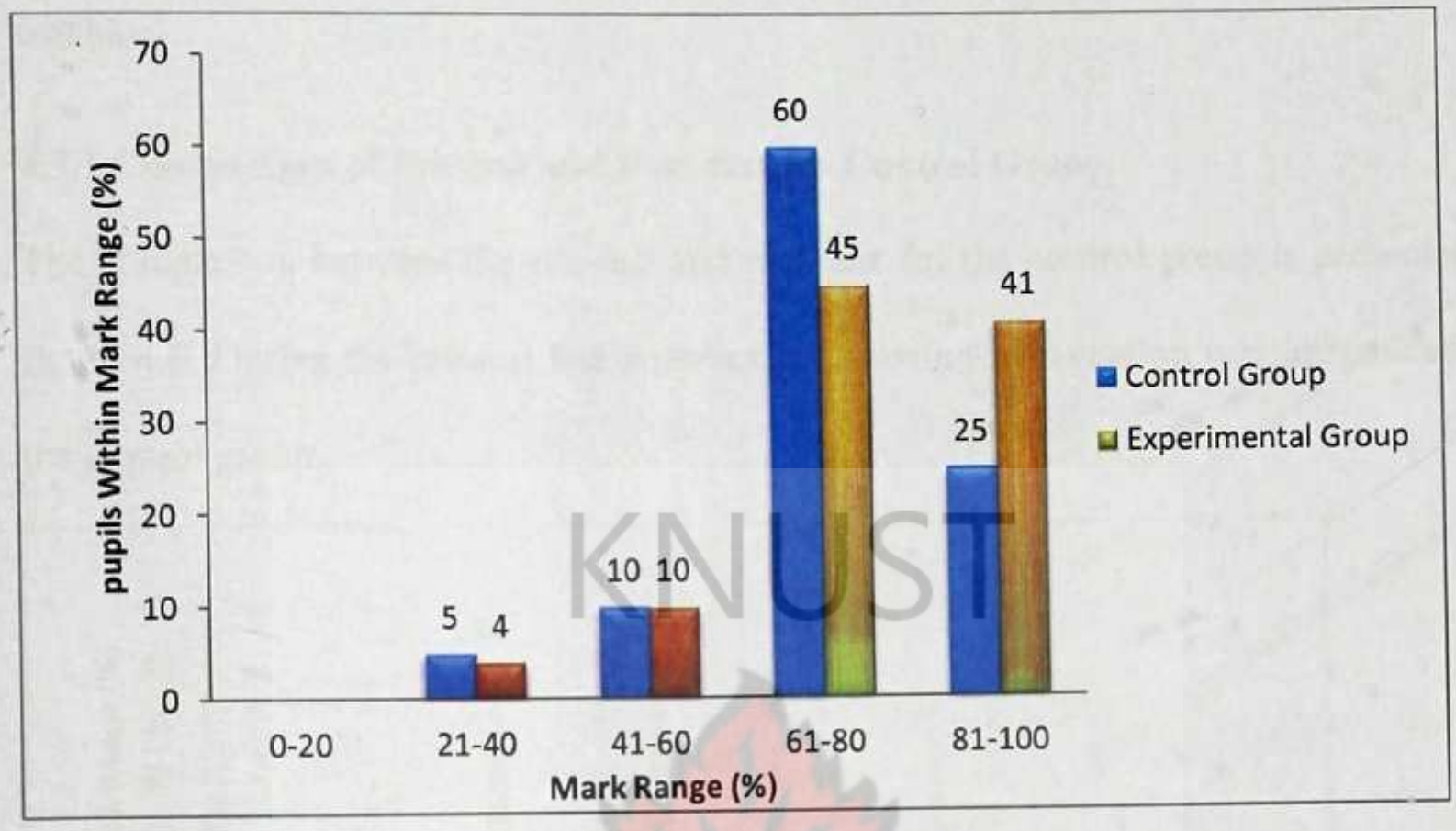


Figure 4.5: Class Work results of Control Group and Experimental Group

Source: Fieldwork, 2012

Figure 4.5 presents a comparison of the mathematics class work performance of the control group and the experimental group during the replicated study done by the class teacher of the experimental group. It is seen that the number of pupils who scored within the 41-60% mark range were at par for both the control and experimental groups. However, the experimental group outperformed the control group in the 81-100% mark range. The fact that the gap between the two groups is not wide in the 21-40% mark range while the control group outperformed the experimental group in the 61-80% mark range confirms the findings of Fioranelli (2001) and Attwell (1998) which indicates that the integration of the arts in mathematics teaching do not significantly improve students' mathematical performance. This contradicts Ingram & Riedel's (2003) conclusion that

pupils' mathematical performance improves after the integration of arts into mathematics teaching.

4.9.5 Comparison of Pre-test and Post-test for Control Group

The comparison between the pre-test and post-test for the control group is presented in figure 4.6. During the pre-test and post-test, no drawing intervention was introduced for the control group.

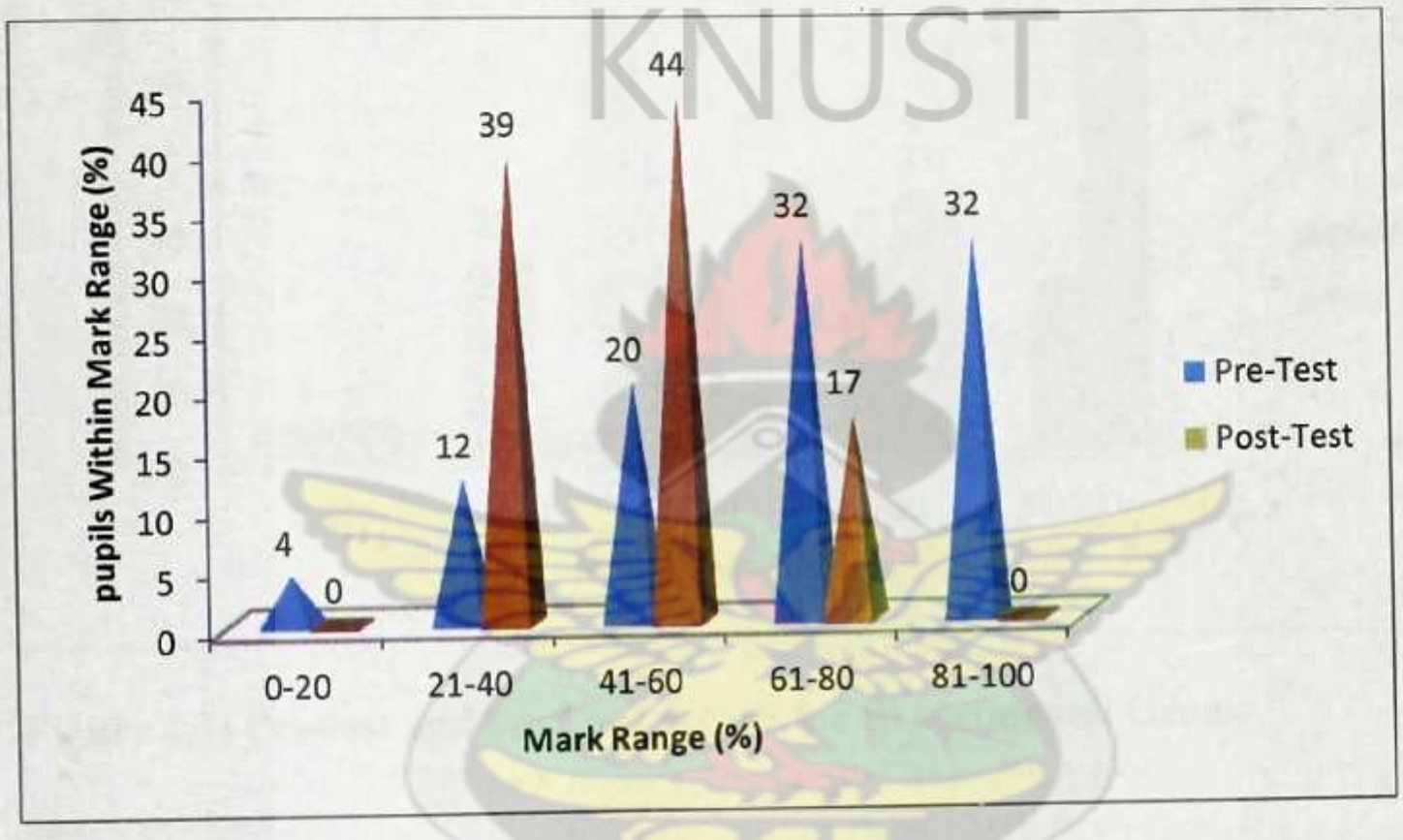


Figure 4.6: Pre-test and Post-test results for Control Group

Source: Fieldwork, 2012

It is seen from Fig 4-6 that the pupils were fairly distributed across all the mark ranges during the pre-test except for the 0-20% mark range which had 4% of the pupils scoring within that mark range. However, except for the 0-20% and 81-100% mark ranges which none of the pupils attained; the pupils also were fairly distributed across the various mark ranges during the post-test. Since no drawing intervention was introduced, the control group's performance was not sustained or improved, rather their performance

declined. This suggests that if a drawing intervention was introduced, their mathematical performance could have improved (Eisner & Ecker, 1990; Gunn, 1998).

4.9.6 Comparison of Pre-test and Post-test for Experimental Group

Figure 4.7 presents the comparison between the pre-test and post-test of mathematics for the experimental group. During the post-test, a drawing intervention was introduced.

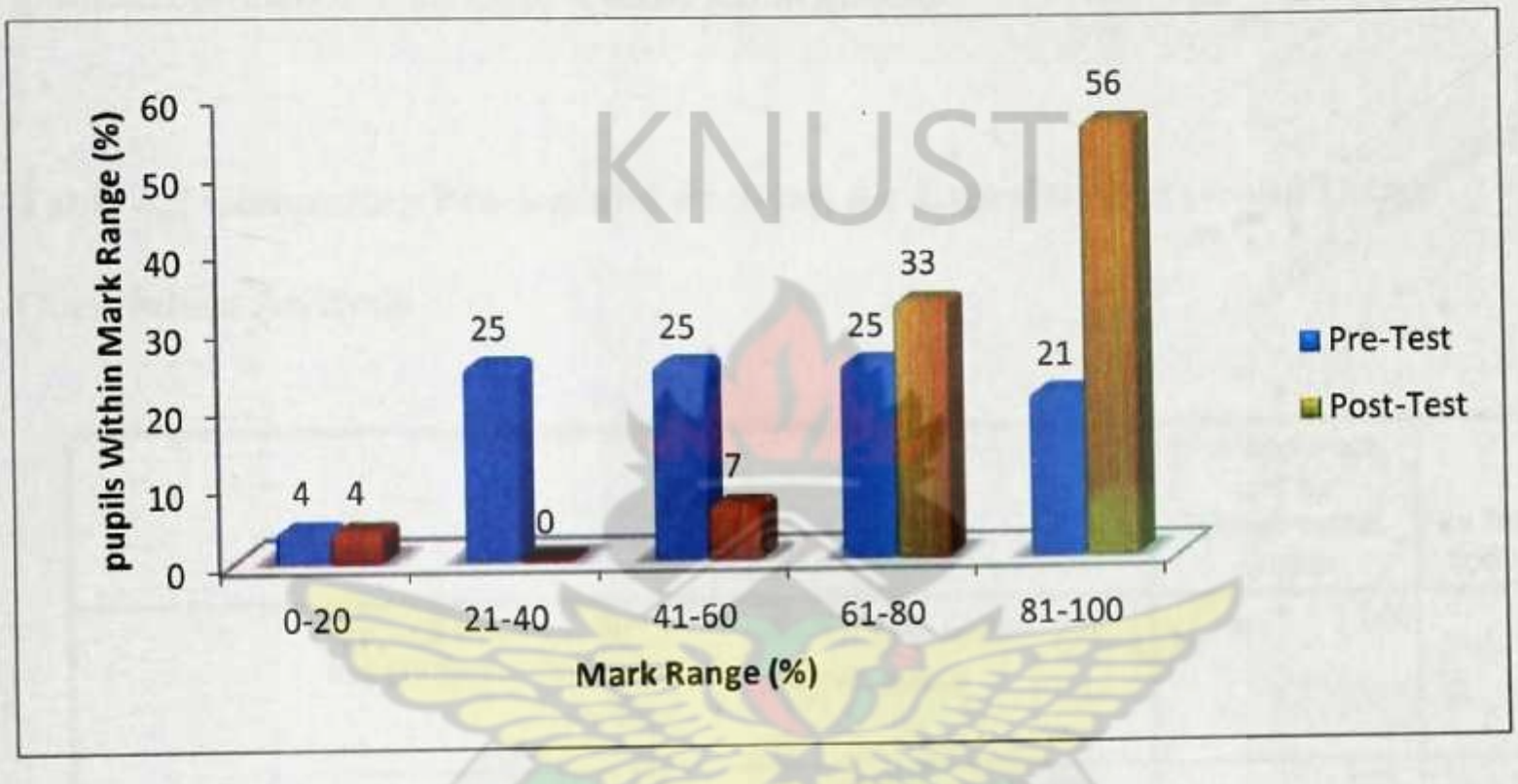


Figure 4.7: Pre-test and Post-test results for Experimental Group

Source: Fieldwork, 2012

It can be observed that except for the 0-20% mark range where four percent of the pupils scored, the rest of the pupils were fairly distributed across the various mark ranges during the pre-test. However, more than half of the pupils scored within the 81-100% mark range during the post-test. This reflects the findings of Andrea, Nancy & Welch (1995) that students' mathematics performance improves after being given lessons in the art.

4.9.7 Correlation Analysis of Pre-test and Post-test for Experimental Group

The relationship between the use of drawings in Mathematics teaching (as measured by the Pre and Post-test marks for experimental group) and pupils' academic performance (as measured by the Pre and Post-test marks) was investigated using Spearman's rho correlation coefficient (which is a non- parametric alternative to the Pearson product moment correlation with more relaxed assumptions).

KNUST

Table 4.3 Comparing Pre-test and Post-test for Experimental Group Using Correlation Analysis

		Pre and Post-test for Experimental Group	Pre and Post-test marks
Pre and Post-test for Experimental Group	Correlation Coefficient	1.000	.533**
	Sig. (2-tailed)	.	.000
	N	55	55
Pre and Post-test marks	Correlation Coefficient	.533**	1.000
	Sig. (2-tailed)	.000	.
	N	55	55

Source: Fieldwork, 2012

**. Correlation is significant at the 0.01 level (2-tailed).

There was a strong, positive correlation between the two variables [r= .533, n=55, p<.0000] with increasing use of drawings in Mathematics teaching associated with improvement in pupils' performance in Mathematics test (Potter, 2007; Adu-Agyem, Enti & Peligah, 2009).

4.9.8 Relationships between the Pre-test and Post-test of the Control Group and Experimental Group Using Descriptive Statistics

Table 4.4: Pre-test and Post-test of Control Group and Experimental Group Using Descriptive Statistics

	Pre-test Experimental Group	Post-test Experimental Group	Pre-test Control Group	Post-test Control Group
Mean	57.4643	82.9630	65.8400	50.8696
Std. Deviation	23.50805	18.56689	23.55080	13.45465
Minimum	15.00	20.00	15.00	30.00
Maximum	100.00	100.00	100.00	80.00

Source: Fieldwork, 2012

Table 4.4 presents the mean marks, standard deviations, minimum and maximum marks for the pre-test and post-test for the experimental and control groups. When performing statistical analysis on a set of data, the mean, standard deviation, minimum and maximum values are very essential to calculate. The mean estimates the average mark or where the middle of a set of data is. It is useful when creating groups to organize larger sets of data. The standard deviation is the average distance between the actual data and the mean. Also, the minimum and maximum values give the lowest and highest values in a set of data (MacMillan, Preston, Wolfe & Yu, 2007).

There was an increase in the mean value of the post-test (82.96) for the experimental group over the mean value of the pre-test (57.46) and this shows how effective the drawing intervention was in improving the pupils mathematics performance (Welch et al, 1995; Ingram & Riedel, 2003).

4.10 Main Findings

In line with the objectives of investigating how the integration of drawings into mathematics teaching and learning can improve pupils' mathematics performance in the selected school, the following outcomes were achieved.

4.10.1 Objective One: Methods of Teaching and Learning of Mathematics at Ayigya M/A Primary School A

With respect to how teaching and learning of mathematics is done at Ayigya M/A Primary School A, the study found that the teachers only use the standard textbook to guide their teaching without considering the individual abilities of the pupils. Although the maths syllabus encourages classroom teachers to use examples and illustrations found outside the standard textbook if pupils find it difficult to grasp the mathematics concepts that are taught, the study showed that textbook examples were used repeatedly by the teachers even where the pupils had difficulties.

It was also found that maths lessons, the teachers seldom integrate practical activities to explain the various mathematics concepts. Time constraint was cited as a cause of this. Low pupil participation in the lessons was also observed in mathematics lessons because the pupils did not understand the mathematics concepts that were taught by the teachers. This made it easy for them to listen without participation.

It was also evident from the observation that the teachers did not factor in the fact that the pupils in their classrooms had different levels of learning abilities and learning styles as the theory of Multiple Intelligences suggests. Knowing that Ghanaian classrooms consist of pupils with mixed ability (Opoku-Asare, 2000; CRDD, 2007)

KNUST
LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TE
KUMASI

makes it necessary for the teachers to adapt their teaching methods so that they can reach all their pupils in all their lessons.

4.10.2 Objective Two: Drawing Interventions to improve Pupils Mathematics Performance

The study showed that the intervention really brought a lot of positive effects in the school. Among the many benefits of the intervention were increase in class attendance of the pupils and a show of greater interest in mathematics. The drawing exercises built the self-esteem of the pupils, encouraged collaboration among them, and built their intergroup harmony. Furthermore, the intervention provided a means for the pupils to exhibit a range of learning styles; it enhanced the pupils' problem solving abilities as the activities offered opportunity for the pupils to express themselves creatively. Additionally, the art activities served as a motivation for the class teacher as she saw her pupils perform so well in the intervention lessons. This shows that if teachers give a little more time for lessons and tests that incorporate drawing activities, they could help improve their pupils' performance in mathematics.

4.10.3 Objective Three: Mathematics Performance of Pupils before and after the Intervention

With respect to the performance of the pupils before and after the intervention activities, because the control group did not receive any intervention, its mathematics performance declined below that of the experimental group with respect to the post-test. On the other hand the experimental group which received the intervention had its mathematics performance increase in the post-test. The correlation analysis showed a

strong improvement in the experimental group's mathematics performance after the introduction of the drawing activities in the maths lessons. This suggests that the integration of drawing intervention in mathematics teaching and learning can improve pupils' performance in mathematics, increase class participation and school attendance, build pupils' confidence, enhance their problem solving skills, offer pupils the opportunity to express themselves creatively, heighten pupils interest in mathematics and afford pupils a broader range of learning styles to boost their class performance.

KNUST

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The integration of drawing activities into mathematics teaching can improve the mathematics performance of Primary School pupils as this research work has shown. This chapter considers the summary, conclusions and recommendations of the main findings of this study.

KNUST

5.2 Summary

This study aimed at developing an intervention by the use of drawing to improve the mathematical performance of pupils at Ayigya M/A Primary School A. this involved examining teaching and learning of mathematics is done in the primary school. A pre-test was administered to attain a prior knowledge of the performance of pupils as well as their understanding of mathematical concepts.

The intervention took the form of drawing activities that were incorporated in the mathematics lessons taught by one class teacher in the sampled school. This research was conducted to test Thomas & Switzer's (2001) model of teaching and learning of mathematics in the selected school to ascertain its impact on mathematics ability of eight to nine year old pupils. It was evident that in developing syllabi for various subjects the theory of multiple intelligence and learning should be seriously considered because the poorest performer in a class might have one or two of the intelligences and when this is capitalized upon would made him a better student.

The observations and interviews showed that the teachers in the sampled primary school only use the standard textbooks when teaching without considering the different learning abilities of the pupils. The teachers also incorporate practical activities in their lessons to help them to explain mathematical concepts to their pupils. For this reason the pupils' participation in class discussions was very low.

In order to measure improvement in performance, pre-test, post-test and class exercises of the two groups were compared. The comparison of pre- and post-test results revealed a significant improvement in mathematics performance for the experimental group. It was found that pupils' interest in mathematics learning was heightened throughout the drawing intervention period. It also made them confident and improved their problem-solving skills. The introduction of the intervention also eliminated the boredom of monotonous teaching using the textbook by catering for different learning styles, hence pupils were motivated. Furthermore, the class teacher was inspired seeing her pupils understand mathematical concepts easily. Moreover, the study revealed that if teachers give pupils a little more time for lessons and examinations, drawing activities can help improve pupils' performance in mathematics.

KNUST

5.3 Conclusions

Even though this research was done on a much smaller scale using two classrooms in one school, it can justifiably be concluded that an art integrated curricula such as was used in this case, which involved the use of drawing activities to explain mathematical concepts, can generally improve the mathematical performance of seven to eight year old pupils as well as make the studying of mathematics fun and interesting. It can also be said

that by giving extra time and factoring the concept of multiple intelligences in lessons plans and teaching activities, teachers can help the pupils who perform averagely or below average to better their performance in mathematics, and invariably, in other subjects.

With respect to how teaching and learning of mathematics is done at Ayigya M/A Primary School A, it can be concluded that teachers only use the standard textbook in teaching without considering the individual abilities of the pupils in their teaching approach so that all the pupils will understand the concepts taught.

Moreover, in the area of how drawing intervention will improve the pupils' mathematics performance, it can be concluded that the intervention activities enhanced the pupils' problem solving abilities. It also afforded the pupils opportunity to express themselves creatively, build their self-esteem, encourage collaboration among them and build their intergroup harmony. In the aspect of the mathematics performance of pupils before and after the intervention, it can be concluded that the experimental group mathematics performance improved after the post-test whereas that of the control group which did not receive any drawing intervention had its mathematics performance decline.

Again, it was observed that about 70% of the pupils in the classes live with relatives and guardians who pay little or no attention to the educational needs of their wards. It is possible that this might have negative effect on learning. The study could not cover this issue, so other researchers might want to research that aspect of schooling for young children.

Another issue not covered by this research was that the "Zongo" community frequently attacks teachers and always encroaches on the school park for their games

KNUST
LIBRARY
KWAME NKRUMAH
UNIVERSITY OF SCIENCE & TEC
KUMASI

even while school is in session. Further research could be done to find out how this can affect teachers' willingness to stay in the school to help the pupils achieve academically and socially.

5.4 Recommendations

The following recommendations can help resolve the issue of low performance in mathematics for primary school pupils.

KNUST

1. To better integrate drawings into mathematics teaching and learning, mathematics teachers should acquaint themselves with the model of mathematics teaching which involves the introduction of mathematics concepts; presentation of scenario to initiate basic drawing activities (including use of matchstick drawings); manipulation of drawing tools and materials; and ensuring that the pupils draw; would enable them help their pupils to understand mathematics concepts and improve in mathematics performance. Although school supplies may not include art materials, they can use chalk, the chalkboard, pebbles, sticks and other objects to initiate such activities.

2. Teachers of arts should collaborate with mathematics teachers to align mathematics concepts to art in order to explain basic and complex concepts to the understanding of primary school pupils as well as to make mathematics learning enjoyable and stress free. Unfortunately, Creative Arts do not have specialist teachers to engage the other teachers. Therefore the Ghana Education Service (GES) should orient the primary school teachers for art teaching so this can happen.

3. The District Inspectors of Education should focus on the quality of exercises and topics rather than on the number of exercises and topics covered in the term.

4. The District Inspectors of Education should sensitize teachers of mathematics to consider the different learning abilities of pupils when preparing lesson notes and lesson plans.

5. The Ministry of Education (MOE) and the Curriculum Research and Development Division of the Ghana Education Service could incorporate more drawing activities in the mathematics syllabus when reviewing syllabus in order for Ghanaian Schools to benefit more from what art contributes to education.

6. The Ministry of Education (MOE) and the Ghana Education Service could allocate more time to the study of mathematics when reviewing the mathematics syllabus so that more practical activities could be done during teaching.

7. Heads of Primary Schools should monitor their mathematics teachers to ensure that they teach well. They should also design programmes that could be used for constant evaluation of teachers' performance in order to identify teachers who do not perform their duties well. Teachers who fail to perform well should be given extra training to better their teaching skills, and those who teach well should be commended and awarded.

8. Art Teachers Associations, Policy makers, Non-Governmental Organizations and stakeholders should organize seminars in art education for teachers in order to create awareness about what art education promises.

KNUST

REFERENCES

Adu-Agyem, J., Enti, M. & Peligah, Y. (2009). Enhancing Children's Learning: the Art Perspective. *International Journal of Education through Art*, 5(2,3), 143-155. doi:10.1386/eta.5.2 ,3.143/1

Agyei, D. (2010). Information Communication Technology use in Mathematics. Retrieved September 6, 2011, from http//www.slideshare.net/ddagyei/ict-use-in-the-teaching-of mathematics.

Andrea, G., Nancy, C. & Welch, I. (1995). Schools, Communities and the Arts: A Research Compedium. Morrison Institute for Public Education.

Aprill, A. (2001). Toward a Finer Description of the Connection between arts Education and Student Achievement. *Arts Education Policy Review,* 102(5), 25-26.

Armstrong, T. (1993). *7 Kinds of Smart: Identifying and Developing Your Many Intelligences,* New York: Plume.

Armstrong, T. (1994). *Multiple Intelligences in the Classroom.* Alexandria, VA: Association for Supervision and Curriculum Development.

Asihene, G.N (2009). *The Role of Core Subject Teachers in the Academic Performance of Visual Arts Students in Ghanaian Senior High Schools.* MA Thesis. Ghana, Kumasi. KNUST

Attwell, A. P. (1988). Measuring the Effects of Subliminal Auditory Stimulation Embeds with Music on Attitudes toward and Achievement in Mathematics for Eighth Grade Students. (Doctoral dissertation, The University of Northern Colorado, 1988*). Dissertation Abstracts International, 49 (05), 1084A.*

Austin, K., Hammond, L.D, Orcutt, S. & Rosso, J. (2001). *The Learning Classroom: Theory intoPractice, A Telecourse for Teacher Education and Professional Development.* Stanford: Stanford University.

Ballengee-Morris, C. & Stuhr, P. (2001). Multicultural Art and Visual Cultural Education in a Changing World. *Art Education,* 54(4), 6–13.

Bamberger, J. (2000). Music, Math and Science: Towards an Integrated Curriculum. *Journal for Learningthrough Music,* 1(Summer), 32-35.

Bamford, A. (2006). *The Wow Factor: Global Research Compendium on the Impact of the Arts in Education*. Munster: Waxmann.

Berman, M. (1998). *A Multiple Intelligences Road to an ELT Classroom*. Wales, UK: Crown House Publishing Limited.

Berthoin-Antal, A., Dierkes, M., Child, J. & Nonaka, I. (Eds.). (2003). *Handbook of organizational learning & knowledge*. New York: Oxford University Press.

Biggs, J (1987). *Student Approaches to Learning and Studying Australian Council for Educational Research.* Hawthorn: Victoria

Boughton, D. (1999). Visual Arts education. In M. Ben-Peretz, S. Brown & R. Moon (Eds.), *International encyclopaedic dictionary of education* (pp. 1– 9). London: Routledge.

Bracey, T. (2003). Art education in New Zealand: Questions of theory and criticality. In E. M. Grierson & J. E. Mansfield. (Eds.), The Arts in education. Critical perspectives from Aotearoa New Zealand. (pp. 181– 198). Palmerston North: Dunmore Press.

Bresler, L. (1995). The Subservient, Co-equal, Affective, and Social Integration Styles and their implications for the Arts. *Arts Education Policy Review,* 96(5), 31-37.

Burnaford, G., Brown, S., Doherty, J. & Mclaughlin, H. J. (2007). Arts Integration Frameworks , Research and Practice. *Integration The Vlsi Journal*.

Catterall, I., James, S., Chapleau, R., & Iwanaga, J. (2002), "Involvement in the Arts and Human Development: Extending an Analysis of General Associations and Introducing the Special Cases of Intensive Involvement in Music and Theatre Arts." In R. Deasy (Ed.), *Critical Links: Learning in the Arts and Student Achievement and Social Development,* Washington, DC: AEP.

Chalmers, G. (2001). Knowing Art through Multiple Lenses: In Defence of Purple Haze and Grey Areas. In P. Duncum & T. Bracey. (Eds.), *On knowing: Art and Visual Culture.* (pp. 86–98). Christchurch: Canterbury University Press.

Chapman, L. H. (1978). A Perspective on Art Education. In L. H. Chapman (Ed.), *Approaches to Art in Education* (pp. 4–21). New York: Harcourt Brake Jovanovich.

Cunningham, T., Gannan, J., Greene. J., Kavanagh, M., Reddy, L. & Whitson, L. (2008). *Theories of Learning and Curriculum design*. Key Positionalities and their Relationships.

Debra, I. & Riedel, E. (2003). *What Does Arts Integration Do for Students ?October*. Minneapolis.

Eisner, E. W., & Eckner, D. W. (1970). Some Historical Developments in Art Education. In G. Pappas (Ed.), *Concepts in art education* (pp. 12–25). Ontario: Macmillan.

EMIS. (2010). *Ministry of Education Republic of Ghana Report on Basic Statistics and Planning Parameters for Basic Education in Ghana. Basic education.*

Farrant, J.S. (1996). *Principles and Practice of Education.* Singapore: Longman Singapore Pub. Pte Ltd.

Fioranelli, D.I. (2001). The Effects of Background Classical Music on the Problem Solving Skills of third graders in a Computer Lab Setting. (Doctoral dissertation, The University of Mississippi). *Dissertation Abstracts International,* 62 (04), 1329A.

Fraenkel, J. R., & Wallen, N. E. (2009). *How to Design and Evaluate Research in Education. Qualitative Research.*

Freedman, K. (2003). Social Perspectives of Art Education in the U.S.: Teaching Visual Culture in a Democracy.

Freyberger, R. M. (1985). Integration: Friend or Foe of Art Education. *Art Education,* 38(6), 6-9.

Gardner, H. (1983). *Frames of Mind: The Theory of Multiple Intelligences.* New York: Basic Books.

Gardner, H. (1993). *Multiple Intelligences: The Theory in Practice.* New York: Basic Books.

Gardner, H. (1999). *Intelligence Reframed: Multiple Intelligences for the 21st century.* New York: Basic Books.

Gee, C. B. (2003). Uncritical Pronouncements Build Critical Links for Federal Arts Bureaucracy. *Arts Education Policy Review,* (104)3, 17-19.

George, P.S. (1999). The Integrated Curriculum: A Reality Check. *Middle School Journal,* 28, 12-19.

Ghana News Agency. (2009, May 7). No Title. Accra.

Given, L. M. (Ed.). (2008). *The Sage Encyclopedia of Qualitative Research Methods. Praxis* (pp. 1-1043). Sage publications,Inc.

Gunn, A. C. (1998). *Visual Art Education in Early Childhood Centers': Teachers'Beliefs and Practices.* Canterbury: University of New Zealand.

Gunn, A. C. (2000). Teachers' Beliefs in relation to Visual Art Education in Early Childhood Centres. *New Zealand Research in Early Childhood Education,* 3, 153–162.

Hallam, S. and Price, J. (1998). Can the Use of Background Music Improve the Behaviour and Academic Performance of Children with Emotional and Behavioural Difficulties? *British Journal of Special Education*, 25(2), 88-91.

Hanson, J. (2002). *Improving Student Learning in Mathematics and Science through the Integration of Visual Art*. Saint Xavier University.

Hood, B.J . (1996). Amazing Science at the Roxy Website. Retrieved October 16, 2011 from http://www.hood-consulting.com/amazing/

Houle, C. (1980). *Continuing Learning in the Professions*. San Francisco: Jossey-Bass.

Ingram, D. & Riedel, E. (2003). *Integrating Mathematics and the Visual arts*. Center for Applied Research and Educational Improvement College of Education and Human Development University of Minnesota.

Iwai, K. (2003). The Contribution of the Arts Education to Children's Lives. *Development* (pp. 1-15).

Kearsley, G. (1994). Explorations in Learning & Instruction: The Theory into Practice Database.

Kelner, L. B., & Flynn, R. M. (2006). *A Dramatic Approach to Reading Comprehension: Strategies and Activities for Classroom Teachers*. Portsmouth, NH: Heinemann

Kilgore, D. W. (2001). Critical and Postmodern Perspective on Adult Learning. New Directions for Adult and Continuing Education, 89, 53-61.

Kolb. D. A. & Fry, R. (1975). Toward an Applied Theory of Experiential learning. In C. Cooper (Ed.) *Theories of Group Process*. London: John Wiley.

Lazear, D. (1992). *Teaching for Multiple Intelligences*. Fastback 342 Bloomington, IN: Phi Delta Kappan Educational Foundation. (ED 356 227)

Leedy, P. D. & Ormrod, J. E. (2005). Practical Research: Planning and Design. Upper Saddle River, New Jersey: Pearson Education Inc.

MacMillan, A., Preston, D., Wolfe J. & Yu, S. (2007). Basic Statistics: Mean, Median, Standard Deviation, Z-Scores, and P-Value. Retrieved from http://www.fourmilab.ch/rpkp/experiments/analysis/z Calc.html. Accessed on 21st November 2012.

Marshall, J. (2006). Substantive Art Integration, Exemplary Art Education. *Art Education*, 59(6), 17-24.

Mello, R. (2004). When Pedagogy Meets Practice:Combining Arts Integration and Teacher Education in the College Classroom . (J. Russell & R. Murphy, Eds.)*Arts and Learning Research*, *20*(1), 135-161.

Merriam, S. B., & Caffarella, R. S. (1999). *Learning in Adulthood: A Comprehensive Guide.*(2nd ed.). San Francisco: Jossey-Bass.

Mereku, K. (2003). Methods in Ghanaian Primary Mathematics Textbooks and Teachers' Classroom Practice. *Learning*, *23*(June), 61-66.

Ministry of Education Science and Sports: Curriculum Research and Development Division (CRDD), September 2007, Accra, Ghana.

Mishook, J. J., & Kornhaber, M. L. (2006). Arts Integration in an Era of Accountability. *Arts Education Policy Review*, 107(4), 3-11.

Opoku-Asare, N. A. A. (2000). "Using Non-Book Instructional Materials to Promote Quality Teaching and Learning in Ghanaian Primary Schools - Rhetoric and Reality". MPhil Thesis, University Of Sussex, Brighton.

Ormrod, J.E. (1995). *Educational Psychology: Principles and Applications.* NJ: Englewood Cliffs, N.J: Prentice-Hall.

Page-Bucci, H. (2003). The Value of Likert Scales in Measuring Attitudes of Online Learners.

Pearson, P. (2001). How Can We Know Art?: The Purple Haze of Epistemology in Art Education. In Duncum, P., & Bracey, T. (Eds.). *On Knowing: Art and Visual Culture.* (pp. 6 –85). Christchurch: Canterbury University Press.

Podlozny, A. (2000). Strengthening Verbal Skills through the Use of Classroom Drama: A clear link. *Journal of Aesthetic Education,* 34(3/4), 239-275.

Reynolds-keefer, L., Johnson, R., Dickenson, T. & Mcfadden, L. (2009). Validity Issues in the Use of Pictorial Likert, *6* (December), 15-24.

Ross, M. (2004). Art at the Crossroads : The Contested Position of Indigenous Arts in Ghana's Post-Colonial Education System. *Art Education*, *45*(2), 117-134.

Scripp, L., & Subotnik, R. F. (2003). Directions for Innovation in Music Education: Integrating Conceptions of Musical Giftedness into General Educational Practice and Enhancing.

Snyder, S. (2001). Connection, Correlation, and Integration. *Music Educators Journal,* 87(5), 32-39, 70

KNUST

LIBRARY
KWAME NKRUMA
UNIVERSITY OF SCIENCE & T
KUMASI

Stokrocki, M. (1997). *Research Methods and Methodologies for Art Education*. (S. D. La Pierre & E. Zimmerman, Eds.) (pp. 33-55). Virginia.

Tanner, R. (2001). "Teaching Intelligently" *English Teaching professional,* 20. (pp. 40-41, 57-58).

Vaughn, K. (2002). "Music and Mathematics: Modest Support for the Oft-Claimed Relationship." In R. Deasy, R. (Ed.), *Critical Links: Learning in the Arts and Student Achievement and Social Development,* Washington, DC: AEP.

Visser, J. (2005).The Historical, Philosophical and Theoretical Influences On Early Childhood Visual Arts Education in Aoteroa New Zealand. *ACE Papers,* (16), pp. 25–37.

Wagner, B. J. (1998). *Educational Drama and Language Arts: What Research Shows.* Portsmouth, NH: Heinemann.

Wagner, B. J. (2002). Understanding Drama-based Education. In G. Brauer (Ed.), Body and Language: *Intercultural Learning through Drama* (pp. 3-18). Westport, CT: Ablex.

Wiggins, J., & Wiggins, R. A. (1997). Integrating through Conceptual Connections. *Music Educators Journal*, 83(4), 38-41.

Wiggins, R. A. (2001). Interdisciplinary Curriculum: Music Educator Concerns. *Music Educators Journal,* 87(5), 40-44.

Wolf, D. P. (1999). Why the Arts Matter in Education: Just What Do Children Learn When they create an Opera. In E. B. Fiske (Ed.), *Champions of Change: The impact of the Arts on Learning (pp. 91-98).* Washington, DC: The Arts Education Partnership.

KNUST

APPENDICES

Appendix A

Letter to Ayigya M/A Primary School

DEPARTMENT OF GENERAL ART STUDIES
FACULTY OF ART, COLLEGE OF ART & SOCIAL SCIENCES
KWAME NKRUMAH UNIVERSITY OF SCIENCE & TECHNOLOGY

KNUST

Tel: (233) 03220-62261
Fax (233) 03220-60137/62217

P.O. Box 50
University Post Office
Kumasi – Ghana
West Africa
E-mail: generalart.cass@knust.edu.gh;
headgeneralart.cass@knust.edu.gh

Our Ref: GAS/S/3

Date: 15th Nov. 2011

The Headmaster
Ayigya M/A Primary School
Ayigya-Kumasi

Dear Sir,

MPhil ART EDUCATION RESEARCH WORK OF A STUDENT –
MISS EVELYN LOVELANCE ARHIN

Miss Evelyn Lovelance Arhin is an MPhil Art Education student in the above Department of KNUST. Her student ID Number is 20137203. She is conducting research on "Enhancing Pupil learning in Mathematics through the Integration of Visual Art" and would need to base the research on your school.

I would be very grateful if you could grant her permission and also assist her to collect the data she requires to complete her thesis.

Thank you very much for your help.

Sincerely yours,

Nana Afia Opoku-Asare, Mrs.
Head of Department

Appendix B

Pre-text for Class two Pupils

AYIGYA M/A PRIMARY SCHOOL

PRE-STANDARD TEST

SUBJECT: MATHEMATICS **CLASS: 2**

TIME:20MINS

ANSWER ALL THE FOLLOWING QUESTIONS

Write all the following as tens and ones

1. 89= ☐ tens + ☐ ones

2. 99= ☐ tens + ☐ ones

3. Use these numbers. Write > or < between them.

   - 26 ☐ 72
   - 69 ☐ 48
   - 59 ☐ 84

4. 14 ¬ 10 = ☐ a) 4 b) 10 c) 14

5. 18 − 8 = ☐ a) 8 b) 10 c) 18

6. 12 + 6 = ☐ a) 18 b) 6 c) 16

7. 18 + 2 = ☐ a) 18 b) 16 c) 20

8. 20 ÷ 2 = ☐ a 10 b) 22 c) 18

9. 9. 3 × 5 = ☐ a) 10 b) 15 c) 20 d) 25

KNUST

10. How many halves are there in 6 oranges? a) 6 b) 9 c) 15 d) 12

KNUST

Appendix C

Post-test for Class two Pupils

AYIGYA M/A PRIMARY SCHOOL

POST-STANDARD TEST

SUBJECT: MATHEMATICS **CLASS: 2**
TIME:20MINS

ANSWER ALL THE FOLLOWING QUESTIONS

Write all the following as tens and ones

1. 55= ☐ tens + ☐ ones

2. 24= ☐ tens + ☐ ones

3. 20– 10 = ☐

4. 16 – 8 = ☐

5. 14 + 6= ☐

6. 30 ÷ 2 = ☐

7. How many halves are there in 8 oranges?

8. How many halves are there in 10 apples?

9. How quarters are there in 4 coconuts?

10. How many quarters are there in 6 mangoes?

11. Show on your clock ~~surface~~ half past 2

12. Show on your clock surface quarter past 2

KNUST

Appendix D

Pictorial Likert Scale

KNUST

Appendix E

Interview Guide

Interview will be conducted informally, using the following points as guide.

STUDENTS

1. History and background of the school
2. Background of students
3. Number of students on roll
4. Average class size
5. Truancy rate
6. Incentives and motivations for students
7. The ethnic make-up of the students
8. The make-up of the surrounding community and its effect on the school
9. Number of schools around

STAFF

1. Number of teachers and their qualifications
2. Number of support staff
3. Average years of experience in the teaching profession
4. The ethnic make-up of staff
5. Number of males and female teachers
6. Teacher parent relationship

TEACHING AND LEARNING OF MATHEMATICS

1. Teachers' knowledge on integrated art curriculum.
2. Teachers' knowledge on multiple intelligences and how they are measured.
3. Teachers' knowledge on the use of practical activities to explain mathematics concepts.
4. Teachers' observation after the drawing intervention.
5. Pupils' attitude toward the drawing intervention.

KNUST

Appendix F

Observational Guide

Indicators	Researcher's Comments
1. Learning methods used by class teacher.	
2. The use of practical activities to bring understanding.	
3. Frequency of practical activities use in teaching.	
4. Pupils' participation in lessons.	
5. Teachers' consideration of multiple intelligences during teaching and learning.	

KNUST

Appendix G

Primary 2 Mathematics Syllabus Structure

UNIT	SPECIFIC OBJECTIVES	CONTENTS	TEACHING AND LEARNING ACTIVITIES	EVALUATION
	The pupil will be able to:			Let pupils:
Unit 2.1 Numbers and Numerals 0-100	2.1.1 Assign numbers to groups of objects up to 100 objects.	Numbers 0-100 Structured Base Ten Materials	Guide pupils to make groups of tens and ones using the following objects: - Bundles of ten sticks/straws and loose ones - Bags, seeds(beans, maize, palm kernel, flamboyant etc) and loose ones	Use objects to make groups of tens and ones for given numbers.
Unit 2.2 Addition (0-18)	2.2.1 Discover that the order of the addends does not change the sum. 2.2.2 Write addition sentences from word problems and solve them.	Sums 0-18 (order of addends) Word problems (Sum 0-18)	Guide pupils to join groups of objects and relate it to addition of numbers. Guide pupils to make addition sentences from word problems and solve.	Add two numbers, summing up to 18. Solve word problems involving addition with sum up to 18.
Unit 2.3 Subtraction (0-18)	2.3.1 Write subtraction sentences with none of the numbers greater than 18. 2.3.2 Complete subtraction sentences with none of the numbers	Subtraction as comparison of two groups of objects. Subtraction sentences	Let pupils revise subtraction as separation of objects from group(s). Guide pupils to write subtraction sentences to show how many more or how many less objects there are	Write subtraction sentences for two story problems and find the answers. Find the difference of pairs of

KNUST

	greater than 18.		in a group.	numbers 0-18 mentally.
Unit 2.4 Number and Numerals (0-1000)	2.4.1 Assign numbers to groups of objects up to groups of 1000 objects.	Numbers 0-1000.	Guide pupils to assign structured groups of objects to given numbers. E.g. 2 flats, 4 longs and 5 cubes is 2 hundred and forty-five or 245.	Write the number that represents the objects in a given group of structured materials.
Unit 2.5 Measure ment of length, capacity and weight.	2.5.1 Compare lengths and heights of objects with a meter rule.	Comparing lengths and heights with a meter stick.	Take pupils to a textiles shop and let the storekeeper measure 3 or 4 meters of cloth for pupils to observe the use of the meter rule or invite the shopkeeper to come and demonstrate it in the classroom.	Identify objects whose lengths or heights are longer or shorter than a meter rule.
Unit 2.6 Addition (Sums 0-100)	2.6.1 Find the sum of three or four 1-digit numbers. 2.6.3 Find the sum of three 2-digit numbers.	Adding three or four 1-digit numbers. Sum of three 2-digit numbers (no regrouping).	Guide pupils to use the number line to add three or four 1-digit numbers. Guide pupils to add three 2-digit numerals using structured base ten materials in expanded form.	Find the sum of three or four 1-digit numbers. Add three 2-digit numbers (no regrouping).
Unit 2.7 Subtractio n (Number less than 100).	2.7.1 Perform subtraction operations involving 2-digit numbers using the expanded and short forms with renaming/regro uping.	Subtraction of 2-digit numbers using the expanded form and the short forms with renaming/regro uping.	Guide pupils to perform subtraction of 2-digit numbers using the expanded and short forms with renaming.	Solve problems using the expanded and short forms with renaming/regro uping.
Unit 2.8 Fraction	2.8.1 Recognize half of a whole object.	One half	Give examples of one whole objects in everyday life. E.g. - A loaf of bread.	Identify one-half of a whole object.

KNUST

			- An orange.	
Unit 2.9 Measurement of Time and Money.	2.9.1 Use arbitrary units to measure time taken to complete simple events.	Measuring time using arbitrary time measures.	Guide the pupils to find the time it takes to complete an event or activity using arbitrary time measures. E.g. number of hand claps it takes to sing a song.	Find the time an event or activity takes using arbitrary time measures- hand claps, steps, jumps, etc.
	2.9.4 Identify currency in circulation up to GH₵50.	Money	Guide pupils to identify the coins and currency notes in circulation up to GH₵50 and record them using the symbol GH₵.	Tell the values of given coins and currency notes up to GH₵50.
Unit 2.10 Addition (Sum 0-999)	2.10.1 Add numbers which sum up to 999.	Addition of 3-digit numbers. Expanded form of a numerical as hundreds, tens and ones.	TLMs: Abacus color-coded and counters. Guide pupils to revise the values of each digit in a 3-digit numeral.	Add 2-or 3-digit numbers using the expanded and short forms.
Unit 2.11 Subtraction of numbers less than 1000.	2.11.1 Subtract a 2-digit number from a 3-digit number.	Subtraction of 3-digit numbers.	Guide pupils to use proportional structured materials to subtract 2-or 3-digit numbers from a 3-digit number. E.g. multi-base blocks, sticks or seeds: Grouped in hundreds, tens and ones. ie Structured base ten materials.	Subtract 2 or 3-digit numbers using the expanded and/or the short forms.
Unit 2.12 Multiplication	2.12.1 Write a multiplication sentence for groups of two.	Multiplication sentences for array of objects.	Guide pupils to make groups of two objects and find the total number of objects in each case.	Match multiplication sentences with pictures of array of objects.
	2.12.2 Build		Guide pupils to make	

KNUST

	the multiplication table for 2 up to the product 18.	Two Times Table	groups of two from 1 group, 2 groups, 3 groups up to 9 groups of two and count to find the number of objects in various groups.	Complete multiplication sentences up to product 18.
Unit 2.13 Division	2.13.1 Illustrate division as sharing	Division as sharing	Guide pupils to perform activities to represent division as sharing.	Solve problems involving sharing.
	2.13.2 Illustrate division as making equal groups.	Division as sharing	Guide pupils to form groups of equal size.	Solve problems involving grouping.
	2.13.3 Convert a division sentence to a multiplication sentence involving a missing factor.	Division as missing factor in multiplication sentence.	There are four groups of three from 12, therefore 12÷3=4	Solve problems involving solving.
Unit 2.14 Collecting and Handling Data.	2.14.1 Collect data by counting different objects with specific attributes or characteristics.	Collecting data by counting.	Guide pupils to find the number of objects or pupils satisfying a given criteria or description. E.g. Pupils born on each day of the week.	Find the number of pupils/items satisfying a given description.
	2.14.3 Represent data as simple block graphs.	Simple Block Graphs	Guide pupils to draw boxes to represent data collected/recorded.	Draw appropriate boxes to represent data recorded/collected.
Unit 2.15 Shape and Space.	2.15.1 Identify common plane shapes.	Common Plane Shapes.	Guide pupils to sort cut-out shapes; identify and name common plane shapes.	Name some common plane shapes.

KNUST

			- Rectangles, squares, triangles and circles; trace around cut-out shapes.	
	2.15.3 Identify plane shapes with straight sides.	Sides of plane shapes.	Guide pupils to identify rectangles and squares as having four straight sides, Guide pupils to identify a triangle as having three straight sides;	Identify the number of sides of a given plane shapes. Draw a triangle, a rectangle, or a square.
	2.15.4 Identify plane shapes by their name and the number of sides.	Naming Plane Shapes.	Guide pupils to make plane shapes with straight sides on a nail board (geo-board). Guide pupils to name and identify plane shapes by their number of sides: squares, rectangles, triangles and circles.	Name plane shapes.

Source: CRDD, 2007

KNUST